LOZEAU DRURY LLP

T 510.836.4200
F 510.836.4205

410 12th Street, Suite 250
Oakland, Ca 94607

www.lozeaudrury.com
richard@lozeaudrury.com

November 14, 2012

Via Electronic Mail Submission

Energy Commissions Dockets Unit
California Energy Commission
Dockets Unit, MS-4
Docket No. 11-AFC-O4
1516 Ninth Street
Sacramento, CA 95814-5512
Email: docket@energy.ca.gov

Mr. Pierre Martinez
Rio Mesa Solar Electric Generating
Facility Project (11-AFC-4)
California Energy Commission
1516 Ninth Street
Sacramento, CA 95813
Email: pierre.martinez@energy.ca.gov

Re: Energy Commission Docket Number: 11-AFC-04. RIO MESA SOLAR ELECTRIC GENERATING FACILITY APPLICATION FOR CERTIFICATION (11-AFC-04), Preliminary Staff Assessment

Dear Commissioners, Energy Commission Dockets Unit Staff, and Mr. Martinez:

This letter is submitted on behalf of Laborers International Union of North America, Local Union 1184, and its members living in Riverside County (collectively "LiUNA" or "Commenters") regarding the Preliminary Staff Assessment (“PSA”) for the proposed Rio Mesa Solar Electric Generating Facility (“Project” or “Rio Mesa SEGF”).[1]

The Rio Mesa SEGF Project, proposed for development by Rio Mesa Solar I, LLC and Rio Mesa Solar II, LLC, subsidiaries of BrightSource Energy, Inc., would consist of two 250-megawatt (“MW”) (nominal) solar concentration thermal power plants situated on the Palo Verde Mesa in Riverside County, California, 13 miles southwest of Blythe, California. Each 250 MW plant requires about 1,850 acres (or 2.9 square miles) of land to operate. The total area required for both plants, including the shared facilities and gen-tie line, is approximately 3,960 acres. Both plants would be situated solely on private land leased from the Metropolitan Water District of Southern California. The project gen-tie line, emergency and construction electrical power supply line, and access road would be located on public land managed by the Bureau of Land Management (“BLM”). BLM is preparing an Environmental Impact Statement (“EIS”) for the actions on federal land. Each plant will utilize a solar power boiler, located on top of a concrete tower (approximately 750-feet tall), surrounded by heliostat (mirror) fields (approximately 85,000 per plant) which focus solar energy on the boiler. Auxiliary boilers will be used to

[1] We reserve the right to supplement these comments at any and all later hearings and proceedings related to this Project, including PSA Part B, Final Staff Assessment, and any and all future Project proceedings. *See Galante Vineyards v. Monterey Water Dist*. (1997) 60 Cal. App. 4th 1109.

operate in parallel with the solar field during partial load conditions and when additional power is needed. A common facilities area will include a combined administration, control, and maintenance facilities, a water treatment facility, as well as a switchyard.

Expert Comments

These comments are supported by the following expert comments, incorporated by reference in their entirety herein:

- November 14, 2012 letter of Scott Cashen, M.S., Independent Biological Resources and Forestry Consultant, *Comments on the Preliminary Staff Assessment prepared for the Rio Mesa Solar Electric Generating Facility Project*. Mr. Cashen's comments and curriculum vitae are attached hereto as Exhibit A.

- November 14, 2012 letter of Matt Hagemann, P.G., C.Hg., *Comments on the Rio Mesa Solar Project, Riverside County, California*. Mr. Hagemann's comments and curriculum vitae are attached hereto as Exhibit B.

CEQA and NEPA Compliance

As a certified regulatory program under CEQA, the CEC's process is required to provide the environmental analysis that satisfies CEQA requirements as a certified regulatory program. See PRC § 21080.5(d); §§25500-25543; 14 CCR 15251(j). LiUNA hereby requests and urges the California Energy Commision ("CEC"), as lead state agency under the California Environmental Quality Act, Pub. Resources Code § 21000 et seq. ("CEQA"), to fully comply with in all aspects of the Project. LiUNA also urges the CEC to work cooperatively with the BLM in all aspects of environmental review of the Project under the National Environmental Policy Act ("NEPA").

LiUNA expressly reserves the right to submit additional comments on the Rio Mesa Project in conjunction with the PSA Part B and Final Staff Assessment ("FSA") for the Project or any other future actions taken with regard to the Project.

LiUNA has previously filed with the CEC a request to be placed on the notice list for any and all CEQA or other land use actions, notices, or hearings related to the Project, and reiterates that request here. We also specifically request that the CEC place us on its notice list to inform us of any other meetings, comment periods, or other actions taken with regard to the Project.

Please send notices by electronic mail and U.S. Mail to:

Richard Drury
Christina Caro
Lozeau Drury LLP
410 12th Street, Suite 250
Oakland, CA 94607

richard@lozeaudrury.com; christina@lozeaudrury.com

Please call should you have any questions. Thank you for your attention to this matter.

Sincerely,

Richard Drury
Christina Caro
Attorneys for Laborers International Union of North America, Laborers Local Union 1184

ATTACHMENT A

November 14, 2012

Mr. Richard Drury
Ms. Christina Caro
Lozeau Drury, LLP
410 12th Street, Suite 250
Oakland, CA. 94607

Subject: Comments on the Preliminary Staff Assessment prepared for the Rio Mesa Solar Electric Generating Facility Project

Dear Mr. Drury and Ms. Caro:

This letter contains my comments on the biological resources chapter of the Preliminary Staff Assessment ("PSA") prepared for the Rio Mesa Solar Electric Generating Facility Project ("Project"). The Project would encompass approximately 5,993 acres of relatively undisturbed land in eastern Riverside County, approximately 13 miles southwest of Blythe, California. The power generating facility would encompass approximately 3,805 acres. It would include two proposed power plants, associated heliostat fields, and support facilities. Off-site project components, including a temporary construction area, transmission line corridors, and access roads would encompass approximately 2,188 acres.

I am an environmental biologist with 20 years of professional experience in wildlife ecology, forestry, and natural resource management. To date, I have served as a biological resources expert for over 40 projects, the majority of which have been renewable energy facilities. My experience in this regard includes testifying before the California Energy Commission and assisting various clients with evaluations of biological resource issues. My educational background includes a B.S. in Resource Management from the University of California at Berkeley, and a M.S. in Wildlife and Fisheries Science from the Pennsylvania State University.

The PSA identifies several instances in which the Applicant has provided inadequate data and conclusions that are scientifically indefensible. As an initial matter, I commend Staff for its objective evaluation of the Project, and I concur with Staff that additional information is needed before the Final Staff Assessment ("FSA") can be completed.

The site for the proposed Project contains thousands of acres of land within a relatively undisturbed portion of the Colorado Desert. This land contains a large block of habitat that supports many unique plant and animal species, including the desert tortoise, Mojave fringe-toed lizard, Nelson's bighorn sheep, burrowing owl, elf owl, Gila woodpecker, and golden eagle, among others. It is known to contain hundreds of acres of jurisdictional waters and five sensitive natural communities. In contrast to many other regions of the Colorado Desert, the site exhibits little sign of human disturbance.

The effects of the Project on plants, animals, and the ecological integrity of the region would be severe. The PSA does not dispute this. However, it ultimately concludes the proposed mitigation would reduce many of the Project's impacts to a less than significant level. Based on my knowledge and experience, I contend the ecological consequences of eliminating and fragmenting a broad expanse of relatively undisturbed Colorado Desert habitat cannot be mitigated to a less than significant level.

A fundamental component of the proposed mitigation strategy is the acquisition of compensation lands for the various species and habitats that would be impacted by the Project. Based on my experience with other projects, there are very few large parcels of land in the region available for acquisition. This suggests the Applicant will only be able to meet Staff's compensatory mitigation requirements by acquiring multiple, disjunct, and relatively small parcels. The number, size, and location of habitat patches affect each species differently. Overall, however, larger reserves are better for maintenance of individual species, biodiversity, and ecological functions than are smaller reserves.[1] Based on this principle alone, the adverse effects of the Project would not be mitigated.

I have the following additional comments for Staff's consideration in preparing the FSA:

1. Sand dune habitat occurs along the northern portion of the gen-tie line. The PSA suggests the sand dune habitat is "marginal," even though special-status plants and 115 Mojave fringe-toed lizards were detected within the dune habitat during the Applicant's surveys.[2] The FSA should explain why Staff considers the sand dunes along the gen-tie line to be "marginal" habitat.
2. The Project would permanently impact approximately 4.1 acres of desert dunes.[3] Consistent with the NECO Plan, the Applicant should be required to provide habitat compensation at a 3:1 ratio for Project impacts to dune habitat.
3. Staff believes the Project has the potential to take one or more bald or golden eagles over the life of the Project, due either to collision with Project facilities or to injury or mortality caused by flying through concentrated solar energy over the heliostat field.[4] The FSA needs to provide additional information on existing conditions pertaining to the golden eagle such that the magnitude of potential impacts to the regional golden eagle population can be evaluated. Specifically, the FSA should identify the status of the regional golden eagle population (i.e., stable, increasing, declining), and the effect that (a) losing an individual; and/or (b) the abandonment of nesting territories would have on the regional population.
4. The FSA needs to provide the data and analyses that Staff used to derive its conclusions pertaining to cumulative impacts.

---

[1] Meffe GK, CR Carroll. 1997. Principles of Conservation Biology, 2nd edition. Sinauer Associates, Inc., Sunderland, MA.
[2] PSA, p. 4.2-130.
[3] *Ibid*, Biological Resources Table 7.
[4] *Ibid*, p. 1.1-14.

5. The PSA concluded "[e]ven with implementation of these [mitigation] measures, the Rio Mesa SEGF's contribution to cumulative impacts to golden eagles from disturbance, net loss of foraging habitat, or other take would be cumulatively considerable."[5] Similar to the golden eagle, the large mammals identified in the PSA (i.e., Nelson's bighorn sheep, burro deer, Yuma mountain lion) require large patches of habitat. Consequently, the FSA needs to provide the scientific rationale for concluding: (a) impacts to wildlife movement are not cumulatively significant; and (b) that the Project's contribution to cumulatively significant effects to large mammal habitat would not be considerable.[6]

6. Mitigation Measure BIO-3 requires the Applicant to acquire compensation lands that provide habitat that is equal or better than the habitat impacted by the Project. The FSA should provide data and analysis demonstrating the mitigation measure is feasible. Specifically, the FSA should provide information on the location, size, and condition of potential compensation lands.

7. There are numerous large projects proposed in the Project region. Presumably the Applicant will be competing for compensation lands with the proponents for these other projects. The FSA should provide analysis of the supply and demand of compensation lands in the Project region.

8. The PSA identifies the potential for the Project to have indirect impacts on vegetation through groundwater pumping. The FSA needs to define the zone of potential affect, and describe the vegetation resources that may be affected by groundwater pumping.

9. Mitigation Measure BIO-3 would require the Project owner to monitor groundwater levels and plant health and vigor in adjacent desert dry wash woodland areas; if plant stress or mortality occurs and is determined to be related to Project activities, then the Project owner shall either refrain from pumping, reduce pumping to allow for recovery of the groundwater table, or offset any additional habitat losses through off-site compensation. The FSA should discuss the feasibility of these remediation measures (e.g., whether it will be feasible for the Applicant to reduce pumping).

10. Staff needs to clarify how it was able to conclude that Mitigation Measure BIO-3 would mitigate any project impacts to off-site groundwater dependent vegetation to a less than significant level given Staff also concluded there may be insufficient quantities of microphyll woodland to acquire as compensation habitat.

11. Mitigation Measure BIO-10 allows the Applicant to mitigation Project impacts to CRPR 1 or 2 plants through salvage and relocation (among other potential strategies). The FSA should provide information pertaining to the success in transplanting Harwood's milk-vetch, and other special-status plant species that may be detected during fall surveys.

12. Mitigation Measure BIO-12 requires the Applicant to retrofit 11 utility poles per year for each raptor taken by the Project. The FSA needs to provide scientific

---

[5] *Ibid*, p. 4.2-132.
[6] *Ibid*, p. 4.2-134 and –135.

data that substantiates retrofitting of 11 utility poles per year compensates for Project-related take.

13. The FSA needs to identify potential translocation sites for the desert tortoise, and describe the status of tortoise populations at those sites (especially tortoise density and health).
14. Mitigation Measure BIO-15 requires the Applicant to develop a Raven Monitoring, Management, and Control Plan capable of detecting "any increases in raven numbers or nesting activities from baseline conditions, as detected by monitoring to be implemented pursuant to the plan."[7] Staff needs to clarify how the Applicant will be able to obtain baseline raven numbers given the final version of the Raven Plan (and associated monitoring) is not required until 30 days prior to construction.
15. Mitigation Measure BIO-17 requires a pre-construction survey for the burrowing owl within 30 days of the start of construction. The proposed measure is not consistent with CDFG guidelines, which recommend an initial pre-construction survey within 14 days prior to ground disturbance, followed by a survey within 24 hours of ground disturbance.[8]

Sincerely,

Scott Cashen, M.S.
Senior Biologist

[7] *Ibid*, p. 4.2-190.
[8] CDFG. 2012 Mar 7. Staff Report on Burrowing Owl Mitigation. Available at: www.dfg.ca.gov/wildlife/nongame/docs/BUOWStaffReport.pdf.

Scott Cashen, M.S.
Senior Biologist / Forest Ecologist
3264 Hudson Avenue, Walnut Creek, CA 94597. (925) 256-9185. scottcashen@gmail.com

Scott Cashen has 19 years of professional experience in natural resources management. During that time he has worked as a field biologist, forester, environmental consultant, and instructor of Wildlife Management. Mr. Cashen currently operates an independent consulting business that focuses on CEQA/NEPA compliance issues, endangered species, scientific field studies, and other topics that require a high level of scientific expertise.

Mr. Cashen has knowledge and experience with many taxa, biological resource issues, and environmental regulations. This knowledge and experience has made him a highly sought after biological resources expert. To date, he has been retained as a biological resources expert for over 30 projects. Mr. Cashen's role in this capacity has encompassed all stages of the environmental review process, from initial document review through litigation support and expert witness testimony.

Mr. Cashen is a recognized expert on the environmental impacts of renewable energy development. He has been involved in the environmental review process for 22 renewable energy projects, and he has been a biological resources expert for more of California's solar energy projects than any other private consultant. In 2010, Mr. Cashen testified on 5 of the Department of the Interior' "Top 6 Fast-tracked Solar Projects", and his testimony influenced the outcome of each of these projects.

Mr. Cashen is a versatile scientist capable of addressing numerous aspects of natural resource management simultaneously. Because of Mr. Cashen's expertise in both forestry and biology, Calfire had him prepare the biological resource assessments for all of its fuels treatment projects in Riverside and San Diego Counties following the 2003 Cedar Fire. Mr. Cashen has led field studies on several special-status species, including plants, fish, reptiles, amphibians, birds, and mammals. Mr. Cashen has been the technical editor of several resource management documents, and his strong scientific writing skills have enabled him to secure grant funding for several clients.

AREAS OF EXPERTISE

- CEQA, NEPA, and Endangered Species Act compliance issues
- Comprehensive biological resource assessments
- Endangered species management
- Renewable energy
- Forest fuels reduction and timber harvesting
- Scientific field studies, grant writing and technical editing

EDUCATION

M.S. Wildlife and Fisheries Science - The Pennsylvania State University (1998)
B.S. Resource Management - The University of California, Berkeley (1992)

PROFESSIONAL EXPERIENCE

Litigation Support / Expert Witness

As a biological resources expert, Mr. Cashen reviews CEQA/NEPA documents and provides his client(s) with an assessment of biological resource issues. He then prepares written comments on the scientific and legal adequacy of the project's environmental documents (e.g., EIR). For projects requiring California Energy Commission (CEC) approval, Mr. Cashen has submitted written testimony (opening and rebuttal) in conjunction with oral testimony before the CEC.

Mr. Cashen can lead field studies to generate evidence for legal testimony, and he can incorporate testimony from his deep network of species-specific experts. Mr. Cashen's clients have included the Sierra Club, Mount Diablo Audubon Society, Save Mount Diablo, and the law firm of Adams Broadwell Joseph & Cardozo.

REPRESENTATIVE EXPERIENCE

Solar Energy Facilities

- Ivanpah Solar Electric Generating System
- Calico Solar Project
- Imperial Valley Solar Project
- Genesis Solar Energy Project
- Blythe Solar Power Project
- Victorville 2 Power Project
- Avenal Energy Power Plant
- Carrizo Energy Solar Farm
- Beacon Solar Energy Project
- Abengoa Mojave Solar Project
- San Joaquin Solar I & II
- Fink Road Solar Farm
- Maricopa Sun Solar Complex
- Catalina Renewable Energy Project
- Vestal Almond, Fireman, and Herder Solar Facilities
- Heber Solar Energy Facility

Geothermal Energy Facilities

- Western GeoPower Power Plant and Steamfield
- East Brawley Geothermal Development
- Mammoth Pacific 1 Replacement Facility

Wind Energy Facilities

- Vasco Winds Relicensing Project
- Tres Vaqueros Windfarm Repowering Project
- Catalina Renewable Energy Project

Development Projects

- Live Oak Master Plan: (*390-acre housing development, Hanford, CA*)
- Rollingwood: (*214-unit housing development, Vallejo, CA*)
- Columbus Salame: (*430,000 ft^2 food processing plant, Fairfield, CA*)
- Concord Naval Weapons Station: (*5,028-acre redevelopment, Concord, CA*)
- Chula Vista Bayfront Master Plan: (*556-acre development, Chula Vista, CA*)
- Alves Ranch: (*320-acre housing development, Pittsburgh, CA*)
- Roddy Ranch: (*640-acre housing and hotel development, Antioch, CA*)
- Aviano: (*320-acre housing development, Antioch, CA*)
- Napa Pipe: (*154-acre development, Napa County, CA*)

Other

- Faria Annexation: (*607-acre parcel annexation, Pittsburgh, CA*)
- Sprint-Nextel Tower: (*communications tower in open space preserve, Walnut Creek, CA*)

Project Management

Mr. Cashen has managed several large-scale wildlife, forestry, and natural resource management projects. Many of these projects have required hiring and training field crews, coordinating with other professionals, and communicating with project stakeholders. Mr. Cashen's experience in study design, data collection, and scientific writing make him an effective project manager, and his background in several different natural resource disciplines enable him to address the many facets of contemporary land management in a cost-effective manner.

REPRESENTATIVE EXPERIENCE

Wildlife Studies

- Peninsular Bighorn Sheep Resource Use and Behavior Study: (*CA State Parks*)
- "KV" Spotted Owl and Northern Goshawk Inventory: (*USFS, Plumas NF*)
- Amphibian Inventory Project: (*USFS, Plumas NF*)
- San Mateo Creek Steelhead Restoration Project: (*Trout Unlimited and CA Coastal Conservancy, Orange County*)
- Delta Meadows State Park Special-status Species Inventory: (*CA State Parks, Locke*)

Natural Resources Management

- <u>Mather Lake Resource Management Study and Plan</u> – (*Sacramento County*)
- <u>Placer County Vernal Pool Study</u> – (*Placer County*)
- <u>Weidemann Ranch Mitigation Project</u> – (*Toll Brothers, Inc., San Ramon*)
- <u>Ion Communities Biological Resource Assessments</u> – (*Ion Communities, Riverside and San Bernardino Counties*)
- <u>Del Rio Hills Biological Resource Assessment</u> – (*The Wyro Company, Rio Vista*)

Forestry

- <u>Forest Health Improvement Projects</u> – (*CalFire, SD and Riverside Counties*)
- <u>San Diego Bark Beetle Tree Removal Project</u> – (*SDG&E, San Diego Co.*)
- <u>San Diego Bark Beetle Tree Removal Project</u> – (*San Diego County/NRCS*)
- <u>Hillslope Monitoring Project</u> – (*CalFire, throughout California*)

Biological Resources

Mr. Cashen has a diverse background with biological resources. He has conducted comprehensive biological resource assessments, habitat evaluations, species inventories, and scientific peer review. Mr. Cashen has led investigations on several special-status species, including ones focusing on the foothill yellow-legged frog, mountain yellow-legged frog, desert tortoise, steelhead, burrowing owl, California spotted owl, northern goshawk, willow flycatcher, Peninsular bighorn sheep, red panda, and forest carnivores.

REPRESENTATIVE EXPERIENCE

Avian

- <u>Study design and Lead Investigator</u> - Delta Meadows State Park Special-Status Species Inventory *(CA State Parks: Locke)*
- <u>Study design and lead bird surveyor</u> - Placer County Vernal Pool Study *(Placer County: throughout Placer County)*
- <u>Surveyor</u> - Willow flycatcher habitat mapping *(USFS: Plumas NF)*
- <u>Independent surveyor</u> - Tolay Creek, Cullinan Ranch, and Guadacanal Village restoration projects *(Ducks Unlimited/USGS: San Pablo Bay)*
- <u>Study design and Lead Investigator</u> - Bird use of restored wetlands research *(Pennsylvania Game Commission: throughout Pennsylvania)*
- <u>Study design and surveyor</u> - Baseline inventory of bird species at a 400-acre site in Napa County *(HCV Associates: Napa)*

- Surveyor - Baseline inventory of bird abundance following diesel spill *(LFR Levine-Fricke: Suisun Bay)*
- Study design and lead bird surveyor - Green Valley Creek Riparian Restoration Site *(City of Fairfield: Fairfield, CA)*
- Surveyor - Burrowing owl relocation and monitoring *(US Navy: Dixon, CA)*
- Surveyor - Pre-construction raptor and burrowing owl surveys *(various clients and locations)*
- Surveyor - Backcountry bird inventory *(National Park Service: Eagle, Alaska)*
- Lead surveyor - Tidal salt marsh bird surveys (*Point Reyes Bird Observatory: throughout Bay Area*)
- Surveyor – Pre-construction surveys for nesting birds (*various clients and locations)*

Amphibian

- Crew Leader - Red-legged frog, foothill yellow-legged frog, and mountain yellow-legged frog surveys *(USFS: Plumas NF)*
- Surveyor - Foothill yellow-legged frog surveys *(PG&E: North Fork Feather River)*
- Surveyor - Mountain yellow-legged frog surveys *(El Dorado Irrigation District: Desolation Wilderness)*
- Crew Leader - Bullfrog eradication *(Trout Unlimited: Cleveland NF)*

Fish and Aquatic Resources

- Surveyor - Hardhead minnow and other fish surveys *(USFS: Plumas NF)*
- Surveyor - Weber Creek aquatic habitat mapping (*El Dorado Irrigation District: Placerville, CA*)
- Surveyor - Green Valley Creek aquatic habitat mapping *(City of Fairfield: Fairfield, CA)*
- GPS Specialist - Salmonid spawning habitat mapping *(CDFG: Sacramento River)*
- Surveyor - Fish composition and abundance study (*PG&E: Upper North Fork Feather River and Lake Almanor*)
- Crew Leader - Surveys of steelhead abundance and habitat use *(CA Coastal Conservancy: Gualala River estuary)*
- Crew Leader - Exotic species identification and eradication *(Trout Unlimited: Cleveland NF)*

Mammals

- Principal Investigator – Peninsular bighorn sheep resource use and behavior study (*California State Parks: Freeman Properties*)

- Scientific Advisor –Study on red panda occupancy and abundance in eastern Nepal *(The Red Panda Network: CA and Nepal)*
- Surveyor - Forest carnivore surveys *(University of CA: Tahoe NF)*
- Surveyor - Relocation and monitoring of salt marsh harvest mice and other small mammals *(US Navy: Skagg's Island, CA)*
- Surveyor – Surveys for Monterey dusky-footed woodrat. Relocation of woodrat houses (*Touré Associates: Prunedale*)

Natural Resource Investigations / Multiple Species Studies

- Scientific Review Team Member – Member of the science review team assessing the effectiveness of the US Forest Service's implementation of the Herger-Feinstein Quincy Library Group Act.
- Lead Consultant - Baseline biological resource assessments and habitat mapping for CDF management units *(CDF: San Diego, San Bernardino, and Riverside Counties)*
- Biological Resources Expert – Peer review of CEQA/NEPA documents (*Adams Broadwell Joseph & Cardoza: California)*
- Lead Consultant - Pre- and post-harvest biological resource assessments of tree removal sites *(SDG&E: San Diego County)*
- Crew Leader - T&E species habitat evaluations for Biological Assessment in support of a steelhead restoration plan *(Trout Unlimited: Cleveland NF)*
- Lead Investigator - Resource Management Study and Plan for Mather Lake Regional Park *(County of Sacramento: Sacramento, CA)*
- Lead Investigator - Biological Resources Assessment for 1,070-acre Alfaro Ranch property *(Yuba County, CA)*
- Lead Investigator - Wildlife Strike Hazard Management Plan *(HCV Associates: Napa)*
- Lead Investigator - Del Rio Hills Biological Resource Assessment *(The Wyro Company: Rio Vista, CA)*
- Lead Investigator – Ion Communities project sites (*Ion Communities: Riverside and San Bernardino Counties*)
- Surveyor – Tahoe Pilot Project: Validation of California's Wildlife Habitat Relationships (CWHR) Model *(University of California: Tahoe NF)*

Forestry

Mr. Cashen has five years of experience working as a consulting forester on projects throughout California. Mr. Cashen has consulted with landowners and timber operators on forest management practices; and he has worked on a variety of forestry tasks including selective tree marking, forest inventory, harvest layout, erosion control, and supervision of logging operations. Mr. Cashen's experience with many different natural resources enable him to provide a holistic approach to forest management, rather than just management of timber resources.

REPRESENTATIVE EXPERIENCE

- Lead Consultant - CalFire fuels treatment projects *(SD and Riverside Counties)*
- Lead Consultant and supervisor of harvest activities – San Diego Gas and Electric Bark Beetle Tree Removal Project *(San Diego)*
- Crew Leader - Hillslope Monitoring Program *(CalFire: throughout California)*
- Consulting Forester – Forest inventories and timber harvest projects *(various clients throughout California)*

Grant Writing and Technical Editing

Mr. Cashen has prepared and submitted over 50 proposals and grant applications. Many of the projects listed herein were acquired through proposals he wrote. Mr. Cashen's clients and colleagues have recognized his strong scientific writing skills and ability to generate technically superior proposal packages. Consequently, he routinely prepares funding applications and conducts technical editing for other organizations.

PERMITS

U.S. Fish and Wildlife Service Section 10(a)(1)(A) Recovery Permit for the Peninsular bighorn sheep

CA Department of Fish and Game Scientific Collecting Permit

PROFESSIONAL ORGANIZATIONS / ASSOCIATIONS

The Wildlife Society

Cal Alumni Foresters

Mt. Diablo Audubon Society

OTHER AFFILIATIONS

Scientific Advisor and Grant Writer – *The Red Panda Network*

Scientific Advisor – *Mt. Diablo Audubon Society*

Grant Writer – *American Conservation Experience*

Scientific Advisor and Land Committee Member – *Save Mt. Diablo*

TEACHING EXPERIENCE

Instructor: Wildlife Management - The Pennsylvania State University, 1998

Teaching Assistant: Ornithology - The Pennsylvania State University, 1996-1997

Selected

References

Staff Report on Burrowing Owl Mitigation

State of California

Natural Resources Agency

Department of Fish and Game

March 7, 2012[1]

[1] This document replaces the Department of Fish and Game 1995 Staff Report On Burrowing Owl Mitigation.

TABLE OF CONTENTS

INTRODUCTION AND PURPOSE

Maintaining California's rich biological diversity is dependent on the conservation of species and their habitats. The California Department of Fish and Game (Department) has designated certain species as "species of special concern" when their population viability and survival is adversely affected by risk factors such as precipitous declines or other vulnerability factors (Shuford and Gardali 2008). Preliminary analyses of regional patterns for breeding populations of burrowing owls (*Athene cunicularia*) have detected declines both locally in their central and southern coastal breeding areas, and statewide where the species has experienced modest breeding range retraction (Gervais et al. 2008). In California, threat factors affecting burrowing owl populations include habitat loss, degradation and modification, and eradication of ground squirrels resulting in a loss of suitable burrows required by burrowing owls for nesting, protection from predators, and shelter (See Appendix A).

The Department recognized the need for a comprehensive conservation and mitigation strategy for burrowing owls, and in 1995 directed staff to prepare a report describing mitigation and survey recommendations. This report, "1995 Staff Report on Burrowing Owl Mitigation," (Staff Report) (CDFG 1995), contained Department-recommended burrowing owl and burrow survey techniques and mitigation measures intended to offset the loss of habitat and slow or reverse further decline of this species. Notwithstanding these measures, over the past 15+ years, burrowing owls have continued to decline in portions of their range (DeSante et al. 2007, Wilkerson and Siegel, 2010). The Department has determined that reversing declining population and range trends for burrowing owls will require implementation of more effective conservation actions, and evaluating the efficacy of the Department's existing recommended avoidance, minimization and mitigation approaches for burrowing owls.

The Department has identified three main actions that together will facilitate a more viable, coordinated, and concerted approach to conservation and mitigation for burrowing owls in California. These include:

1. Incorporating burrowing owl comprehensive conservation strategies into landscape-based planning efforts such as Natural Community Conservation Plans (NCCPs) and multi-species Habitat Conservation Plans (HCPs) that specifically address burrowing owls.
2. Developing and implementing a statewide conservation strategy (Burkett and Johnson, 2007) and local or regional conservation strategies for burrowing owls, including the development and implementation of a statewide burrowing owl survey and monitoring plan.
3. Developing more rigorous burrowing owl survey methods, working to improve the adequacy of impacts assessments; developing clear and effective avoidance and minimization measures; and developing mitigation measures to ensure impacts to the species are effectively addressed at the project, local, and/or regional level (the focus of this document).

This Report sets forth the Department's recommendations for implementing the third approach identified above by revising the 1995 Staff Report, drawing from the most relevant and current knowledge and expertise, and incorporating the best scientific information available pertaining to the species. It is designed to provide a compilation of the best available science for Department staff, biologists, planners, land managers, California Environmental Quality Act (CEQA) lead agencies, and the public to consider when assessing impacts of projects or other activities on burrowing owls.

This revised Staff Report takes into account the California Burrowing Owl Consortium's Survey Protocol and Mitigation Guidelines (CBOC 1993, 1997) and supersedes the survey, avoidance, minimization and mitigation recommendations in the 1995 Staff Report. Based on experiences gained from implementing the 1995 Staff Report, the Department believes revising that report is warranted. This document also includes general conservation goals and principles for developing mitigation measures for burrowing owls.

DEPARTMENT ROLE AND LEGAL AUTHORITIES

The mission of the Department is to manage California's diverse fish, wildlife and plant resources, and the habitats upon which they depend, for their ecological values and for their use and enjoyment by the public. The Department has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and habitats necessary to maintain biologically sustainable populations of those species (Fish and Game Code (FGC) §1802). The Department, as trustee agency pursuant to CEQA (See CEQA Guidelines, §15386), has jurisdiction by law over natural resources, including fish and wildlife, affected by a project, as that term is defined in Section 21065 of the Public Resources Code. The Department exercises this authority by reviewing and commenting on environmental documents and making recommendations to avoid, minimize, and mitigate potential negative impacts to those resources held in trust for the people of California.

Field surveys designed to detect the presence of a particular species, habitat element, or natural community are one of the tools that can assist biologists in determining whether a species or habitat may be significantly impacted by land use changes or disturbance. The Department reviews field survey data as well as site-specific and regional information to evaluate whether a project's impacts may be significant. This document compiles the best available science for conducting habitat assessments and surveys, and includes considerations for developing measures to avoid impacts or mitigate unavoidable impacts.

CEQA

CEQA requires public agencies in California to analyze and disclose potential environmental impacts associated with a project that the agency will carry out, fund, or approve. Any potentially significant impact must be mitigated to the extent feasible. Project-specific CEQA mitigation is important for burrowing owls because most populations exist on privately owned parcels that, when proposed for development or other types of modification, may be subject to the environmental review requirements of CEQA.

Take

Take of individual burrowing owls and their nests is defined by FGC section 86, and prohibited by sections 3503, 3503.5 and 3513. Take is defined in FGC Section 86 as "hunt, pursue, catch, capture or kill, or attempt to hunt, pursue, catch, capture or kill."

Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) implements various treaties and conventions between the United States and Canada, Japan, Mexico, and Russia for the protection of migratory birds, including the burrowing owl (50 C.F.R. § 10). The MBTA protects migratory bird nests from possession, sale, purchase, barter, transport, import and export, and collection. The other prohibitions of the MBTA - capture, pursue, hunt, and kill - are inapplicable to nests. The regulatory definition of take, as defined in Title 50 C.F.R. part 10.12, means to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to hunt, shoot, wound, kill, trap, capture, or collect. Only the verb "collect" applies to nests. It is illegal to collect, possess, and by any means transfer possession of any migratory bird nest. The MBTA prohibits the destruction of a nest when it contains birds or eggs, and no possession shall occur during the destruction (see Fish and Wildlife Service, Migratory Bird Permit Memorandum, April 15, 2003). Certain exceptions to this prohibition are included in 50 C.F.R. section 21. Pursuant to Fish & Game Code section 3513, the Department enforces the Migratory Bird Treaty Act consistent with rules and regulations adopted by the Secretary of the Interior under provisions of the Migratory Treaty Act.

Regional Conservation Plans

Regional multiple species conservation plans offer long-term assurances for conservation of covered species at a landscape scale, in exchange for biologically appropriate levels of incidental take and/or habitat loss as defined in the approved plan. California's NCCP Act (FGC §2800 et seq.) governs such plans at the state level, and was designed to conserve species, natural communities, ecosystems, and ecological processes across a jurisdiction or a collection of jurisdictions. Complementary federal HCPs are governed by the Endangered Species Act (7 U.S.C. § 136, 16 U.S.C.§ 1531 et seq.) (ESA). Regional conservation plans (and certain other landscape-level conservation and management plans), may provide conservation for unlisted as well as listed species. Because the geographic scope of NCCPs and HCPs may span many hundreds of thousands of acres, these planning tools have the potential to play a significant role in conservation of burrowing owls, and grasslands and other habitats.

Fish and Game Commission Policies

There are a number of Fish and Game Commission policies (see FGC §2008) that can be applied to burrowing owl conservation. These include policies on: Raptors, Cooperation, Endangered and Threatened Species, Land Use Planning, Management and Utilization of Fish and Wildlife on Federal Lands, Management and Utilization of Fish and Wildlife on Private Lands, and Research.

GUIDING PRINCIPLES FOR CONSERVATION

Unless otherwise provided in a statewide, local, or regional conservation strategy, surveying and evaluating impacts to burrowing owls, as well as developing and implementing avoidance, minimization, and mitigation and conservation measures incorporate the following principles. These principles are a summary of Department staff expert opinion and were used to guide the preparation of this document.

1. Use the Precautionary Principle (Noss et al.1997), by which the alternative of increased conservation is deliberately chosen in order to buffer against incomplete knowledge of burrowing owl ecology and uncertainty about the consequences to burrowing owls of potential impacts, including those that are cumulative.
2. Employ basic conservation biology tenets and population-level approaches when determining what constitutes appropriate avoidance, minimization, and mitigation for impacts. Include mitigation effectiveness monitoring and reporting, and use an adaptive management loop to modify measures based on results.
3. Protect and conserve owls in wild, semi-natural, and agricultural habitats (conserve is defined at FGC §1802).
4. Protect and conserve natural nest burrows (or burrow surrogates) previously used by burrowing owls and sufficient foraging habitat and protect auxiliary "satellite" burrows that contribute to burrowing owl survivorship and natural behavior of owls.

CONSERVATION GOALS FOR THE BURROWING OWL IN CALIFORNIA

It is Department staff expert opinion that the following goals guide and contribute to the short and long-term conservation of burrowing owls in California:

1. Maintain size and distribution of extant burrowing owl populations (allowing for natural population fluctuations).
2. Increase geographic distribution of burrowing owls into formerly occupied historical range where burrowing owl habitat still exists, or where it can be created or enhanced, and where the reason for its local disappearance is no longer of concern.
3. Increase size of existing populations where possible and appropriate (for example, considering basic ecological principles such as carrying capacity, predator-prey relationships, and inter-specific relationships with other species at risk).
4. Protect and restore self-sustaining ecosystems or natural communities which can support burrowing owls at a landscape scale, and which will require minimal long-term management.
5. Minimize or prevent unnatural causes of burrowing owl population declines (e.g., nest burrow destruction, chemical control of rodent hosts and prey).
6. Augment/restore natural dynamics of burrowing owl populations including movement and genetic exchange among populations, such that the species does not require future listing and protection under the California Endangered Species Act (CESA) and/or the federal Endangered Species Act (ESA).
7. Engage stakeholders, including ranchers; farmers; military; tribes; local, state, and federal agencies; non-governmental organizations; and scientific research and education communities involved in burrowing owl protection and habitat management.

ACTIVITIES WITH THE POTENTIAL TO TAKE OR IMPACT BURROWING OWLS

The following activities are examples of activities that have the potential to take burrowing owls, their nests or eggs, or destroy or degrade burrowing owl habitat: grading, disking, cultivation, earthmoving, burrow blockage, heavy equipment compacting and crushing burrow tunnels, levee maintenance, flooding, burning and mowing (if burrows are impacted), and operating wind turbine collisions (collectively hereafter referred to as "projects" or "activities" whether carried out pursuant to CEQA or not). In addition, the following activities may have impacts to burrowing owl populations: eradication of host burrowers; changes in vegetation management (i.e. grazing); use of pesticides and rodenticides; destruction, conversion or degradation of nesting, foraging, over-wintering or other habitats; destruction of natural burrows and burrow surrogates; and disturbance which may result in harassment of owls at occupied burrows.

PROJECT IMPACT EVALUATIONS

The following three progressive steps are effective in evaluating whether projects will result in impacts to burrowing owls. The information gained from these steps will inform any subsequent avoidance, minimization and mitigation measures. The steps for project impact evaluations are: 1) habitat assessment, 2) surveys, and 3) impact assessment. Habitat assessments are conducted to evaluate the likelihood that a site supports burrowing owl. Burrowing owl surveys provide information needed to determine the potential effects of proposed projects and activities on burrowing owls, and to avoid take in accordance with FGC sections 86, 3503, and 3503.5. Impact assessments evaluate the extent to which burrowing owls and their habitat may be impacted, directly or indirectly, on and within a reasonable distance of a proposed CEQA project activity or non-CEQA project. These three site evaluation steps are discussed in detail below.

Biologist Qualifications

The current scientific literature indicates that only individuals meeting the following minimum qualifications should perform burrowing owl habitat assessments, surveys, and impact assessments:

1. Familiarity with the species and its local ecology;
2. Experience conducting habitat assessments and non-breeding and breeding season surveys, or experience with these surveys conducted under the direction of an experienced surveyor;
3. Familiarity with the appropriate state and federal statutes related to burrowing owls, scientific research, and conservation;
4. Experience with analyzing impacts of development on burrowing owls and their habitat.

Habitat Assessment Data Collection and Reporting

A habitat assessment is the first step in the evaluation process and will assist investigators in determining whether or not occupancy surveys are needed. Refer to Appendix B for a definition of burrowing owl habitat. Compile the detailed information described in Appendix C when conducting project scoping, conducting a habitat assessment site visit and preparing a habitat assessment report.

Surveys

Burrowing owl surveys are the second step of the evaluation process and the best available scientific literature recommends that they be conducted whenever burrowing owl habitat or sign (see Appendix B) is encountered on or adjacent to (within 150 meters) a project site

(Thomsen 1971, Martin 1973). Occupancy of burrowing owl habitat is confirmed at a site when at least one burrowing owl, or its sign at or near a burrow entrance, is observed within the last three years (Rich 1984). Burrowing owls are more detectable during the breeding season with detection probabilities being highest during the nestling stage (Conway et al. 2008). In California, the burrowing owl breeding season extends from 1 February to 31 August (Haug et al. 1993, Thompsen 1971) with some variances by geographic location and climatic conditions. Several researchers suggest three or more survey visits during daylight hours (Haug and Diduik 1993, CBOC 1997, Conway and Simon 2003) and recommend each visit occur at least three weeks apart during the peak of the breeding season, commonly accepted in California as between 15 April and 15 July (CBOC 1997). Conway and Simon (2003) and Conway et al. (2008) recommended conducting surveys during the day when most burrowing owls in a local area are in the laying and incubation period (so as not to miss early breeding attempts), during the nesting period, and in the late nestling period when most owls are spending time above ground.

Non-breeding season (1 September to 31 January) surveys may provide information on burrowing owl occupancy, but do not substitute for breeding season surveys because results are typically inconclusive. Burrowing owls are more difficult to detect during the non-breeding season and their seasonal residency status is difficult to ascertain. Burrowing owls detected during non-breeding season surveys may be year-round residents, young from the previous breeding season, pre-breeding territorial adults, winter residents, dispersing juveniles, migrants, transients or new colonizers. In addition, the numbers of owls and their pattern of distribution may differ during winter and breeding seasons. However, on rare occasions, non-breeding season surveys may be warranted (i.e., if the site is believed to be a wintering site only based on negative breeding season results). Refer to Appendix D for information on breeding season and non-breeding season survey methodologies.

Survey Reports

Adequate information about burrowing owls present in and adjacent to an area that will be disturbed by a project or activity will enable the Department, reviewing agencies and the public to effectively assess potential impacts and will guide the development of avoidance, minimization, and mitigation measures. The survey report includes but is not limited to a description of the proposed project or proposed activity, including the proposed project start and end dates, as well as a description of disturbances or other activities occurring on-site or nearby. Refer to Appendix D for details included in a survey report.

Impact Assessment

The third step in the evaluation process is the impact assessment. When surveys confirm occupied burrowing owl habitat in or adjoining the project area, there are a number of ways to assess a project's potential significant impacts to burrowing owls and their habitat. Richardson and Miller (1997) recommended monitoring raptor behavior prior to developing management recommendations and buffers to determine the extent to which individuals have been sensitized to human disturbance. Monitoring results will also provide detail necessary for developing site-specific measures. Postovit and Postovit (1987) recommended an analytical approach to mitigation planning: define the problem (impact), set goals (to guide mitigation development), evaluate and select mitigation methods, and monitor the results.

Define the problem. The impact assessment evaluates all factors that could affect burrowing owls. Postovit and Postovit (1987) recommend evaluating the following in assessing impacts to raptors and planning mitigation: type and extent of disturbance, duration and timing of disturbance, visibility of disturbance, sensitivity and ability to habituate, and influence of environmental factors. They suggest identifying and addressing all potential direct and indirect impacts to burrowing owls, regardless of whether or not the impacts will occur during the breeding season. Several examples are given for each impact category below; however, examples are not intended to be used exclusively.

Type and extent of the disturbance. The impact assessment describes the nature (source) and extent (scale) of potential project impacts on occupied, satellite and unoccupied burrows including acreage to be lost (temporary or permanent), fragmentation/edge being created, increased distance to other nesting and foraging habitat, and habitat degradation. Discuss any project activities that impact either breeding and/or non-breeding habitat which could affect owl home range size and spatial configuration, negatively affect onsite and offsite burrowing owl presence, increase energetic costs, lower reproductive success, increase vulnerability to predation, and/or decrease the chance of procuring a mate.

Duration and timing of the impact. The impact assessment describes the amount of time the burrowing owl habitat will be unavailable to burrowing owls (temporary or permanent) on the site and the effect of that loss on essential behaviors or life history requirements of burrowing owls, the overlap of project activities with breeding and/or non-breeding seasons (timing of nesting and/or non-breeding activities may vary with latitude and climatic conditions, which should be considered with the timeline of the project or activity), and any variance of the project activities in intensity, scale and proximity relative to burrowing owl occurrences.

Visibility and sensitivity. Some individual burrowing owls or pairs are more sensitive than others to specific stimuli and may habituate to ongoing visual or audible disturbance. Site-specific monitoring may provide clues to the burrowing owl's sensitivities. This type of assessment addresses the sensitivity of burrowing owls within their nesting area to humans on foot, and vehicular traffic. Other variables are whether the site is primarily in a rural versus urban setting, and whether any prior disturbance (e.g., human development or recreation) is known at the site.

Environmental factors. The impact assessment discusses any environmental factors that could be influenced or changed by the proposed activities including nest site availability, predators, prey availability, burrowing mammal presence and abundance, and threats from other extrinsic factors such as human disturbance, urban interface, feral animals, invasive species, disease or pesticides.

Significance of impacts. The impact assessment evaluates the potential loss of nesting burrows, satellite burrows, foraging habitat, dispersal and migration habitat, wintering habitat, and habitat linkages, including habitat supporting prey and host burrowers and other essential habitat attributes. This assessment determines if impacts to the species will result in significant impacts to the species locally, regionally and range-wide per CEQA Guidelines §15382 and Appendix G. The significance of the impact to habitat depends on the extent of habitat disturbed and length of time the habitat is unavailable (for example: minor – several days, medium – several weeks to months, high - breeding season affecting juvenile survival, or over winter affecting adult survival).

Cumulative effects. The cumulative effects assessment evaluates two consequences: 1) the project's proportional share of reasonably foreseeable impacts on burrowing owls and habitat caused by the project or in combination with other projects and local influences having impacts on burrowing owls and habitat, and 2) the effects on the regional owl population resulting from the project's impacts to burrowing owls and habitat.

Mitigation goals. Establishing goals will assist in planning mitigation and selecting measures that function at a desired level. Goals also provide a standard by which to measure mitigation success. Unless specifically provided for through other FGC Sections or through specific regulations, take, possession or destruction of individual burrowing owls, their nests and eggs is prohibited under FGC sections 3503, 3503.5 and 3513. Therefore, a required goal for all project activities is to avoid take of burrowing owls. Under CEQA, goals would consist of measures that would avoid, minimize and mitigate impacts to a less than significant level. For individual projects, mitigation must be roughly proportional to the level of impacts, including cumulative impacts, in accordance with the provisions of CEQA (CEQA Guidelines, §§ 15126.4(a)(4)(B), 15064, 15065, and 16355). In order for mitigation measures to be effective, they must be specific, enforceable, and feasible actions that will improve environmental conditions. As set forth in more detail in Appendix A, the current scientific literature supports the conclusion that mitigation for permanent habitat loss necessitates replacement with an equivalent or greater habitat area for breeding, foraging, wintering, dispersal, presence of burrows, burrow surrogates, presence of fossorial mammal dens, well drained soils, and abundant and available prey within close proximity to the burrow.

MITIGATION METHODS

The current scientific literature indicates that any site-specific avoidance or mitigation measures developed should incorporate the best practices presented below or other practices confirmed by experts and the Department. The Department is available to assist in the development of site-specific avoidance and mitigation measures.

Avoiding. A primary goal is to design and implement projects to seasonally and spatially avoid negative impacts and disturbances that could result in take of burrowing owls, nests, or eggs. Other avoidance measures may include but not be limited to:

- Avoid disturbing occupied burrows during the nesting period, from 1 February through 31 August.
- Avoid impacting burrows occupied during the non-breeding season by migratory or non-migratory resident burrowing owls.
- Avoid direct destruction of burrows through chaining (dragging a heavy chain over an area to remove shrubs), disking, cultivation, and urban, industrial, or agricultural development.
- Develop and implement a worker awareness program to increase the on-site worker's recognition of and commitment to burrowing owl protection.
- Place visible markers near burrows to ensure that farm equipment and other machinery does not collapse burrows.
- Do not fumigate, use treated bait or other means of poisoning nuisance animals in areas where burrowing owls are known or suspected to occur (e.g., sites observed with nesting

owls, designated use areas).
- Restrict the use of treated grain to poison mammals to the months of January and February.

Take avoidance (pre-construction) surveys. Take avoidance surveys are intended to detect the presence of burrowing owls on a project site at a fixed period in time and inform necessary take avoidance actions. Take avoidance surveys may detect changes in owl presence such as colonizing owls that have recently moved onto the site, migrating owls, resident burrowing owls changing burrow use, or young of the year that are still present and have not dispersed. Refer to Appendix D for take avoidance survey methodology.

Site surveillance. Burrowing owls may attempt to colonize or re-colonize an area that will be impacted; thus, the current scientific literature indicates a need for ongoing surveillance at the project site during project activities is recommended. The surveillance frequency/effort should be sufficient to detect burrowing owls if they return. Subsequent to their new occupancy or return to the site, take avoidance measures should assure with a high degree of certainty that take of owls will not occur.

Minimizing. If burrowing owls and their habitat can be protected in place on or adjacent to a project site, the use of buffer zones, visual screens or other measures while project activities are occurring can minimize disturbance impacts. Conduct site-specific monitoring to inform development of buffers (see Visibility and sensitivity above). The following general guidelines for implementing buffers should be adjusted to address site-specific conditions using the impact assessment approach described above. The CEQA lead agency and/or project proponent is encouraged to consult with the Department and other burrowing owl experts for assistance in developing site-specific buffer zones and visual screens.

Buffers. Holroyd et al. (2001) identified a need to standardize management and disturbance mitigation guidelines. For instance, guidelines for mitigating impacts by petroleum industries on burrowing owls and other prairie species (Scobie and Faminow, 2000) may be used as a template for future mitigation guidelines (Holroyd et al. 2001). Scobie and Faminow (2000) developed guidelines for activities around occupied burrowing owl nests recommending buffers around low, medium, and high disturbance activities, respectively (see below).

Recommended restricted activity dates and setback distances by level of disturbance for burrowing owls (Scobie and Faminow 2000).

Location	Time of Year	Level of Disturbance		
		Low	Med	High
Nesting sites	April 1-Aug 15	200 m*	500 m	500 m
Nesting sites	Aug 16-Oct 15	200 m	200 m	500 m
Nesting sites	Oct 16-Mar 31	50 m	100 m	500 m

* meters (m)

Based on existing vegetation, human development, and land uses in an area, resource managers may decide to allow human development or resource extraction closer to these area/sites than recommended above. However, if it is decided to allow activities closer than the setback distances recommended, a broad-scale, long-term, scientifically-rigorous monitoring program ensures that burrowing owls are not detrimentally affected by alternative approaches.

Other minimization measures include eliminating actions that reduce burrowing owl forage and burrowing surrogates (e.g. ground squirrel), or introduce/facilitate burrowing owl predators. Actions that could influence these factors include reducing livestock grazing rates and/or changing the timing or duration of grazing or vegetation management that could result in less suitable habitat.

Burrow exclusion and closure. Burrow exclusion is a technique of installing one-way doors in burrow openings during the non-breeding season to temporarily exclude burrowing owls, or permanently exclude burrowing owls and close burrows after verifying burrows are empty by site monitoring and scoping. Exclusion in and of itself is not a take avoidance, minimization or mitigation method. Eviction of burrowing owls is a potentially significant impact under CEQA.

The long-term demographic consequences of these techniques have not been thoroughly evaluated, and the fate of evicted or excluded burrowing owls has not been systematically studied. Because burrowing owls are dependent on burrows at all times of the year for survival and/or reproduction, evicting them from nesting, roosting, and satellite burrows may lead to indirect impacts or take. Temporary or permanent closure of burrows may result in significant loss of burrows and habitat for reproduction and other life history requirements. Depending on the proximity and availability of alternate habitat, loss of access to burrows will likely result in varying levels of increased stress on burrowing owls and could depress reproduction, increase predation, increase energetic costs, and introduce risks posed by having to find and compete for available burrows. Therefore, exclusion and burrow closure are not recommended where they can be avoided. The current scientific literature indicates consideration of all possible avoidance and minimization measures before temporary or permanent exclusion and closure of burrows is implemented, in order to avoid take.

The results of a study by Trulio (1995) in California showed that burrowing owls passively displaced from their burrows were quickly attracted to adjacent artificial burrows at five of six passive relocation sites. The successful sites were all within 75 meters (m) of the destroyed burrow, a distance generally within a pair's territory. This researcher discouraged using passive relocation to artificial burrows as a mitigation measure for lost burrows without protection of adjacent foraging habitat. The study results indicated artificial burrows were used by evicted burrowing owls when they were approximately 50-100 m from the natural burrow (Thomsen 1971, Haug and Oliphant 1990). Locating artificial or natural burrows more than 100 m from the eviction burrow may greatly reduce the chances that new burrows will be used. Ideally, exclusion and burrow closure is employed only where there are adjacent natural burrows and non-impacted, sufficient habitat for burrowing owls to occupy with permanent protection mechanisms in place. Any new burrowing owl colonizing the project site after the CEQA document has been adopted may constitute changed circumstances that should be addressed in a re-circulated CEQA document.

The current scientific literature indicates that burrow exclusion should only be conducted by qualified biologists (meeting the Biologist’s Qualifications above) during the non-breeding season, before breeding behavior is exhibited and after the burrow is confirmed empty by site surveillance and/or scoping. The literature also indicates that when temporary or permanent burrow exclusion and/or burrow closure is implemented, burrowing owls should not be excluded from burrows unless or until:

- A Burrowing Owl Exclusion Plan (see Appendix E) is developed and approved by the applicable local DFG office;
- Permanent loss of occupied burrow(s) and habitat is mitigated in accordance with the Mitigating Impacts sections below. Temporary exclusion is mitigated in accordance with the item #1 under Mitigating Impacts below.
- Site monitoring is conducted prior to, during, and after exclusion of burrowing owls from their burrows sufficient to ensure take is avoided. Conduct daily monitoring for one week to confirm young of the year have fledged if the exclusion will occur immediately after the end of the breeding season.
- Excluded burrowing owls are documented using artificial or natural burrows on an adjoining mitigation site (if able to confirm by band re-sight).

Translocation (Active relocation offsite >100 meters). At this time, there is little published information regarding the efficacy of translocating burrowing owls, and additional research is needed to determine subsequent survival and breeding success (Klute et al. 2003, Holroyd et al. 2001). Study results for translocation in Florida implied that hatching success may be decreased for populations of burrowing owls that undergo translocation (Nixon 2006). At this time, the Department is unable to authorize the capture and relocation of burrowing owls except within the context of scientific research (FGC §1002) or a NCCP conservation strategy.

Mitigating impacts. Habitat loss and degradation from rapid urbanization of farmland in the core areas of the Central and Imperial valleys is the greatest of many threats to burrowing owls in California (Shuford and Gardali, 2008). At a minimum, if burrowing owls have been documented to occupy burrows (see Definitions, Appendix B) at the project site in recent years, the current scientific literature supports the conclusion that the site should be considered occupied and mitigation should be required by the CEQA lead agency to address project-specific significant and cumulative impacts. Other site-specific and regionally significant and cumulative impacts may warrant mitigation. The current scientific literature indicates the following to be best practices. If these best practices cannot be implemented, the lead agency or lead investigator may consult with the Department to develop effective mitigation alternatives. The Department is also available to assist in the identification of suitable mitigation lands.

1. Where habitat will be temporarily disturbed, restore the disturbed area to pre-project condition including decompacting soil and revegetating. Permanent habitat protection may be warranted if there is the potential that the temporary impacts may render a nesting site (nesting burrow and satellite burrows) unsustainable or unavailable depending on the time frame, resulting in reduced survival or abandonment. For the latter potential impact, see the permanent impact measures below.
2. Mitigate for permanent impacts to nesting, occupied and satellite burrows and/or burrowing owl habitat such that the habitat acreage, number of burrows and burrowing owls impacted are replaced based on the information provided in Appendix A. Note: A

minimum habitat replacement recommendation is not provided here as it has been shown to serve as a default, replacing any site-specific analysis and discounting the wide variation in natal area, home range, foraging area, and other factors influencing burrowing owls and burrowing owl population persistence in a particular area.

3. Mitigate for permanent impacts to nesting, occupied and satellite burrows and burrowing owl habitat with (a) permanent conservation of similar vegetation communities (grassland, scrublands, desert, urban, and agriculture) to provide for burrowing owl nesting, foraging, wintering, and dispersal (i.e., during breeding and non-breeding seasons) comparable to or better than that of the impact area, and (b) sufficiently large acreage, and presence of fossorial mammals. The mitigation lands may require habitat enhancements including enhancement or expansion of burrows for breeding, shelter and dispersal opportunity, and removal or control of population stressors. If the mitigation lands are located adjacent to the impacted burrow site, ensure the nearest neighbor artificial or natural burrow clusters are at least within 210 meters (Fisher et al. 2007).
4. Permanently protect mitigation land through a conservation easement deeded to a non-profit conservation organization or public agency with a conservation mission, for the purpose of conserving burrowing owl habitat and prohibiting activities incompatible with burrowing owl use. If the project is located within the service area of a Department-approved burrowing owl conservation bank, the project proponent may purchase available burrowing owl conservation bank credits.
5. Develop and implement a mitigation land management plan to address long-term ecological sustainability and maintenance of the site for burrowing owls (see Management Plan and Artificial Burrow sections below, if applicable).
6. Fund the maintenance and management of mitigation land through the establishment of a long-term funding mechanism such as an endowment.
7. Habitat should not be altered or destroyed, and burrowing owls should not be excluded from burrows, until mitigation lands have been legally secured, are managed for the benefit of burrowing owls according to Department-approved management, monitoring and reporting plans, and the endowment or other long-term funding mechanism is in place or security is provided until these measures are completed.
8. Mitigation lands should be on, adjacent or proximate to the impact site where possible and where habitat is sufficient to support burrowing owls present.
9. Where there is insufficient habitat on, adjacent to, or near project sites where burrowing owls will be excluded, acquire mitigation lands with burrowing owl habitat away from the project site. The selection of mitigation lands should then focus on consolidating and enlarging conservation areas located outside of urban and planned growth areas, within foraging distance of other conserved lands. If mitigation lands are not available adjacent to other conserved lands, increase the mitigation land acreage requirement to ensure a selected site is of sufficient size. Offsite mitigation may not adequately offset the biological and habitat values impacted on a one to one basis. Consult with the Department when determining offsite mitigation acreages.
10. Evaluate and select suitable mitigation lands based on a comparison of the habitat attributes of the impacted and conserved lands, including but not limited to: type and structure of habitat being impacted or conserved; density of burrowing owls in impacted and conserved habitat; and significance of impacted or conserved habitat to the species range-wide. Mitigate for the highest quality burrowing owl habitat impacted first and foremost when identifying mitigation lands, even if a mitigation site is located outside of

a lead agency's jurisdictional boundary, particularly if the lead agency is a city or special district.

11. Select mitigation lands taking into account the potential human and wildlife conflicts or incompatibility, including but not limited to, human foot and vehicle traffic, and predation by cats, loose dogs and urban-adapted wildlife, and incompatible species management (i.e., snowy plover).
12. Where a burrowing owl population appears to be highly adapted to heavily altered habitats such as golf courses, airports, athletic fields, and business complexes, permanently protecting the land, augmenting the site with artificial burrows, and enhancing and maintaining those areas may enhance sustainability of the burrowing owl population onsite. Maintenance includes keeping lands grazed or mowed with weed-eaters or push mowers, free from trees and shrubs, and preventing excessive human and human-related disturbance (e.g., walking, jogging, off-road activity, dog-walking) and loose and feral pets (chasing and, presumably, preying upon owls) that make the environment uninhabitable for burrowing owls (Wesemann and Rowe 1985, Millsap and Bear 2000, Lincer and Bloom 2007). Items 4, 5 and 6 also still apply to this mitigation approach.
13. If there are no other feasible mitigation options available and a lead agency is willing to establish and oversee a Burrowing Owl Mitigation and Conservation Fund that funds on a competitive basis acquisition and permanent habitat conservation, the project proponent may participate in the lead agency's program.

Artificial burrows. Artificial burrows have been used to replace natural burrows either temporarily or long-term and their long-term success is unclear. Artificial burrows may be an effective addition to in-perpetuity habitat mitigation if they are augmenting natural burrows, the burrows are regularly maintained (i.e., no less than annual, with biennial maintenance recommended), and surrounding habitat patches are carefully maintained. There may be some circumstances, for example at airports, where squirrels will not be allowed to persist and create a dynamic burrow system, where artificial burrows may provide some support to an owl population.

Many variables may contribute to the successful use of artificial burrows by burrowing owls, including pre-existence of burrowing owls in the area, availability of food, predators, surrounding vegetation and proximity, number of natural burrows in proximity, type of materials used to build the burrow, size of the burrow and entrance, direction in which the burrow entrance is facing, slope of the entrance, number of burrow entrances per burrow, depth of the burrow, type and height of perches, and annual maintenance needs (Belthoff and King 2002, Smith et al. 2005, Barclay et al. 2011). Refer to Barclay (2008) and (2011) and to Johnson et al. 2010 (unpublished report) for guidance on installing artificial burrows including recommendations for placement, installation and maintenance.

Any long-term reliance on artificial burrows as natural burrow replacements must include semi-annual to annual cleaning and maintenance and/or replacement (Barclay et al. 2011, Smith and Conway 2005, Alexander et al. 2005) as an ongoing management practice. Alexander et al. (2005), in a study of the use of artificial burrows found that all of 20 artificial burrows needed some annual cleaning and maintenance. Burrows were either excavated by predators, blocked by soil or vegetation, or experienced substrate erosion forming a space beneath the tubing that prevented nestlings from re-entering the burrow.

Mitigation lands management plan. Develop a Mitigation Lands Management Plan for projects that require off-site or on-site mitigation habitat protection to ensure compliance with and effectiveness of identified management actions for the mitigation lands. A suggested outline and related vegetation management goals and monitoring success criteria can be found in Appendix E.

Mitigation Monitoring and Reporting

Verify the compliance with required mitigation measures, the accuracy of predictions, and ensure the effectiveness of all mitigation measures for burrowing owls by conducting follow-up monitoring, and implementing midcourse corrections, if necessary, to protect burrowing owls. Refer to CEQA Guidelines Section 15097 and the CEQA Guidelines for additional guidance on mitigation, monitoring and reporting. Monitoring is qualitatively different from site surveillance; monitoring normally has a specific purpose and its outputs and outcomes will usually allow a comparison with some baseline condition of the site before the mitigation (including avoidance and minimization) was undertaken. Ideally, monitoring should be based on the Before-After Control-Impact (BACI) principle (McDonald et al. 2000) that requires knowledge of the pre-mitigation state to provide a reference point for the state and change in state after the project and mitigation have been implemented.

ACKNOWLEDGEMENTS

We thank Jack Barclay, Jeff Lincer, David Plumpton, Jeff Kidd, Carol Roberts and other reviewers for their valuable comments on this report. We also want to acknowledge all the hard work of the Department team, especially T. Bartlett, K. Riesz, S. Wilson, D. Gifford, D. Mayer, J. Gan, L. Connolly, D. Mayer, A. Donlan, L. Bauer, L. Comrack, D. Lancaster, E. Burkett, B. Johnson, D. Johnston, A. Gonzales, S. Morey and K. Hunting.

REFERENCES

Alexander, A. K., M. R. Sackschewsky, and C. A. Duberstein. 2005. Use of artificial burrows by burrowing owls (athene cunicularia) at the HAMMER Facility on the U.S. Department of Energy Hanford Site. Pacific Northwest National Lab-15414. U.S. Department of Energy, DE-AC05-76RL01830, Richland, Washington, USA.

BIOS. California Department of Fish and Game. The Biogeographic Information Observation System (http://bios.dfg.ca.gov/)

Barclay, J. H. 2008. A simple artificial burrow design for burrowing owls. Journal of Raptor Research. 42: 53-57.

Barclay, J. H. 2012. Albion Environmental, Inc, personal communication.

Barclay, J. H., K. W. Hunting, J. L. Lincer, J. Linthicum, and T. A. Roberts, editors. 2007. Proceedings of the California Burrowing Owl Symposium, 11-12 November 2003, Sacramento, California, USA. Bird Populations Monographs No. 1. The Institute for Bird Populations and Albion Environmental, Inc., Point Reyes Station, CA.

Barclay, J. H., N. Korfanta, and M. Kauffman. 2011. Long-term population dynamics of a managed burrowing owl colony. Journal of Wildlife Management 75: 1295–1306.

Belthoff, J R., R. A. King. 2002. Nest-site characteristics of burrowing owls (athene cunicularia) in the Snake River Birds of Prey National Conservation Area, Idaho, and applications to artificial burrow installation. Western North American Naturalist 62: 112-119.

Botelho, E. S. 1996. Behavioral ecology and parental care of breeding western burrowing owls (Speotyto cunicularia hupugaea) in southern New Mexico, USA. Dissertation, New Mexico State University, Las Cruces, New Mexico, USA.

Burkett, E. E., and B. S. Johnson. 2007. Development of a conservation strategy for burrowing owls in California. Pages 165-168 *in* J. H. Barclay, K. W. Hunting, J. L. Lincer, J. Linthicum, and T. A. Roberts, editors. Proceedings of the California Burrowing Owl Symposium, 11-12 November 2003, Sacramento, California, USA. Bird Populations Monographs No. 1. The Institute for Bird Populations and Albion Environmental, Inc., Point Reyes Station, CA.

CBOC (California Burrowing Owl Consortium). 1997. Burrowing owl survey protocol and mitigation guidelines. Pages 171-177 *in* Lincer, J. L. and K. Steenhof (editors). 1997. The burrowing owl, its biology and management. Raptor Research Report Number 9.

CDFG (California Department of Fish and Game). 1995. Staff report on burrowing owl mitigation. Unpublished report. Sacramento, California, USA.

CNDDB. California Department of Fish and Game. The California Natural Diversity Database (CNDDB) (http://www.dfg.ca.gov/biogeodata/cnddb/), Sacramento, California, USA.

Catlin, D. H. 2004. Factors affecting within-season and between-season breeding dispersal of Burrowing Owls in California. Thesis, Oregon State University, Corvallis, Oregon, USA

Catlin, D. H., and D. K. Rosenberg. 2006. Nest destruction increases mortality and dispersal of Burrowing Owls in the Imperial Valley, California. Southwest Naturalist 51: 406–409.

Catlin, D. H., D. K. Rosenberg, and K. L. Haley. 2005. The effects of nesting success and mate fidelity on breeding dispersal in burrowing owls. Canadian Journal of Zoology 83:1574–1580.

Conway, C. J., and J. Simon. 2003. Comparison of detection probability associated with burrowing owl survey methods. Journal of Wildlife Management 67: 501-511.

Conway, C. J., V. Garcia, M. D., and K. Hughes. 2008. Factors affecting detection of burrowing owl nests during standardized surveys. Journal of Wildlife Management 72: 688-696.

Coulombe, H. N. 1971. Behavior and population ecology of the burrowing owl, Speotyto cunicularia, in the Imperial Valley of California. Condor 73: 162–176.

Dechant, J. A., M. L. Sondreal, D. H. Johnson, L. D. Igl, C. M. Goldade, P. A. Rabie, and B. R. Euliss. 2003. Effects of management practices on grassland birds: burrowing owl. Northern Prairie Wildlife Research Center, Jamestown, North Dakota. Northern Prairie Wildlife Research Center Online. <http://www.npwrc.usgs.gov/resource/literatr/grasbird/buow/buow.htm>.

DeSante, D. F., E. D Ruhlen, and R. Scalf. 2007. The distribution and relative abundance of burrowing owls in California during 1991–1993: Evidence for a declining population and thoughts on its conservation. Pages 1-41 *in* J. H. Barclay, K. W. Hunting, J. L. Lincer, J. Linthicum, and T. A. Roberts, editors. Proceedings of the California Burrowing Owl Symposium, 11-12 November 2003 Sacramento, California, USA. Bird Populations Monographs No. 1. The Institute for Bird Populations and Albion Environmental, Inc., Point Reyes Station, CA.

Desmond, M. J., and J. A. Savidge. 1998. Burrowing Owl conservation in the Great Plains. Proceedings of the Second International Burrowing Owl Symposium, 29-30 September 1999, Ogden, Utah, USA.

Desmond, M. J., and J. A. Savidge. 1999. Satellite burrow use by burrowing owl chicks and its influence on nest fate. Pages 128-130 *in* P. D. Vickery and J. R. Herkert, editors. Ecology and conservation of grassland birds of the western hemisphere. Studies in Avian Biology 19.

Emlen, J. T. 1977. Estimating breeding season bird densities from transects counts. Auk 94: 455-468.

Fisher, J. B., L. A. Trulio, G. S. Biging, and D. Chromczack. 2007. An analysis of spatial clustering and implications for wildlife management: a burrowing owl example. Environmental Management 39: 403-11.

Gervais, J. A., D. K. Rosenberg, and L. A. Comrack. Burrowing Owl (Athene cunicularia) *in* Shuford, W.D. and T. Gardali, editors. 2008. California Bird Species of Special Concern: A ranked assessment of species, subspecies, and distinct populations of birds of immediate conservation concern in California. Studies of Western Birds 1. Western Field Ornithologists, Camarillo, California, and California Department of Fish and Game, Sacramento, California, USA.

Gervais, J. A., D. K. Rosenberg, R. G. Anthony. 2003. Space use and pesticide exposure risk of male burrowing owls in an agricultural landscape. Journal of Wildlife Management 67: 155-164.

Green, G.A.; Anthony, R.G. 1989. Nesting success and habitat relationships of burrowing owls in the Columbia Basin, Oregon. The Condor 91: 347-354.

Haug, E. A. 1985. Observations on the breeding ecology of burrowing owls in Saskatchewan.

Thesis, University of Saskatchewan, Saskatoon, Saskatchewan, Canada.

Haug, E. A., B. A. Millsap, and M. S. Martell. 1993. Burrowing owl (Speotyto cunicularia), *in* A. Poole and F. Gill, editors, The Birds of North America, The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C., USA.

Haug, E. A., and L. W. Oliphant. 1990. Movements, activity patterns, and habitat use of burrowing owls in Saskatchewan. Journal of Wildlife Management 54: 27-35.

Holroyd, G. L., R. Rodriguez-Estrella, and S. R. Sheffield. 2001. Conservation of the burrowing owl in western North America: issues, challenges, and recommendations. Journal of Raptor Research 35: 399-407.

James, P. C., T. J. Ethier, and M. K. Toutloff. 1997. Parameters of a declining burrowing owl population in Saskatchewan. Pages 34-37. *in* J. L. Lincer, and K. Steenhof, editors. The burrowing owl, its biology and management: including the proceedings of the first international symposium. 13-14 November 1992, Bellevue, WA, USA. Raptor Research Report Number 9.

Johnson, D. H., D. C. Gillis, M. A. Gregg, J. L.Rebholz, J. L. Lincer, and J. R. Belthoff. 2010. Users guide to installation of artificial burrows for burrowing owls. Unpublished report. Tree Top Inc., Selah, Washington, USA.

Klute, D. S., A. W. Ayers, M. T. Green, W. H. Howe, S. L Jones, J. A. Shaffer, S. R. Sheffield, and T. S. Zimmerman. 2003. Status assessment and conservation plan for the western burrowing owl in the United States. U.S. Department of the Interior, Fish and Wildlife Service, Biological Technical Publication FWS/BTP-R6001-2003, Washington, D.C, USA.

Koenig, W. D., D. D. Van Vuren, and P. N. Hooge. 1996. Detectability, philopatry, and the distribution of dispersal distances in vertebrates. Trends in Ecology and Evolution 11: 514–517.

LaFever, D. H., K. E. LaFever, D. H. Catlin, and D. K. Rosenberg. 2008. Diurnal time budget of burrowing owls in a resident population during the non-breeding season. Southwestern Naturalist 53: 29-33.

Lincer, J. L., and P. W. Bloom. 2007. The status of the burrowing owl (Athene cunicularia) in San Diego County, CA. Pages 90-102 *in* Proceedings of the California Burrowing Owl Symposium, 11-12 November 2003, Sacramento, California, USA. Bird Populations Monographs No. 1. The Institute for Bird Populations and Albion Environmental, Inc., Point Reyes Station, CA.

Lutz, R. S. and D. L. Plumpton. 1999. Philopatry and nest site reuse by burrowing owls: implications for management. Journal of Raptor Research 33: 149-153.

MacCracken, J. G., D. W. Uresk, and R. M. Hansen. 1985a. Vegetation and soils of burrowing owl nest sites in Conata Basin, South Dakota. Condor 87: 152-154.

Manning, J. A., and R. S. A. Kaler. 2011. Effects of survey methods on burrowing owl behaviors. Journal of Wildlife Management 75: 525-30.

McDonald, T. L., W. P. Erickson, and L. L. McDonald. 2000. Analysis of count data from before-after control-impact studies. Journal of Agricultural, Biological and Environmental Statistics 5: 262-279.

Millsap, B. A., and C. Bear. 2000. Density and reproduction of burrowing owls along an urban development gradient. Journal of Wildlife Management 64:33-41.

Nixon, P A. 2006. Effects of translocation on the Florida burrowing owl (Athene cunicularia floridana). Thesis. University of South Florida, Tampa, Florida, USA.

Noss, R. F., M. A. O'Connell, and D. D. Murphy. 1997. The science of conservation planning:

habitat conservation under the Endangered Species Act. Island Press, Washington D.C., USA.

Postovit, H. R., and B. C. Postovit. 1987. Impacts and mitigation techniques. Pages 183-213 in Raptor management techniques manual scientific technical series number 10, National Wildlife Federation, Washington, D. C., USA

Remsen, J. V., Jr. 1978. Bird species of special concern in California: An annotated list of declining or vulnerable bird species. California Department of Fish and Game, Nongame Wildlife. Investigations, Wildlife Management Branch Administrative Report 78-1, Sacramento, California, USA.

Rich, T. 1984. Monitoring burrowing owl populations: implications of burrow re-use. Wildlife Society Bulletin 12: 178-189.

Richardson, C. T. and C. K. Miller. 1997. Recommendations for protecting raptors from human disturbance: a review. Wildlife Society Bulletin 25: 634-38.

Ronan, N. A. 2002. Habitat selection, reproductive success, and site fidelity of burrowing owls in a grassland ecosystem. Thesis, Oregon State University, Corvallis, Oregon, USA.

Rosenberg, D., 2009 Oregon State University, Corvallis, personal communication.

Rosenberg, D. K., J. A. Gervais, D. F. DeSante, and H. Ober. 2009. An updated adaptive management plan for the burrowing owl population at NAS Lemoore. The Oregon Wildlife Institute, Corvallis, OR and The Institute for Bird Populations, Point Reyes Station, CA. OWI Contribution No. 201 and IBP Contribution No. 375.

Rosenberg, D. K., J. A. Gervais, H. Ober, and D. F. DeSante. 1998. An adaptive management plan for the burrowing owl population at Naval Air Station Lemoore, California, USA. Publication 95, Institute for Bird Populations, P.O. Box 1346, Pt. Reyes Station, CA 94956.

Rosenberg, D. K., and K. L. Haley. 2004. The ecology of burrowing owls in the agroecosystem of the Imperial Valley, California. Studies in Avian Biology 27:120-135.

Rosenberg, D. K., L. A. Trulio, D. H. Catlin, D. Chromczack, J. A. Gervais, N. Ronan, and K. A. Haley. 2007. The ecology of the burrowing owl in California, unpublished report to Bureau of Land Management.

Rosier, J. R., N. A., Ronan, and D. K. Rosenberg. 2006. Post-breeding dispersal of burrowing owls in an extensive California grassland. American Midland Naturalist 155: 162–167.

Sawyer, J. O., T. Keeler-Wolf, and J. M. Evens. 2009. A manual of California vegetation, Second edition. California Native Plant Society, Sacramento, California, USA.

Scobie, D., and C. Faminow. 2000. Development of standardized guidelines for petroleum industry activities that affect COSEWIC Prairie and Northern Region vertebrate species at risk. Environment Canada, Prairie and Northern Region, Edmonton, Alberta, Canada.

Shuford, W. D. and T. Gardali, editors. 2008. California Bird Species of Special Concern: a ranked assessment of species, subspecies, and distinct populations of birds of immediate conservation concern in California. Studies of Western Birds 1. Western Field Ornithologists, Camarillo, California, and California Department of Fish and Game, Sacramento. Gervais, J. A., D. K. Rosenberg, and L. Comrack. 2008. Burrowing Owl (Athene cunicularia).

Smith, M. D., C. J. Conway, and L. A. Ellis. 2005. Burrowing owl nesting productivity: a comparison between artificial and natural burrows on and off golf courses. Wildlife Society Bulletin 33: 454-462.

Thelander, C. G., K. S. Smallwood, and L. Rugge. 2003. Bird risk behaviors and fatalities at the Altamont Pass Wind Resource Area, period of performance: March 1998–

December 2000. U.S. Department of Energy, National Renewable Energy Laboratory, Golden, Colorado, USA.

Thomsen, L. 1971. Behavior and ecology of burrowing owls on the Oakland Municipal Airport. Condor 73: 177-192.

Thompson, C. D. 1984. Selected aspects of burrowing owl ecology in central Wyoming. Thesis, University of Wyoming, Laramie, Wyoming, USA.

Trulio, L. 1995. Passive relocation: A method to preserve burrowing owls on disturbed sites. Journal of Field Ornithology 66: 99–106.

U.S. Fish and Wildlife Service (USFWS). 2002. Birds of conservation concern 2002. U.S. Department of Interior, Division of Migratory Bird Management, Arlington, Virginia, USA.

U.S. Fish and Wildlife Service (USFWS). 2008. Birds of Conservation Concern 2008. U.S. Department of Interior, Division of Migratory Bird Management, Arlington, Virginia, USA.

Wesemann, T. and M. Rowe. 1985. Factors influencing the distribution and abundance of burrowing owls in Cape Coral, Florida. Pages 129-137 *in* L. W. Adams and D. L. Leedy, editors. Integrating Man and Nature in the Metropolitan Environment. Proceedings National Symposium. on Urban Wildlife, 4-7 November 1986, Chevy Chase, Maryland, USA.

Wilkerson, R. L. and R. B. Siegel. 2010. Assessing changes in the distribution and abundance of burrowing owls in California, 1993-2007. Bird Populations 10: 1-36.

Zarn, M. 1974. Burrowing owl. U.S. Department of the Interior, Bureau of Land Management. Technical Note T-N-250, Denver, Colorado, USA.

Appendix A. Burrowing Owl Natural History and Threats

Diet

Burrowing owl diet includes arthropods, small rodents, birds, amphibians, reptiles, and carrion (Haug et al. 1993).

Breeding

In California, the breeding season for the burrowing owl typically occurs between 1 February and 31 August although breeding in December has been documented (Thompson 1971, Gervais et al. 2008); breeding behavior includes nest site selection by the male, pair formation, copulation, egg laying, hatching, fledging, and post-fledging care of young by the parents. The peak of the breeding season occurs between 15 April and 15 July and is the period when most burrowing owls have active nests (eggs or young). The incubation period lasts 29 days (Coulombe 1971) and young fledge after 44 days (Haug et al. 1993). Note that the timing of nesting activities may vary with latitude and climatic conditions. Burrowing owls may change burrows several times during the breeding season, starting when nestlings are about three weeks old (Haug et al. 1993).

Dispersal

The following discussion is an excerpt from Gervais et al (2008):

> "The burrowing owl is often considered a sedentary species (e.g., Thomsen 1971). A large proportion of adults show strong fidelity to their nest site from year to year, especially where resident, as in Florida (74% for females, 83% for males; Millsap and Bear 1997). In California, nest-site fidelity rates were 32%–50% in a large grassland and 57% in an agricultural environment (Ronan 2002, Catlin 2004, Catlin et al. 2005). Differences in these rates among sites may reflect differences in nest predation rates (Catlin 2004, Catlin et al. 2005). Despite the high nest fidelity rates, dispersal distances may be considerable for both juveniles (natal dispersal) and adults (postbreeding dispersal), but this also varied with location (Catlin 2004, Rosier et al. 2006). Distances of 53 km to roughly 150 km have been observed in California for adult and natal dispersal, respectively (D. K. Rosenberg and J. A. Gervais, unpublished data), despite the difficulty in detecting movements beyond the immediate study area (Koenig et al. 1996)."

Habitat

The burrowing owl is a small, long-legged, ground-dwelling bird species, well-adapted to open, relatively flat expanses. In California, preferred habitat is generally typified by short, sparse vegetation with few shrubs, level to gentle topography and well-drained soils (Haug et al. 1993). Grassland, shrub steppe, and desert are naturally occurring habitat types used by the species. In addition, burrowing owls may occur in some agricultural areas, ruderal grassy fields, vacant lots and pastures if the vegetation structure is suitable and there are useable burrows and foraging habitat in proximity (Gervais et al 2008). Unique amongst North

American raptors, the burrowing owl requires underground burrows or other cavities for nesting during the breeding season and for roosting and cover, year round. Burrows used by the owls are usually dug by other species termed host burrowers. In California, California ground squirrel (*Spermophilus beecheyi*) and round-tailed ground squirrel (*Citellus tereticaudus*) burrows are frequently used by burrowing owls but they may use dens or holes dug by other fossorial species including badger (*Taxidea taxus*), coyote (*Canis latrans*), and fox (e.g., San Joaquin kit fox, *Vulpes macrotis mutica*; Ronan 2002). In some instances, owls have been known to excavate their own burrows (Thompson 1971, Barclay 2007). Natural rock cavities, debris piles, culverts, and pipes also are used for nesting and roosting (Rosenberg et al. 1998). Burrowing owls have been documented using artificial burrows for nesting and cover (Smith and Belthoff, 2003).

Foraging habitat. Foraging habitat is essential to burrowing owls. The following discussion is an excerpt from Gervais et al. (2008):

> "Useful as a rough guide to evaluating project impacts and appropriate mitigation for burrowing owls, adult male burrowing owls home ranges have been documented (calculated by minimum convex polygon) to comprise anywhere from 280 acres in intensively irrigated agroecosystems in Imperial Valley (Rosenberg and Haley 2004) to 450 acres in mixed agricultural lands at Lemoore Naval Air Station, CA (Gervais et al. 2003), to 600 acres in pasture in Saskatchewan, Canada (Haug and Oliphant 1990). But owl home ranges may be much larger, perhaps by an order of magnitude, in non-irrigated grasslands such as at Carrizo Plain, California (Gervais et al. 2008), based on telemetry studies and distribution of nests. Foraging occurs primarily within 600 m of their nests (within approximately 300 acres, based on a circle with a 600 m radius) during the breeding season."

Importance of burrows and adjacent habitat. Burrows and the associated surrounding habitat are essential ecological requisites for burrowing owls throughout the year and especially during the breeding season. During the non-breeding season, burrowing owls remain closely associated with burrows, as they continue to use them as refuge from predators, shelter from weather and roost sites. Resident populations will remain near the previous season's nest burrow at least some of the time (Coulombe 1971, Thomsen 1971, Botelho 1996, LaFever et al. 2008).

In a study by Lutz and Plumpton (1999) adult males and females nested in formerly used sites at similar rates (75% and 63%, respectively) (Lutz and Plumpton 1999). Burrow fidelity has been reported in some areas; however, more frequently, burrowing owls reuse traditional nesting areas without necessarily using the same burrow (Haug et al. 1993, Dechant et al. 1999). Burrow and nest sites are re-used at a higher rate if the burrowing owl has reproduced successfully during the previous year (Haug et al. 1993) and if the number of burrows isn't limiting nesting opportunity.

Burrowing owls may use "satellite" or non-nesting burrows, moving young at 10-14 days, presumably to reduce risk of predation (Desmond and Savidge 1998) and possibly to avoid nest parasites (Dechant et al. 1999). Successful nests in Nebraska had more active satellite burrows within 75 m of the nest burrow than unsuccessful nests (Desmond and Savidge

1999). Several studies have documented the number of satellite burrows used by young and adult burrowing owls during the breeding season as between one and 11 burrows with an average use of approximately five burrows (Thompsen 1984, Haug 1985, Haug and Oliphant 1990). Supporting the notion of selecting for nest sites near potential satellite burrows, Ronan (2002) found burrowing owl families would move away from a nest site if their satellite burrows were experimentally removed through blocking their entrance.

Habitat adjacent to burrows has been documented to be important to burrowing owls. Gervais et al. (2003) found that home range sizes of male burrowing owls during the nesting season were highly variable within but not between years. Their results also suggested that owls concentrate foraging efforts within 600 meters of the nest burrow, as was observed in Canada (Haug and Oliphant 1990) and southern California (Rosenberg and Haley 2004). James et al. (1997), reported habitat modification factors causing local burrowing owl declines included habitat fragmentation and loss of connectivity.

In conclusion, the best available science indicates that essential habitat for the burrowing owl in California must include suitable year-round habitat, primarily for breeding, foraging, wintering and dispersal habitat consisting of short or sparse vegetation (at least at some time of year), presence of burrows, burrow surrogates or presence of fossorial mammal dens, well-drained soils, and abundant and available prey within close proximity to the burrow.

Threats to Burrowing Owls in California

Habitat loss. Habitat loss, degradation, and fragmentation are the greatest threats to burrowing owls in California. According to DeSante et al. (2007), “the vast majority of burrowing owls [now] occur in the wide, flat lowland valleys and basins of the Imperial Valley and Great Central Valley [where] for the most part,...the highest rates of residential and commercial development in California are occurring.” Habitat loss from the State’s long history of urbanization in coastal counties has already resulted in either extirpation or drastic reduction of burrowing owl populations there (Gervais et al. 2008). Further, loss of agricultural and other open lands (such as grazed landscapes) also negatively affect owl populations. Because of their need for open habitat with low vegetation, burrowing owls are unlikely to persist in agricultural lands dominated by vineyards and orchards (Gervais et al. 2008).

Control of burrowing rodents. According to Klute et al. (2003), the elimination of burrowing rodents through control programs is a primary factor in the recent and historical decline of burrowing owl populations nationwide. In California, ground squirrel burrows are most often used by burrowing owls for nesting and cover; thus, ground squirrel control programs may affect owl numbers in local areas by eliminating a necessary resource.

Direct mortality. Burrowing owls suffer direct losses from a number of sources. Vehicle collisions are a significant source of mortality especially in the urban interface and where owls nest alongside roads (Haug et al. 1993, Gervais et al. 2008). Road and ditch maintenance, modification of water conveyance structures (Imperial Valley) and discing to control weeds in fallow fields may destroy burrows (Rosenberg and Haley 2004, Catlin and Rosenberg 2006) which may trap or crush owls. Wind turbines at Altamont Pass Wind Resource Area are known to cause direct burrowing owl mortality (Thelander et al. 2003). Exposure to pesticides may pose a threat to the species but is poorly understood (Klute et al. 2003, Gervais et al. 2008).

Appendix B. Definitions

Some key terms that appear in this document are defined below.

Adjacent habitat means burrowing owl habitat that abuts the area where habitat and burrows will be impacted and rendered non-suitable for occupancy.

Breeding (nesting) season begins as early as 1 February and continues through 31 August (Thomsen 1971, Zarn 1974). The timing of breeding activities may vary with latitude and climatic conditions. The breeding season includes pairing, egg-laying and incubation, and nestling and fledging stages.

Burrow exclusion is a technique of installing one-way doors in burrow openings during the non-breeding season to temporarily exclude burrowing owls or permanently exclude burrowing owls and excavate and close burrows after confirming burrows are empty.

Burrowing owl habitat generally includes, but is not limited to, short or sparse vegetation (at least at some time of year), presence of burrows, burrow surrogates or presence of fossorial mammal dens, well-drained soils, and abundant and available prey.

Burrow surrogates include culverts, piles of concrete rubble, piles of soil, burrows created along soft banks of ditches and canals, pipes, and similar structures.

Civil twilight - Morning civil twilight begins when the geometric center of the sun is 6 degrees below the horizon (civil dawn) and ends at sunrise. Evening civil twilight begins at sunset and ends when the geometric center of the sun reaches 6 degrees below the horizon (civil dusk). During this period there is enough light from the sun that artificial sources of light may not be needed to carry on outdoor activities. This concept is sometimes enshrined in laws, for example, when drivers of automobiles must turn on their headlights (called lighting-up time in the UK); when pilots may exercise the rights to fly aircraft. Civil twilight can also be described as the limit at which twilight illumination is sufficient, under clear weather conditions, for terrestrial objects to be clearly distinguished; at the beginning of morning civil twilight, or end of evening civil twilight, the horizon is clearly defined and the brightest stars are visible under clear atmospheric conditions.

Conservation for burrowing owls may include but may not be limited to protecting remaining breeding pairs or providing for population expansion, protecting and enhancing breeding and essential habitat, and amending or augmenting land use plans to stabilize populations and other specific actions to avoid the need to list the species pursuant to California or federal Endangered Species Acts.

Contiguous means connected together so as to form an uninterrupted expanse in space.

Essential habitat includes nesting, foraging, wintering, and dispersal habitat.

Foraging habitat is habitat within the estimated home range of an occupied burrow, supports suitable prey base, and allows for effective hunting.

Host burrowers include ground squirrels, badgers, foxes, coyotes, gophers etc.

Locally significant species is a species that is not rare from a statewide perspective but is rare or uncommon in a local context such as within a county or region (CEQA §15125 (c)) or is so designated in local or regional plans, policies, or ordinances (CEQA Guidelines, Appendix G). Examples include a species at the outer limits of its known range or occurring in a unique habitat type.

Non-breeding season is the period of time when nesting activity is not occurring, generally September 1 through January 31, but may vary with latitude and climatic conditions.

Occupied site or occupancy means a site that is assumed occupied if at least one burrowing owl has been observed occupying a burrow within the last three years (Rich 1984). Occupancy of suitable burrowing owl habitat may also be indicated by owl sign including its molted feathers, cast pellets, prey remains, eggshell fragments, or excrement at or near a burrow entrance or perch site.

Other impacting activities may include but may not be limited to agricultural practices, vegetation management and fire control, pest management, conversion of habitat from rangeland or natural lands to more intensive agricultural uses that could result in "take". These impacting activities may not meet the definition of a project under CEQA.

Passive relocation is a technique of installing one-way doors in burrow openings to temporarily or permanently evict burrowing owls and prevent burrow re-occupation.

Peak of the breeding season is between 15 April and 15 July.

Sign includes its tracks, molted feathers, cast pellets (defined as 1-2" long brown to black regurgitated pellets consisting of non-digestible portions of the owls' diet, such as fur, bones, claws, beetle elytra, or feathers), prey remains, egg shell fragments, owl white wash, nest burrow decoration materials (e.g., paper, foil, plastic items, livestock or other animal manure, etc.), possible owl perches, or other items.

Appendix C. Habitat Assessment and Reporting Details

Habitat Assessment Data Collection and Reporting

Current scientific literature indicates that it would be most effective to gather the data in the manner described below when conducting project scoping, conducting a habitat assessment site visit and preparing a habitat assessment report:

1. Conduct at least one visit covering the entire potential project/activity area including areas that will be directly or indirectly impacted by the project. Survey adjoining areas within 150 m (Thomsen 1971, Martin 1973), or more where direct or indirect effects could potentially extend offsite. If lawful access cannot be achieved to adjacent areas, surveys can be performed with a spotting scope or other methods.
2. Prior to the site visit, compile relevant biological information for the site and surrounding area to provide a local and regional context.
3. Check all available sources for burrowing owl occurrence information regionally prior to a field inspection. The CNDDB and BIOS (see References cited) may be consulted for known occurrences of burrowing owls. Other sources of information include, but are not limited to, the Proceedings of the California Burrowing Owl Symposium (Barclay et al. 2007), county bird atlas projects, Breeding Bird Survey records, eBIRD (http://ebird.org), Gervais et al. (2008), local reports or experts, museum records, and other site-specific relevant information.
4. Identify vegetation and habitat types potentially supporting burrowing owls in the project area and vicinity.
5. Record and report on the following information:
    a. A full description of the proposed project, including but not limited to, expected work periods, daily work schedules, equipment used, activities performed (such as drilling, construction, excavation, etc.) and whether the expected activities will vary in location or intensity over the project's timeline;
    b. A regional setting map, showing the general project location relative to major roads and other recognizable features;
    c. A detailed map (preferably a USGS topo 7.5' quad base map) of the site and proposed project, including the footprint of proposed land and/or vegetation-altering activities, base map source, identifying topography, landscape features, a north arrow, bar scale, and legend;
    d. A written description of the biological setting, including location (Section, Township, Range, baseline and meridian), acreage, topography, soils, geographic and hydrologic characteristics, land use and management history on and adjoining the site (i.e., whether it is urban, semi-urban or rural; whether there is any evidence of past or current livestock grazing, mowing, disking, or other vegetation management activities);
    e. An analysis of any relevant, historical information concerning burrowing owl use or occupancy (breeding, foraging, over-wintering) on site or in the assessment area;
    f. Vegetation type and structure (using Sawyer et al. 2009), vegetation height, habitat types and features in the surrounding area plus a reasonably sized (as supported with logical justification) assessment area; (Note: use caution in discounting habitat based on grass height as it can be a temporary condition variable by season and conditions (such as current grazing regime) or may be distributed as a mosaic).

g. The presence of burrowing owl individuals or pairs or sign (see Appendix B);
h. The presence of suitable burrows and/or burrow surrogates (>11 cm in diameter (height and width) and >150 cm in depth) (Johnson et al. 2010), regardless of a lack of any burrowing owl sign and/or burrow surrogates; and burrowing owls and/or their sign that have recently or historically (within the last 3 years) been identified on or adjacent to the site.

Appendix D. Breeding and Non-breeding Season Surveys and Reports

Current scientific literature indicates that it is most effective to conduct breeding and non-breeding season surveys and report in the manner that follows:

Breeding Season Surveys

Number of visits and timing. Conduct 4 survey visits: 1) at least one site visit between 15 February and 15 April, and 2) a minimum of three survey visits, at least three weeks apart, between 15 April and 15 July, with at least one visit after 15 June. Note: many burrowing owl migrants are still present in southwestern California during mid-March, therefore, exercise caution in assuming breeding occupancy early in the breeding season.

Survey method. Rosenberg et al. (2007) confirmed walking line transects were most effective in smaller habitat patches. Conduct surveys in all portions of the project site that were identified in the Habitat Assessment and fit the description of habitat in Appendix A. Conduct surveys by walking straight-line transects spaced 7 m to 20 m apart, adjusting for vegetation height and density (Rosenberg et al. 2007). At the start of each transect and, at least, every 100 m, scan the entire visible project area for burrowing owls using binoculars. During walking surveys, record all potential burrows used by burrowing owls as determined by the presence of one or more burrowing owls, pellets, prey remains, whitewash, or decoration. Some burrowing owls may be detected by their calls, so observers should also listen for burrowing owls while conducting the survey.

Care should be taken to minimize disturbance near occupied burrows during all seasons and not to “flush” burrowing owls especially if predators are present to reduce any potential for needless energy expenditure or burrowing owl mortality. Burrowing owls may flush if approached by pedestrians within 50 m (Conway et al. 2003). If raptors or other predators are present that may suppress burrowing owl activity, return at another time or later date for a follow-up survey.

Check all burrowing owls detected for bands and/or color bands and report band combinations to the Bird Banding Laboratory (BBL). Some site-specific variations to survey methods discussed below may be developed in coordination with species experts and Department staff.

Weather conditions. Poor weather may affect the surveyor’s ability to detect burrowing owls, therefore, avoid conducting surveys when wind speed is >20 km/hr, and there is precipitation or dense fog. Surveys have greater detection probability if conducted when ambient temperatures are >20º C, <12 km/hr winds, and cloud cover is <75% (Conway et al. 2008).

Time of day. Daily timing of surveys varies according to the literature, latitude, and survey method. However, surveys between morning civil twilight and 10:00 AM and two hours before sunset until evening civil twilight provide the highest detection probabilities (Barclay pers. comm. 2012, Conway et al. 2008).

Alternate methods. If the project site is large enough to warrant an alternate method, consult current literature for generally accepted survey methods and consult with the Department on the proposed survey approach.

Additional breeding season site visits. Additional breeding season site visits may be necessary, especially if non-breeding season exclusion methods are contemplated. Detailed information, such as approximate home ranges of each individual or of family units, as well as foraging areas as related to the proposed project, will be important to document for evaluating impacts, planning avoidance measure implementation and for mitigation measure performance monitoring.

Adverse conditions may prevent investigators from determining presence or occupancy. Disease, predation, drought, high rainfall or site disturbance may preclude presence of burrowing owls in any given year. Any such conditions should be identified and discussed in the survey report. Visits to the site in more than one year may increase the likelihood of detection. Also, visits to adjacent known occupied habitat may help determine appropriate survey timing.

Given the high site fidelity shown by burrowing owls (see Appendix A, Importance of burrows), conducting surveys over several years may be necessary when project activities are ongoing, occur annually, or start and stop seasonally. (See Negative surveys).

Non-breeding Season Surveys

If conducting non-breeding season surveys, follow the methods described above for breeding season surveys, but conduct at least four (4) visits, spread evenly, throughout the non-breeding season. Burrowing owl experts and local Department staff are available to assist with interpreting results.

Negative Surveys

Adverse conditions may prevent investigators from documenting presence or occupancy. Disease, predation, drought, high rainfall or site disturbance may preclude presence of burrowing owl in any given year. Discuss such conditions in the Survey Report. Visits to the site in more than one year increase the likelihood of detection and failure to locate burrowing owls during one field season does not constitute evidence that the site is no longer occupied, particularly if adverse conditions influenced the survey results. Visits to other nearby known occupied sites can affirm whether the survey timing is appropriate.

Take Avoidance Surveys

Field experience from 1995 to present supports the conclusion that it would be effective to complete an initial take avoidance survey no less than 14 days prior to initiating ground disturbance activities using the recommended methods described in the Detection Surveys section above. Implementation of avoidance and minimization measures would be triggered by positive owl presence on the site where project activities will occur. The development of avoidance and minimization approaches would be informed by monitoring the burrowing owls.

Burrowing owls may re-colonize a site after only a few days. Time lapses between project activities trigger subsequent take avoidance surveys including but not limited to a final survey conducted within 24 hours prior to ground disturbance.

Survey Reports

Report on the survey methods used and results including the information described in the Summary Report and include the reports within the CEQA documentation:

1. Date, start and end time of surveys including weather conditions (ambient temperature, wind speed, percent cloud cover, precipitation and visibility);
2. Name(s) of surveyor(s) and qualifications;
3. A discussion of how the timing of the survey affected the comprehensiveness and detection probability;
4. A description of survey methods used including transect spacing, point count dispersal and duration, and any calls used;
5. A description and justification of the area surveyed relative to the project area;
6. A description that includes: number of owls or nesting pairs at each location (by nestlings, juveniles, adults, and those of an unknown age), number of burrows being used by owls, and burrowing owl sign at burrows. Include a description of individual markers, such as bands (numbers and colors), transmitters, or unique natural identifying features. If any owls are banded, request documentation from the BBL and bander to report on the details regarding the known history of the banded burrowing owl(s) (age, sex, origins, whether it was previously relocated) and provide with the report if available;
7. A description of the behavior of burrowing owls during the surveys, including feeding, resting, courtship, alarm, territorial defense, and those indicative of parents or juveniles;
8. A list of possible burrowing owl predators present and documentation of any evidence of predation of owls;
9. A detailed map (1:24,000 or closer to show details) showing locations of all burrowing owls, potential burrows, occupied burrows, areas of concentrated burrows, and burrowing owl sign. Locations documented by use of global positioning system (GPS) coordinates must include the datum in which they were collected. The map should include a title, north arrow, bar scale and legend;
10. Signed field forms, photos, etc., as appendices to the field survey report;
11. Recent color photographs of the proposed project or activity site; and
12. Original CNDDB Field Survey Forms should be sent directly to the Department's CNDDB office, and copies should be included in the environmental document as an appendix. (http://www.dfg.ca.gov/bdb/html/cnddb.html).

Appendix E. Example Components for Burrowing Owl Artificial Burrow and Exclusion Plans

Whereas the Department does not recommend exclusion and burrow closure, current scientific literature and experience from 1995 to present, indicate that the following example components for burrowing owl artificial burrow and exclusion plans, combined with consultation with the Department to further develop these plans, would be effective.

Artificial Burrow Location

If a burrow is confirmed occupied on-site, artificial burrow locations should be appropriately located and their use should be documented taking into consideration:

1. A brief description of the project and project site pre-construction;
2. The mitigation measures that will be implemented;
3. Potential conflicting site uses or encumbrances;
4. A comparison of the occupied burrow site(s) and the artificial burrow site(s) (e.g., vegetation, habitat types, fossorial species use in the area, and other features);
5. Artificial burrow(s) proximity to the project activities, roads and drainages;
6. Artificial burrow(s) proximity to other burrows and entrance exposure;
7. Photographs of the site of the occupied burrow(s) and the artificial burrows;
8. Map of the project area that identifies the burrow(s) to be excluded as well as the proposed sites for the artificial burrows;
9. A brief description of the artificial burrow design;
10. Description of the monitoring that will take place during and after project implementation including information that will be provided in a monitoring report.
11. A description of the frequency and type of burrow maintenance.

Exclusion Plan

An Exclusion Plan addresses the following including but not limited to:

1. Confirm by site surveillance that the burrow(s) is empty of burrowing owls and other species preceding burrow scoping;
2. Type of scope and appropriate timing of scoping to avoid impacts;
3. Occupancy factors to look for and what will guide determination of vacancy and excavation timing (one-way doors should be left in place 48 hours to ensure burrowing owls have left the burrow before excavation, visited twice daily and monitored for evidence that owls are inside and can't escape i.e., look for sign immediately inside the door).
4. How the burrow(s) will be excavated. Excavation using hand tools with refilling to prevent reoccupation is preferable whenever possible (may include using piping to stabilize the burrow to prevent collapsing until the entire burrow has been excavated and it can be determined that no owls reside inside the burrow);
5. Removal of other potential owl burrow surrogates or refugia on site;
6. Photographing the excavation and closure of the burrow to demonstrate success and sufficiency;

7. Monitoring of the site to evaluate success and, if needed, to implement remedial measures to prevent subsequent owl use to avoid take;
8. How the impacted site will continually be made inhospitable to burrowing owls and fossorial mammals (e.g., by allowing vegetation to grow tall, heavy disking, or immediate and continuous grading) until development is complete.

Appendix F. Mitigation Management Plan and Vegetation Management Goals

Mitigation Management Plan

A mitigation site management plan will help ensure the appropriate implementation and maintenance for the mitigation site and persistence of the burrowing owls on the site. For an example to review, refer to Rosenberg et al. (2009). The current scientific literature and field experience from 1995 to present indicate that an effective management plan includes the following:

1. Mitigation objectives;
2. Site selection factors (including a comparison of the attributes of the impacted and conserved lands) and baseline assessment;
3. Enhancement of the conserved lands (enhancement of reproductive capacity, enhancement of breeding areas and dispersal opportunities, and removal or control of population stressors);
4. Site protection method and prohibited uses;
5. Site manager roles and responsibilities;
6. Habitat management goals and objectives:
    a. Vegetation management goals,
        i. Vegetation management tools:
            1. Grazing
            2. Mowing
            3. Burning
            4. Other
    b. Management of ground squirrels and other fossorial mammals,
    c. Semi-annual and annual artificial burrow cleaning and maintenance,
    d. Non-natives control – weeds and wildlife,
    e. Trash removal;
7. Financial assurances:
    a. Property analysis record or other financial analysis to determine long-term management funding,
    b. Funding schedule;
8. Performance standards and success criteria;
9. Monitoring, surveys and adaptive management;
10. Maps;
11. Annual reports.

Vegetation Management Goals

- Manage vegetation height and density (especially in immediate proximity to burrows). Suitable vegetation structure varies across sites and vegetation types, but should generally be at the average effective vegetation height of 4.7 cm (Green and Anthony 1989) and <13 cm average effective vegetation height (MacCracken et al. 1985*a)*.
- Employ experimental prescribed fires (controlled, at a small scale) to manage vegetation structure;

- Vegetation reduction or ground disturbance timing, extent, and configuration should avoid take. While local ordinances may require fire prevention through vegetation management, activities like disking, mowing, and grading during the breeding season can result in take of burrowing owls and collapse of burrows, causing nest destruction. Consult the take avoidance surveys section above for pre-management avoidance survey recommendations;
- Promote natural prey distribution and abundance, especially in proximity to occupied burrows; and
- Promote self-sustaining populations of host burrowers by limiting or prohibiting lethal rodent control measures and by ensuring food availability for host burrowers through vegetation management.

Refer to Rosenberg et al. (2009) for a good discussion of managing grasslands for burrowing owls.

Mitigation Site Success Criteria

In order to evaluate the success of mitigation and management strategies for burrowing owls, monitoring is required that is specific to the burrowing owl management plan. Given limited resources, Barclay et al. (2011) suggests managers focus on accurately estimating annual adult owl populations rather than devoting time to estimating reproduction, which shows high annual variation and is difficult to accurately estimate. Therefore, the key objective will be to determine accurately the number of adult burrowing owls and pairs, and if the numbers are maintained. A frequency of 5-10 years for surveys to estimate population size may suffice if there are no changes in the management of the nesting and foraging habitat of the owls.

Effective monitoring and evaluation of off-site and on-site mitigation management success for burrowing owls includes (Barclay, pers. comm.):

- Site tenacity;
- Number of adult owls present and reproducing;
- Colonization by burrowing owls from elsewhere (by band re-sight);
- Evidence and causes of mortality;
- Changes in distribution; and
- Trends in stressors.

ATTACHMENT B

SWAPE Technical Consultation, Data Analysis and Litigation Support for the Environment

2503 Eastbluff Dr., Suite 206
Newport Beach, California 92660
Fax: (949) 717-0069

Matt Hagemann
Tel: (949) 887-9013
Email: mhagemann@swape.com

November 14, 2012

Christina Caro
Lozeau | Drury LLP
410 12th Street, Suite 250
Oakland, CA 94607

Subject: Comments on the Rio Mesa Solar Project, Riverside County, California

Dear Ms. Caro:

We have reviewed the October 2011 Application for Certification (AFC) and the September 2012 California Energy Commission (CEC) Preliminary Staff Assessment (PSA) for the Rio Mesa Solar Electric Generating Facility (Project). The Project would construct two 250-megawatt solar thermal power plants 13 miles southwest of Blythe in Riverside County, California. The plants would be sited on six square miles of land leased from the Metropolitan Water District of Southern California. Project infrastructure such as gen-tie lines, emergency and construction electrical power supply lines, and access roads would be located on land managed by the Bureau of Land Management. Mirror fields on the Project site will focus solar energy on boilers located on top of 750-foot tall concrete towers. Additional facilities will include an administration, control, and maintenance building, a water treatment plant, and a switchyard.

Our review focused on impacts to the environment and to health and safety from the following issues: Soil and Surface Water, Waste Management, and Air Quality. The potential for significant impacts to the workers, nearby residents and the environment is not adequately disclosed and mitigated by the proposed conditions of certification set forth in the PSA. The Final Staff Assessment (FSA) should be supplemented to disclose potentially significant impacts from Project construction and operation. The FSA should also include additional requirements and conditions of certification to ensure that impacts to workers are minimized.

SOIL AND SURFACE WATER

The Applicant does not adequately evaluate impacts to soil and surface water from Project construction. Flood impacts are inadequately calculated and the provisions in the PSA are not sufficient to mitigate impacts from potential floods. The Applicant has also not submitted the necessary documents, such as an updated Report of Waste Discharge (ROWD) and design plans required by CEC staff to accurately analyze the impacts from the Project's release of wastewater. Finally, the Applicant has not thoroughly analyzed impacts from Project construction on Waters of the State. The FSA must address these impacts and provide adequate mitigation to ensure that impacts to soil and surface water from Project construction are minimized.

1. Impacts from flooding should be more conservatively analyzed

The Applicant completed a hydrology analysis that models peak flows, runoff volumes, maximum velocities, and maximum depth from a 10-year, 24-hour and 100-year, 24-hour storm events (PSA, p. 4.10-12). The PSA states that channels on the Project site would be designed to accommodate flow from all storms less than or equal to a 100-year, 24-hour storm event (PSA, p. 4.10-23). Flood hazards at the site were evaluated by modeling a maximum discharge from a 100-year, 24-hour storm event (PSA, p. 4.10-25).

Flood analysis based on a 100-year, 24-hour storm event is not sufficient and is not the most conservative flood event that could plausibly occur. Flooding recently occurred at the site of the Genesis Solar Project site, approximately 13 miles northwest of the proposed Project. The flood occurred over a 48-hour period in July 2012 and resulted from six inches of rain.[1] The rainfall, which damaged almost 200 parabolic trough mirrors and resulted in a loss of $3 million, was characterized as a 100-year flood event by company representatives.[2] This characterization is incorrect: using data from the National Oceanic and Atmospheric Administration, 6 inches of rain over a 48-hour period corresponds to a 500-year flood.[3] If a storm of similar magnitude were to occur on the Project site, the current channels (designed to allow flow from a 100-year, 24-hour storm event) would be overflown.

In addition to the possibility of unanticipated floods, predicting flood events in a desert environment is notoriously difficult. The Project will be located on a broad alluvial fan surface. Alluvial fans are characterized by ephemeral flow networks that convey high-velocity flows through a complex array of unstable channels which shift positions during flooding. According to recent research, "conventional concepts of floodplain management (i.e., as related to perennial streams) do not transfer" to alluvial fan settings and "flood-hazard management […] is a particularly challenging task." [4]

Predicting large flood events in a desert environment, such as the Project's location, is difficult. As evidenced by the flood that occurred at the Genesis Solar Energy Project site, it is plausible that a 500-year flood could occur at the Project site. Thus, the Applicant's evaluation of impacts from a 100-year, 24-hour storm is inadequate and not sufficient.

1 http://www.earthtechling.com/2012/08/big-desert-solar-project-hit-by-wind-flood/
2 *Ibid.*
3 http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=ca
4 http://www.nbmg.unr.edu/pubs/r/r53/index.html

Because of the recent flooding event at Genesis, and because predicting channel response in a desert environment is difficult, flooding analysis and channel design should be based on a more conservative storm event. The PSA should be revised to require the Applicant to model the increase in peak flows, runoff volumes, maximum velocities and depths from a 500-year, 48-hour storm event (similar to the one that occurred at Genesis). Impacts to Project infrastructure, including mirror arrays, wastewater treatment ponds, and boiler towers, from the flood event should also be evaluated.

2. An updated ROWD needs to be prepared and approved prior to certification

The PSA lacks key documentation for discharge of wastewater to two evaporation ponds on the site. Wastewater will be generated from the reverse osmosis and demineralizer system, chemical feed area, and general plant drains (PSA, p. 4.10-26). Discharge of wastewater to these evaporation ponds is subject to approval of a ROWD from the Colorado River RWQCB.

CEC staff has requested that the Applicant submit updated plans for the two evaporation ponds to Energy Commission staff and the Colorado River RWQCB so that they may complete analyzing and issuing Waste Discharge Requirements (PSA, p. 1.1-14). However, these plans have not yet been submitted. The PSA notes that the staff "cannot complete analysis and development of any monitoring and mitigation methods that would be included in a condition of certification" without the submittal of these plans (PSA, p. 4.10-27).

The Applicant must submit all requested documents, including all final plans and discharge volumes to the two evaporation ponds, so that CEC staff can develop appropriate mitigation and monitoring methods. All necessary documents must be submitted and approved by Energy Commission staff and the Colorado River Basin RWQCB prior to finalization of the Final Staff Assessment.

3. Impacts to Waters of the State must be evaluated

The FSA should require that the Applicant show that Project construction will not cause or contribute to an exceedence of surface and groundwater quality standards set in the Colorado River Basin Plan, which was established to preserve and protect the quality of state waters.[5] A total of 29 ephemeral washes were mapped in the Project area by the Applicant. Three of these were determined to be "Waters of the U.S." under Section 404 of the Clean Water Act (PSA, p. 4.10-11). No delineation of Waters of the State has been conducted and the PSA does not discuss any impacts that may occur to Waters of the State from Project construction and operation. According to the Porter-Cologne Water Quality Act (Section 13000), any waste discharges resulting from placement of fill or construction activities within ephemeral drainages that are considered Waters of the State require a ROWD. Additionally, prior to finalizing the FSA, a Stormwater Pollution Prevention Plan (SWPPP) needs to be prepared for Project construction that identifies BMPs to protect water quality from degradation.

---

[5] Water Quality Control Plan Colorado River Basin – Region 7.
http://www.waterboards.ca.gov/coloradoriver/publications_forms/publications/docs/basinplan_2006.pdf

WASTE MANAGEMENT

A September 2011 Phase I Environmental Site Assessment (ESA) identified conditions that may pose risks to construction workers and to future site personnel:

1. The finding of "several unexploded ordnances (UXO) and munitions and explosives of concern (MEC)" on the project site; and
2. Areas of historic and illegal dumping.

Despite these findings, in the opinion of the Phase I authors, no recognized environmental conditions (RECs)[6] were found in association with the Project site. CEC staff concurred with the determination that no RECs existed and stated:

> Although there are no RECs, staff is concerned that the presence of trash in numerous areas and past uses of the site may have resulted in unrecognized site conditions that require identification, treatment, and/or removal (PSA, p. 4.14-9).

The failure to find UXO and MEC debris as RECs is in contrast with other Phase I ESA findings. CEC staff should consider these findings to be RECs and take appropriate measures to have UXO material surveyed and removed from the site prior of preparation of the FSA. A workplan for debris removal should also be included in conditions of certification.

1. UXO and MEC debris

The Phase I notes that the project area was within General Patton's World War II Desert Training Center, California-Arizona Maneuver Area region used for training troops deployed in the North African Theater. The Training Area was used for a variety of training purposes some of which utilized munitions and explosives.

Other Phase I ESAs have found such land use and the associated potential for UXO and MEC debris as RECs. For example, the Phase I ESA prepared for the Salton City Landfill expansion project identified the historical use of the site for desert and aerial warfare training and the potential for residual ordnance to be a REC.[7]

The Phase I ESA found several UXO occurrences and MEC features including unexploded practice anti-tank mines, mine fuses, and live .50 caliber rounds (p. 5-7). In addition to the explosion hazard

[6] A Recognized Environmental Concern (REC) is the presence or likely presence of any hazardous substances or petroleum products on a property under the conditions that indicate an existing release, past release, or a material threat of a release of any hazardous substance or petroleum products into structures on the property or into the ground, groundwater, or surface water of the property. *See* http://www.astm.org/Standards/E1527.htm

[7] ftp://ftp.co.imperial.ca.us/icpds/eir/salton-city-landfill-expansion/32apph-phase-1-esa.pdf, p. 14

represented by UXO, toxic chemicals may be found in soil associated with the UXO and MEC. These findings, however, are not considered to be a REC.

UXO and MEC debris findings on sites have been identified as a REC in other Phase I ESA investigations considered by CEC staff. For example, a Phase I ESA prepared for the Rice Airfield Solar Energy Project identified the "numerous piles of burned debris" and the "potential for UXO at the site" as RECs.[8]

According to the Phase I ESA, the Riverside County Sheriff's Department was notified of the UXO and MEC at the Project site (Phase I, p. 7-1). No documentation of the notification was provided in the Phase I or in any other application materials. The finding of live UXO is of major significance and the lack of documented response to the findings shows a failure to recognize the potential hazards to construction workers and future site personnel. BLM guidance[9] states that in addition to notification of local law enforcement, the nearest military Explosive Ordnance Disposal unit should be notified as well as the BLM ranger or the hazardous materials coordinator at the BLM office. No documentation that officials were properly notified was included in PSA or any other application materials.

Condition of Certification WASTE-1 would require the project owner to develop a plan for UXO identification training and reporting procedures prior to construction. The UXO plan would include trained UXO experts that are available to complete removal of UXO and supplemental geophysical surveys to search for additional or buried ordnance upon project construction.

Given that live UXO have already been observed on site, a plan to identify UXO only upon Project construction is wholly inadequate. Instead, a thorough visual and geophysical survey of UXO should be conducted immediately and all UXO and MEC removed prior to preparation of the FSA. Following removal, any remaining potential hazards should be addressed through conditions of certification in the FSA.

2. Debris and illegal dumping

The Phase I found Evidence of illegal dumping on the Project site, including several automobile bodies, several small piles of rusty cans and drums, broken glass, tires and metal and debris (p. 5-3). Rusty shells of several drums were also observed in the dumping areas.

Conditions of Certification WASTE-2 and WASTE-3 are proposed in the PSA to address soil contamination that may be encountered during Project construction. Condition WASTE-2 would require qualified personnel to be available for consultation in the event contaminated soil is

[8] http://www.energy.ca.gov/sitingcases/ricesolar/documents/applicant/afc/Volume_2/RSEP_Appendix_5.14A_URS%20Ph%201%20ESA.pdf, p. 7-1
[9] http://www.blm.gov/pgdata/etc/medialib/blm/wo/Information_Resources_Management/policy/blm_handbook.Par.71820.File.dat/H-1703-2.pdf, p. 5-2

encountered. If contaminated soil is identified, Condition WASTE-3 requires that the professional engineer or geologist inspect the site, determine what is required to characterize the nature and extent of contamination, and provide a report to the compliance project manager and the Department of Toxic Substances Control with findings and recommended actions including treatment and any necessary remediation.

These proposed conditions of certification are inadequate. As documented above, debris piles could be considered a REC that requires soil sampling prior to ground disturbance. For example, a Phase I ESA completed for a mixed-use project in Sacramento considered junked cars a REC because of the potential for elevated petroleum and metals in the soil.[10] A plan for debris removal that minimizes construction worker exposure to any potential contamination from debris should be provided. Soil sampling, under a Phase II ESA investigation, should be conducted. Results should be compared to human health screening levels.[11] If soil contamination is present at concentrations exceeding screening levels, the FSA should require appropriate mitigation measures to ensure the health of construction workers and future site personnel are not adversely impacted.

AIR QUALITY

The Project is located in eastern Riverside County and the Mojave Desert Air Basin (MDAB). The Riverside County portion of the MDAB is designated non-attainment for particulate matter (PM10) levels according to standards established by the California Air Resources Board. PM10 emissions from Project construction, in conjunction with emissions from nearby proposed projects, may result in a cumulatively significant impact, further degrading local air quality. Emissions should be evaluated in a cumulative context and mitigated, as necessary, to minimize any potentially significant impacts.

The cumulative analysis in the PSA identifies three projects within a six-mile radius of the Project site:

- Blythe Energy Project;
- Blythe Energy Project Phase II; and
- Blythe Solar Power Project (PSA, 4.1-34).

Our review has shown that the McCoy Solar Energy Project (MSEP) is located 6.5 miles away from the northern boundary of the Project site, just beyond the 6-mile radius. The MSEP is a huge solar generation project that proposes to construct a 750-megawatt facility on 13 square miles of land. The Environmental Impact Statement prepared for the project shows that it will have significant emissions of PM10.[12]

Although the MSEP falls beyond the 6-mile radius, it will have significant impacts on local air quality and should be included in the Project's cumulative analysis. To be conservative, a cumulative analysis for the

[10] Phase I Environmental Site Assessment, Delta Shores, Sacramento, California, February 2007.
[11] Regional Screening Levels: http://www.epa.gov/region9/superfund/prg/; and California Human Health Screening Levels: http://www.calepa.ca.gov/brownfields/documents/2005/CHHSLsGuide.pdf
[12] McCoy Solar Energy Project, Draft Environmental Impact Statement. p.4.2-10

Project should also evaluate PM10 emissions from the MSEP to determine if Project construction will result in cumulatively significant impacts.

The FSA should require the Applicant to recalculate the Project's cumulative emissions, to include the MSEP. Any significant emissions and impacts to residents and workers should be disclosed and appropriately mitigated.

Sincerely,

Matt Hagemann, P.G., C.Hg.

Uma Bhandaram

SWAPE Technical Consultation, Data Analysis and Litigation Support for the Environment

2503 Eastbluff Dr., Suite 206
Newport Beach, California 92660
Tel: (949) 887-9013
Fax: (949) 717-0069
Email: mhagemann@swape.com

Matthew F. Hagemann, P.G., C.Hg., QSD, QSP

Geologic and Hydrogeologic Characterization
Industrial Stormwater Compliance
CEQA Review
Investigation and Remediation Strategies
Litigation Support and Testifying Expert

Education:

M.S. Degree, Geology, California State University Los Angeles, Los Angeles, CA, 1984.
B.A. Degree, Geology, Humboldt State University, Arcata, CA, 1982.

Professional Certification:

California Professional Geologist
California Certified Hydrogeologist
Qualified SWPPP Developer and Practitioner

Professional Experience:

Matt has 25 years of experience in environmental policy, assessment and remediation. He spent nine years with the U.S. EPA in the RCRA and Superfund programs and served as EPA's Senior Science Policy Advisor in the Western Regional Office where he identified emerging threats to groundwater from perchlorate and MTBE. While with EPA, Matt also served as a Senior Hydrogeologist in the oversight of the assessment of seven major military facilities undergoing base closure. He led numerous enforcement actions under provisions of the Resource Conservation and Recovery Act (RCRA) while also working with permit holders to improve hydrogeologic characterization and water quality monitoring.

Matt has worked closely with U.S. EPA legal counsel and the technical staff of several states in the application and enforcement of RCRA, Safe Drinking Water Act and Clean Water Act regulations. Matt has trained the technical staff in the States of California, Hawaii, Nevada, Arizona and the Territory of Guam in the conduct of investigations, groundwater fundamentals, and sampling techniques.

Positions Matt has held include:

- Founding Partner, Soil/Water/Air Protection Enterprise (SWAPE) (2003 – present);
- Geology Instructor, Golden West College, 2010 – present;
- Senior Environmental Analyst, Komex H2O Science, Inc (2000 -- 2003);

- Executive Director, Orange Coast Watch (2001 – 2004);
- Senior Science Policy Advisor and Hydrogeologist, U.S. Environmental Protection Agency (1989–1998);
- Hydrogeologist, National Park Service, Water Resources Division (1998 – 2000);
- Adjunct Faculty Member, San Francisco State University, Department of Geosciences (1993 – 1998);
- Instructor, College of Marin, Department of Science (1990 – 1995);
- Geologist, U.S. Forest Service (1986 – 1998); and
- Geologist, Dames & Moore (1984 – 1986).

Partner, SWAPE:

With SWAPE, Matt's responsibilities have included:

- Lead analyst and testifying expert in the review of numerous environmental impact reports under CEQA that identify significant issues with regard to hazardous waste, water resources, water quality, air quality, greenhouse gas emissions and geologic hazards.
- Stormwater analysis, sampling and best management practice evaluation at industrial facilities.
- Lead analyst and testifying expert in the review of environmental issues in license applications for large solar power plants before the California Energy Commission.
- Technical assistance and litigation support for vapor intrusion concerns.
- Manager of a project to evaluate numerous formerly used military sites in the western U.S.
- Manager of a comprehensive evaluation of potential sources of perchlorate contamination in Southern California drinking water wells.
- Manager and designated expert for litigation support under provisions of Proposition 65 in the review of releases of gasoline to sources drinking water at major refineries and hundreds of gas stations throughout California.
- Expert witness on two cases involving MTBE litigation.
- Expert witness and litigation support on the impact of air toxins and hazards at a school.
- Expert witness in litigation at a former plywood plant.

With Komex H2O Science Inc., Matt's duties included the following:

- Senior author of a report on the extent of perchlorate contamination that was used in testimony by the former U.S. EPA Administrator and General Counsel.
- Senior researcher in the development of a comprehensive, electronically interactive chronology of MTBE use, research, and regulation.
- Senior researcher in the development of a comprehensive, electronically interactive chronology of perchlorate use, research, and regulation.
- Senior researcher in a study that estimates nationwide costs for MTBE remediation and drinking water treatment, results of which were published in newspapers nationwide and in testimony against provisions of an energy bill that would limit liability for oil companies.
- Research to support litigation to restore drinking water supplies that have been contaminated by MTBE in California and New York.
- Expert witness testimony in a case of oil production-related contamination in Mississippi.
- Lead author for a multi-volume remedial investigation report for an operating school in Los Angeles that met strict regulatory requirements and rigorous deadlines.
- Development of strategic approaches for cleanup of contaminated sites in consultation with clients and regulators.

Executive Director:

As Executive Director with Orange Coast Watch, Matt led efforts to restore water quality at Orange County beaches from multiple sources of contamination including urban runoff and the discharge of wastewater. In reporting to a Board of Directors that included representatives from leading Orange County universities and businesses, Matt prepared issue papers in the areas of treatment and disinfection of wastewater and control of the dischrge of grease to sewer systems. Matt actively participated in the development of countywide water quality permits for the control of urban runoff and permits for the discharge of wastewater. Matt worked with other nonprofits to protect and restore water quality, including Surfrider, Natural Resources Defense Council and Orange County CoastKeeper as well as with business institutions including the Orange County Business Council.

Hydrogeology:

As a Senior Hydrogeologist with the U.S. Environmental Protection Agency, Matt led investigations to characterize and cleanup closing military bases, including Mare Island Naval Shipyard, Hunters Point Naval Shipyard, Treasure Island Naval Station, Alameda Naval Station, Moffett Field, Mather Army Airfield, and Sacramento Army Depot. Specific activities were as follows:

- Led efforts to model groundwater flow and contaminant transport, ensured adequacy of monitoring networks, and assessed cleanup alternatives for contaminated sediment, soil, and groundwater.
- Initiated a regional program for evaluation of groundwater sampling practices and laboratory analysis at military bases.
- Identified emerging issues, wrote technical guidance, and assisted in policy and regulation development through work on four national U.S. EPA workgroups, including the Superfund Groundwater Technical Forum and the Federal Facilities Forum.

At the request of the State of Hawaii, Matt developed a methodology to determine the vulnerability of groundwater to contamination on the islands of Maui and Oahu. He used analytical models and a GIS to show zones of vulnerability, and the results were adopted and published by the State of Hawaii and County of Maui.

As a hydrogeologist with the EPA Groundwater Protection Section, Matt worked with provisions of the Safe Drinking Water Act and NEPA to prevent drinking water contamination. Specific activities included the following:

- Received an EPA Bronze Medal for his contribution to the development of national guidance for the protection of drinking water.
- Managed the Sole Source Aquifer Program and protected the drinking water of two communities through designation under the Safe Drinking Water Act. He prepared geologic reports, conducted public hearings, and responded to public comments from residents who were very concerned about the impact of designation.

- Reviewed a number of Environmental Impact Statements for planned major developments, including large hazardous and solid waste disposal facilities, mine reclamation, and water transfer.

Matt served as a hydrogeologist with the RCRA Hazardous Waste program. Duties were as follows:

- Supervised the hydrogeologic investigation of hazardous waste sites to determine compliance with Subtitle C requirements.
- Reviewed and wrote "part B" permits for the disposal of hazardous waste.
- Conducted RCRA Corrective Action investigations of waste sites and led inspections that formed the basis for significant enforcement actions that were developed in close coordination with U.S. EPA legal counsel.
- Wrote contract specifications and supervised contractor's investigations of waste sites.

With the National Park Service, Matt directed service-wide investigations of contaminant sources to prevent degradation of water quality, including the following tasks:

- Applied pertinent laws and regulations including CERCLA, RCRA, NEPA, NRDA, and the Clean Water Act to control military, mining, and landfill contaminants.
- Conducted watershed-scale investigations of contaminants at parks, including Yellowstone and Olympic National Park.
- Identified high-levels of perchlorate in soil adjacent to a national park in New Mexico and advised park superintendent on appropriate response actions under CERCLA.
- Served as a Park Service representative on the Interagency Perchlorate Steering Committee, a national workgroup.
- Developed a program to conduct environmental compliance audits of all National Parks while serving on a national workgroup.
- Co-authored two papers on the potential for water contamination from the operation of personal watercraft and snowmobiles, these papers serving as the basis for the development of nation-wide policy on the use of these vehicles in National Parks.
- Contributed to the Federal Multi-Agency Source Water Agreement under the Clean Water Action Plan.

Policy:

Served senior management as the Senior Science Policy Advisor with the U.S. Environmental Protection Agency, Region 9. Activities included the following:

- Advised the Regional Administrator and senior management on emerging issues such as the potential for the gasoline additive MTBE and ammonium perchlorate to contaminate drinking water supplies.
- Shaped EPA's national response to these threats by serving on workgroups and by contributing to guidance, including the Office of Research and Development publication, Oxygenates in Water: Critical Information and Research Needs.
- Improved the technical training of EPA's scientific and engineering staff.
- Earned an EPA Bronze Medal for representing the region's 300 scientists and engineers in negotiations with the Administrator and senior management to better integrate scientific principles into the policy-making process.
- Established national protocol for the peer review of scientific documents.

Geology:

With the U.S. Forest Service, Matt led investigations to determine hillslope stability of areas proposed for timber harvest in the central Oregon Coast Range. Specific activities were as follows:

- Mapped geology in the field, and used aerial photographic interpretation and mathematical models to determine slope stability.
- Coordinated his research with community members who were concerned with natural resource protection.
- Characterized the geology of an aquifer that serves as the sole source of drinking water for the city of Medford, Oregon.

As a consultant with Dames and Moore, Matt led geologic investigations of two contaminated sites (later listed on the Superfund NPL) in the Portland, Oregon, area and a large hazardous waste site in eastern Oregon. Duties included the following:

- Supervised year-long effort for soil and groundwater sampling.
- Conducted aquifer tests.
- Investigated active faults beneath sites proposed for hazardous waste disposal.

Teaching:

From 1990 to 1998, Matt taught at least one course per semester at the community college and university levels:

- At San Francisco State University, held an adjunct faculty position and taught courses in environmental geology, oceanography (lab and lecture), hydrogeology, and groundwater contamination.
- Served as a committee member for graduate and undergraduate students.
- Taught courses in environmental geology and oceanography at the College of Marin.

Matt currently teaches Physical Geology (lecture and lab) to students at Golden West College in Huntington Beach, California.

Invited Testimony, Reports, Papers and Presentations:

Hagemann, M.F., 2008. Disclosure of Hazardous Waste Issues under CEQA. Presentation to the Public Environmental Law Conference, Eugene, Oregon.

Hagemann, M.F., 2008. Disclosure of Hazardous Waste Issues under CEQA. Invited presentation to U.S. EPA Region 9, San Francisco, California.

Hagemann, M.F., 2005. Use of Electronic Databases in Environmental Regulation, Policy Making and Public Participation. Brownfields 2005, Denver, Coloradao.

Hagemann, M.F., 2004. Perchlorate Contamination of the Colorado River and Impacts to Drinking Water in Nevada and the Southwestern U.S. Presentation to a meeting of the American Groundwater Trust, Las Vegas, NV (served on conference organizing committee).

Hagemann, M.F., 2004. Invited testimony to a California Senate committee hearing on air toxins at schools in Southern California, Los Angeles.

Brown, A., Farrow, J., Gray, A. and **Hagemann, M.**, 2004. An Estimate of Costs to Address MTBE Releases from Underground Storage Tanks and the Resulting Impact to Drinking Water Wells. Presentation to the Ground Water and Environmental Law Conference, National Groundwater Association.

Hagemann, M.F., 2004. Perchlorate Contamination of the Colorado River and Impacts to Drinking Water in Arizona and the Southwestern U.S. Presentation to a meeting of the American Groundwater Trust, Phoenix, AZ (served on conference organizing committee).

Hagemann, M.F., 2003. Perchlorate Contamination of the Colorado River and Impacts to Drinking Water in the Southwestern U.S. Invited presentation to a special committee meeting of the National Academy of Sciences, Irvine, CA.

Hagemann, M.F., 2003. Perchlorate Contamination of the Colorado River. Invited presentation to a tribal EPA meeting, Pechanga, CA.

Hagemann, M.F., 2003. Perchlorate Contamination of the Colorado River. Invited presentation to a meeting of tribal repesentatives, Parker, AZ.

Hagemann, M.F., 2003. Impact of Perchlorate on the Colorado River and Associated Drinking Water Supplies. Invited presentation to the Inter-Tribal Meeting, Torres Martinez Tribe.

Hagemann, M.F., 2003. The Emergence of Perchlorate as a Widespread Drinking Water Contaminant. Invited presentation to the U.S. EPA Region 9.

Hagemann, M.F., 2003. A Deductive Approach to the Assessment of Perchlorate Contamination. Invited presentation to the California Assembly Natural Resources Committee.

Hagemann, M.F., 2003. Perchlorate: A Cold War Legacy in Drinking Water. Presentation to a meeting of the National Groundwater Association.

Hagemann, M.F., 2002. From Tank to Tap: A Chronology of MTBE in Groundwater. Presentation to a meeting of the National Groundwater Association.

Hagemann, M.F., 2002. A Chronology of MTBE in Groundwater and an Estimate of Costs to Address Impacts to Groundwater. Presentation to the annual meeting of the Society of Environmental Journalists.

Hagemann, M.F., 2002. An Estimate of the Cost to Address MTBE Contamination in Groundwater (and Who Will Pay). Presentation to a meeting of the National Groundwater Association.

Hagemann, M.F., 2002. An Estimate of Costs to Address MTBE Releases from Underground Storage Tanks and the Resulting Impact to Drinking Water Wells. Presentation to a meeting of the U.S. EPA and State Underground Storage Tank Program managers.

Hagemann, M.F., 2001. From Tank to Tap: A Chronology of MTBE in Groundwater. Unpublished report.

Hagemann, M.F., 2001. Estimated Cleanup Cost for MTBE in Groundwater Used as Drinking Water. Unpublished report.

Hagemann, M.F., 2001. Estimated Costs to Address MTBE Releases from Leaking Underground Storage Tanks. Unpublished report.

Hagemann, M.F., and VanMouwerik, M., 1999. Potential Water Quality Concerns Related to Snowmobile Usage. Water Resources Division, National Park Service, Technical Report.

VanMouwerik, M. and **Hagemann, M.F**. 1999, Water Quality Concerns Related to Personal Watercraft Usage. Water Resources Division, National Park Service, Technical Report.

Hagemann, M.F., 1999, Is Dilution the Solution to Pollution in National Parks? The George Wright Society Biannual Meeting, Asheville, North Carolina.

Hagemann, M.F., 1997, The Potential for MTBE to Contaminate Groundwater. U.S. EPA Superfund Groundwater Technical Forum Annual Meeting, Las Vegas, Nevada.

Hagemann, M.F., and Gill, M., 1996, Impediments to Intrinsic Remediation, Moffett Field Naval Air Station, Conference on Intrinsic Remediation of Chlorinated Hydrocarbons, Salt Lake City.

Hagemann, M.F., Fukunaga, G.L., 1996, The Vulnerability of Groundwater to Anthropogenic Contaminants on the Island of Maui, Hawaii. Hawaii Water Works Association Annual Meeting, Maui, October 1996.

Hagemann, M. F., Fukanaga, G. L., 1996, Ranking Groundwater Vulnerability in Central Oahu, Hawaii. Proceedings, Geographic Information Systems in Environmental Resources Management, Air and Waste Management Association Publication VIP-61.

Hagemann, M.F., 1994. Groundwater Characterization and Cleanup at Closing Military Bases in California. Proceedings, California Groundwater Resources Association Meeting.

Hagemann, M.F. and Sabol, M.A., 1993. Role of the U.S. EPA in the High Plains States Groundwater Recharge Demonstration Program. Proceedings, Sixth Biennial Symposium on the Artificial Recharge of Groundwater.

Hagemann, M.F., 1993. U.S. EPA Policy on the Technical Impracticability of the Cleanup of DNAPL-contaminated Groundwater. California Groundwater Resources Association Meeting.

Hagemann, M.F., 1992. Dense Nonaqueous Phase Liquid Contamination of Groundwater: An Ounce of Prevention... Proceedings, Association of Engineering Geologists Annual Meeting, v. 35.

Other Experience:

Selected as subject matter expert for the California Professional Geologist licensing examination, 2009-2011.

Selected References

Big Desert Solar Project Hit By Wind, Flood

by Pete Danko

Wind-whipped downpours in late July at the site of an under-construction government-backed utility-scale solar project in the desert of southeastern California caused extensive damage, according to preliminary documents released by the California Energy Commission.

An inspector from the commission, in an email included among the documents released, said estimated damage to NextEra Energy's Genesis Solar Project was $3 million, and said work on the project would be delayed about one month.

Damaged parabolic trough solar collector. (image via NextEra Energy)

In an Aug. 7 email – a week after the July 30 and 31 rains – Mike Conway wrote: "Things are actually pretty good after the storm, they were back to work yesterday. 90% of the problems were related to earthen berms they constructed for temporary access. The berms caused most

Green Ways & Words

The Eco Watch: Telling Time Never Felt This Good

Why Do You Need A Tree Survey?

How Embracing Technology Can Save You Energy And Cash

How to Easily Improve Gas Mileage & Reduce the Carbon Emissions of Your Vehicle

Celebrate Earth Day's 42nd Birthday By

EarthTechling Topic Channels

GREEN BUILDING

TRANSPORTATION

RENEWABLE ENERGY

GREEN LIVING

Turning Your Power Management On

of the flooding and severe damage. The channels and dissipation structures worked as they were designed."

The storm toll did include damage to some 195 mirrors on the parabolic troughs the power plant will use to collect the sun's energy.

image via NextEra Energy

NextEra had told KCET ReWire's Chris Clarke, who broke the story of the flood, that the damage would amount to less than $5 million and would not delay the opening of the plant. The first of two 125-megawatt units is supposed to go online in mid-2013, with the second unit to follow a year later. Power from the project will go to Pacific Gas & Electric.

Parabolic trough plants like Genesis Solar capture and concentrate sunlight to heat a synthetic oil, which then heats water to create steam. The steam is then fed to an onsite turbine-generator to produce electricity.

The Genesis Solar Energy Project received a partial guarantee from the U.S. Department of Energy for an $852 million loan in September 2011. The project had been approved under the Obama administration's fast-track process for renewable energy development on public lands.

The havoc raised by the storm might on the surface be taken as a sign that the power plant could be vulnerable to powerful weather events. But the company suggested that wasn't the case; in its report to the Energy Commission, it blamed the damage on the incomplete state of the construction and the freak nature of the storm.

"It is noteworthy that the rain event on July 31 was a 100 year storm event," the company said. "It is also noteworthy that this 2 day storm that started Monday (5.6-6 inches over the 2 day period) occurred during construction where foundations, fencing, major equipment deliveries, and other temporary construction activities were ongoing and not complete per the design.

Pages: 1 2

Posted on August 15th, 2012 · Comment ↓

Posted in Editor's Pick, Featured, Renewable Energy, Solar Power

This Page

Intentionally

Left Blank

NOAA's National Weather Service
Hydrometeorological Design Studies Center
Precipitation Frequency Data Server (PFDS)

NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES: CA

DATA DESCRIPTION

Data type: precipitation depth **Units:** english **Time series type:** partial duration

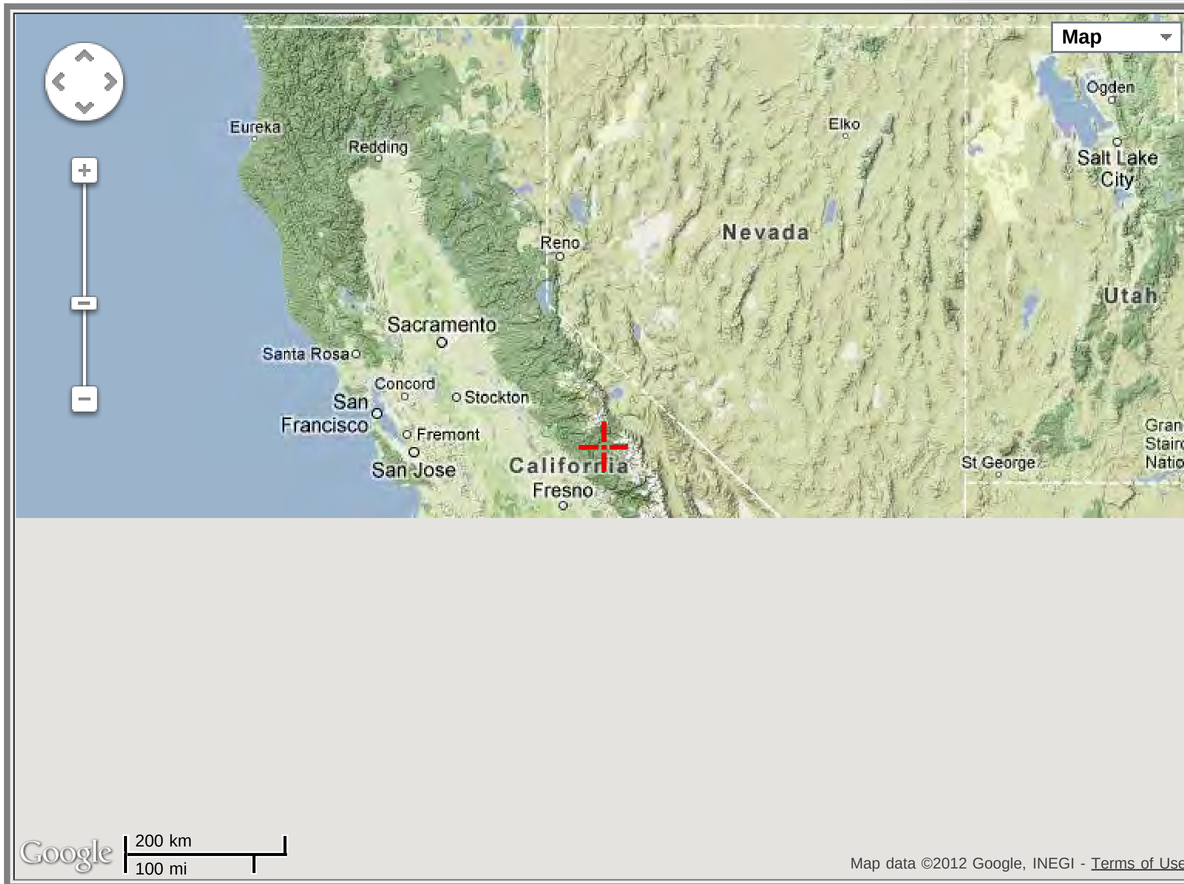
SELECT LOCATION

1. Manually:

a) Enter location (decimal degrees, use "-" for S and W): latitude: longitude:

b) Select station (click here for a list of stations used in frequency analysis for CA): select station

2. Use map:



a) Select location
(move crosshair or double click)
b) Click on station icon
(show stations on map)

LOCATION INFORMATION:
Name: LAKESHORE, California, US*
Latitude: 37.4000
Longitude: -119.2000
Elevation: 7160 ft*

* source: Google Maps

000074

POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION

NOAA Atlas 14, Volume 6, Version 2

PF tabular | PF graphical | Supplementary information

Print Page

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.165** (0.142 0.193)	**0.213** (0.184 0.250)	**0.280** (0.240 0.329)	**0.337** (0.287 0.401)	**0.420** (0.342 0.520)	**0.488** (0.387 0.620)	**0.560** (0.432 0.735)	**0.640** (0.476 0.868)	**0.755** (0.534 1.08)	**0.851** (0.577 1.27)
10-min	**0.237** (0.204 0.277)	**0.306** (0.263 0.358)	**0.401** (0.344 0.472)	**0.483** (0.411 0.574)	**0.602** (0.491 0.746)	**0.699** (0.555 0.889)	**0.803** (0.619 1.05)	**0.917** (0.682 1.24)	**1.08** (0.765 1.54)	**1.22** (0.827 1.82)
15-min	**0.286** (0.247 0.335)	**0.370** (0.318 0.433)	**0.485** (0.417 0.571)	**0.584** (0.497 0.695)	**0.728** (0.593 0.902)	**0.845** (0.671 1.07)	**0.971** (0.748 1.27)	**1.11** (0.825 1.50)	**1.31** (0.926 1.87)	**1.48** (1.00 2.20)
30-min	**0.391** (0.337 0.457)	**0.505** (0.435 0.592)	**0.663** (0.569 0.780)	**0.799** (0.679 0.949)	**0.995** (0.811 1.23)	**1.16** (0.917 1.47)	**1.33** (1.02 1.74)	**1.51** (1.13 2.06)	**1.79** (1.26 2.55)	**2.02** (1.37 3.00)
60-min	**0.509** (0.439 0.596)	**0.658** (0.567 0.771)	**0.863** (0.741 1.01)	**1.04** (0.884 1.24)	**1.29** (1.06 1.60)	**1.50** (1.19 1.91)	**1.73** (1.33 2.27)	**1.97** (1.47 2.68)	**2.33** (1.65 3.33)	**2.63** (1.78 3.91)
2-hr	**0.757** (0.653 0.886)	**0.960** (0.827 1.13)	**1.24** (1.07 1.46)	**1.49** (1.26 1.77)	**1.84** (1.50 2.28)	**2.13** (1.69 2.71)	**2.45** (1.89 3.21)	**2.79** (2.08 3.79)	**3.29** (2.33 4.70)	**3.71** (2.52 5.53)
3-hr	**0.948** (0.818 1.11)	**1.19** (1.03 1.40)	**1.53** (1.31 1.80)	**1.82** (1.55 2.17)	**2.25** (1.83 2.79)	**2.60** (2.07 3.31)	**2.98** (2.29 3.91)	**3.39** (2.52 4.60)	**3.99** (2.82 5.70)	**4.49** (3.05 6.69)
6-hr	**1.41** (1.22 1.65)	**1.76** (1.52 2.06)	**2.24** (1.93 2.64)	**2.66** (2.26 3.16)	**3.26** (2.66 4.04)	**3.76** (2.98 4.78)	**4.29** (3.30 5.62)	**4.87** (3.62 6.60)	**5.70** (4.03 8.14)	**6.39** (4.34 9.52)
12-hr	**2.09** (1.80 2.44)	**2.65** (2.29 3.11)	**3.42** (2.94 4.03)	**4.08** (3.47 4.85)	**5.02** (4.09 6.22)	**5.78** (4.59 7.35)	**6.58** (5.07 8.63)	**7.44** (5.54 10.1)	**8.68** (6.14 12.4)	**9.69** (6.57 14.4)
24-hr	**2.89** (2.57 3.33)	**3.79** (3.35 4.36)	**4.99** (4.42 5.76)	**6.01** (5.28 6.98)	**7.44** (6.36 8.87)	**8.58** (7.21 10.4)	**9.78** (8.06 12.1)	**11.1** (8.91 14.0)	**12.9** (10.0 16.9)	**14.4** (10.9 19.4)
2-day	**3.85** (3.41 4.42)	**5.13** (4.55 5.91)	**6.87** (6.07 7.92)	**8.32** (7.31 9.66)	**10.4** (8.87 12.4)	**12.0** (10.1 14.6)	**13.7** (11.3 17.0)	**15.5** (12.5 19.7)	**18.1** (14.1 23.8)	**20.2** (15.3 27.3)
3-day	**4.42** (3.93 5.09)	**5.97** (5.29 6.87)	**8.04** (7.11 9.27)	**9.78** (8.59 11.4)	**12.2** (10.5 14.6)	**14.2** (11.9 17.2)	**16.2** (13.4 20.1)	**18.4** (14.8 23.3)	**21.5** (16.7 28.1)	**23.9** (18.1 32.3)
4-day	**4.87** (4.32 5.60)	**6.58** (5.83 7.57)	**8.87** (7.85 10.2)	**10.8** (9.49 12.5)	**13.5** (11.5 16.1)	**15.6** (13.1 19.0)	**17.9** (14.7 22.1)	**20.2** (16.3 25.6)	**23.6** (18.4 30.9)	**26.3** (19.9 35.5)
7-day	**5.89** (5.23 6.78)	**7.89** (6.99 9.08)	**10.6** (9.34 12.2)	**12.8** (11.2 14.8)	**15.9** (13.6 19.0)	**18.4** (15.4 22.3)	**20.9** (17.2 25.9)	**23.6** (19.0 29.9)	**27.4** (21.3 35.9)	**30.5** (23.0 41.1)
	6.67	**8.88**	**11.8**	**14.3**	**17.7**	**20.3**	**23.1**	**26.0**	**30.1**	**33.3**

000075

10-day	(5.92 7.67)	(7.88 10.2)	(10.5 13.6)	(12.5 16.6)	(15.1 21.1)	(17.1 24.7)	(19.0 28.6)	(20.9 32.9)	(23.4 39.4)	(25.2 44.9)
20-day	**8.72** (7.74 10.0)	**11.6** (10.3 13.4)	**15.3** (13.6 17.7)	**18.4** (16.2 21.4)	**22.5** (19.3 26.9)	**25.7** (21.6 31.2)	**28.9** (23.9 35.8)	**32.3** (26.0 40.9)	**36.9** (28.7 48.3)	**40.4** (30.6 54.5)
30-day	**10.7** (9.51 12.3)	**14.2** (12.6 16.4)	**18.7** (16.6 21.6)	**22.3** (19.6 25.9)	**27.1** (23.2 32.4)	**30.7** (25.9 37.3)	**34.4** (28.3 42.6)	**38.1** (30.7 48.2)	**43.1** (33.5 56.4)	**46.9** (35.5 63.3)
45-day	**13.4** (11.9 15.4)	**17.7** (15.7 20.3)	**23.0** (20.4 26.6)	**27.3** (24.0 31.7)	**32.8** (28.0 39.1)	**36.8** (31.0 44.7)	**40.9** (33.7 50.6)	**44.9** (36.2 56.9)	**50.2** (39.1 65.8)	**54.2** (41.0 73.1)
60-day	**15.9** (14.1 18.3)	**20.9** (18.5 24.0)	**27.0** (23.9 31.1)	**31.7** (27.9 36.8)	**37.8** (32.3 45.1)	**42.2** (35.5 51.2)	**46.5** (38.3 57.6)	**50.8** (40.9 64.3)	**56.3** (43.8 73.8)	**60.4** (45.7 81.4)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Estimates from the table in csv format: precipitation frequency estimates

Main Link Categories:
Home | OHD

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
Office of Hydrologic Development
1325 East West Highway
Silver Spring, MD 20910

Map Disclaimer
Disclaimer
Credits
Glossary

Privacy Policy
About Us
Career Opportunities

Page Author: HDSC webmaster
Page last modified: April 18, 2012

This Page

Intentionally

Left Blank

NBMG Report 53

Geologic Assessment of Piedmont and Playa Flood Hazards in the Ivanpah Valley Area, Clark County, Nevada

P. Kyle House[1], Brenda J. Buck[2], Alan R. Ramelli[1]
[1]Nevada Bureau of Mines and Geology, University of Nevada, Reno
[2]Department of Geoscience, University of Nevada Las Vegas

2010

Prepared in cooperation with the Clark County Flood Control District and the U.S. Geological Survey Statemap Program

Table of Contents

Abstract

A comprehensive surficial geologic mapping effort was undertaken to support the development of a series of relative flood hazard maps of the Ivanpah Valley area, Clark County, Nevada. The study area spans approximately 1030 km^2 (398 mi^2) and is defined by all of three and part of one internally drained basins between Las Vegas and Primm, Nevada. The proximity of the study area to Las Vegas makes it a likely site of urban and suburban development in the near future, and it is currently being considered for the construction of a major airport facility. The geologic study focused on the delineation of surficial deposits of alluvial, aeolian, and playa sediments ranging in age from recent to late Miocene (approximately 5.6 million years old). Mapping emphasized the discrimination of active alluvial and playa surfaces from relict, inactive surfaces for the purpose

000078

of developing a relative flood hazard characterization to provide a baseline physical data set to guide floodplain management and more detailed studies related to hazard mitigation efforts in the area. Ideally, the maps will help planners understand the distribution of flood hazard conditions in the valley and direct mitigation efforts and engineering studies to areas with the highest potential for flooding. Study results indicate that 60% of the total study area (236 mi^2) is composed of surficial geologic deposits. Within that subset, nearly 75% (175 mi^2) is subject to a relative flood hazard level deemed greater than "none", and nearly 53% of that area (125 mi^2) is classified as having a hazard status high enough to represent a significant concern for floodplain management. A series of 9 maps and a complete digital GIS dataset accompany this report.

Introduction

This report describes the application of surficial geologic mapping to flood hazard assessment on desert piedmont and playa surfaces in the Ivanpah Valley area along the I-15 corridor between Las Vegas, Nevada and the California border. It is a descriptive summary of and companion to a GIS data set that has been previously published as 9 separate paper maps (2 maps of the entire area and 7 maps of parts of the area that correspond generally to 7.5 minute quadrangle boundaries). The first map (House et al., 2006) is the surficial geologic map of the study area, and the second (House, 2007) is a qualitative flood hazard assessment of the study area (both at printed scale of 1:50,000). The seven remaining maps (House, 2006b through 2006h) are depictions of the flood hazard classifications on a series of 1:24,000-scale panels that cover the entire study area. The maps and their underlying data will serve as a useful guide for addressing flood-hazard management issues. At a minimum the mapping provides a useful template for determining the location and extent of areas of greatest concern to engineers and land managers responsible for flood hazard assessment and mitigation. These maps are not regulatory maps or actuarial flood hazard maps, but were developed with the intention of illustrating the spatial array of flood hazardous areas in the valley through the geologic interpretation of landforms, sedimentary deposits, soil characteristics, and surface morphology.

Flood-hazard management on desert piedmonts and terminal playas is a particularly challenging task. Desert piedmonts are crossed by ephemeral flow networks that occasionally convey high-velocity flows through a complex array of steep, potentially unstable and highly mobile, alluvial channels. These channels may follow a single, commonly braided thread or may be part of a multi-branched distributary network. Playa surfaces are inundated sporadically with shallow, standing water from a wide range of possible sources. Playa inundation may persist for days to weeks. Difficulties in characterizing floods in these settings also arise from limited amounts of measured data on flow frequency and hydraulics. Rapid urban and suburban growth often further exacerbate the problem by impacting already poorly understood temporal and spatial patterns of runoff and sediment transport while also creating a pressing demand for effective flood hazard mitigation.

Conventional concepts of floodplain management (i.e., as related to perennial streams) do not transfer to desert piedmonts. Numerous studies over the last 20 years have indicated that regulatory models for and approaches to flood hazard assessment on desert piedmonts can produce erroneous results when they ignore geologic information (e.g., Baker et al., 1990; Fuller, 1990; Pearthree, 1991; House et al., 1991, 1992; House, 2005; NRC, 1996; Robins et al., 2009).

Piedmont Geomorphology and Related Flood Hazards

Piedmont is the non-genetic term for a typically broad, generally low-relief area extending from the base of a mountain range toward the center or axis of a valley. The valley axis may host an axial stream, river, or wash; or a lake or playa. The latter is the situation for piedmonts in Ivanpah Valley. Piedmonts are composed mostly of alluvial sediment shed from adjacent highlands by streamflows and debris flows that form complexly coalescing and overlapping deposits and landforms of alluvial fans; but they may also include complex mixtures of eroded bedrock and other kinds of surficial geologic deposits, including: well-defined washes, inactive alluvial fan remnants, river terraces, pediments, sand dunes, sand sheets, spring mounds, and lacustrine beach forms. The mosaic of surficial geologic deposits and geomorphic surfaces that form desert piedmonts contain a geologic record of long-term effects of flooding, climate change, and tectonic activity. The various components of the piedmont can have widely varying ages. The array of landforms and geologic deposits on a particular piedmont is dictated by local conditions and the cumulative effects of geologic and climatic history on overall topography, sediment yield, and the types, rates, and magnitudes of surficial processes.

With respect to floodplain management concerns, the distinction between active and inactive alluvial fans is of greatest and most immediate relevance. Awareness and recognition of other types of deposits and landforms can be very useful for interpreting piedmont history, geomorphic process dominance, and long-term stability. Thus, describing, mapping and understanding the geomorphology and recent geologic history of desert piedmonts is an important part of understanding their flood hazard.

Geomorphology of Alluvial Fans

Alluvial fan flooding is the greatest concern of piedmont flood hazard management. Alluvial fans have been the topic of geologic research for a long time, and there is a correspondingly rich record of related scientific literature (c.f., comprehensive summary in Blair and McPherson, 1994). In the last twenty-five years or so, descriptions and analyses of alluvial fans and desert piedmonts have appeared frequently in the context of floodplain management because of the growing awareness and impact of the problem of alluvial fan flooding on piedmonts (e.g., Dawdy, 1979; French, 1986, 1987; Hjalmarson and Kemna, 1991; NRC, 1996, FEMA, 2000; House, 2005; Robins et al., 2009).

The Federal Emergency Management Agency (FEMA) has a vested interest in the characterization and management of piedmont flood hazards and the definition of alluvial fans and alluvial fan flooding. FEMA (2000, p. 6; and NRC, 1996 pp. 6–7) formally defined an alluvial fan as "...a sedimentary deposit located at a topographic break such as the base of a mountain front, escarpment, or valley side, that is composed of stream flow and/or debris flow sediments and has the shape of a fan, either fully or partially extended." This definition is accompanied by physically based distinctions between active and inactive alluvial fans and their respective flood hazards. These distinctions reflect the ranges of fan geometry and geomorphology on most piedmonts by emphasizing different types of flooding characteristic of active and inactive fans, including stable channel flooding (inactive fans), sheetflow (active fans), debris flow (active fans), and unstable flow path flooding (active fans).

In aerial view, alluvial fans often resemble extended fans, or conic segments (Bull, 1964, 1977); however, the gross planimetric geometry of fans can range from relatively ideal fan shapes to more irregular forms bounded by adjacent fans, bedrock outcrops, and relict fan surfaces, among other possibilities. Even when their shape is elegantly expressed, many alluvial fan landforms are comprised of a mosaic of alluvial deposits that record the evolution of the landform over periods of time in excess of several 100,000s of years (e.g., Ritter et al., 1993; Peterson, 1981).

Alluvial fans are created by sediment erosion, transport, and deposition by stream flows, debris flows, or both. Fans are composed of sediments ranging in size from silt to boulders and are built over time through net deposition of alluvium by a complex and dynamic network of distributary channels of varying dimensions and with varying degrees of lateral confinement. Fans form where a stream channel crosses a transition from a confined channel to a less-confined, but commonly similarly steep channel where the area of flow can expand relatively freely. Below the point of expansion, sediment is deposited over a broad area as the trunk channel widens and diverges into multiple distributary channels. Flow processes that create alluvial fans range from sediment-laden water flows to highly viscous, sediment-charged debris flows. Many fans are composed of deposits from both processes (composite fans), and some are composed largely of deposits from one or the other (Blair 1999a, 1999b).

The position, shape, and size of an alluvial fan collectively represent an approximate balance in the long-term relationship between delivery of sediment to the system, the system's transport competence and capacity, and the influence of bounding features on patterns of erosion and deposition (Bull, 1979). Repeated, large-scale changes in regional climate can profoundly influence this balance by altering watershed sediment yield and watershed runoff in different ways (e.g., Bull, 1991). Active tectonics, base-level changes along a master axial stream, or lake-level changes can also have major impacts on alluvial fan dynamics (Ritter et al., 1995). The result is a potentially complex assemblage of alluvial fan landforms spanning thousands to hundreds-of-thousands to millions of years on a given piedmont.

The Problem of Flooding on Desert Piedmonts and the Role of Geologic Mapping

Flooding on active alluvial fans involves high velocity, sediment-laden, and erosive flows that may follow multiple paths simultaneously (e.g., French, 1987). Flow path locations may shift position during floods and even between floods owing to effects of intervening lower magnitude flows. This presents an obvious complexity and uncertainty to hazard characterization and management on alluvial fans and the piedmonts they comprise. Individual alluvial fan floods may result in surface changes and drainage pattern alterations that invalidate subsequent use of pre-flood topographic and hydraulic assumptions. One key contribution of geologic mapping in this context is that it can summarize a suite of physical criteria that indicate where alluvial fan activity has and has not occurred over very long periods of time, thus indicating areas of highest hazard potential.

The utility of geologic studies in this context was explicitly recognized by FEMA (2000) in their recommended 3-step approach to alluvial fan flood hazard determination:

1. Recognition and characterization of the alluvial fan landform.
2. Defining the nature of the alluvial fan environment and the location of active erosion and deposition.
3. Defining and characterizing areas of "100-year" alluvial fan flooding.

Steps one and two above require geologic interpretation and are best handled with detailed mapping and field reconnaissance. Step three requires detailed technical engineering studies to ultimately develop Flood Insurance Rate Maps (FIRMs). Thus, it is critical to note that ***geologic data alone are inadequate for developing regulatory maps***. Geologic maps provide an informal perspective on the distribution and relative severity of piedmont flood hazards, but they do not supplant conventional flood-risk maps because they do not contain explicit data on flow depths, velocities, or probabilities. Those types of parameters cannot be reliably determined from geologic studies.

The Field Area

The Ivanpah Valley study area includes the entirety of three internally drained valleys and a small part of one internally drained valley southeast of Las Vegas, Nevada (fig. 2 and fig. 3). Each valley is associated with drainage to a specific playa lake: Hidden lake (informal name), Jean Lake, Roach Lake, and Ivanpah Lake. Only a small part of the Ivanpah Lake drainage is included in the study as explained below.

The terminal "lakes" or "playas" in each valley are dry most of the time in any given year. The four playas are aligned along a roughly SW–NE trend that likely reflects control by deep-seated geologic structures. Roach and Ivanpah playas are separated by a low and potentially transient divide formed where the southern extremity of the Spring Mountains meets the toe of a large alluvial fan that extends westward from a deep canyon cut through the Lucy Gray Mountains (the Lucy Gray fan). The lowest part of the divide is obscured by development in Primm, NV, but is less than 1 mi. north of the California state line. Geologic evidence unequivocally indicates that the alluvial divide is transient and has been crossed multiple times by large channels on the Lucy Gray fan. The study area includes the part of the Lucy Gray fan that lies in Nevada and drains to Ivanpah Lake because it includes surficial deposits that represent conditions that could have just as easily affected the Roach Lake basin.

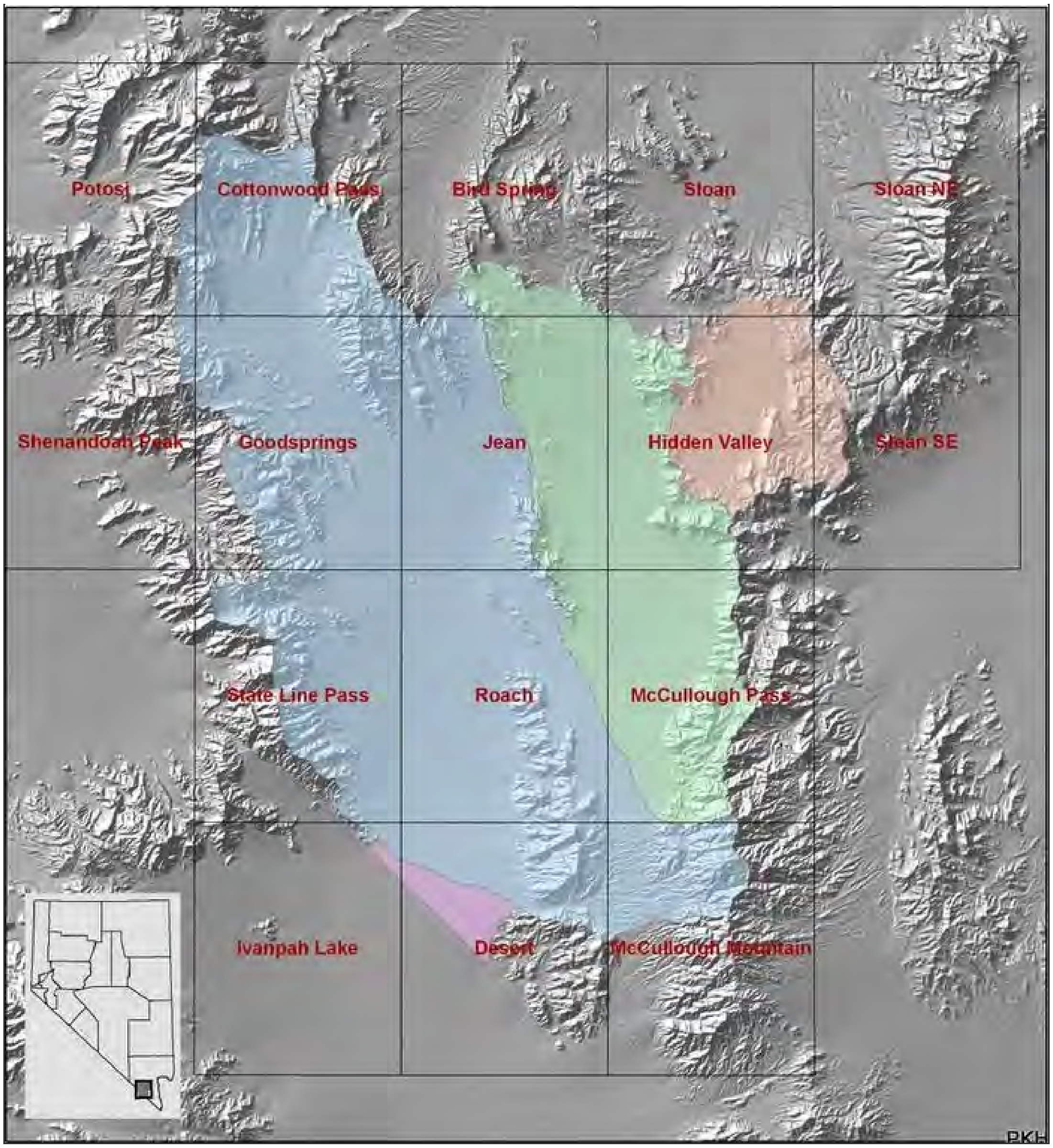
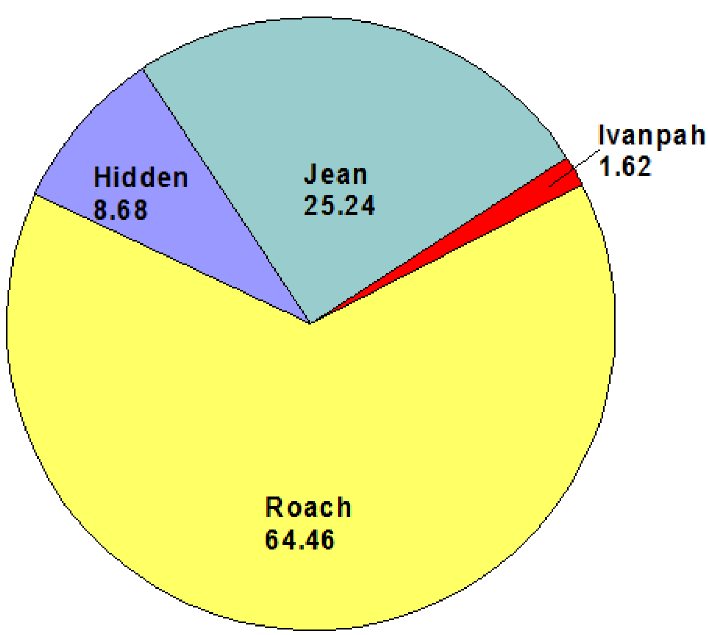


Figure 1. Shaded relief map of Ivanpah Valley study area (colored) showing 7.5' quadrangle maps and playa watersheds (blue: Roach; green: Jean; peach: Hidden Valley; pink: Ivanpah). The shaded relief is based on 30-m digital elevation data from USGS.



000081

Figure 2. Individual playa drainage areas as percentage of study area.

Figure 3. Oblique aerial view of the southern part of the Ivanpah Valley study area. Photographer in airplane situated over the Spring Mountains looking SSE. Roach Playa is prominent playa in center of image; Lucy Gray Mountains and McCullough Mountains in left background; Table Mountain in lower right corner. Photo courtesy of Jim Faulds, NBMG.

Expected Land Use Issues in Ivanpah Valley, Nevada

Construction of a major airport facility on the Roach playa and immediately surrounding low-lying areas has been proposed. A development of this scale will have a significant effect on local drainage. It is also likely that addressing these effects will involve flood hazard mitigation efforts on piedmont areas throughout much of the study area. The construction of the airport would also result in a vastly enhanced utility and transportation infrastructure in the valley that would likely stimulate additional development, much of which would occur on piedmont surfaces. Piedmont and playa areas comprise 60% of the study area. Results from this study indicate that more than 50% of that area pose significant floodplain management concerns.

The Geologic Map

Surficial geologic mapping focuses on the differentiation and delineation of largely unconsolidated sedimentary materials that comprise a surficial veneer over bedrock. Most of these types of deposits in the Mohave Desert are Quaternary in age, a geologic period spanning from the present to approximately 2.6 Ma (million years ago) (USGSGNC, 2007; ICS, 2008) (http://www.stratigraphy.org/upload/ISChart2009.pdf). It is notable, however, that there are extant surficial deposits that may date to as early as the late Miocene (>5.3 Ma) are present in some locations in southern Nevada, including Ivanpah Valley. In this study, the division between deposits mapped in detail and those mapped only generally corresponds to a major geologic unconformity between strongly tectonically deformed deposits (this includes all bedrock units and one Miocene age alluvial deposit) and deposits that are weakly deformed or undeformed.

The previously published geologic map that accompanied the development of this report (House et al., 2006) depicts the distribution of geomorphic surfaces and their associated surficial sedimentary deposits. Geomorphic surfaces are landscape elements that have formed (or are currently forming) during discrete periods of time by an identifiable set of geologic processes (e.g. deposition of alluvium or aeolian sediment). Geomorphic surfaces have distinctive material composition, topographic features, soil profiles, weathering characteristics and stratigraphic relations that can be used to differentiate them by relative age and formative process (Bull, 1991, p. 51). Abandonment of a geomorphic surface by its principal formative processes subjects it to prolonged subaerial exposure and weathering. The duration of exposure is reflected in progressive physical changes in surface properties related to physical and chemical weathering and, quite importantly in this setting, the persistent but variable additions of fine-grained windblown sediment to stable surfaces. The effects of these processes comprise the set of mapping criteria that are used to develop surficial geologic maps of desert piedmonts.

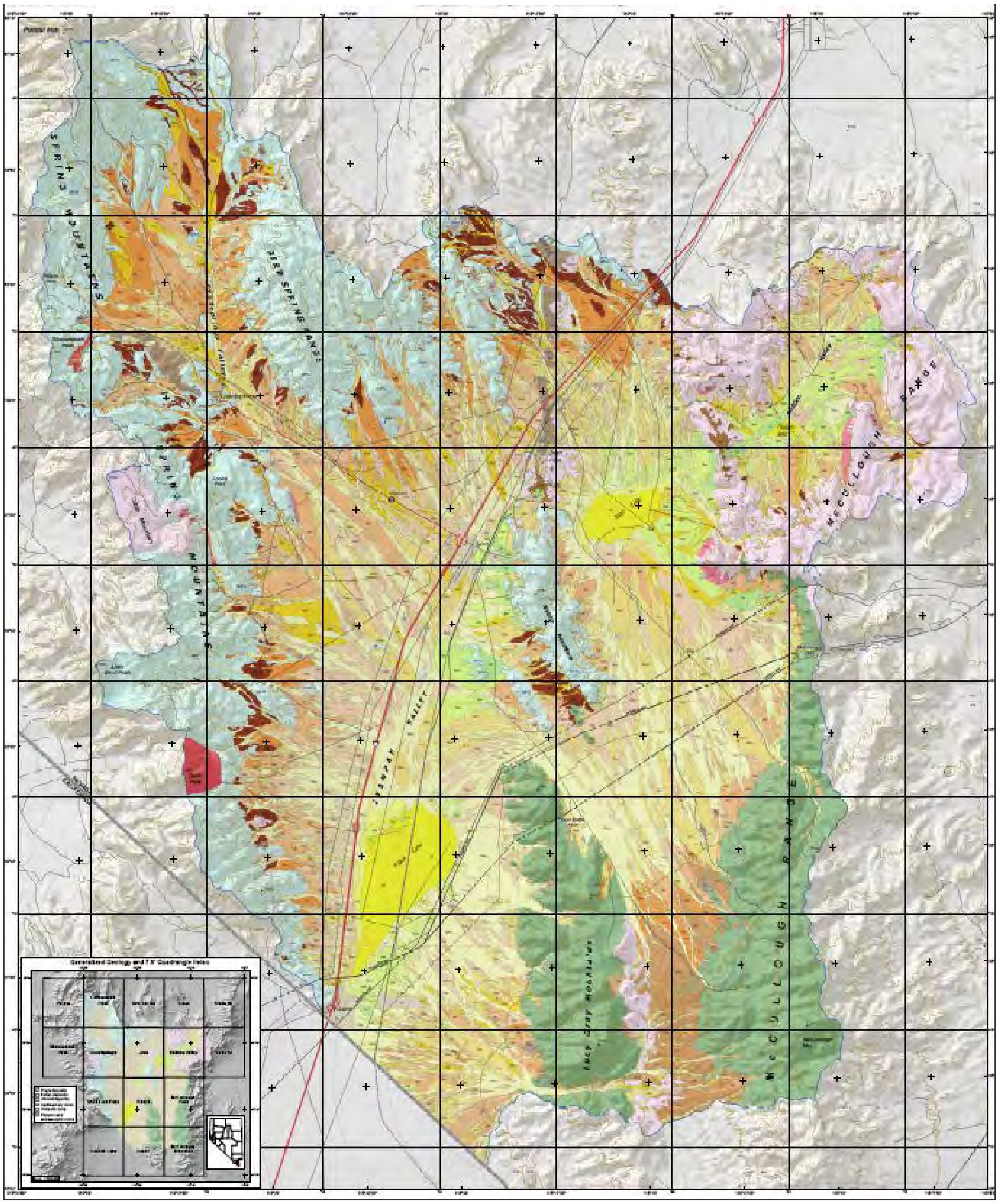


Figure 4. Surficial geologic map of the Ivanpah Valley area (House et al., 2006). Greatly reduced representation.

Download Surficial Geologic Map:

Full Size Hard Copy Version(.pdf) **Google Earth Version** (.kmz) **GIS Data** in UTM NAD 83, ESRI Shapefile format (.zip)

with contours

without contours

Geomorphic surfaces are usually associated with roughly contemporaneous geologic deposits, but not universally—and this is why the distinction is important. Time-correlative geomorphic surfaces are those that were abandoned by active surface processes at the same general point in time and have thus been subject to the same duration of weathering and soil formation; however, the underlying deposits are not necessarily the same age as the surface and it is common for younger surfaces to be associated with older deposits if, for example, the older deposits have been exhumed by erosion. Thus, surface age represents the minimum deposit age, or the duration which the extant deposit surface has been isolated from active constructional processes and exposed to largely uninterrupted weathering and soil development (Peterson, 1981). Surficial geologic maps emphasize surface age over deposit age unless the exposure of an older, underlying deposit is extensive enough to depict on the map at the chosen scale.

Geologic Maps vs. Soil Maps for Flood Hazard Assessment

Various types of maps may be relevant to piedmont flood hazard evaluation, but their specific applicability can vary. Many available geologic maps emphasize bedrock geology and only depict surficial geologic deposits very generally. This type of geologic map has minimal value for flood-hazard characterization. Soil maps (available through the National Resource Conservation Service, NRCS) are available for many areas, and these are also useful for flood-hazard studies; however, it is important to be aware of fundamental differences between surficial geologic maps and soil survey maps and how they relate to piedmont flood hazard characterizations.

Soil survey maps produced by the NRCS are useful and important tools for land-use planning. They contain information that can predict soil behavior for different land uses; they give information regarding soil hazards, soil limitations and methods to overcome those limitations, and predicted environmental impacts from selected land uses. Soil surveys provide detailed descriptions of soils; slope steepness, length, and shape; pattern of drainage; and vegetation. Soil mapping units are identified according to the taxonomic classification of the dominant soil present, but commonly include one or more lesser soils. Classification of soils is based on numerous specific and well-defined properties.

Soil survey maps and surficial geologic maps share both strong similarities and potentially significant differences. Similarities occur where one or more soil-forming factor (parent material, biota, climate, time, topography) has resulted in significant changes in the soil characteristics and significant controls on geomorphic processes. An example of this is where the age of different geomorphic surfaces is significant enough that soils forming on those surfaces have distinctly different features or properties that place them into different taxonomic classifications. Therefore, depending upon the scale of the two types of maps, both the soil survey and the surficial geologic map could have very similar delineations because the difference in age is great enough to affect both the geomorphic characteristics of the landform as well as the soil forming upon it.

On the other hand, clear delineations can often be made using geomorphic data that do not correlate well with soil characteristics used in soil taxonomy. For example, in many places, two or more geomorphic units can be distinguished in a surficial geologic map based upon topographic and crosscutting relationships. However, these geomorphic surfaces may contain soils with similar diagnostic characteristics such that they are all mapped as one soil series in a soil survey. Another example is where an active geomorphic surface has eroded into older deposits. Because of the depth considerations required by soil classification (the uppermost 5 feet of the subsurface), a soil profile excavated into a modern, active channel may encounter a buried, older soil at shallow depths. In this case, the characteristics of the older soil will control the classification of that soil and resulting map unit (Robins et al., 2009).

Surficial geologic maps rely on a set of multiple criteria (soil development being only one) that allow for a finer division of surficial deposits by age and formative process; whereas soil maps focus on specific set of physical criteria contained in the soil which can be related to age and formative process, but not to the same extent. Access to both types of maps for any given area is obviously an advantage in land management applications.

A specific comparison of the Ivanpah geologic maps (House et al., 2006; House, 2007) and soil maps of the same area prepared by the NRCS is described in a recent paper by Robins et al. (2009). Their paper provides important context for evaluating the relative merits of the different approaches, applications, and intentions of these two types of maps.

Previous Work

Previous geologic mapping efforts in the Ivanpah Valley area have focused on characterizing the geologic setting of ore deposits, describing key Paleozoic and Mesozoic rock units, and mapping complex geologic structures (Hewett, 1931, 1956; Longwell et al., 1965; Burchfiel et al., 1974; Carr and Pinkston, 1987; Kohl, 1977; DeWitt et al., 1989; Bridwell, 1991). A recent exception to the emphasis on bedrock geology is a surficial geologic map of the Mesquite Lake 30′x60′ quadrangle (1:100,000-scale) that includes the Ivanpah Valley study area (Schmidt and McMackin, 2006). That map covers a considerably larger area and is thus more general than the mapping associated with this report (House et al., 2006), but it provides a useful perspective on the regional geologic context of the Ivanpah Valley area. It is accompanied by a comprehensive report that presents detailed background information on vegetation, climate, the range of surficial processes in the region, and additional discussions of concepts of soil formation over time that are representative of general conditions in Ivanpah Valley.

Compilation Methods and Base Data

The geologic data depicted in House et al. (2006) were compiled digitally in ESRI ArcGIS software using a combination of base material sources. Orthorectified aerial photograph mosaics (U.S. Geological Survey orthophoto quarter quads, DOQQs) and orthorectified Quickbird® satellite imagery were used extensively to guide digital linework compilation. In most cases, mapping was performed using “heads-up” digitization on desktop computers. In a few cases, preliminary linework was compiled using a PG-2 stereographic plotter. Linework developed using this technique was ultimately refined on-screen with underlays of high-resolution satellite imagery. Digital raster graphic (DRG) images of fifteen, 1:24,000-scale topographic maps served as base maps for linework. The 1:50,000-scale topographic base upon which the map is overlain was compiled from various digital sources that were derived from the 1:100,000-scale Mesquite Lake 30′ x 60′ USGS quadrangle. Minor modifications to road alignments were made to these data from the basis of high-resolution imagery and the 1:24,000-scale base maps.

Some of the basedata sources (described below) allowed for compilation of geologic linework at large scales (up to 1:4000-scale), but mapping at this level of detail was not performed universally in the study area due to data availability issues and basic logistical constraints on time. Overall, the mapping is accurate down to approximately 1:12,000-scale, with the exception of the areas mapped in the Cottonwood Pass and McCullough Mountains quadrangles which are based on less field reconnaissance than the rest of the map and are accurate to approximately 1:24,000-scale. The base imagery and final mapping are based on the North American Datum of 1983 (NAD 83).

The geologic data were initially compiled using a combination of field reconnaissance and interpretation of various types of remotely sensed imagery, including: aerial photographs, digital orthophoto images, Quickbird® satellite imagery, and digital, orthorectified color aerial photographs. Details about the various aerial photograph sources are listed in table 1.

Table 1. Aerial photographs used in compiling geologic data.

Film Type	Source	Series	Date	Scale
b/w	USGS	GS-YP	1953	1:18,000
b/w	AMS	VV HU M	1954	1:50,000
b/w	USGS	GS-VUZ	1958	1:52,000
b/w	USGS	GS-VEFB	1976	1:76,000

b/w	USGS	NAPP	1999	1:40,000
color	BLM	FY-76	1977, 1978	1:18,000

Quickbird® Data

Toward the end of the mapping project, we obtained Quickbird® satellite imagery for nearly the entire study area (fig. 4). Quickbird® is high-resolution commercial satellite capable of 61–72 cm panchromatic resolution and 2.44–2.88 m multispectral resolution (Toutin and Cheng, 2002). Most of the Quickbird® data acquired in this project were 4-band, 8-bit and 3 band natural color, and orthorectified (Digitalglobe Corp., 2006). When adequately post-processed, Quickbird® images have exceptional clarity and resolution and are thus excellent resources for surficial geologic mapping. The vastly improved orthorectified base data allowed for extensive remapping of areas previously mapped using only aerial photos and grayscale DOQQ datasets. It also facilitated relatively rapid mapping of areas added to the mapping task in the final year (this applies to mapping in the parts of the Cottonwood Pass and McCullough Mountain quadrangles which were added to the scope late in the project to ensure that the entire watershed of the Nevada part of Ivanpah Valley was mapped).

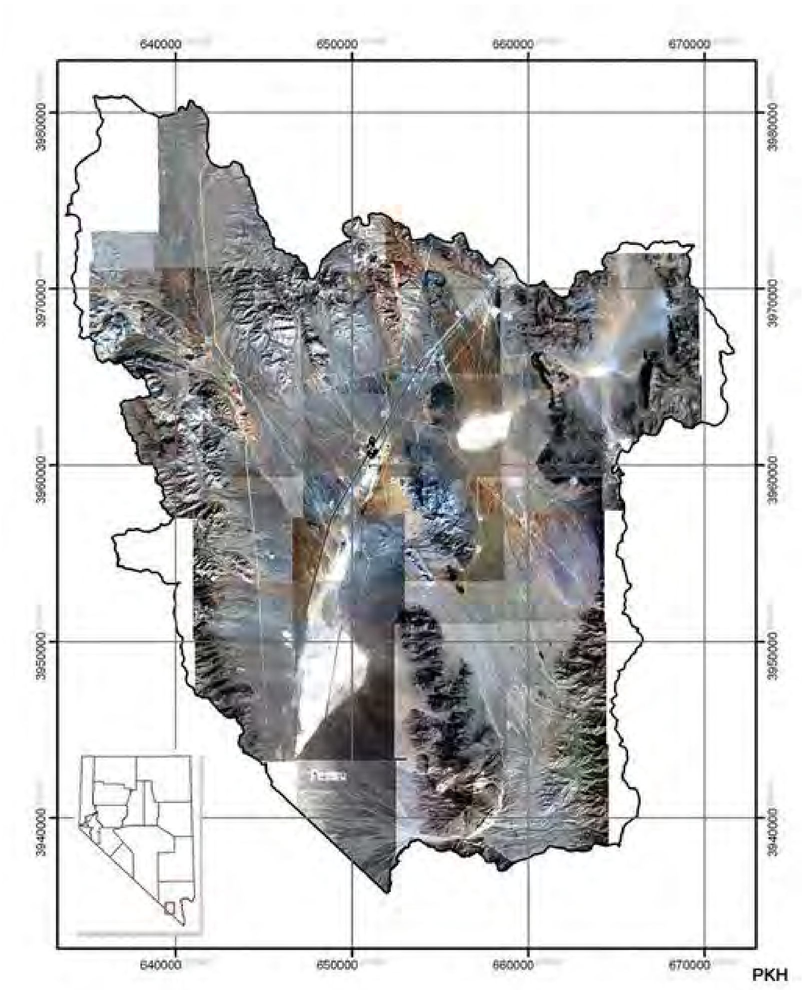


Figure 5. Quickbird® satellite imagery used in the compilation of geologic linework.

Field Data Collection

We collected GPS coordinates for all sites of key observations during field work. The data were collected in (or ultimately converted to) UTM NAD 83. Over the course of the project, our technique for collecting site location data in the field evolved significantly from point coordinate collection using handheld GPS units to collection using handheld computers running ArcPad to collection using ruggedized GPS-enabled laptop computers running ArcGIS. All field sites at which notes were collected and several where ground photographs were taken are recorded in a corresponding geodatabase included with this report (see appendix 1). A subset of field photographs was geotagged, (i.e., encoded with latitude and longitude), and these photos are available online and viewable in Google Earth.

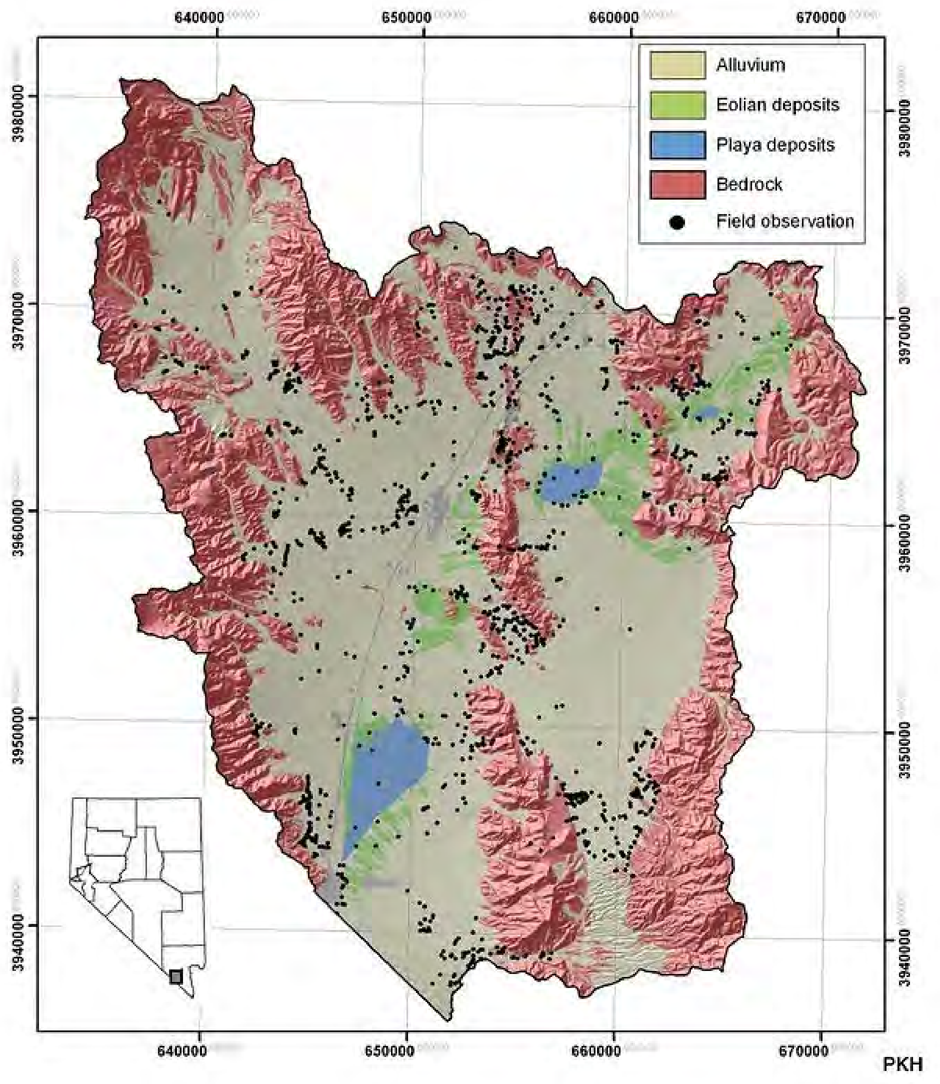


Figure 6. Generalized geologic map of study area also showing locations of recorded field observations by the authors.

Mapping Criteria

Geomorphic surfaces and related sedimentary deposits in the Ivanpah Valley area were discriminated by their relative ages as inferred from observable physical characteristics, including the following: landscape position; surface morphology; surface material weathering; soil development; and stratigraphic relations. Broad age assignments are based on comparison to regional studies of soil and surface characteristics, some with independent sources of age control (described in a subsequent section). A set of useful guidelines for mapping alluvial fans, both in the context of interpreting Quaternary geology and evaluating flood hazards, can be gleaned from the geologic literature (e.g. Christenson and Purcell, 1985; Dohrenwend, 1987; Bull, 1991; Field and Pearthree, 1997). Compilation of geologic data for application in piedmont flood hazard assessment requires a specific emphasis on surface characteristics that develop only in the absence of sediment entrainment, transport, and deposition associated with active alluvial fan and ephemeral wash processes. The following criteria apply in varying degrees to the Ivanpah Valley study area (cf., Field and Pearthree, 1997, table 1, for comprehensive reference list).

Stratigraphic Relationships

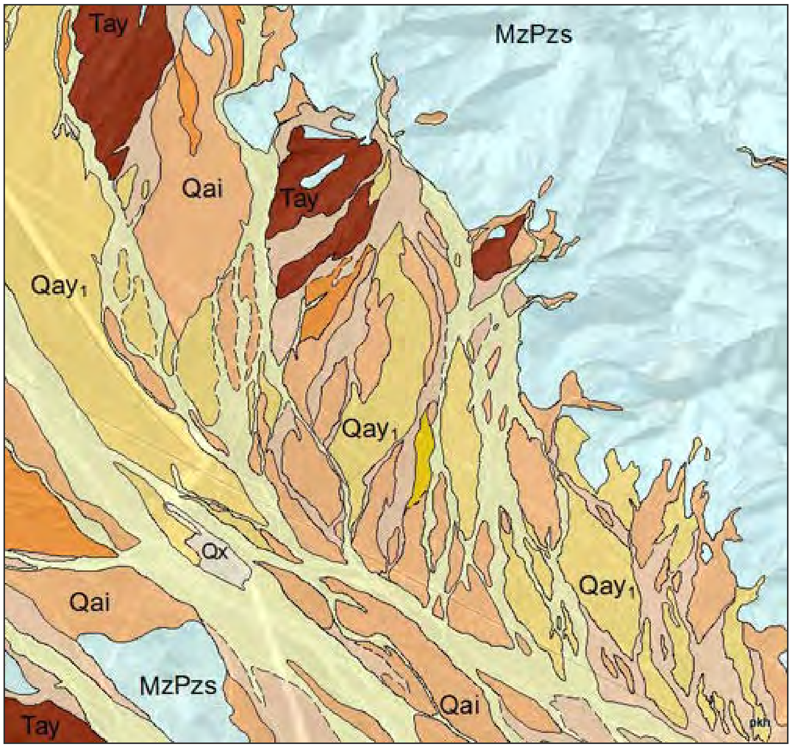
Desert piedmont deposits are composed of stratified (layered) sediments (gravel, sand, and mud) transported by flowing water or debris flows (alluvial deposits), wind (aeolian deposits), by settling from standing water (playa deposits), and by physical weathering and mass wasting of steep bedrock cliffs and slopes (colluvial deposits). The basic stratigraphic relationships among and between different geological units of known or approximately known ages can be used to establish a relative age framework. Evaluation of the superposition of map units in stratigraphic section or in their surface distribution were used in this study, for example: cross-cutting surficial relationships among alluvial fan units, inset geomorphic relations, and degree of overlap or burial by aeolian deposits.

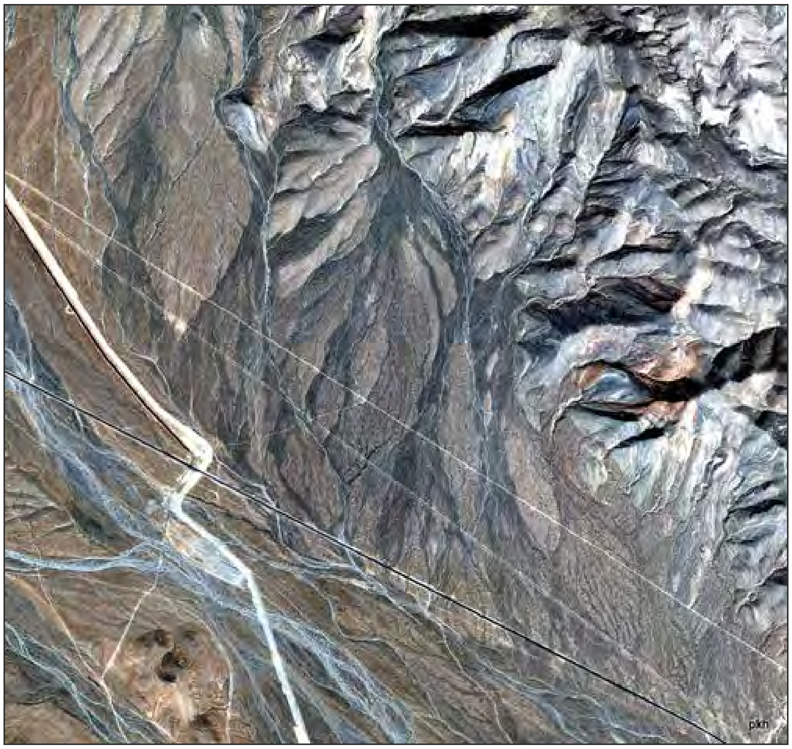
Topographic Characteristics

Piedmont alluvial surfaces of different ages can be distinguished in many cases from the basis of large-scale and small-scale topographic characteristics. Local arrays of piedmont alluvial surfaces of different ages commonly exhibit observable topographic separation and inset or nested relationships. Examination of field relations and aerial-photo stereopairs can help relate the topographic separation to relative degrees of connectedness or non-connectedness between alluvial surfaces and active channels, for example, and can help correlate map units across large parts of the field area. Depth of channel dissection on a given abandoned alluvial surface generally increases with increasing time. Inactive surfaces are often associated with networks of incised stable channels.

Drainage Pattern

Active alluvial surfaces on desert piedmonts commonly have obvious distributary, braided, or anabranching drainage patterns or are well-defined single channels. Inactive alluvial surfaces are characterized by superposed dendritic, or flow-concentrating, tributary drainage patterns that reflect progressive erosion by local surface runoff or by moderately to deeply incised active channel systems. As noted above, tributary drainage networks on inactive fan surfaces often have incised channels that generally increase in depth with increasing relative surface age, although this can vary with landscape position. In most circumstances, older abandoned surfaces are most deeply dissected in upper piedmont areas and dissection progressively decreases toward the valley axis where the toes of remnant fans are commonly buried by younger abandoned surfaces and modern active surfaces.





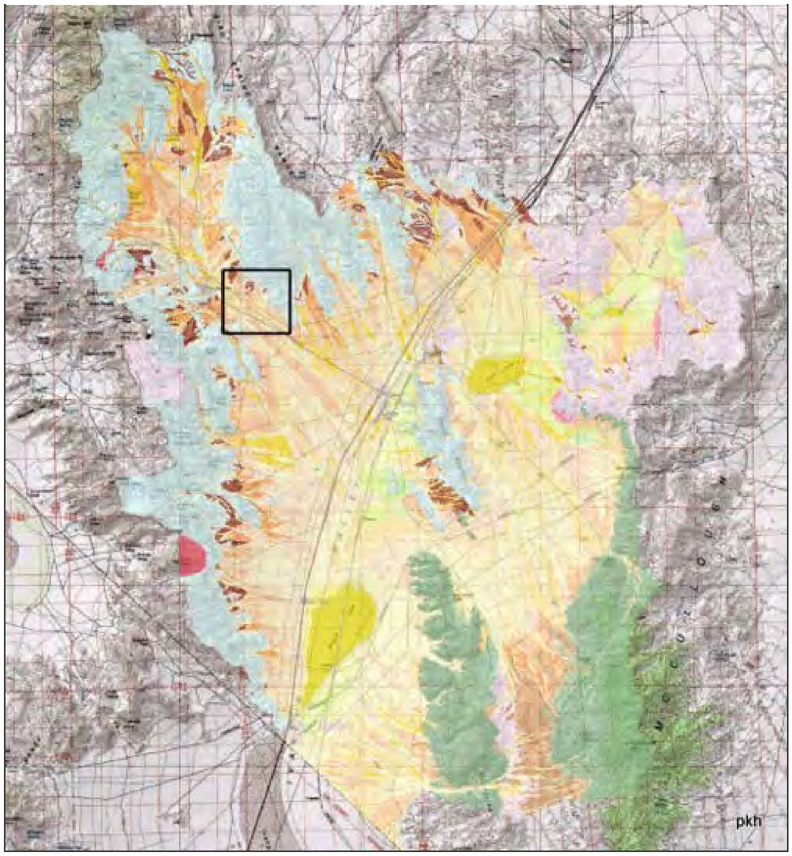


Figure 7. Examples of tributary v distributary drainage pattern, inset topographic relationships, and the the value of Quickbird® imagery for interpreting geologic relations. Red box in third image indicates location of large-scale map and image.

Surface Morphology

The deposition of coarse-grained alluvium in channels and on alluvial fans results in distinctive bar and channel forms composed of sand and gravel (fig. 11). This pristine condition of the surface is referred to as “bar-and-channel” morphology and it reflects active fluvial processes of sediment transport and deposition. Relief between bar crests and channel floors can approach 1–2 meters on some active surfaces, rarely more. Once an active surface is abandoned by fluvial processes, subaerial weathering processes proceed to mute the original surface relief and change the character of sedimentary particles on the surface. Observable changes include the following: progressive flattening of original depositional surface morphology with time; formation of desert pavements that generally become more tightly interlocked with time; development and progressive darkening of rock varnish; and chemical and physical disintegration of surface rocks. Each of these phenomena is a time-dependent changes that has been extensively documented and described on abandoned alluvial surfaces in arid regions (e.g., McFadden et al., 1998; Wells et al., 1998). These characteristics are among the easiest to observe in the field and on remote imagery. Their relative strength reflects varying amounts of time, and they are particularly useful criteria for establishing relative age relationships (e.g., Bull, 1991).

Figure 8. Series of 4 photos that illustrate the sequence of topographic leveling that occurs over time once active alluvial surfaces are abandoned. Top left: coarse gravel bar in active channel, unit Qay_3; Bottom left: greatly subdued gravel bar crest on young abandoned surface, unit Qay_2; Top right: older, but coarser gravel bar crest on older Qay_2; Bottom right: Planar surface remnant with scattered protruding cobbles, unit Qay_1.

Once a formerly active alluvial surface is abandoned, the first noticeable change is the transition to a progressively more muted surface topography characterized by “bar-and-swale” morphology. This is expressed as flattening of bar crests and channel bottoms and an overall reduction in relief between the two forms (fig. 8). Flattening occurs largely as a consequence of aeolian deposition (mainly of silt and fine sand), but local raveling, sheetwash, and surface-creep may also be factors. As time progresses, bar-and-swale topography becomes progressively more muted and the local relief between relict bar crests and swale troughs decreases until a nearly fully planar surface forms. In the case of particularly coarse-grained deposits, the planar form can be locally to extensively interrupted by protuberances of relict cobble and boulder bar crests.

Progressive flattening of depositional topography on abandoned alluvial surfaces in the Ivanpah Valley study area is due largely to the deposition of aeolian silt and fine sand. Major episodes of aeolian deposition probably coincide with major droughts and prolonged exposure of playa and distal alluvial fan surfaces to deflation by wind (Reheis et al., 1995; McFadden et al., 1998). The formation of gravel pavements is a characteristic phenomenon on desert piedmont alluvial surfaces (among other types) that occurs in conjunction with the deposition and translocation of fine-grained aeolian sediment (McFadden et al., 1987; Wells et al., 1995; Anderson et al., 2002). Incipient pavements develop locally in swales and on bar crests on alluvial surfaces that have been abandoned relatively recently, and over time pavements become more distinct with tightly interlocking surface clasts (fig. 10). Pavements do not form as readily (if at all) on surfaces where aeolian deposition is particularly active or involves more sand than silt. Surfaces in these areas do become distinctly planar, but are mantled with aeolian materials and may remain quite active areas of aeolian transport. In Ivanpah Valley, this condition is common along the east and northeast margins of playas.

Characteristics of Desert Soil Development and Surface Clast Weathering

Over time, inactive alluvial surfaces progress through a series of time-dependent physical and chemical changes related to physical weathering, chemical weathering, and translocation of surface materials to deposit interiors. These changes are expressed as surface clast weathering, stone pavement formation, and soil horizon development in the upper 1–2 m of the deposits (Birkeland, 1999). The type and magnitude of changes that occur are related to the duration of subaerial exposure; long-term absence of active fluvial processes; and environmental changes.

Soil Carbonate Development

The most useful changes for evaluating surface age in desert soils occur in the soil B-horizon and include development of soil color and discernible soil structure (Bw horizon); the accumulation of calcium carbonate (or other salt) (Bk or similar horizon), and accumulation of translocated clay (Bt horizon) (Bull, 1991). Soil carbonate development is typically the master criterion for establishing general surface ages on piedmonts in the western U.S. (e.g., Gile et al., 1966; Bachman and Machette, 1977; Machette, 1985).

We relied heavily on soil carbonate morphology in dividing surficial units by relative age in Ivanpah Valley. Carbonates and other soluble minerals (sulfates, halides, nitrates, etc.) are common components of soil profiles in arid and semi-arid regions because there is not sufficient water available to remove them. The elements necessary to form pedogenic carbonate ($CaCO_3$) come from the following sources: CO_2 is derived primarily through root respiration, water (H_2O) enters the soil during precipitation (or through anthropogenic mechanisms), and Ca^{+2} ions are mostly derived from rain and dust (minor contributions can come from weathering of parent materials) (e.g. Gile et al., 1981; McFadden and Tinsley, 1985, McFadden et al., 1998; Naiman et al., 2000). When soil water becomes saturated with respect to calcium carbonate, it precipitates within the soil pore spaces. There is additional evidence that microorganisms can contribute to the formation of carbonate directly and/or indirectly (Monger et al., 1991; Lian et al., 2006).

Precipitation of pedogenic carbonate generally happens at specific depths that can be highly variable and are controlled by the depth of wetting. The depth of wetting is dependent upon many factors including effective precipitation and soil texture. Effective precipitation can vary with seasons and with climate changes (e.g., glacial vs. interglacial). Fine-textured soils have a greater porosity than coarse-textured soils, and thus have a shallower depth of wetting (Gile et al., 1981; McFadden and Tinsley, 1985). Depth of wetting can change through time if soil erosion or deposition occurs (e.g., aeolian sandsheets; or development of Av horizons). In addition, climate changes that result in increased effective precipitation can dissolve pedogenic carbonate and move it deeper or completely out of the soil. Most soils today with pedogenic carbonate are found under grassland or desert-type vegetation, but some exist under pinyon-juniper woodland where the present soil-moisture conditions differ from those that existed when carbonate was accumulating in the soil (Machette, 1985). Increased rainfall associated with climatic gradients near mountain ranges has a profound effect on the distribution and concentration of pedogenic carbonate (Gile et al., 1981).

The accumulation of pedogenic carbonate in the soil profile has been closely linked to soil age (Gile et al., 1981; Machette, 1985). Soils on progressively older geomorphic surfaces contain progressively greater amounts of pedogenic carbonate. In addition, with increasing time, the carbonate forms specific morphologies that have been defined as Stages I through VI (Gile et al., 1981; Bachman and Machette, 1977) (fig. 9).

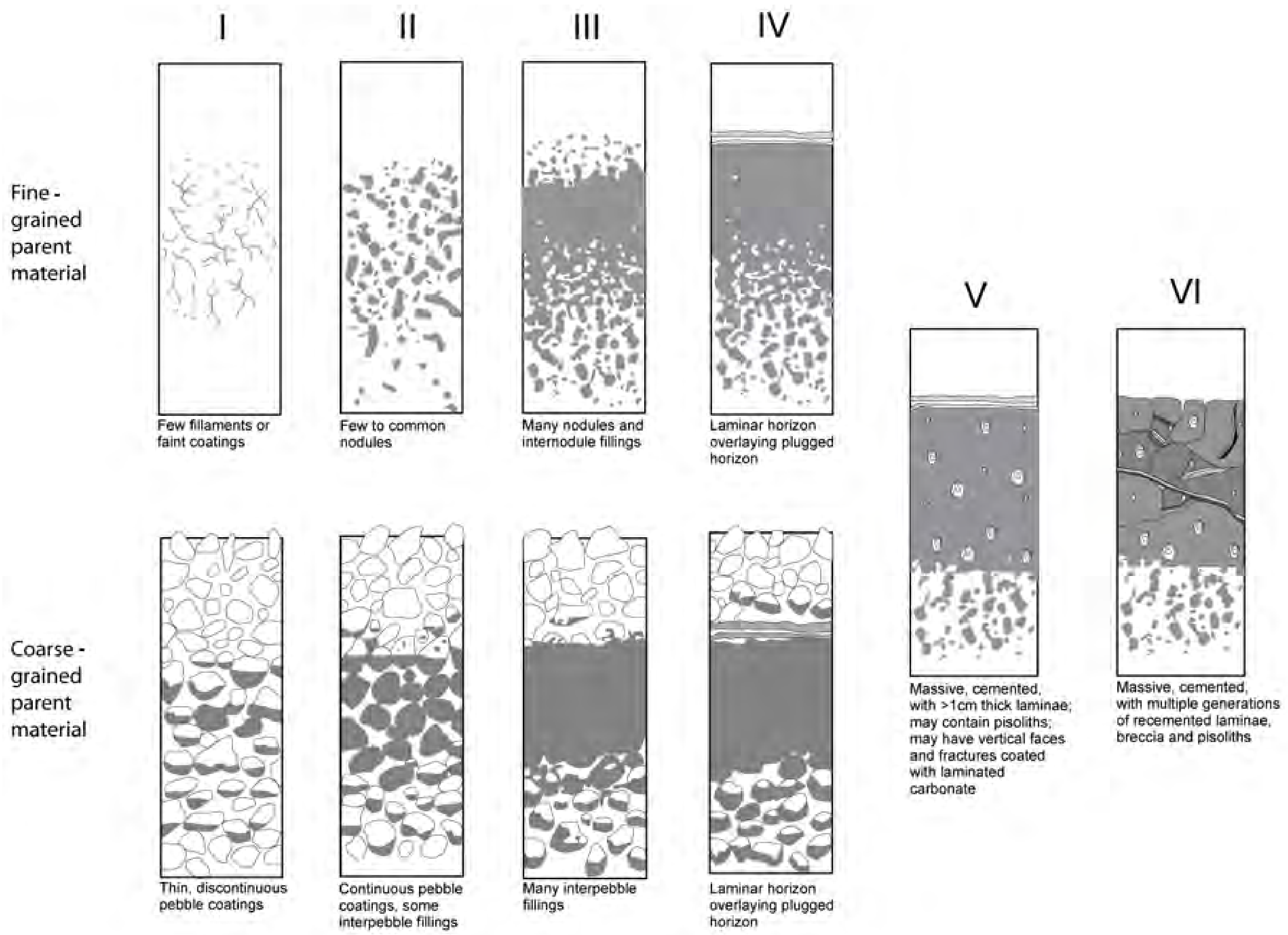


Figure 9. Illustration of time-dependent changes in soil carbonate horizon morphology in gravelly soils. ***Modified with permission from a figure provided by Amy Brock, Univ. Tennessee.***

The definitions of these stages vary between fine-textured (sand and finer) and coarse-textured (gravelly) soils (Gile et al., 1966; Gile et al. 1981). The time required for a soil to develop the different stages of carbonate accumulation is dependent upon the soil's texture, because texture controls soil porosity (volume of pore space). A fine-grained soil contains has greater porosity and requires a correspondingly greater amount of carbonate to fill the pores and form greater stages of carbonate accumulation as compared to a coarse-textured soil (Gile et al., 1981). This generally means that it takes more *time* for a fine-grained soil to reach the same stage of carbonate morphology as a coarse-textured soil in the same area. Recent research has shown that changes in soil texture strongly affect hydrologic conductivity such that the rates of carbonate accumulation may vary greatly even locally (Treadwell-Steitz and McFadden, 2000). Additionally, soils that contain carbonate parent materials appear to form calcic and petrocalcic horizons faster than soils with non-carbonate parent materials (Machette, 1985; Reheis et al., 1992; Treadwell-Steitz and McFadden, 2000). This is a factor in soil formation on the northwest and west sides of Ivanpah Valley where carbonate bedrock is extensively exposed.

In soils with stage III or greater carbonate development, a marked and progressive volumetric expansion occurs as pedogenic carbonate continues to precipitate. This results in the original detrital grains floating in a matrix of pedogenic carbonate, and a volumetric expansion of 400 to 700% from the original framework (Bachman and Machette, 1977; Machette, 1985). Stage V and VI horizons have so much $CaCO_3$—commonly more than 50% in gravelly materials and more than 75% in fine-grained materials—that the texture of the parent material is completely obscured in these horizons. In carbonate stage III or greater, pressure solution (force of crystallization) of parent material clasts adds Si, Mg, Al, and other ions which results in the precipitation of sepiolite and palygorskite clay, and opal (Bachman & Machette, 1977; Watts, 1978; Hay and Wiggins 1980; Watts 1980; Reheis, 1988; Monger and Daugherty, 1991a,b; Monger and Kelly, 2002; Brock, 2007; Robins et al., 2008). These processes also operate inside stage II pendants (Brock and Buck, 2005).

The carbonate morphology (stages) and the rate at which carbonate accumulates in soils are dependent upon:

1. Amount of effective precipitation
2. Amount of Ca^{+2} ion input (dust/rain)
3. Time (landscape stability, erosion/sedimentation)
4. Presence or absence of carbonate minerals in parent material (or in dust)
5. Soil texture
6. Presence of vegetation (must have respiration for carbonate to form in soils) (see Rech et al., 2003; Amit et al., 2006).
7. Microbial precipitation of carbonate (?) (e.g. Monger et al., 1991; Lian et al., 2006)

In most regions within the desert Southwest, the stage of soil carbonate morphology is a useful indicator of the relative age of a geomorphic surface. Previous studies have attempted to measure rates of soil development using soil carbonate, but as is often the case for Quaternary research, the lack of numerical dates has limited this technique. McFadden and Tinsley (1985) modeled the rate and depth of carbonate accumulation with variable temperature and precipitation values and found that these variables can strongly affect pedogenic carbonate formation.

Machette (1985) compared the stage of carbonate development with time for eight different geographic regions and demonstrated how the stages of carbonate morphology are strongly controlled by the amount of effective precipitation and dust (Ca^{+2}) input through time. He found that for Holocene and latest Pleistocene calcic soils (i.e. those that formed during an interglacial climate), average accumulation rates are, in most cases, almost twice as high as compared to older soils (i.e., those that formed during glacial climates). Harden et al. (1991) found that geographical variation in the soil development rates varies by a factor of 2 to 3, whereas the temporal variation between the Holocene versus the Pleistocene may be as much as a factor of 10 or more. Therefore, when using carbonate morphology as a relative age indicator, one must be careful to compare sites with similar climate histories. McFadden (1988) examined soil characteristics versus age for soils in the Mojave Desert. He found that latest Holocene soils aged 100–2000 yr B.P.(B.P.=before present) have no carbonate; late Holocene soils aged 2–4 ka (ka=thousand years ago) have stage I; middle Holocene soils aged 4–8 ka have strong stage I to stage II carbonate; early Holocene to latest Pleistocene soils aged 8–13 ka have stage II carbonate; late Pleistocene soils aged 20–70 ka have strong stage II to incipient stage III carbonate; late Pleistocene to late middle Pleistocene soils aged 70–200 ka have stage III carbonate; and middle Pleistocene soils aged 300–700 ka have strong stage III carbonate morphology (e.g., fig. 10). It is generally the case that soils on older to ancient surfaces (early Pleistocene to Pliocene) develop progressively stronger, massively indurated carbonate horizons (stages IV, V, and VI) if they are isolated from erosion and if climate change has not been sufficiently humid enough to significantly dissolve previous carbonate accumulation. Such ancient soils are common in the Ivanpah Valley study area (e.g., fig. 11 and fig. 12).

Figure 10. Example of strong stage III carbonate soil horizon in unit Qai. Note varnished clasts on planar surface.

Figure 11. Strong stage IV carbonate in unit Qai. Field book for scale. Note laminar carbonate near surface.

Figure 12. Example of very strongly developed Stage VI soil carbonate horizon in unit QTa/Tay. Note prominent and thick laminar carbonate near bottom of photo.

Figure 13. Extremely strongly developed stage VI carbonate soil in unit Tek, Jean Hills area, clipboard for scale. This is an exceptionally thick and strongly developed soil carbonate horizon by any standard.

Calcic soils can be confused with non-pedogenic accumulations of carbonate (Machette, 1985), including: groundwater carbonates, lacustrine carbonates and/or marine limestones, and hot or cold spring-deposited carbonates (e.g. Machette, 1985; Monger and Adams, 1996). Water concentrated in arroyos can preferentially focus accumulation of carbonate beneath the channel surfaces (Amit et al., 2007). Amit et al. (2007) termed these deposits "Fluvial Pedogenic Units" (FPU). Care must be taken to distinguish FPUs developed in channels from pedogenic calcic soils developed across an entire landform. Additionally, surface runoff, especially over exhumed petrocalcic horizons that have low/no permeability along bottoms of arroyos, can quickly precipitate $CaCO_3$ and produce laminar zones that can resemble pedogenic carbonate of stage IV and V morphology. Care must be taken when examining carbonate along bottoms of arroyos or exposure faces where runoff occurs. This (usually very white, sometimes soft) carbonate is part of a process called case hardening. Significant errors can occur when these features are misinterpreted as morphologic stages. Distinctive characteristics of groundwater carbonates include larger crystalline sizes (spar carbonate as compared to micrite in pedogenic carbonate), grain-to-grain contacts (as compared to pedogenic carbonate that is matrix supported), and a lack of horizonation and morphologic structures (i.e. pisoliths, pendants, calcified roots in pedogenic carbonates) (Machette, 1985).

Evidence for lacustrine or marine environments can be distinguished from pedogenic carbonates by the presence of fossils, and surrounding depositional facies. Hot or cold spring carbonate deposits are often similar to those of groundwater carbonates. In addition, spring deposits tend to be local in their distribution (unlike soil carbonates), and fossil evidence may indicate ponded water.

Desert Pavement Development

The development of stone pavements on abandoned alluvial surfaces is a time-dependent process that is intimately linked with desert soil formation processes (Cooke, 1970; Wells et al., 1985; McFadden et al., 1986; McFadden et al., 1987; Al-Ferraj and Harvey, 2000; Quade, 2001; Anderson et al., 2002; Wood et al., 2005; Valentine and Harrington, 2006; Pelletier et al., 2007; Al-Farraj, 2008; Dixon, 2009; Matmon et al., 2009). Desert, or stone, pavements are inflationary, commonly single-grain, organized layers of gravel that are separated from the original depositional surface by a gravel-free layer of silt. They form as fine aeolian sediment is deposited and translocated downward into surface clast interstices and deposit pore spaces forming a soil Av horizon (McFadden et al., 1998; Anderson et al., 2002). The pavement layer is generally one to two grains thick and overlies a layer of aeolian silt with little or no gravel, which in turn overlies the gravelly parent material (Wells et al., 1985; McFadden et al., 1987). Well-developed desert pavements are remarkable for tight, mosaic-like clast interlocking and overall low roughness. Over time, desert pavements get progressively tighter and more intricately interlocked. As surface pavements age, they also incorporate weathered fragments of parent gravels, and fragments of soil carbonate. The darkness, luster, and continuity of rock varnish also generally increases with increasing age (often best expressed on clasts from silica-rich parent materials). It is critical to note, however, that there is a point in time beyond which desert pavements do not remain stable and well-organized. As paved landforms become progressively older, more deeply dissected, and subject to climatic changes, the pavement can become disrupted or destroyed in a cycle of potentially repeating reformation. This can result in retrograde pavements that incorporate clasts of older, degraded carbonate soils and may even form on relatively steep slopes.

Figure 14. Examples of planar morphology and desert pavement patterns typical of unit Qay$_1$ and Qai. Note moderately strong desert pavement development in each example and slightly protruding gravel bar crests in lower image. Top: Qay; Middle: Qai; Bottom: Qay$_1$.

The processes that form planar surfaces, desert pavements, and rock varnish are polycyclic. As climate varies between wet and dry, abandoned alluvial surfaces progress through similar subaerial processes in each interval. This can include a cycle of pavement formation, aeolian deposition, and soil calcic horizon development that is interrupted by a moist climate regime that leaches materials deeper into the soil and may also be associated with an increase in vegetation density. The once stable surface may be disrupted by the growth and death of multiple generations of vegetation (e.g. Quade, 2001). If the cycle begins again, the disrupted surface will be subjected to a new round of aeolian deposition and pavement formation. In this instance the pavement may include clasts derived from the previously stable soil.

Surface Clast Weathering

Long-term subaerial exposure of abandoned alluvial surfaces can promote the physical weathering of surface clasts by processes of dissolution, disintegration, cracking, and spalling. Prolonged exposure and solar radiation also results in the development of rock varnish on surface gravels, formation of carbonate collars on surface clasts, and reddening of surface clast undersides (Mcfadden et al., 1998; McFadden et al., 2005). Degrees of surface clast weathering and staining by desert varnish are useful map criteria.

In desert areas, dissolution features are common on surface gravels from carbonate source rocks or with carbonate cement. In the Ivanpah Valley area, the most common dissolution forms are pitting and etching of limestone clasts. These clasts have very rough textures, prominent rough-textured micro-karst features, and are often characterized by protruding chert nodules, lenses, and laminae that are not subject to dissolution (fig. 14). The relative depth of etching and the relative relief of resistant inclusions increase with increasing surface age. Some sandstone clasts in the study area exhibit a solution-weathering pattern with a honeycomb texture that resembles raindrop impacts (fig. 15). Clast disintegration is most common in granitic rocks in the study area and may be related to salt-weathering and mineral decomposition. Clast cracking and spalling is characteristic of all rock types in the area to varying extents and may reflect responses to thermal stresses induced by prolonged, diurnal phases of solar heating (McFadden et al., 2005).

Dark staining of surface clasts by the development of rock varnish on exposed surfaces and reddening of clast undersides is a characteristic feature of stable geomorphic surfaces in arid landscapes (fig. 16). Rock, or desert, varnish is a dark, manganese-rich coating that commonly forms on silicic clasts on stable desert landforms and bedrock surfaces. It apparently forms through a complex organo-chemical process that involves dissolution of silica and concurrent incorporation of microbial components (Perry et al., 2006). The extent, darkness, and sheen of desert varnish all have some degree of time-dependence. In the Ivanpah Valley area, weak and discontinuous varnish is evident on relatively young, inactive surfaces, typically on the crest of gravel bars in areas of bar and swale topography; however, varnish is much more distinct and more strongly developed on planar surfaces associated with Pleistocene deposits (fig. 17).

Figure 15. Deeply weathered limestone boulders on Qai surface. Darker, protruding areas are chert lenses and nodules that are not susceptible to chemical dissolution; Unit Qai.

Figure 16. Dissolution pits on large sandstone cobble (upper) and etched furrows on limestone clast (lower). Both examples from Qai surface.

Figure 17. Top: Moderately to darkly varnished granitic gneiss surface clasts in tight desert pavement on unit Qai, Lucy Gray fan. Overturned clast shows strongly reddened bottom surface. Lithology includes volcanics and granitic gneiss. Bottom: Example of split rock fragments on Qai surface. Predominantly granitic gneiss.

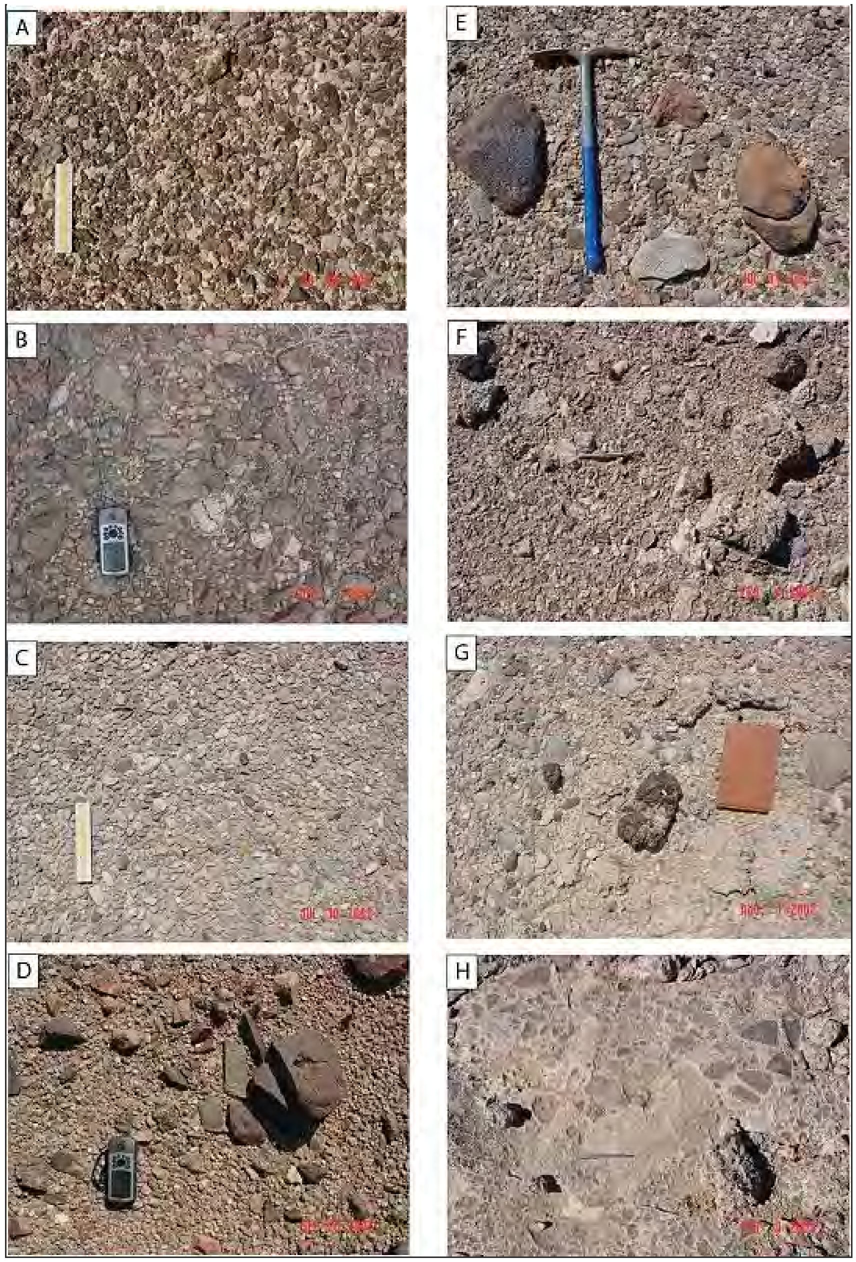


Figure 18. Variability in desert pavements in the study area. A: Qay_1 surface with abundant varnished chert and sandstone gravel; B. Qay; C. Qay_1; D. Qay_1; E. Qai; F. QTa surface with fragments of petrocalcic horizon; G. older Qai surface with calcic pendants and petrocalcic fragments; H. QTa/Tay with exposed petrocalcic horizon.

Descriptions and Examples of Ivanpah Valley Map Units (House et al., 2006)

The principal surficial map units in the study area include three general bedrock types, and various deposits composed of alluvial, colluvial, aeolian, and playa sediments. Some units include combinations of these sediment types. Alluvial deposits constitute the majority of surficial map units in the valley (Table 2. Areal extents and relative percentages of all geologic map units in study area). The following descriptions are slightly expanded from those in House et al. (2006).

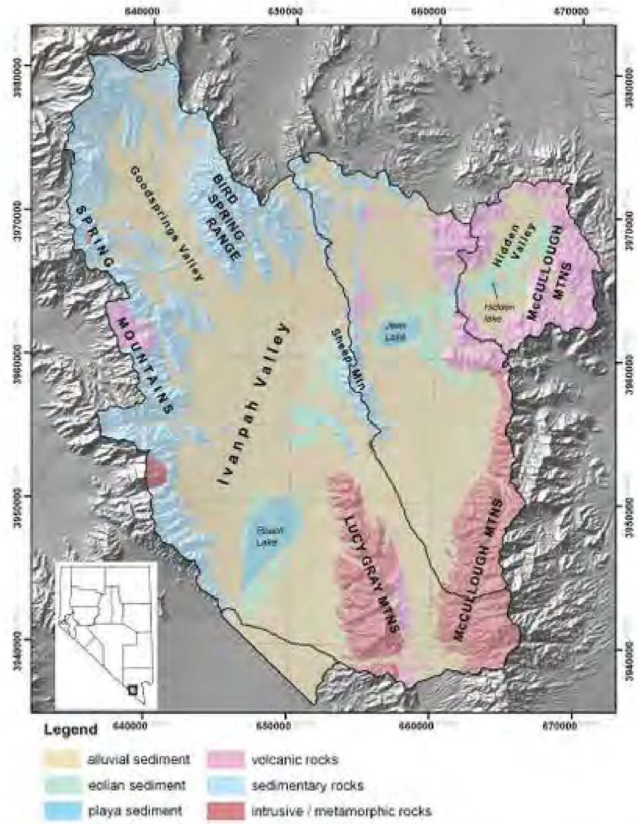


Figure 19. Simplified geologic map of the study area showing the distribution of general surficial units and bedrock types. Basin boundaries are indicated. UTM grid (NAD 83) shown with 10 km spacing.

Statement on Nomenclature

We used a conventional alphanumeric nomenclature for the surficial geologic map units in the Ivanpah Valley area (House et al., 2006). The labels range in length from 2 to 5 characters. The first character represents the geologic period to which the deposit dates: Q, Quaternary; T, Tertiary, Mz, Mesozoic, Pz, Paleozoic; YX, Proterozoic. Combinations of two of these modifiers (listed from youngest to oldest) represent either uncertainty in the age of the deposit (e.g. QT) or intentional generalization of two or more units into one (e.g., MzPzs). The second character in the label indicates the type of deposit: a, alluvium; p, playa sediment; e, aeolian (windblown) sediment; c, colluvial sediment; x, disturbed area. The third character is either a relative age indicator for alluvial deposits (y: young; i: intermediate; and o: old) or a modifier to the previous character indicating a specific context; the latter case was applied in only three instances: Qea, which is a mixed deposit of alluvium overlain by a veneer of aeolian sand; Qcf, which is a composite of colluvium and alluvium that often has a steep fan-like morphology; and Tek, which is an extremely strongly developed, ancient carbonate soil formed in aeolian sediment. Some related unit labels include a fourth, numeric identifier. When a number is present within a suite of related units, it represents their relative depositional order. In other words, the deposit that came earlier has a lower number.

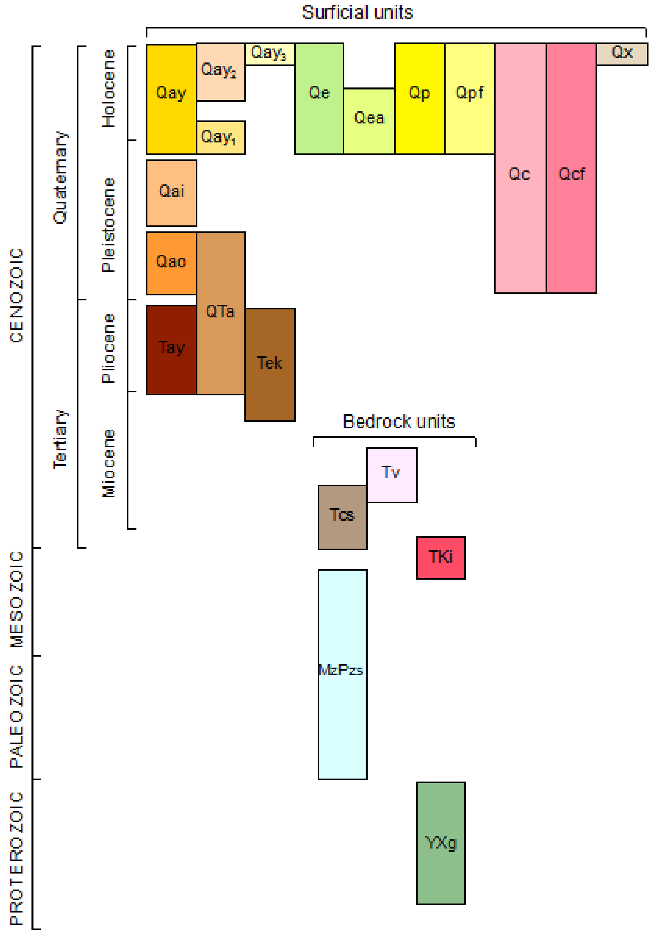


Figure 20. Correlation of map units.

Numbering map units in relation to the order of their deposition is a standard convention in geological mapping, but it is occasionally reversed in surficial mapping efforts. This can lead to confusion. The rationale for a reverse numbering system often appeals to the reasoning that the youngest unit is the easiest to identify and is thus the basis for beginning the numbering sequence. However, this logic is underpinned by an implicit assumption that the resulting map will represent a single point in time (e.g., the date of the most recent base materials used in the mapping or the date of the field work; or, more likely, a combination of each). However, if a surficial geologic map is compiled with the possibility of revision in mind, a numbering scheme based on depositional sequence is arguably a better approach. For example, if there is a significant flooding event in a given area that results in notable and mappable amounts of erosion and deposition, the resulting "new" deposits would be more easily incorporated into a mapping scheme that is based on depositional order. Thus, one school of thought reflects a concern for the possibility of subsequent recognition of older deposits unidentified in the original mapping effort; whereas the scheme used in these maps reflects a concern for accommodating inevitable changes in the future.

Each unit is described below. The descriptions are based on those in House et al., (2006) but are somewhat extended. Each unit type is accompanied by a photograph of a representative example of the unit in the field area.

Anthropogenic Features and Deposits

The study area currently has only minor amounts of anthropogenic disturbance. Some of the features are locally significant, for example: Interstate Highway 15; casino complexes in Jean and Primm, the town of Goodpsrings; various power stations; gravel pits; and miscellaneous cultural features. These features may have important local consequences on runoff amounts and patterns, but overall, the amount of anthropogenic modification in Ivanpah Valley is presently quite small. Significantly expanded development is likely in the future.

Qx Disturbed and modified areas

Figure 21. View looking ESE across the study area toward Sheep Mountain (foreground) and the McCullough Range (background). Hotel-casino structures typical of unit Qx in the valley are evident.

This unit includes areas of extensive anthropogenic disturbance, including: commercial development (hotel casinos, apartments, shopping malls, parking lots, power plants, and similar features, mainly in the areas of Jean and Primm), town sites (Goodsprings), mining operations (quarry and aggregate) and borrow pits, and major transportation corridors (Interstate Highway 15, Union Pacific Railroad). Areas mapped as Qx are either too disrupted or obscured to map them as the original geological deposit.

Playa and Related Deposits

The Ivanpah Valley study area is entirely internally drained. All runoff in the watershed drains to one of four dry lakes (playas): Roach Lake, Jean Lake, Hidden lake (informal name), and Ivanpah Lake. The latter lies almost entirely in California and may receive intermittent runoff from a small part of the map area. The extremely small part of Ivanpah Playa that lies in Nevada is covered by pavement and a casino/shopping mall in Primm, Nevada (unit Qx). The flat playa surfaces are often fringed by a zone of mixed playa, aeolian, and alluvial deposits that mark the transition between the fan-dominated piedmont and the playa. The concentration of aeolian sediment is highest along the north and northeast edges of the playas.

Qp Playa deposits (latest to late Holocene)

Figure 22. South-looking view from near the southern edge of Jean Playa. McCullough and Lucy Gray ranges and Sheep Mountain in the background. Photographer standing on the playa surface which, here, is characterized by widely dispersed fluvial cobbles on flat-lying muds. Light yellow band in middle ground is playa fringe area and green swath beyond is comprised of alluvial fan deposits.

Figure 23. Automobile wreckage on Roach Playa. View looking south toward the southern end of the Spring Mountains. Clark Mountains in the distance.

Playa surfaces in the study area are exceptionally conspicuous features characterized by very light tone, flatness, and location in valley bottoms. They consist of flat-lying deposits of light-gray to tan silt, clay, and minor sand. Fine-grained playa deposits are interfingered with and locally overlain by pebble-cobble gravel and sand along marginal interface with active, distal alluvial surfaces. Morphologically, playas are conspicously planar and flat, with some long wave-length, low-amplitude undulations. Local topography associated with gilgai features include small (few meters) depressions and mounds. Some areas have extensive mudcracks and large desiccation cracks present locally (Neal et al., 1968). Aeolian features are present on some parts of the playas in the form of low linear dunes and discontinuous sand sheets, which are rarely within the main perimeter of the playa landform. Each playa in the study area is characterized by abundant aeolian deposits along their downwind margins (predominantly the north-northeast margins). These aeolian deposits comprise the playa fringe unit on the map.

The soils on these active playa surfaces are characterized by A-Bw-Bk horizons composed of clay loam, and stage I or II carbonate morphology. These areas are active sites of deposition and are inundated frequently with shallow, standing water. Older playa sediments or shoreline features were not found at the surface in the study area.

Qpf Playa fringe deposits (latest Holocene to latest Pleistocene)

Figure 24. Roach Playa fringe. This photo, looking north toward the Bird Spring Range, shows mudcracked silt from recent piedmont runoff onto the playa surface. Darker toned area just beyond the truck is veneer of gravel related to the same runoff event. Light band of vegetation beyond the playa edge marks zone of predominantly aeolian deposits.

The playa fringe unit includes deposits of silt, sand, and gravel along the perimeter of playa surfaces. This unit is comprised of an intricate mixture of aeolian, fluvial, and playa sediments. each of which varies in relative proportion depending on local conditions. and geographic position relative to the playa and prevailing wind directions; aeolian and fluvial sediments are dominant surficial constituents in the map unit. Locally, this unit grades into Qea, Qe, or Qay, and may include some Qay_1. The playa fringe unit is interpreted to represent playa-bajada interface with locally significant aeolian component, particularly along the east and northeast boundaries of playa surfaces. On aerial and remotely sensed imagery, the playa fringe areas are characterized by irregular and diffuse, light-to medium-toned pattern.

Soils on Qpf surfaces are generally characterized by thin (4–15 cm) A horizons composed of loamy sand or sandy loam, that usually overlie a C horizon or a series of horizons belonging to a buried soil. Rarely, a Bk (15 cm thick) horizon containing stage I carbonate morphology can occur beneath the surficial A horizon.

Aeolian Deposits and Related Deposits

Aeolian deposits in Ivanpah Valley consist of unconsolidated deposits of wind-blown sand in the form of sheets, dunes, and ramps. The distribution of aeolian deposits defines a north-northeast trend through the study area that coincides with the distribution of playas. The playas themselves and deposits along the distal ends of alluvial fans are the presumed source of the sand. Thickest deposits of aeolian sand occur upslope of the north-northeast margins of playas. Several aeolian “passes” are present in the study area where the long-term sand transport trend encounters steep, bedrock topography. Most striking among these include parts of the Sheep Mountain and “little” Sheep Mountain areas, the prominent volcanic cliffs to the NE of Jean Lake, and the similar cliffs to the NE of Hidden lake. Correspondingly, much of the western piedmont of Sheep Mountain, the eastern side of Jean Valley, and all but the NW part of Hidden Valley have significant accumulations of aeolian sand.

Overall, the map pattern of aeolian deposits suggests a “causeway” of aeolian transport extending from Ivanpah Lake (just beyond the southern margin of the study area) to the steep bedrock slopes that form the eastern margin of Hidden Valley.

Qe Aeolian sand (latest Holocene to late Pleistocene)

This map unit includes unconsolidated deposits of windblown sand and minor silt. Light tan to light yellow color. Very light tone on aerial imagery. Unit generally corresponds to areas with at least 1 m thick mantles of aeolian sand. Morphology ranges from flat-lying to broadly undular sheets of sand on inactive or rarely active alluvial fan surfaces, sand ramps and falling dunes on steep bedrock slopes (best expressed in the Sheep Mountain and Hidden Valley areas), and small areas of active dunes. These aeolian deposits are relatively easy to discern on remotely sensed imagery because they are relatively light in tone and have a generally smooth appearance. The latter characteristic is particularly pronounced in places where aeolian deposits onlap irregular bedrock exposures and paved and varnished abandoned alluvial fan surfaces.

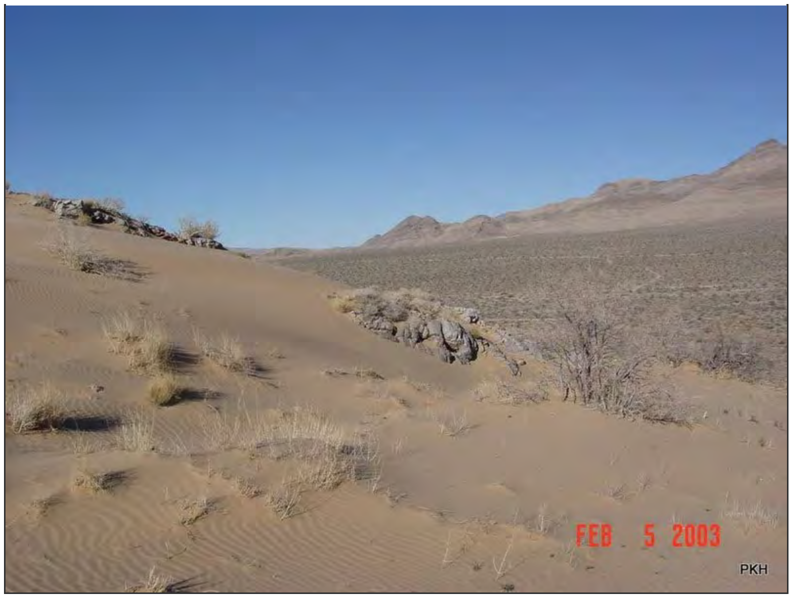


Figure 25. Fresh aeolian sand on crest of small bedrock ridge NE of Roach Playa. View toward Sheep Mountain. Note fresh ripples in sand deposit. Many bedrock outcrops in this area show clear evidence of wind-abrasion.

Figure 26. Thick aeolian deposits in the form of "sand ramps" on the west-facing slopes of a ridge of the McCullough Mountains that encloses Hidden Valley along its western edge.

Soils on Qe surfaces are commonly characterized by A or C horizons overlying B or Bk horizons of variable thickness that most commonly contain little/no carbonate. With increased depth, Bk horizons may contain stage I filaments and, in places, stage II nodules.

Qea Mixed aeolian sand and alluvium (early Holocene to middle Holocene)

Figure 27. Typical aeolian sand sheets in the field area.

This map unit is predominantly comprised of sand "sheets" or really extensive veneers of aeolian sand that range up to approximately 1.0 m thick.

and mantle inactive alluvial fan surfaces (mainly Qay_1 and Qai surfaces in this case, although older surfaces are commonly mantled with Qe). These deposits commonly mantle inactive to infrequently active alluvial surfaces located between playa surfaces and areas of active dunes or ramps on hillslopes.

The Qea surfaces are distinct from the Qe surfaces in most cases, although their boundaries are gradational. In particular, Qea surfaces host a distinctly higher vegetation density, and are commonly mantled with a thin (~single-grain) veneer of subangular fluvial gravel. Where present on unit Qea, the surface gravel lag is commonly separated from the underlying alluvial gravel by up to 1 m of aeolian sand with dispersed, sparse pebbles. The surface gravel lag is generally loose and dispersed but grades upfan/upslope into moderate to strongly developed gravel pavements in some locations. The loose gravel lag may be an inflationary veneer or thin alluvial veneer, or both. Landscape position of this unit suggests that it represents burial of Qay_1 surfaces by a significant early to early-middle Holocene episode of aeolian deposition (e.g., McDonald et al., 2003). Unit Qea is more extensive than mapped, but is only divided in areas where aeolian sand component is strongly evident in remote imagery and where field examination indicates thickness of aeolian mantle in excess of 75 cm. Soils on Qea surfaces are very similar to those associated with Qe surfaces.

Tek Ancient petrocalcic soil remnants (Pliocene to late Miocene)

Figure 28. Typical outcrop of unit Tek.

This map unit includes a small number of exposures of of relatively flat-lying, massively indurated layers of soil carbonate on bedrock surfaces. This conspicuous deposit was first recognized and mapped as a separate unit by Kohl (1978). The Tek surfaces that were identified in central Ivanpah Valley are characterized by variably eroded (i.e., from deeply etched to brecciated), thick stage VI petrocalcic horizons developed in deposits of aeolian sand and silt overlying bedrock. During our investigation, we identified Tek-like surfaces overlying alluvial gravels in parts of the Bird Spring Range.

The highest concentration of Tek outcrops in the study area corresponds to zones of persistent and long term flux of aeolian sediment, mainly in and around the perimeter of Hidden Valley and the hills northeast of Jean (the Jean "hills"). Tek also caps relatively flat-lying volcanic rocks in the hills that flank the west side of Hidden Valley. These massive petrocalcic horizons are characterized by intervals of multiple cross-cutting laminae that can be up to 12 cm thick, pisoliths (often vertically elongated), and ooids. Where present, one or more of the following horizons may overlie the stage VI petrocalcic horizon: C (recent aeolian sediment of variable thickness), Av (4+ cm thick), and Bk (31+ cm thick) containing stage I, II, or incipient III carbonate morphology. In best exposures, Tek petrocalcic horizons are up to 4–5 m thick. Tek surfaces express a very light tone on aerial imagery.

Hillslope Deposits

In the study area, mapped hillslope deposits include weakly to strongly consolidated deposits of angular and subangular gravel on steep bedrock hillslopes. Locally may include disaggregated mantles of weathered bedrock, but is more commonly associated with gravity-driven accumulations of coarse gravelly talus below steep bedrock cliffs and gravels forming small, steeply sloping debris fans. In many cases, the latter type exhibits morphology and sorting consistent with debris flow processes. These deposits were not mapped to the level of detail applied to alluvial and aeolian deposits and they are certainly more extensive than shown on the map.

Qc Colluvium (latest Holocene to Pleistocene)

Figure 29. Unit Qc is most common in areas of cliff-forming sedimentary rocks in the field area. This photo is from near the Bird Spring area.

This is an undivided map unit comprised of coarse, poorly sorted deposits of angular and subangular boulder-to pebble-gravel on steep bedrock slopes. It is particularly common in small mountain-front embayments and below steep bedrock cliffs. Colluvial deposits may include irregular mantles of weathered and disaggregated rock on steep bedrock slopes, small debris cones/alluvial fans in small drainages, and areas of thick accumulations of angular gravel (talus) below steep bedrock cliffs. Overall, this unit was mapped sparingly with emphasis only on the most extensive deposits and those easiest to discern on aerial imagery. It is expected that colluvial deposits are very extensive in the mountains in the map area, but are impractical to map in detail. Unit age varies widely from Recent to early(?) Pleistocene. Surface clasts vary from weakly to very strongly varnished, pavements rarely present, soil calcic horizon development varies from minimal to strongly developed stage III to IV.

Qcf Colluvium and debris fans (latest Holocene to Pleistocene)

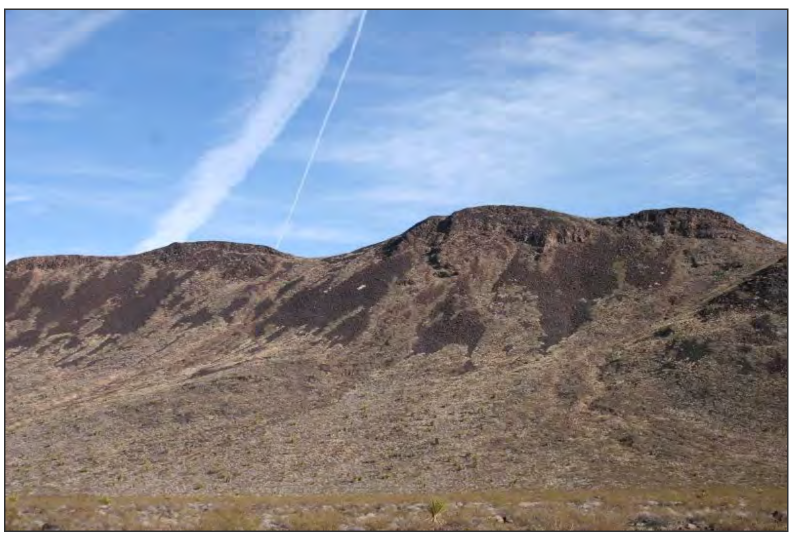


Figure 30. Typical expression of unit Qcf as mapped in the study area in the Northern McCullough Mtn area. The map unit is commonly a mix of talus, colluvium, and small bouldery debris fans.

This is a mixed map unit comprised of coarse gravel deposits of slope wash, debris fans, and minor talus on steep bedrock slopes. The “f” in the designation indicates that the unit includes small, steep, alluvial fan or debris fan deposits composed of angular to subangular boulders and cobbles. These are particularly common on steep bedrock slopes formed in mafic volcanic rocks in the northeast part (i.e., Hidden Valley) of the study area. The surface morphology of this unit is variable, but generally rugged or irregular. It can be characterized by block fields, debris cones, small debris fans, or debris flow levee complexes. Unit age probably varies widely as well. Surface clasts are weakly to very strongly varnished, pavements are rare, soil calcic horizon development varies from minimal to strongly developed stage III to IV.

Alluvial Deposits

The most extensive class of surficial deposits in the study area is comprised of active and relict alluvial fan and ephemeral wash surfaces and their related sedimentary deposits. Alluvial deposits make up over 50% of the map area. Washes include alluvial fan feeder channels, well-defined axial streams, and channels in stable distributary flow networks. Alluvial fans include extensive areas of downstream branching, unstable distributary flow networks, broad areas that convey relatively shallow swaths of unconfined flows, and areas of intricately braided washes. In many cases, active washes and fans are intricately interrelated or gradational, so no effort has been made to separate them on the map.

Collectively, these features have been formed, intermittently occupied, and abandoned by active fluvial processes for approximately the last 4 to 5 million years. However, most of the deposits date to the Quaternary Period, which spans the last 2.6 million years. The majority of ancient and recent alluvial deposits examined in the field were deposited by streamflow processes. Deposits related to debris flow processes were observed in some areas (described below) but are far less common and rarely extend much below the mountain fronts. Alluvial fan and wash deposits form the bulk of the piedmont areas below mountains and hills in the study area. Correspondingly, clast compositions of the alluvial deposits reflect the primary source lithologies as follows: Spring Mountains (predominantly Mesozoic and Paleozoic carbonate and siliciclastic rocks with minor volcanic and intrusive rocks below Table Mountain and Devils Peak, respectively), the Bird Spring Range (predominantly Mesozoic and Paleozoic carbonate and siliciclastic rocks with minor volcanic rocks and Tertiary gravels), the McCullough Mountains (predominantly granite and gneiss with minor volcanic rocks in the south part; and predominantly volcanic rocks in the north part), and the Lucy Gray Mountains (predominantly granite and gneiss with minor amount of volcanic rocks). Alluvial fans are also present below principal drainages that head in the Sheep Mountain area (Paleozoic carbonate and siliciclastic rocks, minor Proterozoic granite and gneiss), and the Jean hills (informal name; Tertiary volcanic rocks and polylithic gravels).

Alluvial fan and wash deposits are composed predominantly of massive to moderately sorted, moderately to well stratified sands and gravels ranging from pebbles to boulders. Clast diameter generally increases with proximity to highland source areas. Notably boulder-rich deposits, often linked to debris flow deposition, are present near and within the interior parts of the major mountain ranges in the study area and are particularly common on alluvial fans fed by high-relief source areas with extensive outcrops of volcanic or granitic rocks. Older alluvial units are generally coarser grained than younger ones, but this may reflect the fact that the upper and middle parts of the associated alluvial fans are best preserved. In all deposits, the constituent clasts are subangular and moderately sorted, and they are crudely to moderately stratified. Degree of consolidation increases markedly with deposit age and ranges from very weak to very strong.

The study area, like most of the Mojave Desert, exhibits an array of alluvial deposits of widely varying ages. Alluvial fans of different ages on the map were distinguished on the basis of a suite of surficial and morphologic characteristics discussed earlier including these: topographic position; degree of dissection and nature of surface drainage pattern (e.g., tributary or distributary); alteration of original depositional morphology evident as progressive smoothing of surface morphology over time; development of gravel pavement; degree of chemical and physical weathering of surface clasts; and soil horizon development, particularly carbonate morphology (e.g., Gile et al., 1981; Birkeland, 1999; Bull, 1991; Christenson and Purcell, 1985; Machette, 1985).

Qay Young alluvium, undivided (latest Holocene to latest Pleistocene)

This is the undivided class of young alluvial deposits. It is comprised of predominantly coarse-grained alluvial fan and wash deposits from principal drainages in the Spring, Bird Spring, McCullough, and Lucy Gray Mountains and various local sources. The latter may include remnants of high-standing and incised older alluvial deposits. The unit is typically composed of subangular sandy pebble-cobble gravel with lesser amounts of sand and silty sand (relative proportions vary with nature of and proximity to source area). Deposits are generally crudely to moderately stratified. Boulder-gravels are common in upslope parts of Qay deposits in high-relief mountain interior and mountain front areas. In several of these cases there is strong local evidence for debris flow processes.

Surface and soil characteristics of Qay deposits depend strongly on relative age and frequency of fluvial activity. Surface morphology ranges from high relief, with fresh bar and channel forms reflecting original depositional morphology, to progressively more subdued bar and swale forms, to planar surfaces. Surface clast weathering ranges from nil to moderate varnish and carbonate clast etching. Well-developed gravel pavements present only in oldest subunit surfaces (Qay_1). Relatively weak, loose pavements may be present in swales on surfaces of younger subunits. Associated soils range from nil to weak development of Bw and Bk horizons (up to stage 2 Bk in Qay_1).

Qay_3 Youngest active alluvium (Recent to late Holocene)

Figure 31. The active channel of Roach Wash, the principal axial drainage at the north end of Roach Lake. Fresh fluvial bedforms and bar features are obvious.

Active wash and alluvial fan deposits of poorly to moderately sorted gravel, sand, and minor silt. Fresh bar and channel morphology, relatively low density of vegetation, easily visible on aerial photographs and satellite imagery due to high albedo of fresh sand and gravel. Alluvial fan surfaces have obvious and complex distributary flow patterns, and broad, sheet-like gravelly areas with few obvious channels. Active washes are well-defined and range from single channels with low flanking terraces, to braided channels interspersed with gravel bars.

Figure 32. Boulder deposit in unit Qay_3.

Figure 33. Typical active ephemeral wash in unit Qay_3.

Active surfaces (modern) to latest Holocene with little to no carbonate morphology, often contain buried soil horizons. Characterized by C or Av horizons overlying Bw/Bk or buried Bk horizons. Vesicular A horizons vary from 1 to 8 cm thick and overlie either Bw (8–23 cm thick) or Bk (10–95 cm thick) horizons containing very slight carbonate coats underneath clasts. Surface clasts are minimally weathered and unvarnished.

Qay_2 Young, active and recently abandoned alluvial surfaces (Late Holocene)

Figure 34. Typical Qay_2 surface showing muted but obvious depositional topography and weakly weathered surface clasts.

This division of Qay includes intermittently active surfaces that flank and grade laterally from Qay_3 surfaces and a group of somewhat older abandoned surfaces that are interpreted as morphologically and chronologically intermediate between Qay_1 and Qay_3.

The surface morphology of this unit shows some modification of original depositional topography and ranges from bar-and-swale to subdued bar-and-swale, often interspersed with semi-stable distributary channel networks. Surface clast weathering ranges from slight to moderate varnish and minor carbonate clast etching. Gravel pavements relatively sparse, but may be weakly to moderately developed in some swales. Distributary flow pattern clear on high-resolution satellite imagery and aerial photos, but tone can vary from bright white to dark gray depending on source lithology, vegetation density, and presence of biologic crust which is locally common.

Various mechanisms of the separation of this unit from Qay_3 are plausible. In some cases, the presence of large tracts of Qay_2 are related to hiatus in fluvial deposition associated with shifts in major alluvial fan feeder channels and little topographic separation is present between the two map units. In other cases, incision or deepening of a principal feeder channel has isolated large tracts of fans from active fluvial processes.

The Qay_2 surface dates in the range of latest to middle-late Holocene (<5 to possibly 7 ka). The underlying soil is characterized by Bk horizons with weak to strong stage I carbonate morphology. A horizons (1–9 cm thick) commonly occur in granitic parent materials near Lucy Gray and McCullough Mountains. Elsewhere Av (4–5 cm thick) horizons overlie either Bw (4–10 cm) or Bk (2–111 cm) horizons. Unit is largely unconsolidated. Somewhat more consolidated, buried soils are commonly present at depth. The geologic map does not differentiate deposits in that particular circumstance for practical reasons and for map clarity.

Qay_1 Youngest inactive alluvial surface (early Holocene to latest Pleistocene)

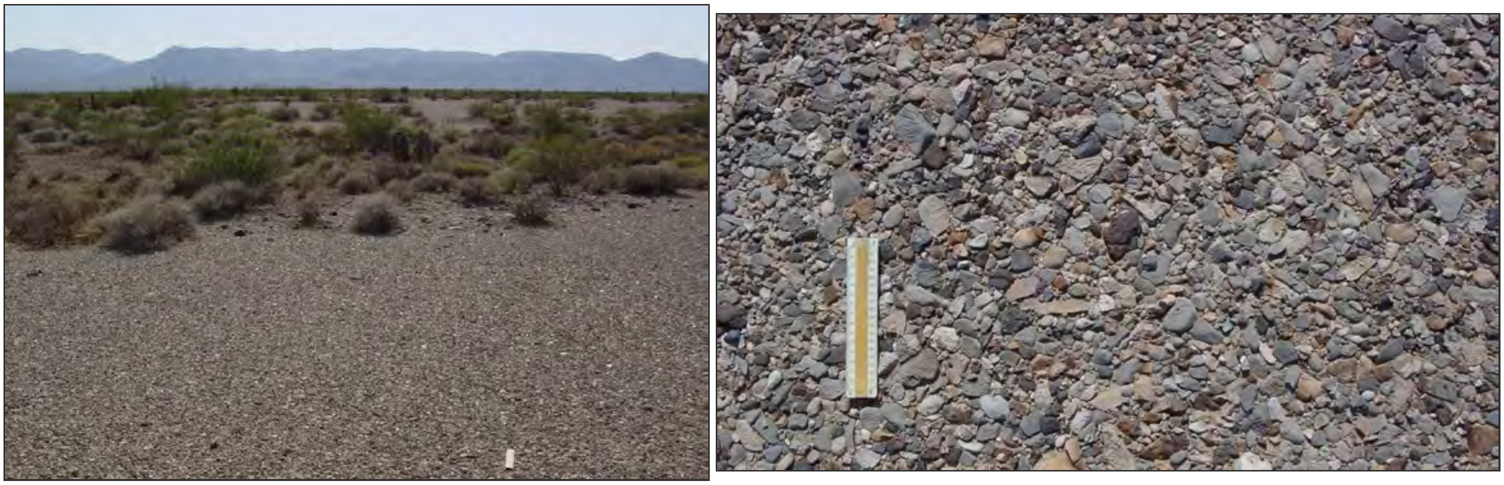


Figure 35. Typical distal Qay_1 surface showing flat pavement with moderately interlocking surface clasts.

This is an extensive and distinctive unit in the study area and throughout the region. It is composed of the youngest series of inactive alluvial fan surfaces that have well-developed planar morphology. This unit is also distinctive for exhibiting moderate to strongly developed desert pavement, and moderate to dark (less typical) rock varnish. Minor etching of carbonate clasts is also common on Qay_1 surfaces. The unit exhibits a distinctive aerial photograph pattern that is characterized by a "trellis" or "alligator skin" appearance expressed as lighter-toned roughly rectangular areas with gravel pavement separated by roughly rectilinear pattern of vegetation bands and active, incised channels. This pattern occurs on older, planar remnants (Qai) but is more typical of Qay_1.

The Qay_1 surface is an early Holocene-latest Pleistocene (7–15 ka) surface characterized by stage II carbonate morphology, and in granitic parent materials, argillic horizons. A or Av horizons (2–8 cm thick) overlie Bw (8–31 cm thick), Bt (8–18 cm thick), and/or Bk (10–61 cm thick) horizons. Bk horizons may contain strong stage I carbonate morphology, but more commonly display stage II carbonate morphology. Argillic horizons contain clay cutans on sand grains.

Qai Intermediate alluvium, undivided (middle to late Pleistocene)

Figure 36. Typical medial Qai surface remnant showing flat surface with moderate to tightly interlocking pavement and strongly weathered clasts.

Deposits and surfaces of relict, inactive alluvial fans. Undivided unit includes up to three subunits that are locally divisible on basis of slight differences in soil carbonate horizon development and topographic position (the latter characteristic is only easily discerned where subunits are adjacent to one another). Overall, surface characteristics of the various subunits are very similar in imagery and in the field. Thus, consistent division is difficult without extensive field work. Qai surfaces are distinctly planar with strongly developed gravel pavement and dark to very dark varnish on surface clasts of siliceous composition. Many surface clasts are strongly weathered. Deeply etched and pitted carbonate clasts; and split, shattered, and disaggregated clasts of crystalline rocks, where present, are common. Surface drainage has tributary pattern and depth of channel incision generally ranges from 2 to 5 m.

Qai deposits are moderately to strongly consolidated. Soil development ranges from stage III to incipient stage IV carbonate morphology. The youngest subunit within Qai is possibly as young as late Pleistocene (30–75 ka), the older and more widespread subunit(s) are likely late-middle Pleistocene (75–300 ka). Typical Qai soils are characterized by stage III to incipient stage IV petrocalcic carbonate morphology. A/Av/Avk horizons (1–7 cm thick) overlie Bw (8–10 cm thick); Btk (occurs in granitic alluvium only, 77 cm thick); Bk (20–89 cm thick), and/or Bkm (20–197 cm thick) horizons. Carbonate morphology increases with depth. Bk horizons display strong stage I to stage II carbonate morphology and overlie stage III Bkm petrocalcic horizons.

Qao Old alluvium, (middle to early Pleistocene)

Deposits and surfaces of very old alluvial fans remnants. Typically characterized by concordant to discordant, weakly to moderately crowned surface remnants separated by deeply (3–6 m) dissected tributary drainage networks. Surface clasts include moderately to deeply weathered fluvial pebble and cobble and sparse boulder gravels; abundant angular clasts derived from petrocalcic horizons; exposed mantle of aeolian silt locally common. Abundant surface carbonate litter results in somewhat lighter to much lighter tone in aerial photographs and satellite imagery than Qai and Qay_1 surfaces.

Figure 37. Typical Qao surface showing variably paved surface composed of abundant petrocalcic chips and darkly varnished rock fragments.

Soils characterized by strongly developed, thick, stage IV to V petrocalcic horizons. A/Av/Avk (1–8 cm thick) overlies either Btk (9–39 cm thick) or Bk (16–38 cm thick) horizons that display stage I–II carbonate morphology. Btk horizons occur in granitic parent materials in the southeast part of the study area and contain well developed clay coats and clay bridges between sand grains. The underlying, strongly indurated, Bkm horizon (50+ cm thick) is characterized by a laminar cap <1 cm thick.

QTa Old alluvium, undivided (early Pleistocene to late Miocene(?))

Figure 38. Eroded, ridge-like remnant of QTa showing deeply weathered clasts and retrograde pavement on moderate to steep slopes.

Deposits and surfaces of very old to ancient alluvial fan remnants, includes undivided Qao and Tay (see below). Deposits consist predominantly of subangular to subrounded gravel. Surface morphology ranges from deeply dissected ridge-and-ravine topography with roughly concordant ridge crests to isolated ballenas with discordant ridge crests. Deeply dissected areas with well preserved petrocalcic horizons may locally exhibit planar topography where eroded to the petrocalcic horizon. Surface clasts include deeply weathered fluvial pebble to cobble gravel, large angular clasts of disaggregated petrocalcic soil horizon(s), and abundant small angular clasts of soil carbonate litter in an extensive surficial matrix of calcareous silt. Gravel pavements rare except locally on surface crests and side slopes where they are interpreted as retrograde features. QTa deposits overlie well-exposed bedrock erosion surfaces in some upper piedmont areas. Carbonate litter and exposure of intact indurated carbonate horizons imparts light tone to surface in aerial photographs and satellite imagery.

Soils characterized by strongly developed stage IV, V, or VI petrocalcic horizons. Commonly, the overlying horizons have been eroded exposing the petrocalcic horizon at the surface. The high variability in carbonate morphology is a result of deflation of the surface, which leads to the erosion of the morphologic features (esp. thickness of laminar cap) that define stages IV, V, or VI carbonate morphology. Where exposed, the petrocalcic horizon can be 2+ m thick. Where overlying horizons are present, one or more of the following are observed: A (2–8 cm thick), Bw (15–17 cm thick), Bt (25 cm thick) in granitic parent materials, and Bk (20–29 cm thick) containing stage I and II carbonate morphology.

Tay Ancient alluvium (Pliocene to late Miocene(?))

Figure 39. Typical outcrop and surface expression of Tay showing very strongly cemented carbonate horizon.

Deposits and surfaces of ancient alluvial fans. Deposits consist predominantly of subangular to subrounded gravel. Unit surface is characterized by strongly developed stage VI petrocalcic horizons developed in coarse alluvium. Commonly, the overlying soil horizons are eroded, leaving a surficial rubble layer of broken petrocalcic fragments and exposing the petrocalcic horizon at the surface. The petrocalcic horizons are characterized by multiple crosscutting laminae that can be up to 15 cm thick, multiple pisoliths, and ooids (often concentrated in 1- to 3-mm-thick zones within laminar layers). Where overlying horizons are present, one or more of the following may be present: C (recent aeolian sediment), Av, and/or Bk (containing stage I, or II) horizons of variable thickness. Where fully exposed, Tay petrocalcic horizons can be 3+ m thick. Unit has very light tone in aerial photographs and satellite imagery.

Many (most?) exposures of Tay remnants are located in areas of deep dissection, and the relict surfaces occur as relatively high-standing features. The typical remnant occurs as a mesa-like feature capped with a layer of strongly carbonate-cemented alluvium that overlies an eroded bedrock surface.

Bedrock Units

The surficial geologic map shows only principal bedrock units divided on the basis of major lithologic characteristics, including the following: Middle Miocene siliciclastic sedimentary rocks (conglomerate, sandstone, and minor mudstone); Mesozoic and Paleozoic sedimentary rocks (carbonate and siliciclastic, undivided); Miocene volcanic rocks (undivided rhyolite, andesite, and basalt); Miocene to Cretaceous silicic intrusive rocks; and Proterozoic crystalline basement rocks (granite, quartz monzonite, and granitic gneiss, undivided). No structure or individual formations are shown. Previously published bedrock maps showing bedrock structure and individual formations in this study area are cited in each general category below. The contacts between surficial geologic units and bedrock units were developed with high-resolution imagery and field reconnaissance in the compilation of this map and may not exactly coincide with contacts in the previously published maps.

Tv Volcanic rocks, undivided (middle to late? Miocene)

Includes numerous volcanic rock units ranging in composition from basalt to rhyolite (Bingler and Bonham, 1972; Bridwell, 1991; Hewett, 1931, 1956; Kohl, 1978;). Extensive exposures occur in the Hidden Valley, Jean hills, and Table Mountain areas. Smaller outcrops overlie Tao in the Bird Spring Range and in the upper piedmont of the McCullough Mountains. Minor Tv outcrops occur on the upper piedmont of the southern Spring Mountains. Also of note is a stratum of subrounded pebbles of pumice and obsidian in a fine-grained, white, ashy(?) matrix that crops out along the east side of the wash that transects the Jean hills.

Tao Middle (?) Miocene sediments

Deposits of subrounded to rounded, coarse-grained fluvial gravels (up to large boulders) and minor lithic sandstone and mudstone. Clast composition includes abundant subrounded to well-rounded quartzite clasts, which are uncommon in all younger alluvial deposits in the study area (the "early gravels" of Hewett, 1931). Gravels are generally clast-supported, moderately sorted to well sorted, well bedded, and commonly tilted and crossed by small faults. Relict Tao deposits are commonly associated with well-developed, high-standing ballena landforms that are characterized by highly degraded, possibly multiple petrocalcic soils with relict stage III or greater carbonate morphology. A series of Tao ballenas north of Jean define a distinctly linear trend that may be fault controlled. A large Tao outcrop to the immediate northwest of Goodsprings exhibits a thick, tilted sequence of Tao that contains a substantial thickness (>5 m) of carbonate-cemented gravel.

Tao gravels rest unconformably on Mesozoic and Paleozoic sedimentary rocks (MzPzs) and are overlain by a sequence of middle Miocene volcanic rocks (Tv). This relation was first noted in the Jean area by Kohl (1978) and is particularly well expressed in the ridges north of Jean. In a deep wash cut through the hills northeast of Jean (informally named the "Jean hills"), a sequence of lithic sandstone, pebble conglomerate, and minor mudstone are included in Tao. The fine-grained deposits have only been noted in small outcrops there and in a small area at the foot of the southern Spring Mountains in the State Line Pass quadrangle. The stratigraphic relation between the fine-grained and coarse-grained deposits is unresolved. In the Jean hills, there is a thin volcanic sequence containing pebble- to cobble-sized clasts of pumice and obsidian in an apparent interbedded relationship with Tao sediments.

TKi Intrusive igneous rocks (middle Miocene to Cretaceous)

Undivided unit includes fine-grained rhyolite plug comprising Devils Peak and coarsely porphyritic granite intrusions north and west of Goodsprings

(Hewett, 1931; Carr and Pinkston, 1987).

MzPzs Sedimentary rocks, undivided (Mesozoic to Paleozoic)

Includes numerous carbonate (limestone and dolomite) and siliciclastic (sandstone, mudstone, and conglomerate) rock units spanning the Paleozoic and Mesozoic. Composite unit is locally folded and is extensively cut by a series of major thrust faults and younger normal faults (Burchfiel, et al., 1974; Hewett, 1931, 1956; Longwell et al., 1965; Carr and Pinkston, 1987; Garside et al., 2009). These rocks form the bulk of the Spring Mountains, Bird Spring Range, and Sheep Mountain.

YXg Crystalline basement rocks (Proterozoic)

Includes granite, granite gneiss, granitic augen gneiss, and quartz monzonite. These rocks form the bulk of the Lucy Gray Mountains, and the south range of the McCullough Mountains (Bingler and Bonham, 1972; DeWitt et al., 1989). Unconformable onlap of MzPzs rocks (the “Great Unconformity”) is exposed in a few locations along the base of the the south and southwest face of Sheep Mountain.

Table 2. Areal extents and relative percentages of all geologic map units in study area.

Map Unit	Area, mi^2	% of map	% of class	
Bedrock	**150.89**	**39.02%**	**100.00%**	
MzPzs	75.83	19.61%		50.25%
Tv	30.61	7.92%		20.29%
Yxg	40.05	10.36%		26.54%
Tki	1.21	0.31%		0.80%
Tao	2.56	0.66%		1.70%
Tek	0.63	0.16%		0.42%
Alluvium	**209.03**	**54.06%**	**100.00%**	
Qay	9.45	2.44%		4.52%
Qay_3	76.03	19.66%		36.37%
Qay_2	28.73	7.43%		13.74%
Qay_1	38.76	10.02%		18.54%
Qai	29.46	7.62%		14.09%
Qao	10.75	2.78%		5.14%
QTa	13.89	3.59%		6.65%
Tay	0.84	0.22%		0.40%
Qc	0.56	0.15%		0.37%
Qcf	0.56	0.14%		0.37%
Aeolian	**15.28**	**3.95%**	**100.00%**	
Qe	2.75	0.71%		18.00%
Qea	9.98	2.58%		65.30%
Playa	**7.22**	**1.87%**	**100.00%**	
Qp	7.22	1.87%		100.00%
Qpf	2.55	0.66%		35.37%
Disturbed				
Qx	4.26	1%		100%

Age Estimates of the Surficial Units

We estimated the ages of surficial map units in the Ivanpah Valley study area by comparing our observations to those reported from studies in similar settings in the same general region. For example, soils in the Ivanpah study area are correlative to those found on alluvial fans below the Spring Mountains and the Sheep Range in the general vicinity of Las Vegas and Pahrump, NV (Sowers et al., 1988; Bell et al., 1998, 1999; Page et al., 2005). The parent materials for alluvial fans in these areas are quite similar to most of the Ivanpah map area (predominantly Mesozoic and

Paleozoic sedimentary rocks), and they were presumably subject to the same general climate throughout the Quaternary. Other study areas located in the larger general region include the Silver Lake and Providence Mountain areas in the central Mohave Desert south of Ivanpah Valley (McDonald et al., 2003; Wells et al., 1987; Reheis et al., 1989; Harden et al., 1991); and the vicinity of the Nevada Test Site, north of the Ivanpah Valley area (Taylor, 1986; Harden et al., 1991; Peterson et al., 1995).

Las Vegas and Pahrump Valleys

Kyle Canyon is a major drainage in the Spring Mountains west-northwest of Las Vegas. A large alluvial fan complex associated with Kyle Canyon on the eastern piedmont of the range has been the site of several geological investigations. Sowers et al. (1988) and Reheis et al. (1992) describe four geomorphic surfaces (Surfaces 1–4) on the Kyle Canyon alluvial fan. Bell et al. (1998) use the same units for mapping the alluvial fan but subdivide Surface 3 into 3a and 3b on the basis of inset relations and differences in soil development where applicable. Soil carbonate descriptions vary somewhat among studies for the same units (Sowers et al., 1988; Reheis et al., 1992; Harden et al., 1991; Bell et al., 1998). Sowers et al. (1988) used U-Th (uranium series), ^{14}C, and paleomagnetism to estimate soil ages. Their reported U-Th ages are minima for several reasons, including that the analyses focused on inner rinds of carbonate pendants, which were later found to often contain some of the youngest laminae (Brock and Buck, 2005).

Kyle Canyon Surface 4 (Sowers et al., 1988) and unit Qa of Bell et al. (1998) comprise active alluvial surfaces with little to no soil development; the corresponding unit in the Ivanpah Valley study area is Qay_3. Unit Q4 of Bell et al. (1998) is a less frequently active to recently abandoned surface. Thus, it is a slightly older part of the undivided unit Q4 of Sowers et al. (1988), and it overlaps in age with parts of Ivanpah units Qay_3 and Qay_2.

Surface 3 in the Kyle Canyon area occupies a stratigraphic position between active and recently abandoned surfaces of middle-late Holocene age and long-abandoned stable surfaces with strongly developed soils and weathered surfaces of Pleistocene age. Kyle Canyon Surface 3 corresponds primarily to Ivanpah unit Qay_1 and, possibly, younger parts of undivided Ivanpah unit Qai. Soil descriptions for Kyle Canyon Surface 3 vary among authors. It contains pedogenic carbonate morphology that has been described as ranging from stage I to stage III (Sowers et al., 1988; Bell et al., 1998; Harden et al., 1991;). Bell et al. (1998) subdivide this unit into Qsp3b (younger) and Qap3a (older) based on inset relations and slight differences in surface morphology and soil development evident in some areas. This subdivision corresponds with the division between Qay_1 and younger parts of Qai in the Ivanpah Valley area.

Several absolute dating methods have been applied to material within this unit and results vary from 76 ka (Uranium-series dating of pendants) to 4 ka (organic ^{14}C) (Sowers et al., 1988). Several ^{14}C dates of pedogenic carbonate range between 10–15 ka (Sowers et al., 1988). Bell et al. (1998, 1999) report that Q3b deposits overlie fine-grained axial valley deposits that date to between 9 and 12 ka, early Holocene to Latest Pleistocene. Descriptions of strong stage II to stage III carbonate morphology in upper piedmont parts of Surface 3 in Kyle Canyon (Sowers et al., 1988) and unit Qsp3a of Bell et al. (1998) are similar to younger parts of undivided Ivanpah unit Qai. Descriptions of surface morphology comparison to Sowers et al., (1988) and Bell et al., (1998) suggest that the younger parts of undivided Ivanpah unit Qai are late Pleistocene.

Surface 2 in Kyle Canyon is characterized by a stage IV petrocalcic horizon that is in many places, eroded with petrocalcic fragments littering the surface (Sowers et al., 1988; Bell et al., 1998). These characteristics closely correlate to Ivanpah map unit Qao and possibly older parts of undivided unit Qai. Sowers et al., (1988) have averaged U-Th dates of 129 ka; ^{14}C $CaCO_3$ date of 34 ka; and ^{14}C org date of 18 ka. Paleomagnetic data on the petrocalcic horizon of Surface 2 suggest that it is <730 ka. This surface, then, has a reasonably firm middle Pleistocene age.

Sowers et al., (1988) describe Surface 1 as comprised of deeply dissected, discordant, rounded fan remnants (ballenas) littered with petrocalcic soil fragments and underlain by stage IV petrocalcic horizon. Bell et al. (1998) describe this same unit as having a 3 to 5 m thick stage V petrocalcic horizon. The soil development in this unit and the general morphology most closely correlates to Ivanpah map unit Qao, and some QTa surfaces. Kyle Canyon Surface 1 has U-Th dates on pendant inner-rinds that vary between 88 and >350 ka; and paleomagnetic data that indicate an age >730 ka (Sowers et al., 1988). The strongly developed petrocalcic soils in Ivanpah units Qao and QTa suggest ages more closely in line with the paleomagnetic data: middle to early Pleistocene.

Page et al. (2005) compiled existing and new mapping of surficial deposits in the Las Vegas and Pahrump Valleys and report new mineral luminescence, ^{14}C, and U-series age estimates on Quaternary deposits. Their alluvial fan units (Qay, Qayy, Qayo, Qaiy, Qai, Qao, and QTa) can be correlated to Ivanpah map units. Page et al. (2005) use stages of pedogenic carbonate accumulation to describe their alluvial map units. In the Las Vegas and Pahrump Valleys, map unit Qayy encompasses soils that range from little/no development in modern arroyos to those that contain stage I–II pedogenic carbonate. This map unit best corresponds to map units Qay_3 and Qay_2 (stage I) in the Ivanpah Valley. Although both of these units contain a lower stage of carbonate morphology (none-stage I) as compared to that described for Qayy (stage I–II), other geomorphic characteristics support this correlation.

Page et al. (2005) map unit Qay contains stage I–II pedogenic carbonate and overlies deposits near that date to between 8 and 12 ka. This unit correlates to portions of Ivanpah map units Qay_2 (stage I carbonate), and Qay_1 (stage II carbonate). Deposits of Qayo are described has also having stage I–II carbonate morphology and locally overlie deposits dated to 10–16 ka (Page et al., 2005). Qayo is interpreted to be early Holocene-latest Pleistocene and correlates with Qay_1 (stage II) in Ivanpah Valley. Younger intermediate fan alluvium (Qaiy) in the Las Vegas and Pahrump areas are defined by stage II to IV carbonate morphology. Qaiy is correlated to Qfiy on Fortymile Wash, Nevada, which has been dated between 25 to 40 ka (Lundstrom et al., 1999). This unit most closely corresponds to the undivided Ivanpah map unit Qai, which has strong stage II to incipient stage III carbonate morphology and is interpreted to be late Pleistocene in age.

Page et al. (2005) map unit Qai is described as having stage II to IV carbonate morphology; a thermoluminescence date of 100–120 ka; it corresponds to undivided Ivanpah map unit Qai, which typically has stage III carbonate development. The next older unit, Qao, is characterized by a stage IV petrocalcic horizon that in many places is partially eroded leaving carbonate fragments as clasts on the surface. Qao is interpreted to be Pleistocene in age, and in part contains deposits of middle and late Pleistocene age (Page et al., 2005). Qao corresponds to the map unit of the same designation, Qao, in Ivanpah Valley. Their oldest alluvial unit, QTa contains a stage IV petrocalcic horizon, but has evidence of significant erosion. This indicates that the deposit is older than the extant surface. This unit correlates to units QTa, Tek, Tay, and possibly Tao(?) in the Ivanpah Valley area.

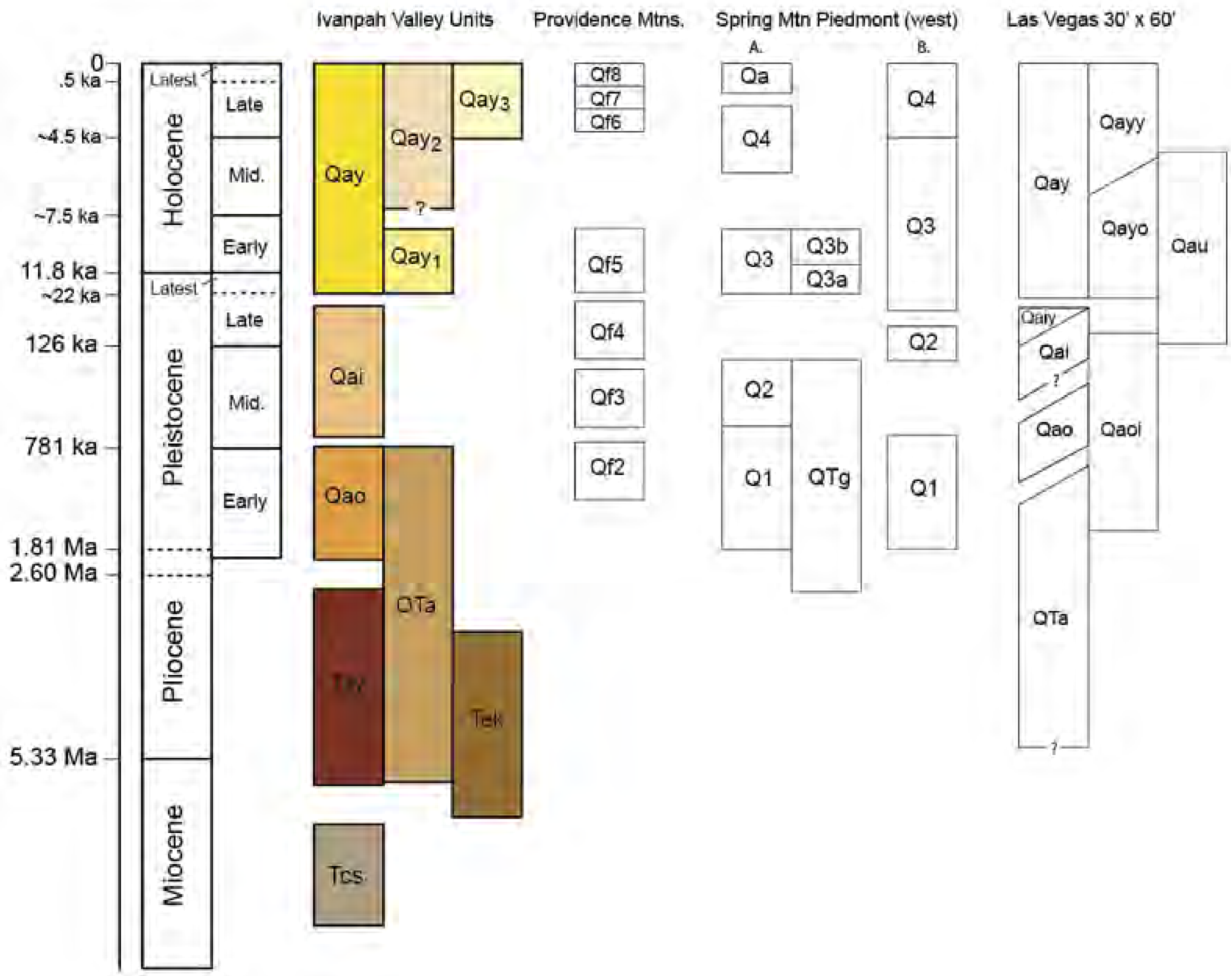


Figure 40. Comparison of Ivanpah Valley alluvial units to piedmont alluvial chronologies reported from proximate sites in the Mohave Desert. Providence Mountain data from McDonald et al., 2003; Spring Mountain piedmont data from: A. Bell et al., 1997, 1998; B. Sowers et al., 1988; Las Vegas 30' x 60', Page et al., 2005. Ages and representative durations in individual units are, in part, approximated. Geologic time scale based on USGS and ICS.

Eastern Mohave Desert

McDonald et al. (2003) described soils and summarized a variety of age estimates for seven Quaternary surficial alluvial units and three related aeolian units on the piedmont of the Providence Mountains, which lie south of Ivanpah Valley (Qf8, Qf7, Qe3, Qf6, Qe2, Qf5, Qe1, Qf4, Qf3, and Qf2). Their reported age estimates are based on IRSL and ^{14}C analysis and modeling. Their unit Qf8 is active alluvium and corresponds to Ivanpah unit Qay_3. Their unit Qf7 has stage I soil carbonate and a radiocarbon age range of approximately 4.4 to 5.9 ka. This unit correlates to Ivanpah unit Qay_2 and younger parts of Qay. A related aeolian unit (Qe_3) has a reported IRSL age of 4.3 ka.

McDonald et al. (2003) unit Qf6 has stage I to II carbonate, a generally weak pavement, and an estimated radiocarbon age range of approximately 4 to 6.2 ka. We also correlate this to Ivanpah unit Qay_2 and parts of Qay. Unit Qf5 from the Providence Mountains area is characterized by a stage II to III carbonate soil, and moderate to strong pavement; it has a reported age range of approximately 10 to 22 ka And correlates to Ivanpah unit Qay_1 and, possibly, younger parts of Qai. Providence Mountains piedmont Units Qf4, Qf3, and Qf2 have strong stage III, stage IV, and stage V carbonate soils, respectively (McDonald et al., 2003) and correlate to Ivanpah units Qai, Qao, and QTa/Tay.

Nevada Test Site Vicinity

Taylor (1986) and Harden et al. (1991) described alluvial units and soils near Fortymile Wash, NV, east of Yucca Mountain. Peterson et al., (1995) described seven surficial units in nearby Crater Flat, southern Nevada (Q1a, Q1b, Q1c, Q2a, Q2b, Q2c, QTa). Based on soil characteristics, the following correlations can be made to surficial units in Ivanpah Valley: Q1a and Q1b contain little (weak stage I) to no pedogenic carbonate and are correlated to Qay_3. Q1c contains weak stage I (Peterson et al., 1995) to stage II carbonate morphology (Harden et al., 1991) and is correlated to Qay_2 (stage I; for Crater Flat) or Qay_1 (stage II; for Fortymile Wash). Q2a soils at Crater Flat can be correlated to Qay_1, although Qay_1 surfaces in Ivanpah have a greater carbonate morphology than those described at Crater Flat (Peterson et al., 1995). This may be due to the influence of more carbonate parent material, or carbonate-containing dust input in Ivanpah as compared to Crater Flat. It is believed that most of the carbonate in the Crater Flat soils is derived from aeolian deposition (Pendall et al., 1994; Vaniman et al., 1994; Reheis, 1999). Soils forming on geomorphic surfaces older than Qay_2 have carbonate morphologies significantly greater than those found in similar geomorphic positions in Crater Flat (Q2b, Q2c). These surfaces may correlate to Qai or possibly Qao in Fortymile Wash. Harden et al., (1991) report U-Th ages for Q2b that range between 120–170 ka. Unit Q2c contains three different soils, which have similar characteristics to Qai soils in Ivanpah Valley. Peterson et al., (1995) interpret Q2c as 270-800 ka, which is consistent with a late to middle Pleistocene age for Ivanpah Qai and younger Qao units. Harden et al. (1991) report U-Th ages for Q2c of 240–340 ka and < 440 ka. Crater Flat QTa contains an eroded, 3 m-thick stage IV petrocalcic horizon, which is similar to soil development in Qao and QTa surfaces in Ivanpah. Peterson et al., (1995) interpret their QTa unit as possibly spanning 110 ka to 2.0 Ma. Ivanpah Qao and QTa units are interpreted to be <700 ka to 5+(?) Ma.

Mormon Mesa Area

None of the aforementioned studies describe soils with massive, thick, stage VI carbonate horizons that characterize units Tay and Tek in the Ivanpah Valley study area. To our knowledge, the strongest regional corollary for these soils occurs on Mormon Mesa. Mormon Mesa is located approximately ~100 km north of Las Vegas, Nevada along the I-15 corridor between the towns of Moapa, Overton and Mesquite. It is a flat-topped mesa that extends north and south around the Mormon Mountains, ending in a point near Overton. The mesa extends approximately 198 m above the Virgin River on the east, and the Muddy River and Meadow Valley Wash on the west. Mormon Mesa is unique because it is capped by a ~3 to 4-m thick stage VI petrocalcic soil that has developed on Tertiary sediments of the Muddy Creek Formation. The initiation of soil formation on Mormon Mesa is believed to have begun when the lower Colorado River drainage system formed approx. 5.4 Ma (Williams, 1996; House et al., 2005, 2008; Brock and Buck, 2009).

Stage VI petrocalcic horizons in Ivanpah may be of similar or even older age. Map unit Tek is characterized by a stage VI petrocalcic horizon that has formed in aeolian sediments deposited upon basalt. Therefore, sediment deposition and soil development could have been initiated shortly after the cessation of volcanic activity. The great degree of induration of these petrocalcic horizons, coupled with continued episodic aeolian deposition (during multiple interglacial periods? or even earlier), has led to their preservation. The brecciation features diagnostic of stage VI petrocalcic horizons form from repeated cycles of erosion of overlying unconsolidated soil horizons, exposing and fragmenting portions of the petrocalcic horizon, followed by sedimentation (usually aeolian in these topographically high landforms), and reburial of the petrocalcic horizons and associated fragments (see Brock and Buck, 2009). Soil carbonate continues to accumulate and re-cements these jumbled pieces (Bachman and Machette, 1977). This process may occur multiple times, resulting in very thick, brecciated, stage VI petrocalcic horizons (Brock and Buck, 2009). In addition, the degree of each successive erosion event will control the resulting stage of carbonate development. Brecciation features in stage VI petrocalcic horizons in southern Nevada generally occur in the upper <50 cm (Brock and Buck, 2006). This indicates that previous erosion and re-cementation events have affected only the upper portion of the indurated petrocalcic horizon, and in many cases have built it upward, increasing its thickness with time. However, if erosion is severe, then the evidence of stage VI development can be erased, leaving the underlying indurated portion of the petrocalcic horizon that may only be classified as stage III. Evidence for a former stage VI petrocalcic horizon may thus only be preserved in the remaining petrocalcic fragments that litter the surface. Therefore, Tek, Tay, and portions of QTa that contain intact, thick, stage VI petrocalcic horizons may represent surfaces that are several millions of years old, and perhaps even older than Mormon Mesa.

Flood Hazard Interpretation of the Geologic Map

The geologic map (House et al., 2006) is translated into a relative flood hazard map in House (2007). This map shows a direct reclassification of the surficial geologic units into a series of relative flood hazard classes based on surface age, stability, morphology, and landscape position. A series of maps (House, 2006b through 2006h) show the same reclassification on composite 1:24,000-scale topographic base maps (fig. 20). The former map is provided for perspective on the distribution of flood hazards in the entire study area and the latter series provides detail of the entire area. The maps show the same data, only at different scales[1]. Evaluation of the GIS data set for the maps obviates the need to view on the map-by-map basis shown in the figure, but users may find the paper maps useful.

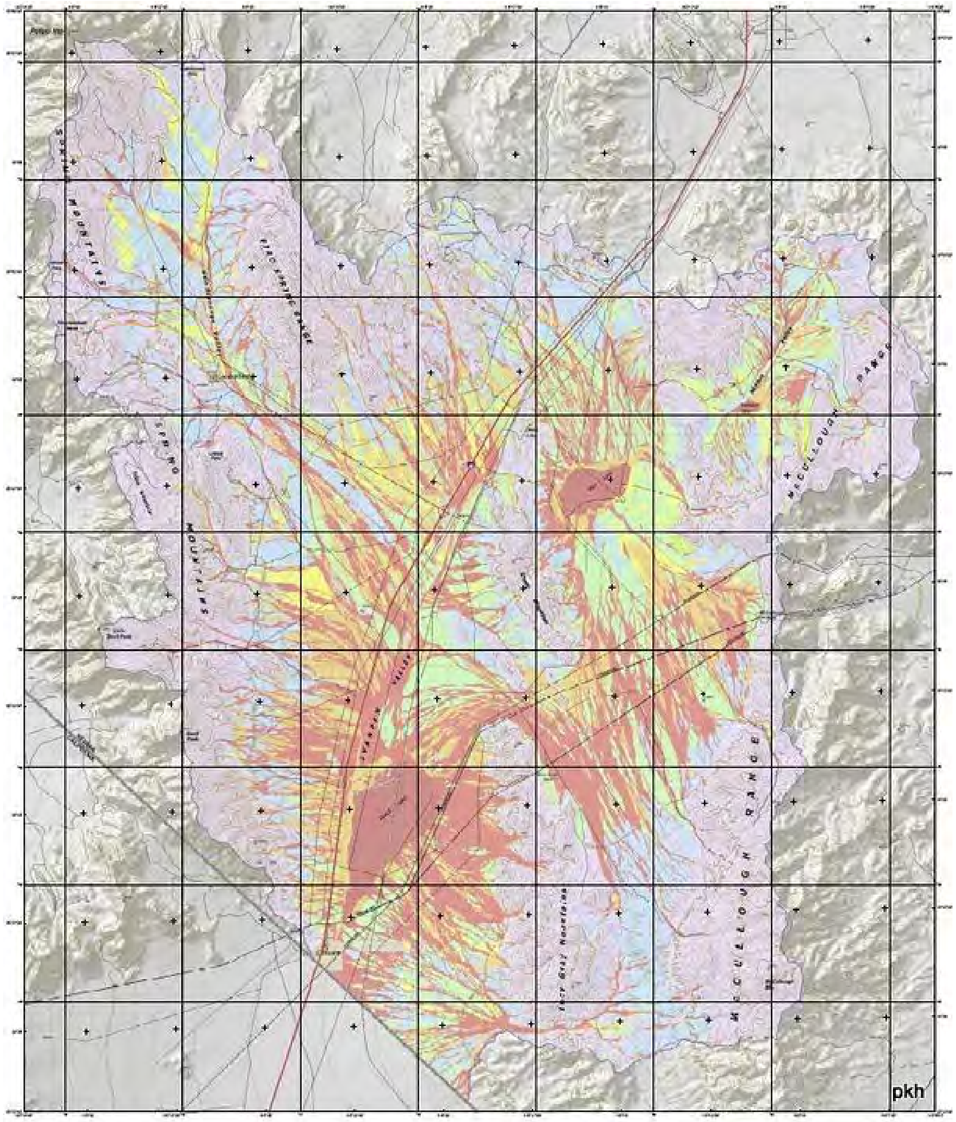


Figure 41. Relative flood hazard map of the Ivanpah Valley study area.

Download Flood Hazard Map:

Full Size Hard Copy Version(.pdf) **Google Earth Version**(.kmz)

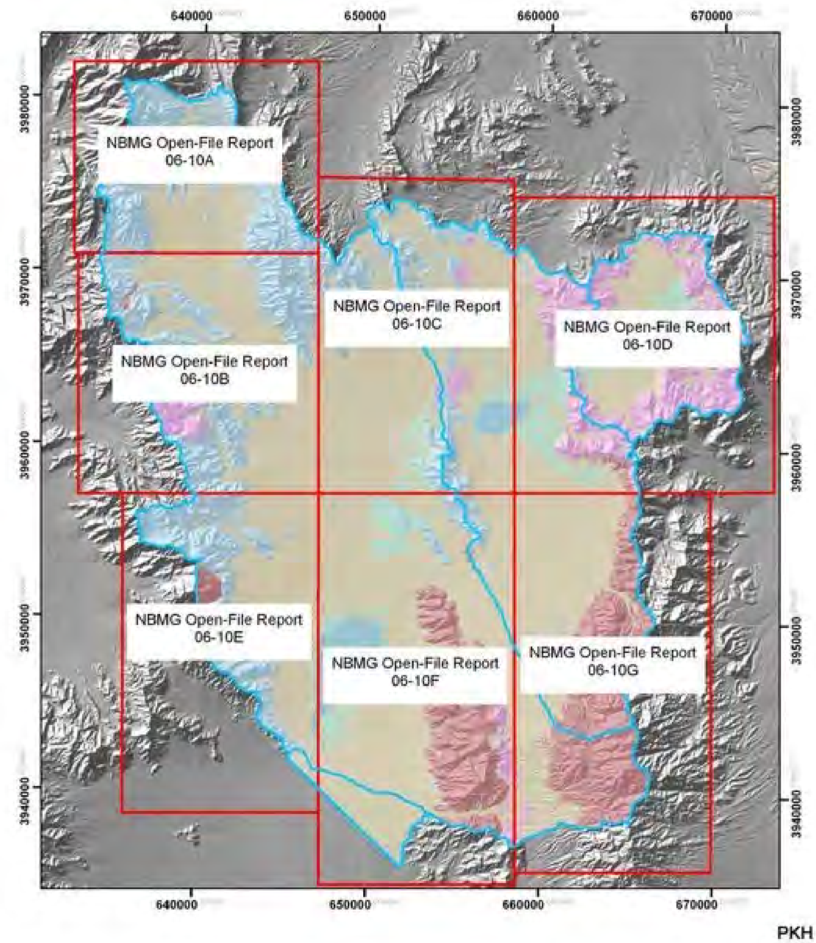


Figure 42. Areal extents of the series of 1:24,000-scale flood hazard maps.

The flood hazard classes are decidedly qualitative and are not intended to explicitly represent or supplant administrative or regulatory flood zone boundaries. They do not have specific implications of flow depths and velocities which often form the basis for actuarial assessments of flood insurance requirements, for example. The hazard zones depict the loci and spatial extent of flood hazards as inferred from geologic evidence of relative flow frequency and vigor; and surface stability and landform type (see House, 2005 for detailed discussion of this concept). Each classification represents a composite of physical properties related to surface age, stability, and geomorphic position that form the basis of the geologic map. Derivation of the relative flood hazard map is based upon the concept that the recent geologic history of the study area has direct influence on the distribution of flooding.

The classification scheme represents a cautiously conservative interpretation of the geologic evidence pertaining to surface stability. In general, all Holocene deposits (except for aeolian deposits, Qe) have been assigned to a flood hazard class greater than “very low”, including surfaces that have very likely been isolated from flooding for more than 7–10 thousand years This division is based on the fact that the suite of active Holocene-aged alluvial surfaces (Qay_3, Qay_2, and parts of Qay) have physical characteristics that are very distinct from all inactive surfaces in the study area (Qai, Qao, QTa, and Taf). Unit Qay_1, on the other hand, though morphologically quite distinct from younger units, is assigned a “low” hazard classification for reasons explained below.

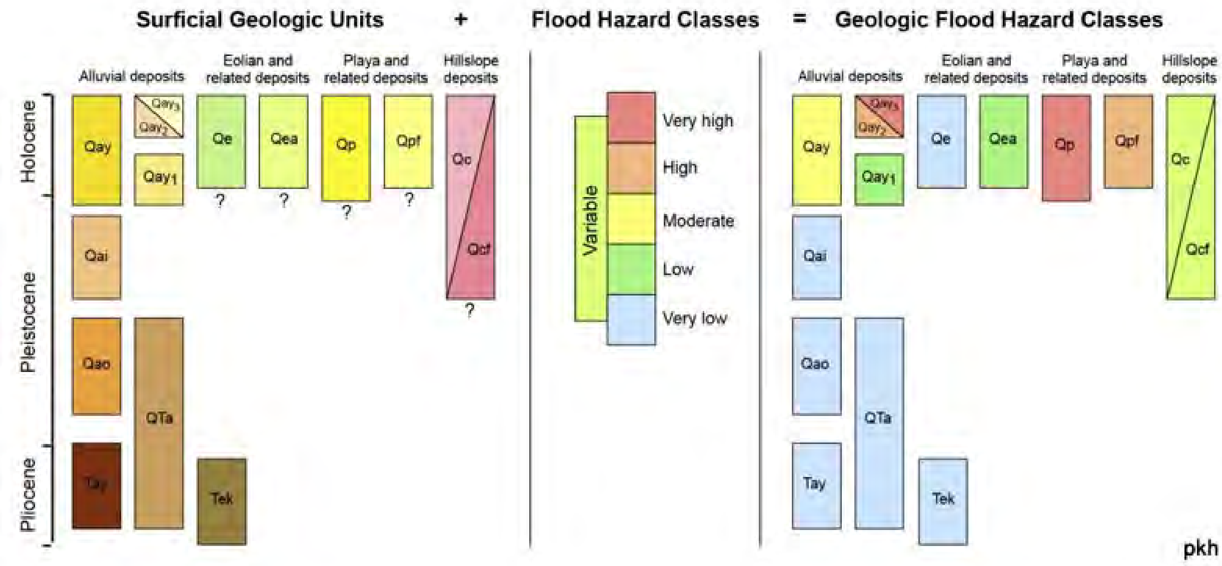


Figure 43. Simple relationship between geologic map units and relative flood hazard classes.

The NRC panel on alluvial fan flooding suggests that a conservative standard of distinguishing active from inactive alluvial fans is the chronologic boundary between the Pleistocene and the Holocene (in the range of 10,000 to 11,800 years ago). This time-boundary relates to a major shift in climate from glacial to interglacial, which had a profound effect on alluvial fan development that is clearly reflected in the geology of desert piedmonts in the southwest US. Unit Qay_1 has distinctive surface properties that indicate prolonged stability (planar morphology, moderately tight desert pavement; moderate to dark varnish on siliceous clasts); but existing evidence suggests that its period of activity straddles the Pleistocene–Holocene boundary. Correlative alluvial units described in other studies in the general region of the Ivanpah Valley area have been dated to between about 7500 and 24,000 years (e.g., Bell et al., 1998; Sowers et al., 1986; Page et al., 2005), and the episode of accelerated deposition of aeolian dust that contributed strongly to the development of the unit's distinctive surface morphology may have ended as recently as 5000–4500 years ago (Anderson et al., 2002; McDonald et al., 2003; McFadden et al., 1998).

The age of Qay_1 extends into the Holocene, and its associated alluvial surfaces are locally only shallowly incised by active surfaces (as little as 0.5 to 3 m, depending on local conditions and piedmont position). Therefore, this surface has been classified as having a "low" flood hazard status. This reflects a cautiously conservative characterization intended to indicate that those areas are not unequivocally free from flood hazards. However, it is clear that they have been free from active alluvial processes (i.e. flooding) for more than 5000 years and, as such, they may be relatively easy areas in which to mitigate potential flood hazards. It is notable that the Qay_1 surfaces on the lower parts of the piedmont (i.e. closer to the center of the valley) are only shallowly incised and more vulnerable to overflow from active channels than they are higher on the piedmont (closer to the mountains) where incision is deeper and isolation is stronger.

The flood hazard map (House, 2006a) is a direct derivative of the geologic map (House et al., 2006), which was compiled at scales of at least 1:10,000-scale and, locally, up to 1:4,500-scale. The scale of 1:24,000 is a general standard for most geologic maps at NBMG, and a series of map panels (House, 2006b through 2006h) have been prepared at this scale. The digital data that accompany the maps can be viewed at greater scales, but 1:10,000-scale should be considered the reasonable limit based on the overall range of scales used in the compilation.

Relative flood hazard classes

Very high (geologic units Qay_3 and Qp)

Areas of the most frequent and concentrated runoff including well-defined active channels; broad, gravelly, and sparsely vegetated zones of intricate distributary flow networks on active alluvial fans; alluvial fan feeder channels; local trunk drainages; and terminal playas. Processes include high-velocity, channelized flow and high-velocity sheetflow on piedmont drainages and playa perimeters. Channel boundaries and positions are generally unstable and may shift considerably during and between large flows. Central playa areas are subject to extensive, shallow inundation on a regular basis. Playa perimeters are subject to flooding from the toes of adjacent, active alluvial fans and channels. Processes of sediment erosion, transport, and deposition in these areas are vigorous and involve particle sizes ranging from coarse gravel (boulders and cobbles) to sand and silt. Corresponding surface morphology includes prominent alluvial channels, fresh gravel bars, and relatively flat gravel sheets in broad distributary flow areas and playa-fan interface areas. Gravel pavements, rock varnish, and soil development are absent or weak on surfaces in this class. Geologic deposits and surfaces in this class are latest Holocene to late Holocene in age (0 to approximately 4000 years).

Washes and fans draining high-relief parts the Lucy Gray Range, the McCullough Range (northern and southern parts), and parts of the southern Spring Mountains (in particular the Table Mountain and Potosi Mountain areas) are characterized by boulder-rich flood and debris flow deposits. Elsewhere in the study area, debris flows and boulder-rich flood deposits are typically restricted to tributary washes and fans draining high-relief mountain interior or mountain areas.

Geologic evidence indicates that areas in this hazard class convey dangerous floods most frequently and thus pose a very significant floodplain management concern.

High (geologic units Qay_2 and Qpf)

Areas subject to relatively frequent, concentrated to widespread runoff. This class is commonly adjacent to and linked with areas mapped in the preceding class. It includes large areas of diffuse "very high" hazard-type zones too intricate to divide. This class includes active and intermittently active alluvial fan areas, low channel-bounding terraces, and parts of playa perimeters. Class includes areas that are vulnerable to overflow and reoccupation by active channel networks. Sediment characteristics similar to areas mapped in “very high” hazard class. These areas have a high potential to convey flow during large floods because of their proximity to highly active alluvial surfaces and because their relatively young age and low relief precludes a lower hazard determination. Channel and flow-swath boundaries and positions are generally unstable. Morphology characterized by relatively fresh bar and channel to slightly weathered bar and swale complexes; relatively flat-lying terrace surfaces adjacent to active channels, and relatively flat gravel sheets in playa fringe areas. Gravel pavements are rare but may be present on inclusions of small, older surface remnants and locally in low-lying swales. Light rock varnish may be present on siliceous surface clasts. Soil development ranges from none to weak. Yellowish-brown cambic horizon (Bw) and stage 1 calcic horizon (Bk) may be present in some areas. Geologic deposits in this class range from latest Holocene to at least late Holocene (0 to approximately 4000 years).

Geologic evidence indicates that areas in this class have high potential to convey dangerous flows during large flood events. They pose a significant floodplain management concern. A cautiously conservative interpretation of the flood hazard classes would group this class with the preceding one.

Moderate (geologic unit Qay)

Areas characterized by an intricate mixture of highly active alluvial surfaces with intermittently active or recently abandoned alluvial surfaces and small, dispersed remnants of stable alluvial surfaces. This zone includes active and recently abandoned (last 100 to few 1000s of years) alluvial surfaces, distal areas of overflow from active surfaces, and some infrequently active alluvial surfaces fed by small drainage areas. It includes stable distributary flow networks and areas of shallow sheetflow. Classification does not preclude hazardous condition but only indicates that flow is generally less frequent, less intense, less recently occurring, or that the distribution of different geologic units is too fine to map at this scale. Channel boundaries and positions range from moderately stable to unstable. Morphological characteristics include weathered bar and swale complexes with muted topography and light to moderate varnish and weathering of surface clasts; class also includes shallowly dissected remnants of older, stable surfaces interspersed among stable distributary flow networks. Classification represents a composite characteristic within the mapped areas, but may not adequately represent conditions in specific sub-areas. A more cautious interpretation of this class would upgrade it to “high.” Depending on local conditions, these areas may not convey flow, even during particularly large floods. In high relief areas, they may be subject to debris flow. Geologic deposits and surfaces in this class span an age range from latest Holocene to latest Pleistocene (0 to approximately 14,000 years; House et al., 2006).

Geologic evidence indicates that this class has moderate but variable potential to convey dangerous flow during large floods. It poses a definite floodplain management concern. A very cautiously conservative interpretation of the flood hazard classes would group this class with the preceding one(s). For this reason, we have chosen not to include it with the “variable” category.

Low (geologic units Qay_1 and Qea)

Areas of stable alluvial surfaces that have been largely excluded from active alluvial fan processes for at least 5000 years. Members of this class, however, are linked too closely in space and time with areas in the high and moderate classes to assert that they are unequivocally not flood hazardous. Alluvial surfaces in this class exhibit strongly planar surfaces with moderate to strong gravel pavement development and moderately to darkly varnished surface clasts. Surface clasts of carbonate rocks are weakly to moderately etched, otherwise clast weathering is minor. Soil development associated with these surfaces is characterized by strong Av and Bw horizons and stage 1 to 2 Bk horizon development.

This class also includes broad areas of planar alluvial fan surfaces that are downwind from playas and mantled with at least 0.75 m of windblown sand that is commonly overlain by a thin and loose gravel lag. The preponderance of aeolian materials on these surfaces indicates the general absence of active alluvial fan processes. This type of feature is particularly widespread in Hidden Valley and along the north and east sides of Jean, Roach, and Ivanpah lakes. Soil development on the sand-mantled surfaces is minimal and characterized by weak cambic (Bw) and calcic (Bk stage 1) horizons.

Surface morphology, soil development, and relations to regional studies strongly suggest that surfaces in this class have not been subject to alluvial fan processes for at least the last 5000 and more likely the last 7000 to 8000 years. Flood hazards in this class are not significant except locally where members are adjacent to major active channels or where they are crossed by incised, active channels. In these areas (particularly along their lateral and upslope margins in middle and lower reaches of major fan complexes) shallow to moderate overflow or lateral erosion may be relevant concerns. Geologic deposits and surfaces in this class range in age from early Holocene to latest Pleistocene (ca. 8000 to at least 14,000 years). Based on regional comparisons described previously, it is unlikely that surfaces in this class are younger than 5000 years.

This class represents a notably lower floodplain management concern than preceding ones. They are locally vulnerable to overflow and lateral erosion.

Very Low (geologic units Qai, Qao, QTa, Tay, Qe)

This class includes geologic deposits and surfaces that do not experience alluvial fan flooding. It includes thick, actively accumulating mantles of aeolian sand and ancient, moderately to very strongly carbonate-cemented relict alluvial surfaces that have been free from active alluvial fan processes for 10,000s to 1,000,000s of years. In some cases, surfaces included in this class are so high-standing as to very obviously preclude alluvial fan flood hazards, but even the lowest-lying members exhibit surface morphology and soil development characteristics that are consistent with extremely long periods of stability, including the following: planar surface remnants with tight, darkly varnished gravel pavements that may include abundant clasts of calcrete litter; moderately to deeply weathered surface clasts (etching, pitting, and splitting); deeply furrowed planar to weakly convex surface remnants with exposed calcic soil horizons; high-standing, deeply incised fan remnants with retrograde gravel pavements on surface and sideslopes; and high-standing planar ridges underlain by massive petrocalcic soils up to 3 m thick. Aeolian features included in this class include locally thick accumulations of sand on ancient fan and bedrock surfaces, thick sand ramps that overlie steep mountain-front slopes, and some small areas of dunes.

This class does not represent a significant floodplain management concern.

Variable (geologic units Qc and Qcf)

Small areas that may have special hazardous conditions that are not linked to alluvial fan/piedmont flood hazards. This includes mixed colluvial gravel and debris flow deposits on steeply sloping hillslopes and variably active talus piles and colluvial debris cones below steep bedrock cliffs. The former situation is common on steep slopes in volcanic rocks of the McCullough Range in the Hidden Valley area, and below Table Mountain in the Southern Spring Mountains. The latter situation is mainly present in parts of the Bird Spring and Spring Mountain Ranges where steep bedrock cliffs are common. These types of units (mainly the latter type) were mapped sparingly throughout the area where they were easily distinguished on aerial photographs and other imagery.

Members of this class represent special situations and should be evaluated on an individual basis. They comprise a very small part of the map area and are often in rugged and remote settings.

Indeterminate (geologic unit Qx)

Areas that have been extensively modified by excavation; artificial fill; or commercial or industrial development. Flood hazards in these areas cannot be reasonably assessed on the basis of geologic evidence. This class includes Interstate Highway 15, the Union Pacific railroad right-of-way, borrow pits and mining operations, and developed areas in Goodsprings, Jean (including the Jean Airport and the correctional facility), and Primm.

This class represents a special situation. It may locally represent a significant floodplain management concern, but large tracts of it are obviously not flood prone.

Unmapped (geologic units Tek, Tao, TKi, Tv, MzPzs, YXg)

Areas mapped as bedrock by House et al. (2006). Locally includes small areas of active and inactive alluvial surfaces, colluvium, and minor amounts of aeolian sediment. Significant flood and debris flow hazards exist in narrow bedrock canyons and steep slopes in these areas but are too small to map. Extremely rugged topography in most bedrock areas limits, but may not always preclude potential for future commercial and suburban development.

This class may locally represent a floodplain management concern, but very large tracts of it are neither flood prone nor readily accessible.

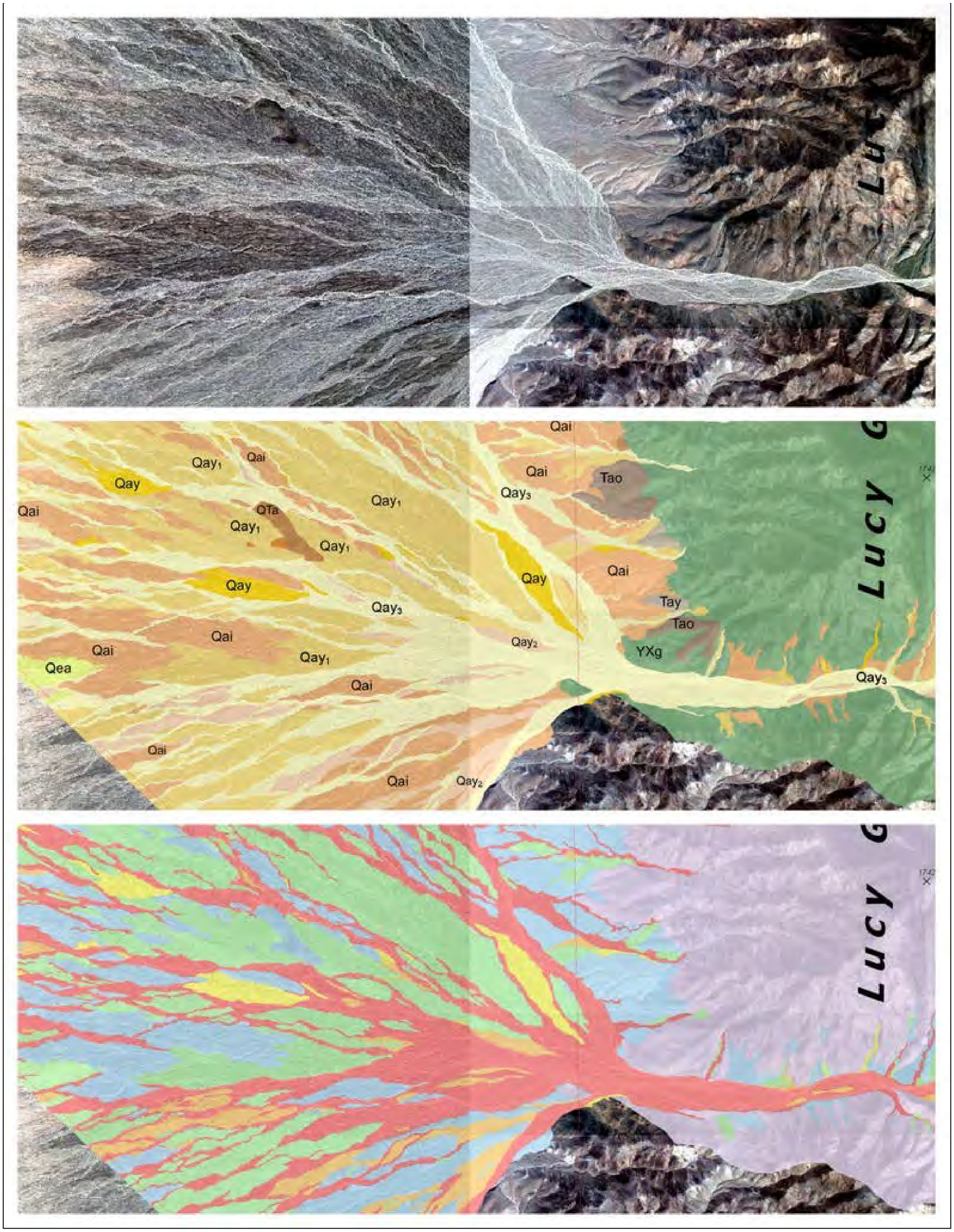
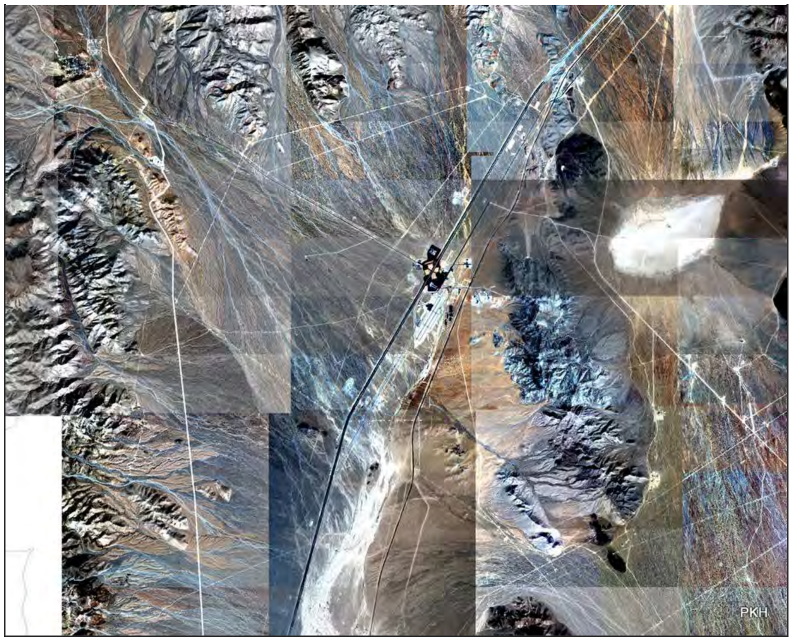
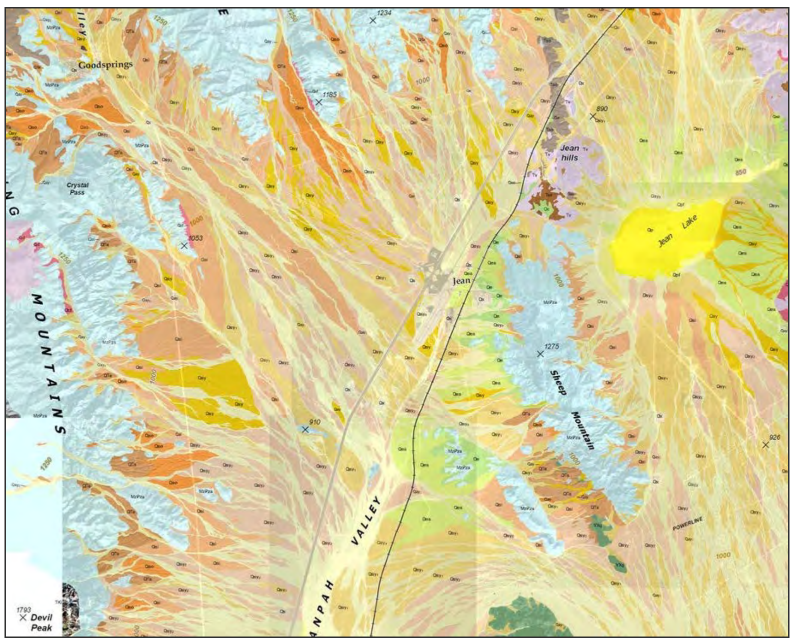


Figure 44. Three characterizations of The Lucy Gray alluvial fan. Upper: Quickbird® satellite image; Middle: Surficial geologic map; Lower: Relative flood hazard class map.


PKH


Goodsprings
Crystal Pass
MOUNTAINS
1234
1185
1053
890
Jean hills
Jean Lake
Jean
1275
Sheep Mountain
910
926
VALLEY
POWERLINE
1793
Devil Peak

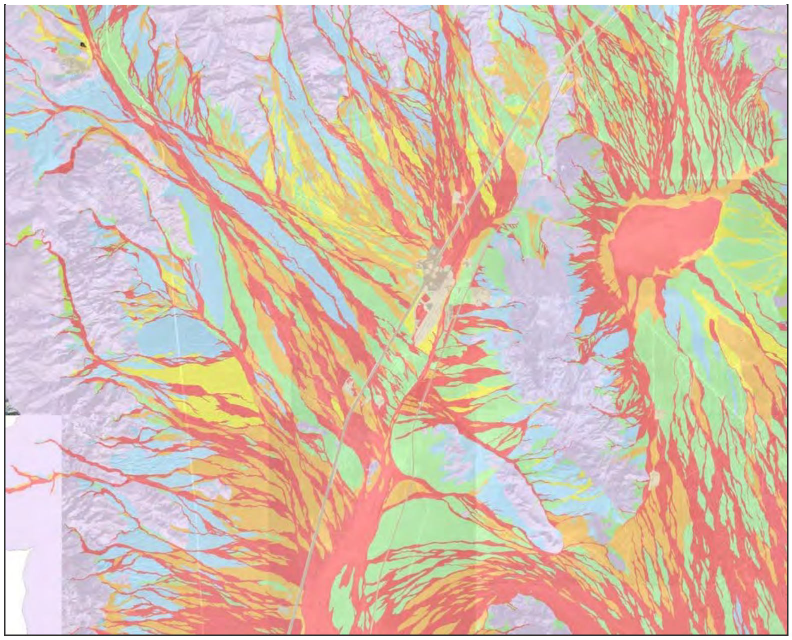


Figure 45. Three characterizations of the central study area. Upper: Quickbird® image mosaic; Lower: Relative flood hazard class map.

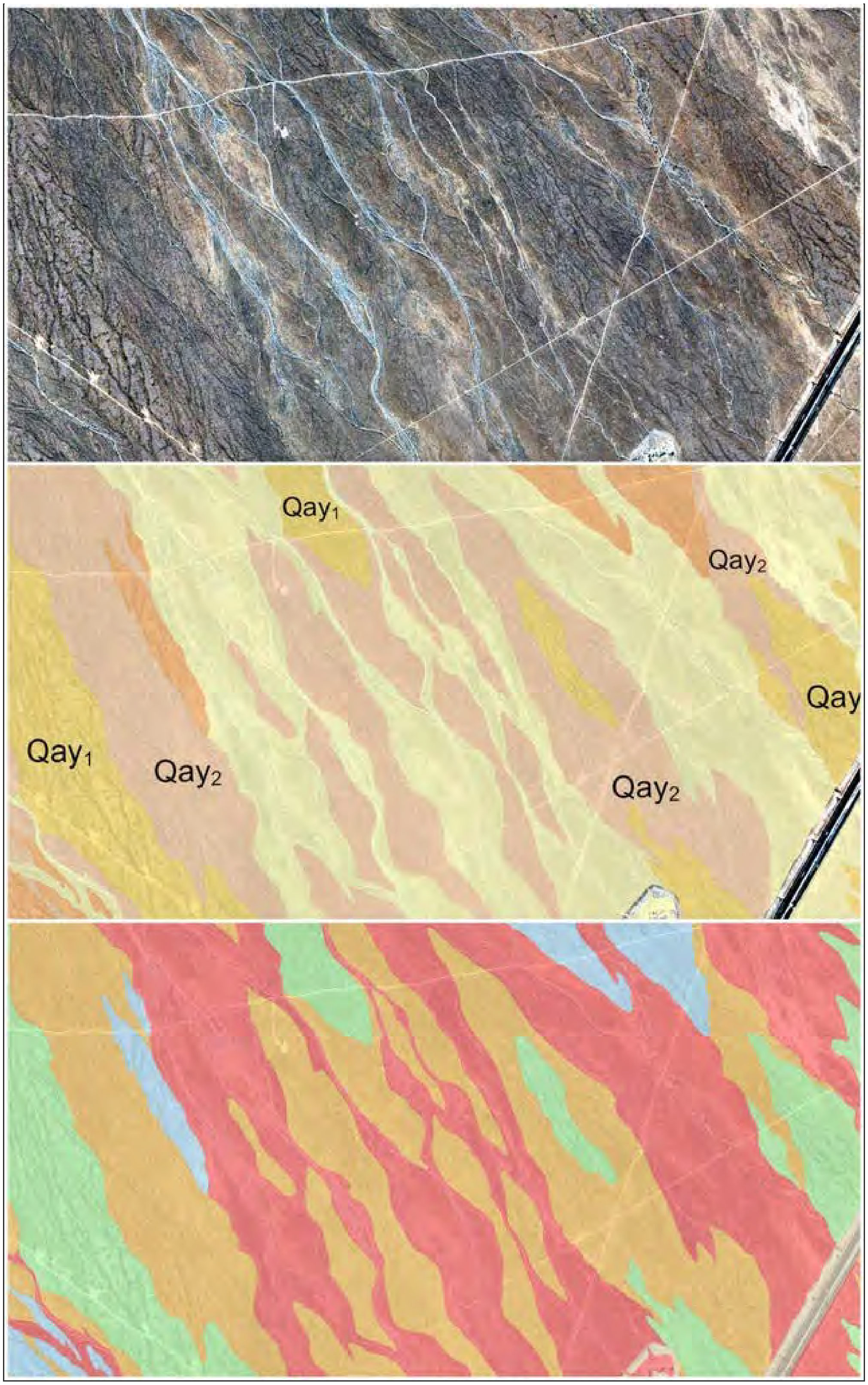


Figure 46. Top: Quickbird® image; middle: geologic map; bottom: derivative flood hazard map for lower part of the Goodsprings Fan.

General Geologic Assessment of Flood Hazards in the Ivanpah Valley Area

The surficial geology and geomorphic history of the Ivanpah Valley area lend themselves to a relatively straightforward assessment of relative flood hazards. We used conventional criteria to differentiate and map surficial geologic deposits on the basis of depositional process, landscape position, and relative age. We were able to bolster the relative age assignments by comparing physical characteristics of the Ivanpah Valley map units to similar units in the region with better age controls. In general, the ages of the alluvial deposits and surfaces are directly related to the duration of time that they have been isolated from active fluvial processes, hence flooding. In the case of other types of deposits (e.g., aeolian deposits, playa deposits, and hillslope deposits) evaluation of relative flood hazards was influenced by additional factors such as landscape position and process type. In the case of some hillslope deposits and certain settings with veneers of aeolian sand, the relative hazard is indeterminate. The geologically based assessment is not presented as a substitute for engineering and actuarial studies of flooding that have implications for mitigation measures and flood insurance rates; rather, it is presented solely as an informed set of baseline data to improve the focus of specific land management decisions.

Overall, the geologic and topographic diversity in the study area is conducive to a wide range of fluvial processes and related flood hazard severity, ranging from sediment-laden water floods to debris flow to prolonged inundation by standing water. The flood hazard maps (House, 2006a through 2006i) clearly indicate that even a cautiously conservative assessment of flood hazards results in a dense and intricate array of hazardous areas. However, geologic information about piedmont flood hazards often results in a lesser extent of flood hazardous areas than does the application of regulatory models in absence of geologic information (e.g., House, 2005; NRC, 1996). Ideally, the geologic data and related maps of the Ivanpah Valley areas will serve the purpose of informing hazard assessment by directing management efforts to areas where hazards clearly exist.

The scope of the problem is approximated in table 3, where the general distribution of flood hazard classes within the entire map area (all map units) and the potential hazard area (PHA—all surficial units) are listed. In total, the mapping indicates that just over 60% of the entire study area is composed of surficial geologic deposits that have broad potential to be flood hazardous (i.e. those areas given a flood hazard classification of any kind). Nearly 75% of that area (approx. 175 mi^2) is classified as having a flood hazard greater than "none"; and 52% of that area (approx. 125mi^2) is classified as having a flood hazard greater than "low".

Table 3. Areal extent and relative percentage of flood hazard classes in the study area.

Hazard	Area (sq. mi)	% of PHA	% of map
Very High	83.25	35%	22%
High	31.28	13%	8%
Moderate	9.45	4%	2%
Low	48.74	21%	13%
Variable	1.12	0.5%	0.3%
Very low	57.69	24%	15%
Indeterminate	4.26	2%	1%
	235.78	100%	61%

Natural drainage patterns that are readily apparent in the geologic map and the derivative flood hazard map (House et al., 2006; House, 2007) represent the culmination of a long and complex process of geomorphic evolution. Nonetheless, the broad outline of the array of the youngest and, hence, most flood prone areas is generally stable and easy to identify. The specific patterns, recurrence frequency, and absolute magnitude of individual floods within the active areas are indeterminate with existing data, but the outlines of areas in which the flooding is most likely to transpire can be delineated on the basis of observable physical criteria. Thus, it seems clear that explicit avoidance of development in these areas would be a particularly prudent land management strategy. Aside from certain physical settings in the study area that are particularly well suited for specific types of development in spite of their flood hazards, other types of land use should be situated in ways that acknowledge the potential for flooding as expressed by observable evidence. This generalization applies to all desert piedmont settings. Superimposing a rectilinear grid on a complex landscape with very well-established and easily identifiable natural topography and drainage may not be cost-effective over the long term.

References

Al-Farraj, A., 2008, Desert pavement development on the lake shorelines of Lake Eyre (South), South Australia: Geomorphology, v. 100, p. 154–163.

Al-Farraj, A., and Harvey, A., 2000, Desert pavement characteristics on wadi terrace and alluvial fan surfaces: Wadi Al-Bih, U.A.E., and Oman: Geomorphology, v. 35, p. 279–297.

Amit, R., Enzel, Y., and Sharon, D., 2006, Permanent Quaternary hyperaridity in the Negev, Israel, resulting from regional tectonics blocking mediterranean frontal systems: Geology, v. 34, no. 6, p. 509–512.

Amit, R., Lekach, J., Ayalon, A., Porat, N., and Grodek, T., 2007, New insight into pedogenic processes in extremely arid environments and their paleoclimatic implications–the Negev Desert, Israel: Quaternary International, v. 162–163, p. 61–75.

Amundson, R.G., Chadwick, O.A., Sowers, J.M., Doner, H.E., 1989, The stable isotope chemistry of pedogenic carbonates at Kyle Canyon, Nevada: Soil Science Society of America Journal, v. 53, p. 201–210

Anderson, K., Wells, S., and Graham, R., 2002, Pedogenesis of vesicular horizons, Cima Volcanic Field, Mojave Desert, California: Soil Science Society of America Journal, v. 66, p. 878–887.

Bachman, G.O., and Machette, M.W., 1977, Calcic soils and calcretes in the southwestern U.S.: U.S. Geological Society Open-File Report 77-794, 163p.

Baker, V.R., Demsey, K.A., Ely, L.L., Fuller, J.E., House, P.K., O'Connor, J.E., Onken, J.A., Pearthree, P.A., and Vincent, K.R., 1990. Application of geologic information to Arizona flood hazard assessment, *in* Hydraulics and hydrology of arid lands, Richard H. French (editor). American Society of Civil Engineers, New York, pp. 621–626.

Bell, J.W., Ramelli, A.R., dePolo, C.M., Maldonado, F., and Schmidt, D.L., 1999, Geologic map of the Corn Creek Springs quadrangle, Nevada: Nevada Bureau of Mines and Geology Map 121, scale 1:24,000.

Bell, J.W., Ramelli, A.R., and Caskey, S.J., 1998, Geologic map of the Tule Springs Park quadrangle, Nevada: Nevada Bureau of Mines and Geology Map 113, scale 1:24,000.

Bingler, E.G., and Bonham, H.F. Jr., 1972, Reconnaissance geologic map of the McCullough Range and adjacent areas, Clark County, Nevada: Nevada Bureau of Mines and Geology Map 45, scale 1:125,000.

Birkeland, P.W., 1999, Soils and Geomorphology (3rd ed.): New York, Oxford University Press, 430 p.

Blair, T. C., and McPherson, J.G., 1994. Alluvial fans and their natural distinction from rivers based on morphology, hydraulic processes, sedimentary processes, and facies assemblages: Journal of Sedimentary Research A64: 450–489.

Blair, T.C., 1999a. Sedimentary processes and facies of the waterlaid Anvil Spring Canyon alluvial fan, Death Valley, California: Sedimentology, v. 46, p. 913–940.

Blair, T.C., 1999b. Sedimentology of the debris-flow-dominated Warm Spring Canyon alluvial fan, Death Valley, California: Sedimentology, v. 46, p. 941–965.

Bridwell, H.L., 1991, The Sloan sag—a mid-Miocene volcanotectonic depression, north-central McCullough Mountains, southern Nevada [MS thesis]: University of Nevada, Las Vegas, 147 p.

Brock, A., and Buck, B.J., 2005, A new formation process for calcic pendants from Pahranagat Valley, Nevada, USA, and implication for dating Quaternary landforms: Quaternary Research, v. 63, p. 359–367.

Brock, A.L., and Buck, B.J. 2006, Genesis of pisoliths and brecciation features in stage VI petrocalcic horizons, Mormon Mesa, NV, USA: *18th World Congress of Soil Science, Abstracts with program*, Philadelphia, PA.

Brock, A.L. and Buck, B.J., 2009. Polygenetic development of the Mormon Mesa, NV petrocalcic horizons: Geomorphic and paleoenvironmental interpretations: Catena, 77: 65–75.

Brock, A.L., 2007. Characterization of stage VI petrocalcic horizons—S. Nevada and N.W. Arizona. Ph.D. Dissertation. University of Nevada Las Vegas, Department of Geoscience. 148 pages.

Bull, W.B., 1964. Geomorphology of segmented alluvial fans in western Fresno County, California: U.S. Geological Survey Professional Paper 352-E: 89-128

Bull, W.B., 1977. The alluvial-fan environment: Progress in Physical Geography, v. 1, p. 222–270.

Bull, W.B., 1979, Threshold of critical power in streams: Geological Society of American Bulletin, v. 90, p. 453–464.

Bull, W.B., 1991, Geomorphic response to climate change: New York, Oxford University Press, 326 p.

Burchfiel, B.C., Fleck, R.J., Secor, D.T., Vincelette, R.R., and Davis, G.A., 1974, Geology of the Spring Mountains, Nevada: Geological Society of America Bulletin, v. 85, p. 1013–1022.

Carr, M.D., and Pinkston, J.C., 1987, Geologic map of the Goodsprings District, southern Spring Mountains, Clark County, Nevada: U.S. Geological Survey Miscellaneous Field Studies Map MF-1514, scale 1:24,000.

Christenson, G.E., and Purcell, C., 1985, Correlation and age of Quaternary alluvial-fan sequences, Basin and Range province, southwestern United States, *in* Weide, D.L., ed., Soils and Quaternary geology of the southwestern United States: Geological Society of America Special Paper 203, p. 115–122.

Cooke RU (1970) Stone pavements in deserts. Annals Assoc. Am. Geog. 60, 560–577.

Dawdy, D.R., 1979. Flood-frequency estimates on alluvial fans. Journal of Hydraulic Engineering 105(11):1407–1412.

DeWitt, E., Anderson, J.L., Barton, H.N., Jachens, R.C., Podwysocki, M.H., Brickey, D.W., and Close, T.J., 1989, Mineral resources of the South McCullough Mountains Wilderness Study Area, Clark County, Nevada: U.S. Geological Survey Bulletin 1730-C, 24 p.

Dixon, J., 2009, Aridic soils, patterned ground, and desert pavements, *in* Geomorphology of desert environments, 2nd ed., A.J. Parsons, A.D. Abrahams (eds.), Springer Science, p. 101–122.

Dohrenwend, J.C., 1987. Basin and range, *in* Geomorphic systems of North America, William L. Graf (Editor). Geologic Society of America, Centennial Special Volume 2, Boulder, Colorado, pp. 303–342.

Durrenberger, R.W., and R.S. Ingram, 1978. Major storms and floods in Arizona, 1862–1978. Climatological Publications. Precipitation Series 4. Office of the State Climatologist, Arizona State University, Tempe, Arizona, 44 pp.

Federal Emergency Management Agency (FEMA), 1990. Fan—an alluvial fan flooding computer program: Washington, D.C.

FEMA, 2000. Guidelines for determining flood hazards on alluvial fans: *Available at* http://www.fema.gov/pdf/fhm/ft_afgd.pdf. *Accessed on* August 26, 2004.

FEMA, 2004. Flood hazard mapping—flood hazard zone designations: *Available at* http://www.fema.gov/fhm/fq_gen13.shtm. *Accessed on* August 26, 2004.

Field, J.J., 2001, Channel avulsion on alluvial fans in southern Arizona: Geomorphology, v. 37, p. 93–104.

Field, J.J., and Pearthree, P.A.,, 1997. Geomorphologic flood-hazard assessment of alluvial fans and piedmonts: Journal of Geoscience Education, v. 45, p. 27–37.

French, R.H., 1986. Flood hazard assessment on alluvial fans—an examination of the methodology, *in* Application and Frequency Risk in Water Resources, Vijay P. Singh (Editor), D. Reidel, Dordrecht, The Netherlands, pp. 361–375.

French, R.H., 1987. Hydraulic processes on alluvial fans: Elsevier, Amsterdam, The Netherlands.

French, R.H., 1992. Preferred directions of flow on alluvial fans: Journal of Hydraulic Engineering, 118(7):1002–1013.

French, R.H., Fuller, J.E., and Waters, S., 1993, Alluvial fans—proposed new process-oriented definitions for arid southwest: Journal of Water Resources Planning and Management v. 119, no. 5, p. 588–600.

Fuller, J.E., 1990, Misapplication of the FEMA alluvial fan model—a case history, *in* Hydraulics and Hydrology of Arid Lands, Richard H. French (editor). American Society of Civil Engineers, New York, pp., 367–372.

Garside, L.G., House, P.K., Burchfiel, B.C., and Rowland, S.M., 2009, Preliminary geologic map of the Jean quadrangle, Clark County, Nevada. Nevada Bureau of Mines and Geology Open-file Map 09-5, scale 1:24,000. Link to 7.2 Mb pdf file

Gatewood, J.S., Schrader, F.F., and Stackpole, M.R., 1946, Notable local floods of 1939: U.S. Geological Survey Water-Supply Paper 967.

Gile, L.H., Hawley, J.W., and Grossman, R.B., 1981, Soils and geomorphology in the Basin and Range area of southern New Mexico—guidebook to the Desert Project, New Mexico Bureau of Mines and Mineral Resources, Memoir 39. 222 p.

Gile, L.H., Peterson, F.F., and Grossman, R.B., 1966, Morphological and genetic sequences of carbonate accumulation in desert soils: Soil Science, v. 101, no. 5, p. 347–360.

Harden, J.W., Taylor, E.M., Hill, C., Mark, R.L., McFadden, L.D., Reheis, M.C., Sowers, J.M., and Wells, S.G., 1991, Rates of soil development from four soil chronosequences in the southern Great Basin: Quaternary Research, v. 35, p. 383–399.

Hay, R.L. and Wiggins, B., 1980. Pellets, ooids, sepiolite and silica in three calcretes of the southwestern United States. Sedimentology, 27: 559–576.

Helms, J. G., McGill, S. and Rockwell, T., 2003, Calibrated, late Quaternary age indices using clast rubification and soil development on alluvial surfaces in Pilot Knob Valley, Mojave Desert, southeastern California: Quaternary Research, v. 60, p. 377–393.

Hewett, D.F., 1931, Geology and ore deposits of the Goodsprings quadrangle, Nevada: U.S. Geological Survey Professional Paper 162, 172 p.

Hewett, D.F., 1956, Geology and mineral resources of the Ivanpah quadrangle, California and Nevada: U.S. Geological Survey Professional Paper 275, 172 p.

Hjalmarson, H.W., and Kemna, S.P., 1991, Flood hazards of distributary-flow areas in southwestern Arizona: U.S. Geological Survey Water-Resource Investigations Report 91-4171, 58 pp.

House, P.K., 2006a, Geologic assessment of piedmont and playa flood hazards in the Ivanpah Valley area, Clark County, Nevada: Nevada Bureau of Mines and Geology Map 158, scale 1:50,000.Link to 25 Mb pdf file

House, P.K., 2006b, Geologic assessment of piedmont flood hazards in the Ivanpah Valley part of the Cottonwood Pass and Potosi 7.5' quadrangles, Clark County, Nevada: Nevada Bureau of Mines and Geology Open-File Report 06-10A, scale 1:24,000.Link to 10 Mb pdf file

House, P.K., 2006c, Geologic Assessment of piedmont flood hazards in the Ivanpah Valley part of the Goodsprings and Shenandoah Peak 7.5' quadrangles, Clark County, Nevada: Nevada Bureau of Mines and Geology Open-File Report 06-10B, scale 1:24,000.Link to 9 Mb pdf file

House, P.K., 2006d, Geologic assessment of piedmont and playa flood hazards in the Ivanpah Valley part of the Jean and Bird Spring 7.5' quadrangles, Clark County, Nevada: Nevada Bureau of Mines and Geology Open-File Report 06-10C, scale 1:24,000. Link to 8 Mb pdf file

House, P.K., 2006e, Geologic assessment of piedmont and playa flood hazards in the Ivanpah Valley part of the Hidden Valley, Sloan, Sloan NE, and Sloan SE 7.5' quadrangles, Clark County, Nevada: Nevada Bureau of Mines and Geology Open-File Report 06-10D, scale 1:24,000. Link to 13 Mb pdf file

House, P.K., 2006f, Geologic assessment of piedmont and playa flood hazards in the Ivanpah Valley part of the State Line Pass and Ivanpah Lake 7.5' quadrangles, Clark County, Nevada: Nevada Bureau of Mines and Geology Open-File Report 06-10E, scale 1:24,000. Link to 10 Mb pdf file

House, P.K., 2006g, Geologic assessment of piedmont and playa flood hazards in the Ivanpah Valley Part of the Roach and Desert 7.5' quadrangles, Clark County, Nevada: Nevada Bureau of Mines and Geology Open-File Report 06-10F, scale 1:24,000.Link to 10 Mb pdf file

House, P.K., 2006h, Geologic assessment of piedmont flood hazards in the Ivanpah Valley part of the McCullough Pass and McCullough Mountain 7.5' quadrangles, Clark County, Nevada: Nevada Bureau of Mines And Geology Open-File Report 06-10G, scale 1:24,000.Link to 7.2 Mb pdf file

House, P.K., 2005, Using geology to improve flood hazard management on alluvial fans, an example from Laughlin, Nevada. Journal of the American Water Resources Association, v. 41, n. 6, p. 1431–1447.

House, P.K., Pearthree, P.A., and Vincent, K.R., 1991, Flow patterns, flow hydraulics and flood-hazard implications of a recent extreme alluvial-fan flood in southern Arizona. Geological Society of America Abstracts with Programs, v. 23, no. 5, p. A121.

House, P.K., Pearthree, P.A., and Vincent, K.R., 1992, Geological insights into deficiencies in federal procedures for flood hazard assessment on alluvial fans. Geological Society of America Abstracts with Programs, v. 24, no. 7, p. A-284.

House, P.K., Ramelli, A.R., and Buck, B.J., 2006, Surficial geologic map of the Ivanpah Valley area, Clark County, Nevada: Nevada Bureau of Mines and Geology Open-File Report 06-8, scale 1:50,000.

House, P.K., Pearthree, P.A., Howard, K.A., Bell, J.W., Perkins, M.E., and Brock, A.L., 2005, Birth of the lower Colorado River—stratigraphic and geomorphic evidence for its inception near the conjunction of Nevada, Arizona, and California, *in* Pederson, J., and Dehler, C.M., eds., Interior Western United States: Boulder, Colo., Geological Society of America Field Guide 6.

Kohl, M.S., 1978, Tertiary volcanic rocks of the Jean-Sloan area, Clark County, Nevada, and their possible relationship to carnotite occurrences in caliches [M.S. thesis]: University of California, Los Angeles, 116 p.

Lian, B., Hu, Q., Chen, J., Hi, J. and Teng, H., 2006, Carbonate biomineralization induced by soil bacterium *Bacilus megaterium*: Geochimica et Cosmochimica Acta, v. 70, p. 5522–5535.

Longwell, C.R., Pampeyan, E.H., Bower, B., and Roberts, R.J., 1965, Geology and mineral deposits of Clark County, Nevada: Nevada Bureau of Mines and Geology Bulletin 62, 230 p.

Ludwig, K.R., Paces, J.B., 2002, Uranium-series dating of pedogenic silica and carbonate, Crater Flat, Nevada: Geochemica et Cosmochemica Acta, v. 66, p. 487–506.

Machette, M.N., 1985, Calcic soils of the southwestern United States, *in* Weide, D.L., ed., Soils and Quaternary geology of the southwestern United States, Geological Society of America Special Paper 203, p. 1–21.

Matmon, A., Simhai, O., Amit, R., Haviv, I., Porat, N., McDonald, E., Benedetti, L., and Finkel, R., 2009, Desert pavement-coated surfaces in extreme deserts present the longest-lived landforms on Earth, GSA Bulletin, v. 121, no. 5/6, p. 688–697.

McDonald, E.V., McFadden, L.D., and Wells, S.G., 2003, Regional response of alluvial fans to the Pleistocene-Holocene climatic transition, Mohave Desert, California, *in* Y. Enzel, S.G. Wells, and N. Lancaster, eds., Paleoenvironments and Paleohydrology of the Mohave and Southern Great Basin Deserts. Boulder, CO: Geological Society of America Special Paper 368, p. 189–205.

McFadden, L.D., 1988, Climatic influences on rates and processes of soil development in Quaternary deposits of southern California: Geological Society of America Special Paper 216; p. 153–177.

McFadden, L.D., Wells, S.G., and Jercinovich, M.J., 1987, Influences of aeolian and pedogenic processes on the origin and evolution of desert pavements: Geology, v. 15., p. 504–508.

McFadden, L.D., Amundson, R.G., Chadwick, O.A., 1991, Numerical modeling, chemical and isotopic studies of carbonate accumulation in soils of arid regions—occurrence, characteristics, and genesis of carbonate, gypsum and silica accumulations in soils: Soil Science Society of America Special Publication, v. 26, p. 17–35.

McFadden, L.D., and Tinsley, J.C., 1985, The rate and depth of accumuilation of pedogenic carbonate accumulation in soils—formation and testing of a compartment model. In: D.W. Weide, (ed.), Soils and Quaternary geology of the southwestern United States, Geological Society of America Special Paper 203, p. 23–42.

McFadden, L.D., Wells, S.G., Dohrenwend, J.C., 1986, Influences of Quaternary climatic changes on processes of soil development on desert loess deposits of the Cima Volcanic Field, California: Catena, v. 13, p. 361–389.

McFadden, L.D., McDonald, E.V., Wells, S.G., Anderson, K.A., Quade, J., and Forman, S.L., 1998, The vesicular layer and carbonate collars of desert soils and pavements—formation, age and relation to climate change: Geomorphology, v. 24, p. 101–145.

McFadden, L.D., Eppes, M.C., Gillespie, A.R., and Hallet, B., 2005, Physical weathering in arid landscapes due to diurnal variation in the direction of solar heating: Geological Society of America Bulletin, v. 117, p. 161–173.

Monger, H.C. and Daugherty, L.A., 1991a. Pressure solution—possible mechanism for silicate grain dissolution in a petrocalcic horizon. Soil Science Society of America Journal, 55: 1625–1629.

Monger C.H., and Daugherty, L.A., 1991b, Neoformation of palygorskite in a southern New Mexico Aridisol: Soil Science Society of America Journal, v.55, p. 1646–1650.

Monger, C.H., and Adams, H.P., 1996, Micromorphology of calcite-silica deposits, Yucca Mountain, Nevada: Soil Science Society of America Journal, v. 60, p. 519–530.

Monger, H.C. and Kelly, E.F., 2002. Silica minerals, *in* Dixon, J.B. and Schulze, D.G., eds. Soil mineralogy with environmental applications. SSSA Book Series No.7. Madison, Soil Science Society of America: 611–636.

Monger, C.H., Daugherty, L.A., Lindemann, W.C., and Liddell, C.M., 1991, Microbial precipitation of pedogenic calcite: Geology, v. 19, p. 997–1000.

National Research Council (NRC), 1996, Alluvial fan flooding: National Academy Press, Washington, D.C.

Naiman, Z., Quade, J., and Patchett, J., 2000, Isotopic evidence for eolian recycling of pedogenic carbonate and variations in carbonate dust sources throughout the southwest United States: Geochimica et Cosmochimica Acta, v. 64, no. 18, p. 3099–3109.

Neal, J.T., Langer, A.M., and Kerr, P.F., 1968, Giant desiccation polygons of Great Basin playas: Geological Society of America Bulletin, v. 79, p. 69-90. DOI: 10.1130/0016-7606(1968)79[69:GDPOGB]2.0.CO;2. http://bulletin.geoscienceworld.org/cgi/content/abstract/79/1/69

Page, W.R., Lundstrom, S.C., Harris, A.G., Langenheim, V.E., Workman, J.B., Mahan, S.A., Paces, J.B., Dixon, G.L., Rowley, P.D., Burchfiel, B.C., Bell, J.W., and Smith, E.I., 2005, Geologic and geophysical maps of the Las Vegas 30′ x 60′ quadrangle, Clark and Nye Counties, Nevada, and Inyo County, California: United States Geological Survey Scientific Investigations Map 2814, scale 1:100,000.

Pearthree, P.A., 1991, Geologic insights into flood hazards in piedmont areas of Arizona: Arizona Geology, v. 21, p. 1–5.

Pelletier, J.D., M. Cline, and S. DeLong, 2007. Desert pavement dynamics—numerical modeling and field-based calibration, Earth Surface Processes and Landforms, 32, 1913–1927.

Pendall, E. G., Harden, J.W., Trumbore, S.E., and Chadwick, O.A., 1994, Isotopic approach to soil carbonate dynamics and implications for paleoclimatic interpretations: Quaternary Research, v. 42, p. 60–71.

Perry, R.S., Lynne, B.Y., Sephton, M.A, Kolb, V.A., Perry, C.C., and Staley, J.T., 2006, Baking black opal in the desert sun—the importance of silica in desert varnish: Geology, v. 34, p. 537–540.

Peterson, F.F., 1981. Landforms of the Basin and Range Province defined for soil survey. University of Nevada, Nevada Agricultural Experiment Station Technical Bulletin 28, Reno, Nevada, 52 p.

Peterson, F.F., Bell, J.W., Dorn, R.I., Ramelli, A.R., Ku, T., 1995, Late Quaternary geomorphology and soils in Crater Flat, Yucca Mountain area, southern Nevada: Geological Society of America Bulletin, v. 107, p. 379–395.

Quade, J., 2001, Desert pavements and associated rock varnish in the Mojave Desert—how old can they be?: Geology, v 29, no. 9., p. 855–858.

Rech, J.A., Quade, J., and Hart, W.S., 2003, Isotopic evidence for the origin of Ca and S in soil gypsum, anhydrite, and calcite in the Atacama Desert, Chile: Geochimica et Cosmochimica Acta, v. 67, p. 575–586, doi: 10.1016/S0016-7037(02)01175-4.

Reheis, M.C., Goodmacher, J.C., Harden, J.W., McFadden, L.D., Rockwell, T.K., Shroba, R.R., Sowers, J.M., and Taylor, E.M., 1995, Quaternary soils and dust deposition in southern Nevada and California: Geological Society of America Bulletin, 107, p. 1003–1022.

Reheis, M., 1988. Pedogenic replacement of aluminosilicate grains by $CaCO_3$ in Ustollic Haplargids, south-central Montana, U.S.A. Geoderma, 41: 243–261.

Reheis M.C., 1999, Dust deposition and its effect on soils; a progress report, *in* Desert winds—monitoring wind-related surface processes in Arizona, New Mexico, and California, in Breed, C.S. and Reheis, M.C., eds., U.S. Geological Survey Professional Paper, P1598, p. 121–131.

Reheis, M.C., Sowers, J.M., Taylor, E.M., McFadden, L.D., Harden, J.W., 1992, Morphology and genesis of carbonate soils on the Kyle Canyon fan, Nevada, U.S.A.: Geoderma 52, p. 303–342.

Rhoads, B.L., 1986. Flood hazard assessment for land-use planning near desert mountains. Environmental Management, v. 10, no. 1, p. 97–106.

Ritter, J.B., Miller, J.R., Enzel, Y., and 14 others, 1993, Quaternary Evolution of Cedar Creek alluvial fan, Montana: Geomorphology v. 8, p. 287–304.

Ritter, J.B., Miller, J.R., Enzel, Y., and Wells, S.G., 1995, Reconciling the roles of tectonism and climate in Quaternary alluvial fan evolution: Geology, v. 23, p. 245–248.

Robins, C.R., Buck, B.J., Williams, A.J., Morton, J.L., House, P.K., Howell, M.S., and Yonovitz, M.L., 2009, Comparison of flood hazard assessments on desert piedmonts and playas—a case study in Ivanpah Valley, Nevada: Geomorphology, v. 103, no. 4, p. 520–532.

Robins, C., Buck, B.J., Spell, T., Soukup, D., 2008, Micromorphology of sepiolite, palygorskite, and other phyllosilicates in petrocalcic soils of the southwest USA: Implications for arid soil dating, Abstracts of the 13th International Conference on Soil Micromorphology, Sept. 11–16, Chengdu China, p. 119.

Schmidt, K.M., and McMackin, M., 2006, Preliminary surficial geologic map of the Mesquite Lake 30′ x 60′ quadrangle, California and Nevada: U.S. Geological Survey Open-File Report 2006-1305, scale 1:100,000, 55 p.

Sowers, J.M., Harden, J.W., Robinson, S.W., McFadden, L.D., Amundson, R.G., Jull, A.J.T., Reheis, M.C., Taylor, E.M., Szabo, B.J., Chadwick, O.A., Ku, T.L., 1988, Geomorphology and pedology on the Kyle Canyon alluvial fan, southern Nevada., *in* Weide, D.L. and Faber, M.L., eds., This Extended Land, Geological Journeys in the Southern Basin and Range, Geological Society of America Cordilleran Section, Field Trip Guidebook, pp. 137–157.

Taylor, E.M., 1986, Impact of time and climate on Quaternary soils in the Yucca Mountain area of the Nevada Test Site [M.S. thesis]:University of Colorado, Boulder, CO., 217 p.

Toutin, T. and Cheng, P., 2002, Quickbird®—a milestone for high-resolution mapping: Earth Observation Magazine, no. 11, v. 4. Available online: (http://www.eomonline.com/Common/currentissues/Apr02/cheng.htm); last accessed August 1, 2006.

Treadwell-Steitz, C., and McFadden, L.D., 2000, Influence of parent material and grain size on carbonate coatings in gravelly soils, Palo Duro Wash, New Mexico: Geoderma, v. 94, p. 1–22.

U.S. Geological Survey Geologic Names Committee (USGSGNC) 2007, Divisions of geologic time—Major chronostratigraphic and geochronologic units: U.S. Geological Survey Fact Sheet 2007-3015, 2 p. http://pubs.usgs.gov/fs/2007/3015/

(USGSGNC, 2007; ICS, 2008) (http://www.stratigraphy.org/upload/ISChart2009.pdf)

Valentine, G., and Harrington, C., 2006, Clast size controls and longevity of Pleistocene desert pavements at Lathrop Wells and Red Cone volcanoes, southern Nevada: Geology, v.34, no. 7, p. 533–536.

Vaniman, D.T., Chipera S.J., Bish, D.L., 1994, Pedogenesis of siliceious calcretes at Yucca Mountain, Nevada: Geoderma, v. 63, p. 1–17.

Watts, N.L., 1978, Displacive calcite: evidence from recent and ancient calcretes: Geology, v. 6, p. 699–703.

Watts, N.L., 1980. Quaternary pedogenic calcretes from the Kalahari (southern Africa): mineralogy, genesis and diagenesis. Sedimentology, 27: 661–686.

Wells, S.G., Dohrenwend, J.C., McFadden, L.D., Turin, B.D., and Mahrer, K.D., 1985, Late Cenozoic landscape evolution on lava flow surfaces of the Cima volcanic field, Mojave Desert, California: Geological Society of America Bulletin, v. 96, p. 1518–1529.

Williams, V., 1996, Preliminary geologic map of the Mesquite quadrangle, Clark and Lincoln counties, Nevada and Mojave county Arizona: U.S. Geological Survey Open-File Report 96-0678, scale 1:24,000, 12p.

Whitney, J.W., Taylor, E.M., and Wesling, J.R., 2004, Quaternary stratigraphy and mapping in the Yucca Mountain area, *in* Keefer, W.R., Whitney, J.W., and Taylor, E.M., eds., Quaternary paleoseismology and stratigraphy of the Yucca Mountain area, Nevada, U.S. Geological Survey Professional Paper 1689: Reston, Virginia, p. 11–23.

Wood, Y., Graham, R., and Wells, S., 2005, Surface control of desert pavement pedologic process and landscape function, Cima Volcanic field, Mojave Desert, California: Catena v. 59, p. 205–230.

Suggested Citations

Online version:
House, P.K., Buck, B.J., and Ramelli, A.R., 2010, Geologic assessment of piedmont and playa flood hazards in the Ivanpah Valley area, Clark County, Nevada (online version): Nevada Bureau of Mines and Geology Report 53.

DVD version:
House, P.K., Buck, B.J., and Ramelli, A.R., 2010, Geologic assessment of piedmont and playa flood hazards in the Ivanpah Valley area, Clark County, Nevada (DVD version): Nevada Bureau of Mines and Geology Report 53.

Acknowledgments

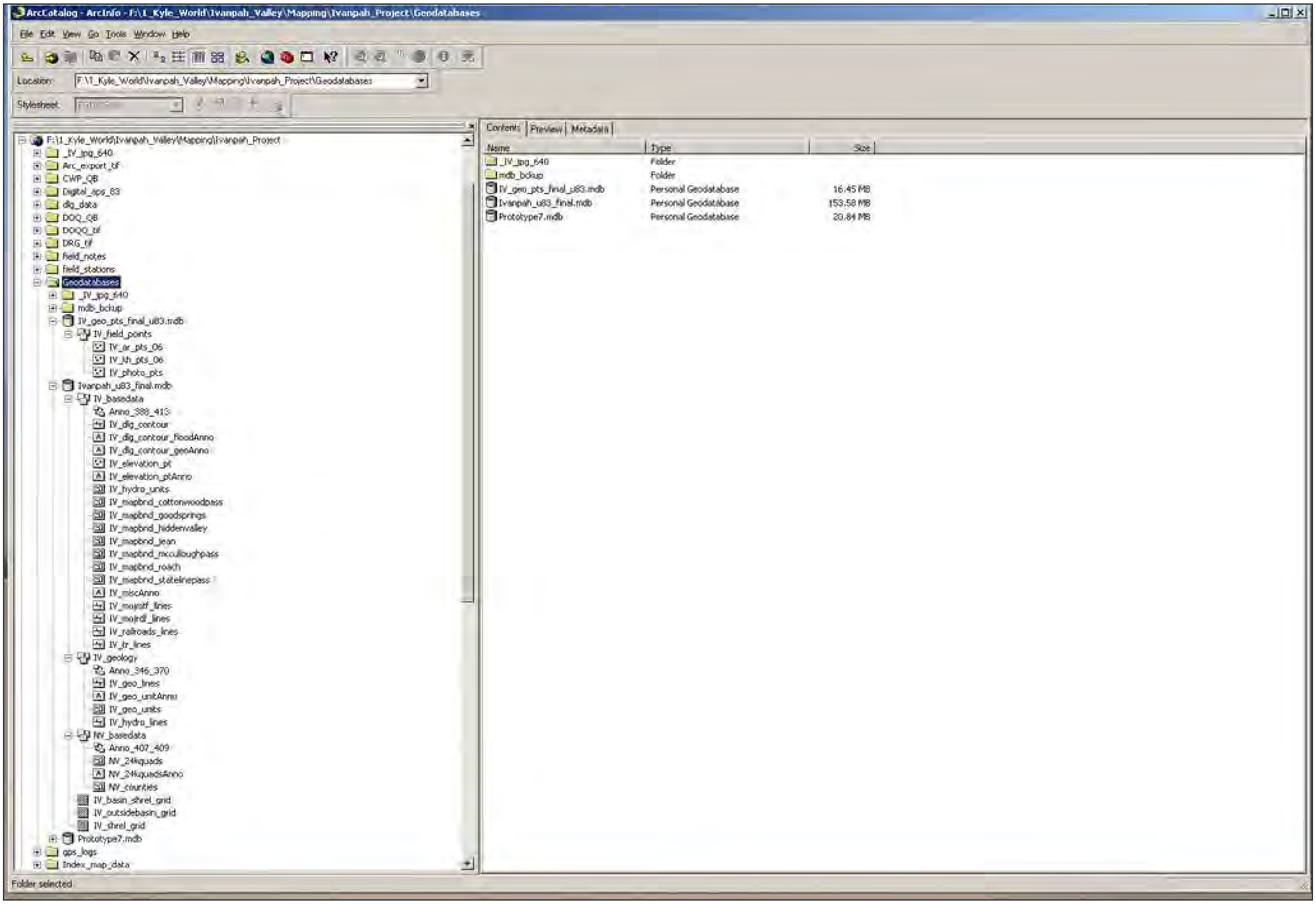
This research was supported by the Clark County Regional Flood Control District, the United States Geological Survey (Statemap program), the Nevada Bureau of Mines and Geology (UNR), and the University of Nevada, Las Vegas. The authors gratefully acknowledge the following individuals who contributed in various ways to the collection, interpretation, and presentation of the data: Brien Park, Amy Brock, Tom Prescott, Andrew Hanson, Doug Merkler, Robert Chaney, Ron Hess, Liz Crouse, Christine Arritt, Dick Meeuwig, and Gary Johnson. Thanks to John Bell, Gale Fraser, John Hawley, and Philip Pearthree for constructive reviews of the report.

Appendix 1. Explanation of digital data sets associated with this report

Project DVD / Online Data

A project DVD is available that contains all of the digital data used in developing the maps described in this report, including: geologic data geodatabase; field point and photo geodatabase; *mxd files used in ArcMap to display and print the maps; layer files (*.lyr) that ensure the data are displayed the appropriate way; and *.pdf files of each map (plates 1–9). Contact the NBMG Publication Sales Office to inquire about the DVD.

Project Geodatabases in ESRI *.mdb format



All of the geologic data have been complied in two ArcGIS personal geodatabases. The primary geodatabase, **Ivanpah_u83_final.mdb** contains all of the data used to develop the geologic map and the derivative flood hazard maps. The secondary geodatabase, **IV_geo_pts_final_u83.mdb**, contains field site locations and a set of linked field photographs. The general database structure is shown below (for additional details view the metadata that accompanies the geodatabase on the data DVD included with this report):

Ivanpah_u83_final.mdb
IV_basedata (basemap data)
Anno_388_413internal file related to labeling)
IV_dlg_contour50 meter contours from 100k dataset)
IV_dlg_contour_floodAnno(contour labels for flood map)
IV_dlg_contour_geoAnno(contour labels for geologic map)
IV_elevation_pt(spot elevation locations for selected points)
IV_elevation_ptAnno(spot elevation labels)
IV_hydro_units(playa watershed polygons)
IV_mapbnd_cottonwoodpass
(clipping boundary for 24k flood map)
IV_mapbnd_goodsprings
(clipping boundary for 24k flood map)
IV_mapbnd_hiddenvalley
clipping boundary for 24k flood map)
IV_mapbnd_jean
clipping boundary for 24k flood map)
IV_mapbnd_mccullоughpass
clipping boundary for 24k flood map)
IV_mapbnd_roach
clipping boundary for 24k flood map)
IV_mapbnd_statelinepass
clipping boundary for 24k flood map)
IV_miscAnno(labels for geographic features in map area)
IV_mojmtf_linestransmission lines)
IV_mojrdf_lines(roads)
IV_railroad_lines(railroad)

IV_tr_lines(township and range grid lines)
IV_geology(Feature class—geologic unit contacts, polygons, and labels)
Anno_346_370
IV_geo_linesgeologic contacts)
IV_geo_unitAnno(geologic unit labels)
IV_geo_units(geologic unit polygons, includes flood-related attribution)
IV_hydro_lines(watershed outlines)
NV_basedata(base data for Nevada index map)
Anno_407_409internal file related to labeling)
NV_24kquadsboundaries of 7.5' / 24k quadrangles)
NV_24kquadsAnnoquadrangle names)
NV_counties(Nevada county outlines)
IV_basin_shrel_gridelevation grid for study area)
IV_outsidebasin_grid(elevation grid for area outside of study area)
IV_shrel_grid(elevation grid for entire map area)
Geodatabase of Field Photographs (ESRI format)
IV_geo_pts_final_u83.mdb
IV_field_points (field point dataset)
IV_ar_pts_06 Alan Ramelli, NBMG)
IV_kh_pts_06(Kyle House, NBMG)
IV_photo_pts(points with linked photos)

To view the photos:
Open the feature class "IV_photo_pts" in ArcMap or ArcCatalog. Click the "i" button (blue circle with white "i"). Click on a point. On the right side of the newly-popped-up-window, scroll down to the "raster_no" field. If there is a button with a greater than symbol, click on it. You will see the photo for that site (if the field is "<null>", there is no photo available). To view a larger image, right-click in the image and select "view". This will pop-out another window for you to zoom-in or out, pan, and view properties of the image. To close the window, hit the "x" in the upper right corner.

A selection of field photographs is also available online in the browser-based Google Earth viewer below.

Loading...

View larger map

Download Geotagged Photos(.kmz)

000127

Nevada Bureau of Mines and Geology | University of Nevada, Reno/178 | Reno, NV 89557 | ph. 775.784.6691 | fx. 775.784.1709

Great Basin Science Sample and Records Library/NBMG Sales Office | 2175 Raggio Pkwy. | Reno, NV 89512 | ph. 775.682.8766 | fx. 775.784.6690
Hours Mon-Fri 8:00am to 4:00pm (cash register closes at 3:30)

This Page

Intentionally

Left Blank

WATER QUALITY CONTROL PLAN

COLORADO RIVER BASIN- REGION 7

Includes Amendments Adopted by the Regional Board through June 2006

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
STATE WATER RESOURCES CONTROL BOARD

COLORADO RIVER BASIN MAPS

FOREWORD

On November 17, 1993 the Regional Board adopted Resolution No. 93-145 which approved this 1993 Basin Plan. This Basin Plan was subsequently approved by the State Water Resources Control Board on February 17, 1994 (Resolution No. 94-18). The California Office of Administrative Law approved the adoption of the 1993 Basin Plan on August 3, 1994. This Basin Plan now supersedes the previous (1991) Basin Plan.

This Basin Plan was prepared by the California Regional Water Quality Control Board, Colorado River Basin Region, in accordance with criteria contained in the California Porter-Cologne Water Quality Control Act, the Federal Clean Water Act, and other pertinent state and federal rules and regulations.

The intent of this plan is to provide definitive guidelines, and give direction to the full scope of Regional Board activities that serve to optimize the beneficial uses of state waters within the Colorado River Basin Region of California by preserving and protecting the quality of these waters.

This plan is also subject to review by the United States Environmental Protection Agency (EPA). The plan is in itself not a final statement on regional water quality planning, but is subject to continuous review, and update as necessary. Updated sections of the plan may appear as periodic Basin Plan amendments, which are also subject to approval by the State Water Resources Control Board and the Office of Administrative Law.

This Basin Plan includes amendments adopted by the Regional Board through June 2006.

COVER: PHOTO OF THE SALTON SEA

TABLE OF CONTENTS

CHAPTER 1 - INTRODUCTION

I. THE REGIONAL BOARD

The Regional Board consists of nine members appointed by the Governor for staggered four-year terms. Members must reside or maintain a place of business within the Region and must be associated with or have special knowledge of specific activities related to the control of water quality. Members of the Board conduct their business at regular meetings and public hearings at which public participation is encouraged.

All duties and responsibilities of the Regional Board are directed at providing reasonable protection and enhancement of the quality of all waters of the Region, both surface and underground. The programs by which these duties and responsibilities are carried out include:

- Preparing new or revised policies addressing region-wide quality concerns;

- Adopting, monitoring compliance with, and enforcing waste discharge requirements and National Pollutant Discharge Elimination System permits;

- Providing recommendations to the State Board on financial assistance programs, proposals for water diversion, budget development, and other statewide programs and policies;

- Coordinating with other public agencies which are concerned with water quality control; and

- Informing and involving the public on water quality issues.

Administration of these duties is accomplished by a permanent staff of State Employees, directed by an Executive Officer who is selected by and serves at the pleasure of the Regional Board.

II. FUNCTION OF THE BASIN PLAN

This Water Quality Control Plan (herein referred to as the Basin Plan) for the Colorado River Basin Region was prepared by the California Regional Water Quality Control Board, Colorado River Basin Region, in accordance with criteria contained in the California Porter-Cologne Water Quality Control Act, the Federal Clean Water Act, and other pertinent state and federal rules and regulations.

The intent of the Basin Plan is to provide definitive guidelines, and give direction to the full scope of Regional Board activities that serve to optimize the beneficial uses of the state waters within the Colorado River Basin Region of California by preserving and protecting the quality of these waters.

Water uses and water benefits vary. Water quality is an important factor in determining use and benefit. For example, drinking water has to be of higher quality than the water used to irrigate pastures. Both of these are beneficial water uses, but the quality requirements for irrigation water are different from those for drinking water. The Basin Plan recognizes the variations of water quality and water uses.

This Basin Plan lists and defines the various beneficial water uses (Chapter 2). It describes the water quality which must be maintained to support such uses (Water Quality Objectives, Chapter 3). The section on implementation (Chapter 4) describes the programs, projects and other actions which are necessary to achieve the standards established in this Plan. Plans, Policies and Issues (Chapter 5), summarize the various plans and policies which protect water quality. This chapter also describes water quality issues which require special attention. Surveillance and Monitoring (Chapter 6), describes activities within the Colorado River Basin Region which are related to surveillance, monitoring, assessment, lab support, quality assurance and quality control.

The Regional Board implements the Basin Plan by issuing and enforcing waste discharge requirements to persons; which can include individuals, communities, or businesses whose waste discharges may affect water quality. These requirements can be either state Waste Discharge Requirements for discharge to land, or federally delegated National Pollutant Discharge Elimination System permits for discharges to surface water. Dischargers are required to meet water quality objectives and thus protect beneficial uses.

This Basin Plan also encourages water users to improve the quality of their water supplies, particularly where the wastewater they discharge is likely to be reused. Public works and other projects, which can affect water quality, are reviewed and their impacts are identified. Proposals, which implement or help achieve the goals of the Basin Plan, are supported.

This Basin Plan is subject to review by the State Water Resources Control Board (State Board) and the United States Environmental Protection Agency (USEPA). The Basin Plan is, in itself, not a final statement on regional water quality planning, but is subject to continuous review and update as necessary. Updated sections of the plan may appear as periodic amendments, which are also subject to approval by the State Board and USEPA.

III. LEGAL BASIS AND AUTHORITY

The Porter-Cologne Water Quality Control Act which is contained in Division 7 of the California Water Code, establishes the responsibilities and authorities of the nine Regional Water Quality Control Boards (Regional Board) and the State Water Resources Control Board (State Board). The Porter-Cologne Act names these Boards "...the principal state agencies with primary responsibility for the coordination and control of water quality" (Section 13001). Each Regional Board is directed to "...formulate and adopt water quality control plans for all areas within the region." A water quality control plan for the waters of an area is defined as having these three components: beneficial uses which are to be protected, water quality objectives which protect those uses, and an implementation plan which accomplishes those objectives (Section 13050). Further, "such plans shall be periodically reviewed and may be revised" (Section 13240). The Federal Clean Water Act (Public Law 92-500, as amended) provides for the delegation of certain responsibilities of water quality control and water quality planning to the states. Where the USEPA and the State Board have agreed to such delegation, the Regional Boards implement portions of the Clean Water Act, such as the NPDES program and toxic substance control programs.

The Porter-Cologne and Clean Water Acts also describe how enforcement of waste discharge requirements is to be carried out. Enforcement tools available to the Regional Board range from simple letters to the discharger, through formal Board Orders and administrative civil liabilities, to judicial abatement for civil and/or criminal penalties. Legally noticed public hearings are required for Cease and Desist Orders, but Cleanup and Abatement Orders may be issued by the Executive Officer to allow for a quicker response than regularly scheduled board meetings can provide.

This Water Quality Control Plan was prepared to comply with all applicable Federal and State laws, regulations, plans, policies, and guidelines. The laws, regulations, and guidelines are summarized below. The plans and policies are summarized in Chapter 5. Also, future amendments thereto, are hereby included in this plan by reference.

A. FEDERAL REQUIREMENTS

One Federal law specifically and directly addresses the matter of water pollution control. This law is known as the Federal Clean Water Act. Several other Federal laws, classifiable as "environmental" laws, may also apply to water pollution control activities. These laws include the National Environmental Policy Act, the Clean Air Act, and the Resource Conservation and Recovery Act.

1. <u>Federal Clean Water Act</u>

   The objective of the Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. The Act further states that it is the policy of Congress to recognize, preserve, and protect the primary responsibilities, and rights of the States to prevent, reduce, and eliminate pollution, to plan the development and use (including restoration, preservation, and enhancement) of land and water resources, and that full public participation in the development and/or revision of regulations, plans and programs be provided for, encouraged, and assisted. The responsibility to administer the Act is placed with the Administrator of the U.S. Environmental Protection Agency.

2. <u>National Environmental Policy Act (NEPA)</u>

   In general, this Act proposes to satisfactorily preserve the environment and to restore that which has been degraded. The method devised to accomplish this is to require evaluation of the effect of each action proposed upon the environment, and to consider the results in making decisions regarding such action. NEPA applies to the actions of the Federal Government.

NEPA declares a continuing policy for all levels of government and concerned public and private organizations to create and maintain conditions under which people and nature can exist in productive harmony and fulfill the social, economic, and other needs of present and future generations. The Act directs an interdisciplinary approach to integrated use of all talents in planning and decision-making that impact on the environment (Sec. 102). Each report or recommendation must be accompanied by a detailed statement prepared by the responsible official on:

- The environmental impact of the proposed action;

- Any adverse environmental effects which cannot be avoided if the action is taken;

- Alternatives to the action;

- Relationship between local short-term uses of the environment, and maintenance and enhancement of long-term productivity; and

- Any irreversible and irretrievable commitments of resources if the proposed action is taken.

Appropriate alternatives to proposed actions must be studied and developed when conflicts in use of available resources are encountered.

B. CALIFORNIA STATUTORY AND ADMINISTRATIVE LAWS

The laws in California are organized into the Constitution, Statutes, and Administrative Codes encompassing all facets of the State's governmental controls. Laws that directly affect water resources planning are contained principally in the California Water Code, with additional specificity in those Administrative Codes which are titled Water Resources, Health and Safety, Public Resources, and Fish and Game.

1. California Water Code

One Division of statutory law is directed primarily towards the control of water quality. This is Division 7 of the California Water Code, also referred to as the "Porter-Cologne Water Quality Control Act". Those portions of said Division 7 which relate to or govern the preparation of basin plans are summarized below.

This Act establishes that the waters of the State shall be protected for use and enjoyment by the people of the State; that the activities and factors which may affect the quality of the waters of the State shall be regulated to attain the highest water quality which is reasonable, considering all demands being made or to be made and the total values involved, beneficial and detrimental, economic and social, tangible and intangible; that the health, safety, and welfare of the people require that there be a statewide program for control of the quality of all waters of the State; that quality and quantity of water shall be administered conjunctively; and that the statewide program for water quality can most effectively be administered regionally within a framework of statewide coordination and policy. The State Water Resources Control Board, hereinafter referred to as "State Board", and the nine Regional Water Quality Control Boards, hereinafter referred to as "Regional Board(s)", are established under the Act as the principal state agencies with primary responsibility for control of water quality.

The State Board is responsible for the formulation and adoption of state policy for water quality control. State policy consists of:

- Water quality principles and guidelines for long-range planning for ground waters and surface waters, and the use of reclaimed water;

- Water quality objectives at key locations; and

- Other principles and guidelines deemed essential for water quality control.

The State Board may adopt water quality control plans for waters for which water quality standards are required by the Federal Clean Water Act. The Regional Water Quality Control Plans are prepared to conform with policies of the State Water Resources Control Board.

Each Regional Board must formulate and adopt, for its region, water quality control plan(s) which establish such water quality objectives as in its judgement will ensure reasonable protection of beneficial uses.

Article 4 of Chapter 4 of Division 7 of the Water Code establishes basic procedures for prescription of waste discharge requirements upon dischargers of waste. Any person who is discharging, or proposes to discharge waste other than into a community sewer, that could affect the quality of water, shall file a report with the Regional Board containing information required by the Board. After any necessary hearing, the Board may impose waste discharge requirements based on the nature of the proposed discharge relative to conditions existing in the disposal area or receiving waters. Discharge requirements may be reviewed and revised as appropriate, upon application by any affected person or by the Regional Board on its own motion. The discharge of wastes does not create any vested right to continue such discharge.

Section 2100 of the Water Code provides for adjudication to protect ground water quality. The State Board, upon a finding of existing or threatened irreparable damage, may file an action in the Superior Court to restrict pumping or to impose physical solutions, or both, to the extent necessary to prevent destruction of or irreparable injury to the quality of ground water. The State Board may take such action only if an affected local agency charged with this responsibility fails to take appropriate action.

The Water Code contains provisions which control almost every consideration of water and its use. Division 2 of the Water Code provides that the State Board shall consider and act upon all applications for permits to appropriate waters. The State Board's authority includes water quality considerations in granting a water right; Division 3 deals with dams and reservoirs; Division 5 pertains to flood control; Division 6 controls conservation, development and utilization of the state water resources; Division 7, as described above, covers water quality; and Divisions 11 through 21 provide for the organization, operation, and financing of various types of local water-oriented agencies.

2. <u>California Environmental Quality Act (CEQA)</u>

   CEQA is contained in Sections 21000 to 21176 of the Public Resources Code. CEQA, which is the State-level equivalent of the Federal NEPA, requires all State agencies, boards, and commissions to include, in any report on any project having a significant effect on the environment, an environmental impact report (EIR). CEQA also requires, in addition to the five items set forth in Section 102 of NEPA, that the EIR include a discussion of mitigation measures proposed to minimize the impact. The responsibility for development of objectives, criteria, and procedures to assure proper preparation and evaluation of the EIR is placed with the State Office of Planning and Research.

3. <u>California Code of Regulations</u>

   The administrative procedures of the State Board are contained in Title 23, Chapter 3, of the California Code of Regulations. Regulations relating to the many facets of water rights and water quality are contained in the several subchapters of said Chapter 3. Title 17 (Public Health) of the California Code of Regulations contains requirements for quality of water for domestic uses. Restrictions on the uses of waters reclaimed from wastewater are contained in Title 22 (Environmental Health).

4. Other State Statutes

Portions of various other codes, such as the Health and Safety Code, Fish and Game Code, Public Resources Code, and Revenue and Taxation Code, impose various regulations that are to be considered in the basin planning process. The Health and Safety Code contains regulations relating to the formation and operation of county sanitation and sewer maintenance districts, sewer revenue bonds, the use by the public of reservoirs, and ocean water-contact sports. The Fish and Game Code provides for the preservation, protection, and enhancement of birds, mammals, fish, amphibians, and reptiles, and their habitats.

C. OTHER PLANNING AGENCIES

There are various other regional and local governmental agencies whose policies are considered during any Water Quality Control Plan update. These include but are not limited to the following:

- Southern California Association of Governments
- Coachella Valley Association of Governments
- Imperial Valley Association of Governments
- San Bernardino Association of Governments
- Agencies, districts, and other public bodies responsible for collection, treatment, and disposal of wastewaters and for water conservation and production.

IV. THE PLANNING PROCESS

A. BASIN PLAN AMENDMENT PROCESS

Both Federal and State laws require public participation in the development of Water Quality Control Plans and amendments thereto. The principal laws governing public participation with respect to development of water quality control plans are listed below:

- Federal Clean Water Act
- Division 7 of the California Water Code
- California Environmental Quality Act (CEQA)

In addition to these laws, both Federal and State regulations and guidelines have been developed to ensure compliance with the intent of the laws.

This Regional Board uses the following procedures for adoption of Water Quality Control Plans:

- Proposed Plans are prepared by Regional Board staff, under the direction of the Regional Board's Executive Officer.
- An Environmental Checklist Form for the proposed Plan is prepared.
- Staff prepares a summary report containing:
  - A brief description of the proposed Plan;
  - Reasonable alternatives to the proposed Plan; and
  - Mitigation measures to minimize any significant adverse environmental impacts.
- A Notice of Filing and Notice of Public Hearing is mailed to all interested agencies (Federal, State, and local), organizations, and individuals at least 45 days prior to the scheduled Regional Board hearing on the proposed Plan. Those agencies, organizations, and individuals who are presumed to have special interest in the proposed Plan are forwarded copies of the proposed plan, the Environmental Checklist Form, and the summary report.
- At least 45 days prior to the scheduled Regional Board Public Hearing, a copy of the Notice of Filing and Notice of Public Hearing is published in newspapers for major circulation in areas affected by the proposed Plan.
- Copies of the proposed Plan, environmental checklist, and summary report are provided upon request to other agencies and persons.
- The Regional Board staff prepares written responses to comments concerning significant issues raised during the public

review period. If a comment is received less than 15 days prior to the date of the Regional Board hearing on the proposed Plan, an oral response is presented at the hearing. The oral response, as well as comments and responses at the Board meeting, are included in the meeting minutes.

- Following Regional Board adoption of the Plan, the Regional Board's Executive Officer will forward the Plan for consideration of approval to the State Water Resources Control Board.
- Following State Board approval of the Plan, a Notice of Decision will be filed by the Regional Board with the Secretary of the Resources Agency for public posting for a period of at least 30 days.

In addition to the above procedure, other provisions are made to allow for public involvement. All Regional Board files containing information regarding the proposed plan are open to public inspection at the office of the California Regional Water Quality Control Board, Colorado River Basin Region, 73-720 Fred Waring Drive, Suite 100, Palm Desert, California, 92260, during the hours of 9 a.m. to 4 p.m. of each business day. Also, appointments can be made with Regional Board staff to discuss the proposed plan and answer any questions.

B. TRIENNIAL REVIEW PROCESS

The Federal Clean Water Act (Section 303(c)) requires states to hold public hearings for review of water quality standards at least once every three years. Water quality standards consist of beneficial use designations and water quality objectives necessary to protect those uses. The Porter-Cologne Water Quality Control Act requires the Basin Plan to be reviewed periodically. While a major part of the review process consists of identifying potential problems, an important part of the review is the reaffirmation of those portions of the plan where no potential problems exist.

At the conclusion of the triennial review public hearing, Regional Board staff prepares a priority list of potential problems with the Basin Plan that may result in amendments. Placing a potential problem on the priority list will only require Regional Board staff investigation of the need for an amendment. It does not necessarily mean a revision of the water quality control plan will be made.

Other items completed after the public hearing include:

- Detailed Workplans of each issue;
- Regional Board identification of issues that can be completed within existing resource allocations over a three-year period; and
- List of projects requiring additional resources to complete.

Once the triennial review process is complete, Regional Board staff begins investigating the issues in order of rank. After each investigation, staff determines the need for a Basin Plan amendment.

Basin Plan amendments can also be prepared for issues not identified during the triennial review. Amendments can be prepared for urgent issues or to reflect new legislation.

V. THE COLORADO RIVER BASIN REGION

A. GEOGRAPHICAL SETTING

The Colorado River Basin Region covers approximately 13 million acres (20,000 square miles) in the southeastern portion of California (Plate 1-1, Page 1-10). It includes all of Imperial County and portions of San Bernardino, Riverside, and San Diego Counties. It is bounded for forty miles on the northeast by the State of Nevada, on the north by the New York, Providence, Granite, Old Dad, Bristol, Rodman, and Ord Mountain ranges, on the west by the San Bernardino, San Jacinto, and Laguna Mountain ranges, on the south by the Republic of Mexico, and on the east by the Colorado River and State of Arizona. Geographically the region represents only a small portion of the total Colorado River drainage area which includes portions of Arizona, Nevada, Utah, Wyoming, Colorado, New Mexico, and Mexico.

A significant geographical feature of the Region is the Salton Trough, which contains the Salton Sea and the Coachella and Imperial Valleys. The two valleys are separated by the Salton Sea, which covers the lowest area of the depression. The trough is a structural extension of the Gulf of California. In prehistoric times it contained the ancient Lake Cahuilla (not to be confused with the present Lake Cahuilla which is located at the terminus of the Coachella Branch of the All-American Canal). Much of the agricultural economy and industry of the Region is located in the Salton Trough. There are also industries associated with agriculture, such as sugar refining. During the past several years there has been increasing development of geothermal industries. In the future, agriculture is expected to experience little growth in the Salton Trough, but there will likely be increased development of other industries (e.g. construction, manufacturing, and services).

The present Salton Sea, located on the site of a prehistoric lake, was formed between 1905 and 1907 by overflow of the Colorado River. Today, it serves as a drainage reservoir for irrigation return water and stormwater from the Coachella Valley, Imperial Valley, and Borrego Valley, and also receives drainage water from the Mexicali Valley in Mexico. The Sea is California's largest inland body of water and it provides a very important wildlife habitat and sportfishery.

Developments along California's 230 mile reach of the Colorado River, which flows along the eastern boundary of the Region, include agricultural areas in Palo Verde Valley and Bard Valley, urban centers at Needles, Blythe, and Winterhaven, several transcontinental gas compressor stations, and numerous small recreational communities. Some mining operations are located in the surrounding mountains. Also the Fort Mojave, Chemehuevi, Colorado River, and Yuma Indian Reservations are located along the River.

B. GEOLOGY

The mountains of the Region consist mainly of metamorphic and igneous rocks of pre-Cambrian to Tertiary age, and the sediments in the intervening valleys are generally weakly consolidated to unconsolidated sediments of late Cenozoic age. Northwest-trending faults are extensive and are a major factor in determining the configuration of the land. The well known San Andreas Fault Zone cuts diagonally across the southwesterly portion of the Region and borders the highlands on the northeast side of the Salton Trough. Borrego Valley is a typical valley formed by the San Jacinto Fault. The valleys, mountains, and dry lakes generally trend toward the northwest as oriented by the major fault systems.

The Coachella and Imperial Valleys were created when the Colorado River formed a delta that isolated the Salton Trough from the Gulf of California. Subsequently, under desert conditions, the inland sea dried up. Later, the trough was occupied by lakes for various periods, and deposition into these lakes gives the valleys their characteristic flat lands and fertile soils.

The Anza-Borrego planning area is made up of the Old California batholith that has been weathered and eroded. Today only low dissected hills remain.

The East Colorado River Basin planning area consists of a sediment-filled structural trough. Deep alluvial deposits composed of silt, clay, and sand were laid down by ancestral streams of the present Colorado River system.

C. MAJOR HYDROLOGIC FEATURES

The Colorado River is the most important waterway in the Region. The River supplies water for use within the Region and elsewhere. Regional drainage to the River is from a strip about 200 miles long, with a watershed which (in California) ranges from 7 to 40 miles in width. This watershed strip is referred to as the East Colorado River Basin.

Near Parker Dam, water is diverted by the Metropolitan Water District for export through the Colorado River Aqueduct to coastal counties. The dam forms Lake Havasu, a major recreational development. At Palo Verde Diversion Dam, water is diverted for irrigation in Palo Verde Valley. At Imperial Dam, water is diverted to the All-American Canal, which conveys water in California to the Bard Valley, and to the agricultural areas of the Imperial and Coachella Valleys.

Apportionment of water available for diversion from the River is made in accordance with a number of documents collectively referred to as the Law of the River. These include interstate compacts, federal legislation, water delivery contracts, state legislation, a treaty with Mexico, United States Supreme Court decrees, and federal administrative actions. Presently, California is receiving waters unused by other states. When Arizona is diverting its full apportionment, it is anticipated that there will be only infrequent periods of surplus, and California's diversions will be limited to its basic apportionment of 4.4 million acre-feet per year.

Regional drainage waters resulting from Colorado River diversions and use, and which do not return to the Colorado River, drain into the Salton Sea. That portion of the Region that does not drain into the Colorado River is referred to as the Colorado River Basin (West) or West Basin.

Much of the northern portion of the West Basin drains to several individual internal sinks or playas, while the southern portion generally drains to the Salton Sea. The Imperial and Coachella Valleys contain numerous drains that transport irrigation return flows and stormwater, as well as canals for importation and distribution of Colorado River water.

The Salton Sea, which is replenished principally by irrigation drainage and stormwater, is the largest body of water in the West Basin. The Sea serves as a reservoir to receive and store agricultural drainage and seepage waters, but also provides important wildlife habitat and is used for recreational purposes which include boating and fishing. Several smaller constructed recreational lakes are located in the Imperial Valley. In addition, Lake Cahuilla in Coachella Valley is used to store Colorado River water for irrigation and recreational purposes.

D.CLIMATE

The Region has the driest climate in California. The winters are mild and summers are hot. Temperatures range from below freezing to over 120°F. In the Colorado River valleys and the Salton Trough frost is a rare occurrence, and crops are grown all year round.

Snow falls in the Region's higher elevations, with mean seasonal precipitation in the upper San Jacinto and San Bernardino Mountains ranging from 30 to 40 inches. The lower elevations receive relatively little rainfall. An average of about four inches of precipitation occurs along the Colorado River, with much of this coming from late summer thunderstorms moving north from Mexico.

Typical mean seasonal precipitation in the desert valleys is 3.6 inches at Indio and 3.2 inches at El Centro. Precipitation over the entire area occurs mostly from November through April, and August through September, but its distribution and intensity are often sporadic. Local thunderstorms may contribute all the average seasonal precipitation at one time, or only a trace of precipitation may be recorded at any locale for the entire season.

E. FISH AND WILDLIFE RESOURCES

The Region provides habitat for a variety of native and introduced species of wildlife. Increasing human population and its associated development have adversely affected the habitat for some species, while enhancing it for others.

Large areas within the Region are inhabited by animals tolerant of arid conditions, including small rodents, coyotes, foxes, birds, and a variety of reptiles. Along the Colorado River and in the higher elevations of the San Bernardino and San Jacinto Mountains, where water is more abundant, deer, bighorn sheep, and a diversity of small animals exist.

Practically all of the fishes inhabiting the Region are introduced species. The most abundant species in the Colorado River and irrigation canals include largemouth bass, smallmouth bass, flathead and channel catfish, yellow bullhead, bluegill, redear sunfish, black crappie, carp, striped bass, threadfin shad, red shiner, and in the colder water above Lake Havasu, rainbow trout. Grass carp have recently been introduced into sections of the All American Canal system for aquatic weed control. Fishes inhabiting agricultural drains in the Region generally include mosquito fish, mollies, red shiners, carp, and tilapia, although locally significant populations of catfish, bass, and sunfish occur in some drains. A considerable sportfishery exists in the Salton Sea, with orangemouth corvina, gulf croaker, sargo, and tilapia predominating.

The Salton Sea National Wildlife Refuge and state waterfowl management areas are located in or near the Salton Sea. The refuge supports large numbers of waterfowl in addition to other types of birds. Located along the Colorado River are the Havasu, Cibola and Imperial National Wildlife Refuges.

The Region provides habitat for certain endangered/threatened species of wildlife including desert pupfish, razorback sucker, Yuma clapper rail, black rail, least Bell's vireo, yellow billed cuckoo, desert tortoise, and peninsular bighorn sheep.

VI. PLANNING AREAS

For planning and reporting purposes, the Region has been divided into the following seven major planning areas on the basis of different economic and hydrologic characteristics (Plate 1-1):

- Lucerne Valley
- Hayfield
- Coachella Valley
- Anza-Borrego
- Imperial Valley
- Salton Sea
- East Colorado River Basin

A. LUCERNE VALLEY PLANNING AREA

The Lucerne Valley planning area comprises many small internal drainage basins which cover 6,500 square miles, approximately the northern third of the West Basin. In the upper desert, which contains Lucerne Valley, Yucca Valley, Joshua Tree, and Twentynine Palms, precipitation is higher, and frost often occurs. The San Bernardino Mountains on the northwest have the highest peaks in the planning area, with elevations exceeding 7,000 feet.

1. Surface Water Hydrology

Precipitation occurs mostly as rainfall, with -some snowfall in the San Bernardino Mountains. Rainfall is sporadic, and amounts vary widely with location. Mean annual precipitation ranges from 16 inches in the San Bernardino Mountains to less than three inches in the Bristol Lake (dry) area. The average annual rainfall over the entire planning area is five inches. Little of the rainwater percolates into the ground water table and most is lost by evaporation and by evapotranspiration. Arrastre and Crystal Creeks are the most significant streams in the planning area.

2. Ground Water Hydrology

Ground water is stored principally in the unconsolidated alluvium. Except for areas near some of the dry lakes, ground water is unconfined. The depth of the water bearing deposits is not known, but the basins have accumulated hundreds of feet of sediments (e.g. 1,200 feet of sediments have been measured in the Dale Hydrologic Subunit).

Wells yield from a few gallons-per-minute (gpm) to 3,000 gpm. In 1970, depth to ground water ranged from flow at the surface to 445 feet in the Copper Mountain hydrologic unit.

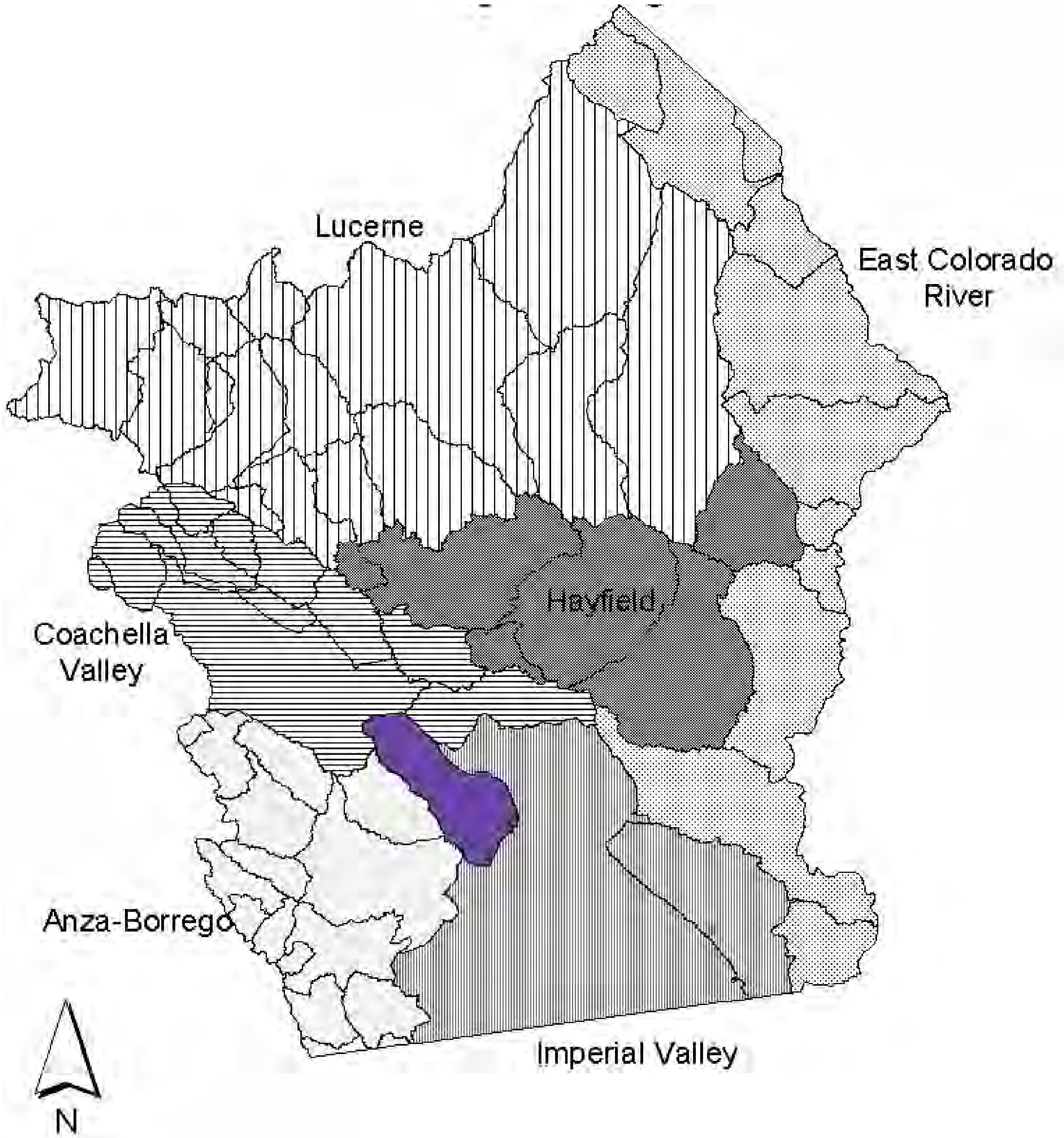
There may be some flow (less than an average 100 acre-feet per year) from the Lucerne Hydrologic unit into the Upper Mojave River Hydrologic Subunit in the South Lahontan Basin. There is also an undetermined amount of outflow from the Cadiz Hydrologic Unit into the Palen Hydrologic Subunit of the Hayfield Planning Area.

Ground water flow follows the general gradient of the land surface except in areas of heavy extraction and where subsurface flow may be affected by faults. The Baseline Fault along the south side of Twentynine Palms Valley causes a long linear zone of rising water covered by dense vegetation, which includes the Twentynine Palms Oasis. Another fault, the Mesquite Dry Lake Fault, intersects the Baseline Fault four miles east of Twentynine Palms and impedes ground water movement locally, causing a higher water table on the southwest side of the fault. Other faults have less effect on the hydrology, but may be responsible for high fluoride in the water and for high water temperatures. Wells in the Dale hydrologic unit yield water with temperatures ranging from 70^{o} to 118^{o}F.

B. HAYFIELD PLANNING AREA

The Hayfield Planning Area lies primarily in Riverside County and covers approximately 1,860 square miles. The Hayfield Planning Area is a desert, with barren mountains and valleys and with dry lake beds at the lower elevations.

PLATE 1-1. Colorado River Basin Planning Areas.



The area is bounded on the south by the Chuckwalla Mountains, and on the east by the McCoy Mountains. The highest elevation in the Planning Area is close to 5,000 feet, but most of the mountain tops are at lower elevations.

1. Surface Water Hydrology

   Average annual precipitation ranges from less than three inches in the lower valley to eight inches in the higher elevations of the Little San Bernardino Mountains. The average annual runoff for the area, which occurs principally during thunderstorms, is 5,000 acre-feet. No perennial streams flow in the planning area. Almost all the moisture from rain is lost through evaporation and evapotranspiration.

2. Ground Water Hydrology

   Runoff from the higher elevations is the main source of recharge of the ground water basins. Small amounts might percolate to the ground water table from direct precipitation. Water in storage is generally unconfined in the sediments that fill the valleys.

   Water levels range from ground surface down to 400 feet. Wells in the planning area yield from a few gpm to over 5,000 gpm. The water-bearing sediments have been penetrated to a depth of 1,200 feet. Most of the pumping in the area has been done by the Kaiser Steel Corporation for industrial use.

   Ground water flow generally follows the gradient of the land surface but may be affected by pumping depressions and by the local geology of the non-water-bearing rocks. An example is the subsurface basalt dike that impedes ground water movement at the east end of the Pinto hydrologic subunit and prevents flow into the adjoining Palen Hydrologic Subunit.

C. COACHELLA VALLEY PLANNING AREA

This planning area contains the Whitewater Hydrologic Unit and the East Salton Sea Hydrologic Unit. It lies almost entirely in Riverside County and covers 1,920 square miles in the west central portion of the Region. The San Bernardino Mountains and the Little San Bernardino Mountains form the northern boundary.

The San Jacinto and Santa Rosa Mountains and the Salton Sea shoreline form the western and southern boundaries. Elevations range from over 10,000 feet in the San Jacinto Mountains to 230 feet below sea level at the Salton Sea shoreline.

The higher elevations of the San Bernardino and San Jacinto Mountains have evergreen forests with perennial streams. A contrasting scene is presented on the Coachella Valley floor where the land contains desert vegetation, except where the land has been irrigated with pumped ground water or with imported Colorado River water.

1. Surface Water Hydrology

   Average annual precipitation ranges from less than three inches in the valleys to 40 inches in the San Bernardino Mountains. Seasonal snows fall on the higher elevations in the San Bernardino and San Jacinto Mountains. In the valleys, precipitation from summer thunderstorms often exceeds that of winter.

   Runoff resulting from rains and snowmelt at the higher elevations is the major source of ground water replenishment. Perennial streams include the upper reaches of the San Gorgonio and Whitewater Rivers, and Palm Canyon, Tahquitz, Snow, Deep Canyon, Chino, and Andreas Creeks.

   The Whitewater River is the major drainage course in the Planning Area. There is perennial flow in the mountains, but because of diversions and percolation into the basin, the River becomes dry further downstream. The constructed downstream extension of the River channel known as the Coachella Valley Storm Water Channel, serves as a drainage way for irrigation return flows, treated community wastewater, and storm runoff.

   There is one relatively large surface water impoundment. Lake Cahuilla, at the terminus of the Coachella Canal, serves as a storage reservoir to regulate irrigation water demands, and is also used for recreational purposes.

2. Ground Water Hydrology

Ground water is stored principally in the unconsolidated Pleistocene sediments. Wells yield up to 4,000 gpm. Maximum thickness of the water-bearing sediments is not known; however, it exceeds 1,000 feet in Coachella Valley.

Ground water is generally unconfined except in the lower areas of the Coachella Valley. A clay aquitard, a result of past sedimentation in the old lake bed, extends from the Salton Sea to some distance west of Indio, overlying the domestic-use aquifers. The clay layer underlies lenses of permeable sediments and perched ground waters which are replenished by percolating irrigation water.

The planning area is faulted extensively, altering ground water movement. The Mission Creek, Banning, and San Andreas Faults form effective barriers to ground water movement. The Indio Hills, Garnet Hills, and Mecca Faults form partial barriers.

The Indio and Mecca Hills have been uplifted along the northwest-trending San Andreas Fault system. The alignment of oases on the flanks of those hills results from faults that impede the movement of ground water. The most prominent of these oases is the Thousand Palms Oasis on the Mission Creek Fault.

D.ANZA-BORREGO PLANNING AREA

This Planning Area includes the Clark, West Salton Sea, and Anza-Borrego Hydrologic Units. It comprises 1,000 square miles in the southwest corner of the Region, mostly in San Diego and Imperial Counties, with a small segment in Riverside County.

Elevations range from 230 feet below sea level at the Salton Sea to over 6,000 feet along the western boundary. The principal communities in the planning area are Salton City and Borrego Springs.

1. Surface Water Hydrology

Drainage flows to the Salton Sea except for two small areas of internal drainage in Clark and Borrego Valleys in the northwest corner of the planning area.

Average annual precipitation ranges from less than three inches along the eastern boundary, near Imperial Valley, to 25 inches in the mountain divide between the Salton Sea and Pacific Ocean drainages. Runoff occurs from winter precipitation especially in the higher elevations and from summer thunderstorms. Perennial flow includes reaches of Coyote and San Felipe Creeks.

2. Ground Water Hydrology

Ground water is pumped principally from the unconsolidated Pleistocene sediments, but some is pumped from low-yield wells that extend to weathered and fractured bedrock.

Ground water flows in the same general direction as surface water to Clark Lake, Borrego Sink, and the Salton Sea. However, this subsurface flow is affected by pumping and may be impeded by faults. About 10,000 acre-feet of subsurface flow reaches the Salton Sea annually. A safe yield of 22,000 acre-feet/year is estimated for the Planning Area. Storage capacity of the ground water basin is estimated at seven million acre-feet.

E. IMPERIAL VALLEY PLANNING AREA

This Planning Area comprises 2,500 square miles in the southern portion of the Region, almost all of it in Imperial County. The easterly and westerly boundaries are contiguous with the westerly and easterly boundaries of the East Colorado River Basin and the Anza-Borrego Planning Area, respectively. Its northerly boundary is along Salton Sea and the Coachella Valley Planning Area and its southerly boundary follows the International Boundary with Mexico. The Planning Area's central feature is the flat, fertile Imperial Valley. The principal communities are El Centro, Brawley, and Calexico.

1. Surface Water Hydrology

Surface waters mostly drain toward the Salton Sea. The New and Alamo Rivers convey agricultural irrigation drainage water from farmlands in the Imperial Valley, surface runoff, and lesser amounts of treated municipal and industrial waste waters from the Imperial Valley. The flow in the New River also contains agricultural drainage, treated and untreated sewage, and industrial waste discharges from Mexicali, Mexico.

Average annual precipitation ranges from less than three inches over most of the planning area to about eight inches in the Coyote Mountains on the western border.

Colorado River water, imported via the All American Canal, is the predominant water supply and is used for irrigation, industrial, and domestic purposes.

2. Ground Water Hydrology

Ground water is stored in the Pleistocene sediments of the valley floor, the mesas on the west, and the East Mesa and sand hills on the east. However, the fine-grained lake sediments in the central portion of Imperial Valley inhibit ground water movement, and tile-drain systems are utilized to dewater the sediments to a depth below the root zone of crops and to prevent the accumulation of saline water on the surface.

Few wells have been drilled in these lake sediments because the yield is poor and the water is generally saline. The few wells in the Valley are for domestic use only. In the Coyote Wells Hydrologic Subunit and Davies Hydrologic Unit, which are at higher elevations, the water yield from wells is higher, and the waters are of lower salt concentration. Ground water is the main water supply in those areas.

Factors that diminish ground water reserves are consumptive use, evapotranspiration, evaporation from soils where ground water is near the surface, and losses through outflow and export.

F. SALTON SEA PLANNING AREA

This planning area consists entirely of the Salton Sea, which is a saline body of water in a natural sink between the Imperial and Coachella Valleys, in Riverside and Imperial Counties. The sea is 30 miles long, about 10 to 15 miles wide, with an average depth of 30 feet. It has an area of approximately 360 square miles, and its surface elevation, although variable, is approximately 227 feet below mean sea level. The climate is arid, and average annual precipitation is about 2.6 inches.

Replenishment of the Salton Sea is predominantly from farm drainage and seepage, and occasional and sometimes significant storm runoff, from the Coachella Valley, Imperial Valley, and Anza-Borrego area in this Region, and from the Mexicali Valley in Mexico. The gross contributing watershed comprises about 7,500 square miles.

G. EAST COLORADO RIVER BASIN PLANNING AREA

The East Colorado River Basin Planning Area, encompasses the eastern portion of San Bernardino, Riverside, and Imperial Counties. It is bounded on the north by Nevada, on the east by the Colorado River, which generally forms the Arizona-California state line, on the south by Mexico, and on the west by the drainage division of the California streams and washes directly tributary to the Colorado River. The planning area is 200 miles long, with a maximum east-west width of 40 miles. The area is characterized by desert valleys and low mountains that are generally less than 4,000 feet above sea level. The Palo Verde and Bard Valleys are within this planning area.

1. Surface Water Hydrology

Precipitation is 3-4 inches annually with about half of this occurring from summer thunderstorms, and the other half from generally weak winter storms.

All drainage flows to the Colorado River except for a minor amount which flows into the Colorado River aqueduct via Gene Wash and Copper Basin Reservoirs.

Perennial flow is limited to the Colorado River, and associated drains, canals, and aqueducts. Piute Creek, a small stream northwest of Needles flows perennially for about a mile before infiltrating into the ground.

2. Ground Water Hydrology

Ground water is generally unconfined in all four hydrologic units of the Planning Area. However, some confined zones probably exist in the more than 700 feet of alluvial sediments that form the aquifers in three of the units.

Some subsurface water probably enters the Planning Area from other than the Colorado River. However, no data is available upon which to base an estimate. The subsurface inflow from Nevada into the Piute Hydrologic Subunit and from the Chuckwalla and Rice Hydrologic Units into the Palo Verde and Vidal Hydrologic Subunits, respectively, may be significant in terms of the limited capacity of these subunits.

About 10,000 acre-feet of precipitation deep-percolates annually. The combined total storage capacity of all hydrologic units is about 35 million acre-feet within a selected 200-foot zone that lies above the base of the deepest well in each hydrologic unit. In three hydrologic units, wells are 300 feet or more deep.

CHAPTER 2 - BENEFICIAL USES

Division 7 of the California Water Code (also known as the Porter-Cologne Water Quality Control Act) requires the Regional Board to consider past as well as present and probable future beneficial uses when establishing water quality objectives. Section 13050 (f) of said Division 7 describes "beneficial uses" as follows:

> "Beneficial uses of the waters of the State that may be protected against quality degradation include, but are not necessarily limited to, domestic, municipal, agricultural, and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves."

Beneficial water uses are of two types - consumptive and nonconsumptive. Consumptive uses are those normally associated with people's activities, primarily municipal, industrial and irrigation uses that consume water and cause corresponding reduction and/or depletion of water supply. Nonconsumptive uses include swimming, boating, waterskiing, fishing, hydropower generation, and other uses that do not significantly deplete water supplies. Maintenance of fish and wildlife may be either a consumptive or a nonconsumptive use. Because each use may be best served by a specific set of water quality conditions, beneficial uses are a controlling factor in establishing water quality objectives for a particular body of water.

I. PAST OR HISTORICAL BENEFICIAL USES

Historical beneficial uses of water within the Colorado River Basin Region have largely been associated with irrigated agriculture and mining. With the discovery of gold in the East Colorado River Basin about 1860, mining activities began at Picacho, California. Crops were also grown along the Colorado River to graze livestock.

In 1877, the first request was filed for use of the Colorado River water in Palo Verde Valley, California, for agricultural, mining, manufacturing, domestic, and commercial purposes.

In 1901, water was first delivered to Imperial Valley through the Canal del Alamo and was used to irrigate land. With the completion of Hoover Dam in 1935 and the All-American Canal in 1940, most of the land in the Imperial Valley was developed for agriculture. In 1949, the Coachella branch of the All-American Canal was completed which delivers water for irrigation and other beneficial uses in Coachella Valley. Today approximately 500,000 acres in Imperial Valley and about 70,000 acres in Coachella Valley are under cultivation.

Executive Order of Withdrawal (Public Water Reserve No. 114, California No. 26), signed by the President of the United States on February 26, 1928, withdrew from all forms of entry all public lands of the United States in the Salton Sea area lying below the elevation of 220 feet below sea level for the purpose of creating a reservoir in Salton Sea for storage of wastes and seepage water from irrigated land in the Imperial Valley.

By the 1920's, large acreages of land in Palo Verde Valley were being irrigated with Colorado River water. A few years later, canals were constructed to irrigate land within the Bard Valley. At present, about 92,000 acres in Palo Verde Valley and about 14,000 acres in Bard Valley are under cultivation.

Availability of good quality ground water has been very important in the development of many areas including Coachella Valley, Borrego Springs, Morongo Valley, Twentynine Palms, Joshua Tree, Yucca Valley, Lucerne Valley, and Desert Center.

Industrial use of water has become increasingly important in the Region, particularly in the agricultural areas. Recreational use (both contact and non-contact uses) of the Colorado River and Salton Sea is a very important use of these waters; and this use supports millions of dollars worth of recreational oriented businesses.

The surface waters in the Region provide habitat for the support of a variety of fish and wildlife.

Definitions and abbreviations of beneficial use categories are listed in Table 2-1.

II. PRESENT BENEFICIAL USES

From a quantity standpoint, agricultural use is the predominant beneficial use of water in the Colorado River Basin Region, with the major irrigated acreage being located in the Coachella, Imperial and Palo Verde Valleys. The use of water for municipal and industrial purposes, which is second in quantity of usage, is also located largely in these valleys and in the Joshua Tree and Dale Hydrologic Units of the Lucerne Valley Planning Area. The third major category of beneficial use, recreational use of surface waters, represents another important segment of the Region's economy.

The beneficial uses found in many areas/hydrologic units today are the result of not only naturally occurring resources but also of improved technology and the importation of water into the Region. The importation of Colorado River water, via the Canal del Alamo, which began shortly after the turn of the century, and subsequently via the All-American Canal, has resulted in numerous supply canals, drainage channels, and water bodies where previously surface waters were non-existent, intermittent, or limited in nature. The development of deep well drilling and pumping technology allowed development in areas of the Region where water supplies were previously not available. Since the mid-1970's, a portion of the Colorado River water which is imported via the California Aqueduct by the Metropolitan Water District of Southern California is used for ground water recharge in the upper portions of Coachella Valley.

The primary purpose of the Salton Sea and the agricultural drains in the Imperial, Palo Verde, Coachella, and Bard Valleys is for collection, transport, and/or storage of drainage (including subsurface) waters from irrigated cropland in order to maintain adequate soil salinity balance for agriculture in the Region. Although this is clearly the primary purpose of these waters, this cannot be recognized as a beneficial use in Tables 2-2 and 2-3 since federal regulations specify that waste transport or assimilation cannot be designated as a beneficial use for any waters of the United States (as per Clean Water Act, 40 CFR Section 131.10 (a)).

Most of the data contained in Tables 2-2, 2-3, and 2-4 uses is based on information compiled in the following reports:

- Surface Water Survey, March 1984 (revised September 1988);
- Survey of Springs, 1984; and
- Survey of Springs, 1986.

In Tables 2-2, 2-3, and 2-4 present beneficial uses are designated by X, potential beneficial uses are designated by P, and intermittent uses by I. Intermittent uses include those uses which occur only seasonally because of limiting environmental conditions (e.g. provide habitat for trout during colder months of the year), and uses which are dependent on and occur only when sufficient flow exists.

Identification of beneficial uses of surface waters is based strictly on documentation of the existence of those uses and should not in any way be construed to indicate Regional Board authorization or approval of the uses. In some instances water quality may not be adequate to support beneficial uses indicated, or beneficial uses may be occurring illegally[1] or without authorization (for example: fishing in Coachella Valley drains[2]).

The beneficial uses for ground water which are contained in Table 2-5 are for each hydrologic unit as an entirety, unless otherwise specified. Some hydrologic units contain multiple aquifers which may each support different beneficial uses.

III. POTENTIAL BENEFICIAL USES

Beneficial uses of surface water and ground water in the Region are expected to change little, if at all, between now and the year 2000. Tables 2-2, 2-3 and 2-4 are also valid for potential beneficial uses. However, the relative amount of water resource used for each category of beneficial use may change during the above period.

The existing quality of water in the New and Alamo Rivers limits the present beneficial uses of these waters. Existing beneficial uses for these Rivers are indicated in Table 2-3. When Mexico corrects its present discharges of raw and inadequately treated sewage and other wastes into the New River, beneficial uses of New River water are expected to increase, particularly fish and wildlife, and non-contact water recreational use. The Rivers also have potential

[1] "Illegal" means that the access to the surface waters is not allowed by the agency which owns, operates and maintains those bodies of waters.

[2] Documentation of unauthorized fishing in Coachella Valley drains is cited in: 208 Planning Study, Agricultural Wastewater Practices, 1978, CVWD.

for hydropower generation and as cooling/replenishment water for production of geothermal energy.

Where REC I and II are indicated as potential uses in Tables 2-2, 2-3, and 2-4, the designations are solely intended to indicate that water quality of the designated waterways are believed to be satisfactory to support REC I or II usage, but not that REC I or II usage is either appropriate or suitable. For example, although a potential REC I use for the MWD aqueduct is indicated in Table 2-3, actual usage would be extremely dangerous and also illegal. For the purpose of applying water quality objectives, a potential REC I use would have the same significance as an existing REC I use.

IV. SOURCES OF DRINKING WATER POLICY[3]

The following "Sources of Drinking Water" policy as adopted by the State Board on May 19, 1988 (Resolution No. 88-63) shall apply to all waters of the Region:

All surface and ground waters are considered to be suitable, or potentially suitable, for municipal or domestic water supply with the exception of:

A. SURFACE AND GROUND WATERS WHERE:

1. The total dissolved solids (TDS) exceed 3,000 mg/l (5,000 us/cm, electrical conductivity), and it is not reasonably expected by the Regional Board to supply a public water system, or

2. There is contamination, either by natural processes or by human activity (unrelated to a specific pollution incident), that cannot reasonably be treated for domestic use using either Management Practices or best economically achievable treatment practices, or

3. The water source does not provide sufficient water to supply a single well capable of producing an average, sustained yield of 200 gallons per day.

B. SURFACE WATERS WHERE:

1. The water is in systems designed or modified to collect or treat municipal or industrial wastewaters, process waters, mining wastewaters, or storm water runoff, provided that the discharge from such systems is monitored to assure compliance with all relevant water quality objectives as required by the Regional Board; or,

2. The water is in systems designed or modified for the primary purpose of conveying or holding agricultural drainage waters, provided that the discharge from such systems is monitored to assure compliance with all relevant water quality objectives as required by the Regional Board.

C. GROUND WATERS WHERE:

1. The aquifer is regulated as a geothermal energy producing source or has been exempted administratively pursuant to 40 Code of Federal Regulations, Section 146.4 for the purpose of underground injection of fluids associated with the production of hydrocarbon or geothermal energy, provided that these fluids do not constitute a hazardous waste under 40 CFR, Section 261.3.

D. REGIONAL BOARD AUTHORITY TO AMEND USE DESIGNATIONS:

Any body of water which has a current specific designation previously assigned to it by the Regional Board in the Water Quality Control Plan may retain that designation at the Regional Board's discretion. Where a body of water is not currently designated as MUN but, in the opinion of the Regional Board, is presently or potentially suitable for MUN, the Regional Board shall include MUN in the beneficial use designation. The Regional Board shall assure that the beneficial uses of municipal and domestic supply are designated for protection wherever those uses are presently being attained, and assure that any

[3] This policy does not affect any determination of what is a potential source of drinking water for the limited purposes of maintaining a surface water impoundment after June 30, 1988, pursuant to Section 25208.4 of the Health and Safety Code.

changes in beneficial use designations for waters of the State are consistent with all applicable regulations adopted by the U.S. Environmental Protection Agency.

Tables 2-4 and 2-5 have not yet been modified to reflect this policy, but may be modified in future updates of this Plan after sufficient information has been collected to make determinations based on this policy.

TABLE 2-1: DEFINITIONS OF THE BENEFICIAL USES OF WATER

CATEGORY		DEFINITION
MUN	Municipal and Domestic Supply	Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.
AGR	Agriculture Supply	Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.
AQUA	Aquaculture	Uses of water for aquaculture or mariculture operations including, but not limited to, propagation, cultivation, maintenance, or harvesting of aquatic plants and animals for human consumption or bait purposes.
IND	Industrial Service Supply	Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, and oil well repressurization.
GWR	Ground Water Recharge	Uses of water for natural or artificial recharge of ground water for purposes of future extraction, maintenance of water quality, or halting salt water intrusion into fresh water aquifers.
REC I	Water Contact Recreation	Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, and use of natural hot springs.
REC II	Non-Contact Water Recreation	Uses of water for recreational activities involving proximity to water, but not normally involving contact with water where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.
WARM	Warm Freshwater Habitat	Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

TABLE 2-1 (CONT.)

DEFINITIONS OF THE BENEFICIAL USES OF WATER

CATEGORY		DEFINITION
COLD	Cold Freshwater Habitats	Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.
WILD	Wildlife Habitat	Uses of water that support terrestrial ecosystems including, but not limited to, the preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.
POW	Hydropower Generation	Uses of water for hydropower generation.
FRSH	Freshwater Replenishment	Uses of water for natural or artificial maintenance of surface water quantity or quality.
RARE	Preservation of Rare, Threatened, or Endangered Species	Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened or endangered.

TABLE 2-2: BENEFICIAL USES OF SURFACE WATERS IN THE EAST COLORADO RIVER BASIN
(Listing of the beneficial uses is indicated by X for existing uses,
P for potential uses, and I for intermittent uses)

	MUN	AGR	AQUA	FRSH	IND	GWR	RECI	RECII	WARM	COLD	WILD	POW	RARE
Rivers/Streams													
Colorado River and associated lakes and reservoirs	X	X	X		X	X	X	X	X	X[1]	X	X	X
Copper Basin Creek	P					X	X[2]	X[2]	X		X		X
Piute Creek	P	X				X	X	X	X		X		X
Lakes													
Haughtelin Lake	P	X					X	X	X		X		
West Pond	P						X	X	X		X		X
Canals/Aqueducts													
Bard Valley Canals	X	X				X	X[2]	X	X		X	P	
Palo Verde Valley Canals	P	X	X			X[3]	X[2]	X[2]	X		X		
Drains													
Bard Valley Drains							X[8]	X	X		X		
Palo Verde Valley Drains							X[8]	X[2]	X		X		
Palo Verde Lagoon and Outfall Drain							X[4]	X[4]	X		X		X
Other													
Unlisted Perennial and Intermittent Streams	P[5]					I X	I P X	I X	I X		I X		[6]
Washes (Ephemeral Streams)						I		I	[7]		I		

Footnotes for Table 2-2

1. Limited to reach from Parker Dam to Nevada State Line.

2. Unauthorized Use.

3. Palo Verde Irrigation District regards any loss of water through seepage from the canals as entirely detrimental to their operations, despite any corollary benefit which occurs from recharging the local ground water basin.

4. Unauthorized use within Riverside County portion of flow.

5. Potential use designation will be determined on a case-by-case basis as necessary in accordance with the "Sources of Drinking Water Policy" in this chapter.

6. Rare, endangered, or threatened wildlife may exist in or utilize some of these waterways. If the RARE beneficial use may be affected by a water quality control decision, responsibility for substantiation of the existence of rare, endangered, or threatened species on a case-by-case basis is upon the California Department of Fish and Game on its own initiative and/or at the request of the Regional Board; and such substantiation must be provided within a reasonable time frame as approved by the Regional Board.

7. Use, if any, to be determined on a case-by-case basis.

8. The only REC I usage known to occur is from fishing activity.

TABLE 2-3: BENEFICIAL USES OF SURFACE WATERS IN THE WEST COLORADO RIVER BASIN
(Listing of the beneficial uses is indicated by X for existing uses,
P for potential uses, and I for intermittent uses)

	MUN	AGR	AQUA	FRSH	IND	GWR	RECI	RECII	WARM	COLD	WILD	POW	RARE
Canals/Aqueducts													
All American Canal System	X	X	X	X[1]	X	X	X[2]	X[2]	X		X	X	X[13]
Coachella Canal	P	X				X	X[2]	X[2]	X		X		X[13]
MWD Aqueduct and Associated reservoirs	X					X	P[3]		X		X	P	
Drains													
Alamo River				X			X[16]	X	X		X	P	X[13]
Coachella Valley Drains				X			X[2]	X[2]	X		X		X[13]
Coachella Valley Storm Water Channel[4]				X			X[2]	X[2]	X		X		X[13]
Imperial Valley Drains				X			X[2, 16]	X[2]	X		X		X[13]
New River				X	P		X[5]	X	X		X		X[13]
Lakes													
Finney Lake							X[15]	X	X		X		X
Lake Cahuilla	P	X					X	X	X	I	X		
Ramer Lake							X	X	X		X		X
Salton Sea			X		P		X	X	X		X		X
Sunbeam Lake	P	X					X	X	X	I[6]	X		
Wiest Lake	P						X	X	X	I[6]	X		
Wister Unit							X[15]	X	X		X		X
Streams													
Andreas Creek	P	X				X	X	X	X		X		
Arrastre Creek	X				X	X	X	X	X		X		
Azalea Creek	P	X				X	X	X	X		X		
Banner Creek	P	X			X	X	X	X	X		X		
Big Morongo Creek	P	X				X	X[8]	X	X		X		

TABLE 2-3 (Cont.)
BENEFICIAL USES OF SURFACE WATERS IN THE WEST COLORADO RIVER BASIN

Streams (Cont.)	MUN	AGR	AQUA	FRSH	IND	GWR	REC I	REC II	WARM	COLD	WILD	POW	RARE
Borrego Palm Canyon Creek	P					X	X	X	X		X		X
Boundary Creek	P	X				X	X	X	X		X		
Brown Creek	P	I				I	I	I	I		I		
Carrizo Creek		X				X	X	X	X		X		X
Chino Canyon Creek	X					X	P	X	X		X		
Coyote Creek	P					X	X	X	X		X		X
Crystal Creek	X	X				X	X	X	X		X		
Dutch Creek	P	I				I	I	I	I		I		
Falls Creek	X					X	P	X[9]		X	X		
Grapevine Canyon Creek	P					X	X	X	X		X		
Hathaway Creek	P	X				X	P	X	X		X		
Little Morongo Creek	P	X				X	X	X	X		X		
Millard Canyon Creek	X	X				X	X	X	X		X		
Mission Creek	P	X				X	X	X	X		X		
Palm Canyon Creek	P	X				X	X	X	X		X		
Pipes Canyon Creek	P					I	I	I	I		I		
Potrero Creek	P	X				X	X	X	X		X		
Salt Creek				X		X	X	X	X		X		X
San Felipe Creek		X		X		X	X	X	X		X		X
San Gorgonio River	P	X				X	X	X		X	X		
Snow Creek	X					X	X	X[9]		X	X		
Tahquitz Creek	P					X	X	X		X	X		
Thousand Palms Canyon Creek	P	X				X	X[2]	X	X		X		
Tubb Canyon Creek	X					X	P	X	X		X		X
Tule Creek	P	X				X	X	X	X		X		

TABLE 2-3 (Cont.)

BENEFICIAL USES OF SURFACE WATERS IN THE WEST COLORADO RIVER BASIN

	MUN	AGR	AQUA	FRSH	IND	GWR	REC I	REC II	WARM	COLD	WILD	POW	RARE
Streams (Cont.)													
Twin Pines Creek	X	X				X	X	X	X		X		
Vallecito Creek	P	I				I	I	I	I		I		
Walker Creek	P	X				X	X	X	X		X		
Whitewater River[10]	X	X				X	X	X	I	X	X	X	
Willow Creek	P					X	X	X		X	X		
Other													
Unlisted Perennial and Intermittent Streams	P[11]			I X[12]		I X	I P X	I X	I X		I X		I X[13]
Washes[14] (Ephemeral Streams)				I[12]		I		I	[7]		I		

Footnotes for Table 2-3

1. Some very limited spillage of canal water occurs providing freshwater replenishment to Salton Sea.

2. Unauthorized use.

3. The water quality is satisfactory to support REC I use, although such use is strictly prohibited and would be extremely dangerous.

4. Section of perennial flow from approximately Indio to the Salton Sea.

5. Although some fishing occurs in the downstream reaches, the presently contaminated water in the river makes it unfit for any recreational use. An advisory has been issued by the Imperial County Health Department warning against the consumption of any fish caught from the river and the river has been posted with advisories against any body contact with the water.

6. The lake was experimentally stocked with trout during the winter of 1987/88. The results from this stocking will be evaluated to see if future stocking will be recommended.

7. Use, if any, to be determined on a case-by-case basis.

8. Although it is not encouraged, children play in the water infrequently on the wildlife reserve.

9. Most of the creek is on National Forest Service land except one section which is owned by Desert Water Agency. This section provides the only reasonable access to the area. To enter Falls or Snow Creek through Desert Water Agency's land, a permit is required. The permit stipulates that persons entering through DWA's land must agree not to swim, fish, or wade in any portion of the creek.

10. Includes the section of flow from the headwaters in the San Gorgonio Mountains to (and including) the Whitewater Recharge Basins near Indian Avenue crossing in Palm Springs.

11. Potential use designations will be determined on a case-by-case basis as necessary in accordance with the "Sources of Drinking Water Policy" in this chapter.

12. Applies only to tributaries to Salton Sea.

13. Rare, endangered, or threatened wildlife exists in or utilizes some of these waterway(s). If the RARE beneficial use may be affected by a water quality control decision, responsibility for substantiation of the existence of rare, endangered, or threatened species on a case-by-case basis is upon the California Department of Fish and Game on its own initiative and/or at the request of the Regional Board; and such substantiation must be provided within a reasonable time frame as approved by the Regional Board.

14. Including the section of ephemeral flow in the Whitewater River Storm Water Channel and Coachella Valley Storm Water Channel from Indian Avenue to approximately 1/4 mile west of Monroe Street crossing.

15. The California Department of Fish and Game manages these lakes and does not permit swimming in them.

16. The only REC I usage that is known to occur is from infrequent fishing activity.

TABLE 2-4: BENEFICIAL USES OF WATERS FROM SPRINGS IN THE COLORADO RIVER BASIN

(Listing of the beneficial uses is indicated by X for existing uses and P for potential uses. Flow in some springs is intermittent)

	MUN[3]	AGR	AQUA	FRSH	IND	GWR	REC I	REC II	WARM	COLD	WILD	POW	RARE
Lucerne Hydrologic Unit													
Bousic Spring 3N/1E - 7QS					X	X	P	P	X		X		
Veale Spring 3N/1E - 18NS					X	X	P	P		X	X		
Nett Spring 3N/1E - 18NS					X	X	P	P		X	X		
Box Spring 4N/1E - 33RS	X					X	P	P	X		X		
Gordon Spring 3N/1W - 13GS					X	X	P	P		X	X		
Furnace Spring 3N/1W - 12JS		X				X	P	X	X	X	X		
Arctic Canyon Spring 3N/1E - 17RS				X	X	X	P	P		X	X		
Rabbit Spring 4N/1W - 11DS		X				X	P	X		X	X		
Crystal Spring 3N/1W - 11RS	X	X		X		X	P	X	X	X	X		
Johnson Hydrologic Unit													
Rattlesnake Spring 3N/3E - 19HS1		X				X	P	P		X	X		
Two Hole Spring 3N/3E - 20CS1		X				X	P	P		X	X		
Old Woman Spring 4N/3E - 31FS1	X	X				X	X	X	X		X		
Anza-Borrego Hydrologic Unit													
Santa Rosa Spring 7S/5E - 28AS				X		X	X	X		X	X		
CYCC #1 Spring 11S/5E - 22CS1		X				X	X	X	X		X		

TABLE 2-4 (Cont.)

BENEFICIAL USES OF WATERS FROM SPRINGS IN THE COLORADO RIVER BASIN

	MUN[3]	AGR	AQUA	FRSH	IND	GWR	REC I	REC II	WARM	COLD	WILD	POW	RARE
Anza-Borrego HU (Cont.)													
CYCC #2 Spring 11S/5E - 22CS2		X				X	X	X	X		X		
Dubber Spur Spring 17S/8E - 29LS1X				X		X	P	X	X		X		
Jacumba Spring 18S/8E - 7JS				X		X	P	X	X		X		
Palm Spring 14S/7E - 25PS						X	P	X	X		X		X
Agua Caliente Spring 14S/7E - 18PS		X				X	X	X	X		X		
Bristol Hydrologic Unit													
Van Winkle Spring 8N/13E - 23DS		X				X	P	X		X	X		
Cove Spring 8N/13E - 18FS	X					X	P	P	X		X		
Mitchell Caverns Spring 10N/14E - 21GS	X					X	P	P		X	X		
Bonanza Spring 7N/15E - 22DS	X					X	P	X	X		X		
Rock Spring 12N/15E - 1DS		X				X	X	X		X	X		
Cave Spring[1, 2] 11N/15E - 32DS1		X				X	P	P	X		X		
Hackberry Spring[1, 2] 11N/16E - 1PS1		X				X	P	P	X		X		
Bathtub Spring[1] 13N/15E - 9NS1		X				X	P	P	X		X		
Roth Spring[1] 11N/14E - 11FS1		X				X	P	P	X		X		
Desert Spring[1] 10N/16E - 18GS1		X				X	P	P	X		X		

TABLE 2-4 (Cont.)

BENEFICIAL USES OF WATERS FROM SPRINGS IN THE COLORADO RIVER BASIN

	M[3] U N	A GR	A Q U A	F R S H	I N D	G W R	R E C I	R E C II	W A RM	CO L D	W I L D	P O W	RA R E
Bristol HU (Cont.)													
Forshay Spring[1, 2] 10N/14E - 32GS2		X				X	P	X	X		X		
Imperial Hydrologic Unit													
Mountain Spring 17S/8E - 24JS				X		X	P	X	X		X		
Whitewater Hydrologic Unit													
Agua Caliente Spring 4S/4E - 14ES	X					X	X	P	X		X		
Thousand Palms Oasis (Lower) 4S/6E - 12LS		X		X		X	P	X	X		X		
West Fork Spring 5S/4E - 14FS				X		X	X	X	X		X		
Cottonwood Spring 5S/11E - 14LS						X	P	X	X		X		X
Twin Pines Spring 3S/2E - 33AS		X				X	P	X	X		X		
Hidden Palms Spring 6S/6E - 30FS				X		X	X	X	X		X		X
Sheldon Bass Spring 1S/4E - 18BS1			X	X		X	X	X	X		X		P
Unnamed Spring 1S/4E - 18LS2		X		X		X	P	X	X		X		
Piute Hydrologic Unit													
Sacramento Spring 9N/21E - 3RS		X				X	P	X	X		X		
Kleinfelter Spring 9N/21E - 3JS	X	X				X	P	P	X		X		
Piute Spring 12N/18E - 24DS		X				X	P	X	X		X		
Von Trigger Spring[1] 11N/17E - 4RS1	X					X	P	P	X		X		

TABLE 2-4 (Cont.)

BENEFICIAL USES OF WATERS FROM SPRINGS IN THE COLORADO RIVER BASIN

	MUN[3]	AGR	AQUA	FRSH	IND	GWR	REC I	REC II	WARM	COLD	WILD	POW	RARE
Piute Hydrologic Unit (Cont.)													
Coates Spring[1] 15N/17E - 27HS1		X				X	P	P	X		X		
Malpais Spring[1, 2] 15N/17E - 22AS1	X	X				X	P	P	X		X		
Indian Spring[1, 2] 15N/17E - 16RS1		X				X	P	P	X		X		
Ward Hydrologic Unit													
Wilhelm Spring 5N/18E - 33FS		X				X	P	X	X		X		
Sunflower Spring 5N/18E - 7BS	X	X				X	P	X	X	X	X		
Colorado Hydrologic Unit													
Arrowweed Spring 11S/21E - 28AS		X				X	P	X	X		X		X
Miscellaneous													
Unlisted Springs						X	X P	X P	X[4]		X		X[5]

(see Footnotes Page 2-17)

The following springs have the same beneficial uses noted for Unlisted Springs (above):

Anza-Borrego Hydrologic Unit

Mountain Home Spring, 7S/5E - 29HS
Chimney Spring, 11S/5E - 15NS1
Jim Spring, 11S/5E - 16LS1
Pena Spring, 11S/5E - 10NS1
Carizzo Creek Spring, 17S/8E - 29NS
Arsenic Spring, 17S/8E - 32FS
Cotttonwood Spring, 11S/5E - 21HS1
Johnnie Spring, 11S/5E - 15MS3
By Jim Spring, 11S/5E - 16MS1
Kane Spring, 12S/11E - 21MS
Bankhead Spring, 17S/7E - 34JS
Lews Spring, 11S/5E - 15MS4
Rusty Spring, 11S/5E - 15MS2
Parali Spring, 11S/5E - 16CS1
Mountain Palm Spring, 15S/7E - 13PS
Sacatone Spring, 17S/7E - 2QS

East Salton Sea Hydrologic Unit

Canyon Spring, 7S/13E - 20MS1[1]

Bristol Hydrologic Unit

Woods Spring, 12N/15E - 34AS1[1, 2]
Blind Spring. 10N/14E - 28PS1[1]
Mail Spring, 14N/16E - 28JS2[1, 2]
Willow Well Spring, 11N/14E - 2B1[1]
Gold Valley Spring, 12N/15E - 31LS1[1, 2]
Goldstone Spring, 10N/14E - 31QS1[1, 2]
No Name Spring, 9N/14E - 3FS2[1]
Boulder Spring, 12N/15E - 27BS1[1, 2]
Keystone Spring, 14N/16E - 29MS1[1]
Bighorn Spring, 9N/14E - 29ES1[1]

Imperial Hydrologic Unit

Unnamed Spring, 9S/12E - 15AS
Frink Spring, 9S/13E - 20LS
Dos Cabezas Spring, 17S/8E - 3RS

Whitewater Hydrologic Unit

Willis Palms Spring, 4S/6E - 14DS
Rarick Spring, 7S/4E - 18FS
Mockingbird Spring, 1S/3E - 36BS1
Thousand Palms Oasis (upper), 4S/6E - 1PS
Cotton Spring, 5S/11E - 14CS
Magnesia Spring, 5S/5E - 23CS
Stubby Spring, 2S/7E - 27QS1

Piute Hydrologic Unit

Stagecoach Spring, 15N/17E - 25DS1[1, 2]

Joshua Tree Hydrologic Unit

Coyote Hole Spring, 1S/6E - 1GS

Dale Hydrologic Unit

Forty-Nine Palms Springs, 1S/8E - 12DS
Johnson Spring, 1S/8E - 16ES
Oasis of Mara, 1N/9E - 33GS

Footnotes for Table 2-4

1. U.S. Geological Survey Data

2. Bureau of Land Management Data

3. Many springs may have the potential to support a MUN beneficial use in accordance with the "Sources of Drinking Water Policy" (page 2-3). Only the springs with an existing MUN use are noted in this table.

4. And/or COLD

5. The RARE beneficial use occurs in at least some of these springs. If the RARE beneficial use may be affected by a water quality control decision, responsibility for substantiation of the existence of rare, endangered or threatened species on a case-by-case basis is upon the California Department of Fish and Game on its own initiative and/or at the request of the Regional Board; and such substantiation must be provided within a reasonable time frame as approved by the Regional Board.

TABLE 2-5: BENEFICIAL USES OF GROUND WATERS IN THE COLORADO RIVER BASIN[1]

Area Code	Hydrologic Unit	MUN[2]	IND	AGR
	Lucerne Valley Planning Area			
701.00	Lucerne hydrologic unit	X	X	X
702.00	Johnson hydrologic unit	X	X	X
703.00	Bessemer hydrologic unit			
704.00	Means hydrologic unit	X		
705.00	Emerson hydrologic unit	X		X
706.00	Lavic hydrologic unit			
707.00	Deadman hydrologic unit	X		
708.00	Joshua Tree hydrologic unit	X	X	
709.00	Dale hydrologic unit	X	X	X
710.00	Bristol hydrologic unit	X	X	X
711.00	Cadiz hydrologic unit	X	X	
712.00	Ward hydrologic unit	X		X
	Hayfield Planning Area			
716.00	Rice hydrologic unit	X		
717.00	Chuckwalla hydrologic unit	X	X	X
718.00	Hayfield hydrologic unit			
	Coachella Valley Planning Area			
719.00	Whitewater hydrologic unit			
719.10	Morongo hydrologic subunit[3]	X		
719.20	Shavers hydrologic subunit	X		
719.30	San Gorgonio hydrologic subunit	X	X	X
719.40	Coachella hydrologic subunit	X	X	X
725.00	East Salton Sea hydrologic unit	X		X
	Imperial Valley Planning Area			
723.00	Imperial hydrologic unit	X	X	
724.00	Davies hydrologic unit			
726.00	Amos-Ogilby hydrologic unit	X		

TABLE 2-5 (Cont.)

BENEFICIAL USES OF GROUND WATERS IN THE COLORADO RIVER BASIN[1]

Area Code	Hydrologic Unit	MUN[2]	IND	AGR
	Anza-Borrego Planning Area			
720.00	Clark hydrologic unit	X		
721.00	West Salton Sea hydrologic unit	X		X
722.00	Anza-Borrego hydrologic unit	X	X	X
	Colorado River Planning Area (East Colorado River Basin)			
713.00	Piute hydrologic unit	X	X	X
714.00	Chemehuevi hydrologic unit	X		X
715.00	Colorado hydrologic unit	X	X	X
727.00	Yuma hydrologic unit	X		X

Footnotes for Table 2-5

1. Ground waters are important to sustain vegetation for wildlife habitat in some areas where surface waters are not present.

2. At such time as the need arises to know whether a particular aquifer which has no known existing MUN use should be considered as a source of drinking water, the Regional Board will make such a determination based on the criteria listed in the "Sources of Drinking Water Policy" in Chapter 2 of this Basin Plan. An "X" placed under the MUN in this Table for a particular hydrologic unit indicates only that at least one of the aquifers in that unit currently supports a MUN beneficial use. For example, the actual MUN usage of the Imperial hydrologic unit is limited only to a small portion of that ground water unit.

3. The term "hydrologic subunit" has the same meaning as the term "hydrologic area".

CHAPTER 3 - WATER QUALITY OBJECTIVES

Section 13241, Division 7 of the California Water Code, specifies as follows:

> "Each regional board shall establish such water quality objectives in water quality control plans as in its judgement will ensure the reasonable protection of beneficial uses and the prevention of nuisance; however, it is recognized that it may be possible for the quality of water to be changed to some degree without unreasonably affecting beneficial uses..."

"Water quality objectives", as defined in said Division 7 are "limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area". Water quality objectives contained herein are designed to be in accordance with all pertinent State and Federal requirements.

Existing Statewide Plans and Policies of the State Water Resources Control Board that must be considered in establishing and implementing water quality objectives in the Colorado River Basin Region are listed in Chapter 5. Some of these statewide plans contain water quality objectives that apply to waters in this Region. However, most statewide objectives are not listed in this chapter but can be obtained by referring to the text of the statewide plans. In the event that statewide and regionwide objectives conflict the most stringent objective will apply.

The water quality objectives contained in this Plan supersede and replace those contained in the Water Quality Control Plan, dated May 1991, and any amendments thereto.

Controllable water quality factors shall conform to the water quality objectives contained herein. When other factors result in the degradation of water quality beyond the levels or limits established herein as water quality objectives, the controllable factors shall not cause further degradation of water quality. Controllable water quality factors are those actions, conditions, or circumstances resulting from people's activities which may influence the quality of the waters of the State and which may feasibly be controlled.

Actions to be taken by the Regional Board to achieve compliance with water quality objectives are described in the Implementation section of this Plan (see Chapter 4). Implementation actions directed toward nonpoint source discharges will be in conformance with the State Board's Nonpoint Source Management Plan, will be reasonable, and will consider economic and technical feasibility.

I. GENERAL OBJECTIVES

The following objective shall apply to all waters of the Region:

Wherever the existing quality of water is better than the quality established herein as objectives, such existing quality shall be maintained unless otherwise provided for by the provisions of the State Water Resources Control Board Resolution No. 68-16, "Statement of Policy with Respect to Maintaining High Quality of Waters in California".

II. GENERAL SURFACE WATER OBJECTIVES

Regarding controllable sources of discharge, in the absence of site specific objectives established herein, the following objectives apply to all surface waters of the Colorado River Basin Region:

A. AESTHETIC QUALITIES

All waters shall be free from substances attributable to wastewater of domestic or industrial origin or other discharges which adversely affect beneficial uses not limited to:

- Settling to form objectionable deposits;
- Floating as debris, scum, grease, oil, wax, or other matter that may cause nuisances; and
- Producing objectionable color, odor, taste, or turbidity.

B. TAINTING SUBSTANCES

Water shall be free of unnatural materials which individually or in combination produce undesirable flavors in the edible portions of aquatic organisms.

C. TOXICITY [1]

All waters shall be maintained free of toxic substances in concentrations which are toxic to, or which produce detrimental physiological responses in human, plant, animal, or indigenous aquatic life. Compliance with this objective will be determined by use of indicator organisms, analyses of species diversity, population density, growth anomalies, 96-hour bioassay or bioassays of appropriate duration or other appropriate methods as specified by the Regional Board. Effluent limits based upon bioassays of effluent will be prescribed where appropriate, additional numerical receiving water objectives for specific toxicants will be established as sufficient data become available, and source control of toxic substances will be encouraged.

The survival of aquatic life in surface waters subjected to a waste discharge or other controllable water quality factors, shall not be less than that for the same water body in areas unaffected by the waste discharge, or other control water which is consistent with the requirements for "experimental water" as described in Standards Methods for the Examination of Water and Wastewater, 18th Edition. As a minimum, compliance with this objective as stated in the previous sentence shall be evaluated with a 96-hour bioassay.

As described in Chapter 6, the Regional Board will conduct toxic monitoring of the appropriate surface waters to gather baseline data as time and resources allow.

D. TEMPERATURE

The natural receiving water temperature of surface waters shall not be altered by discharges of waste unless it can be demonstrated to the satisfaction of the Regional Board that such alteration in temperature does not adversely affect beneficial uses.

E. pH

Since the regional waters are somewhat alkaline, pH shall range from 6.0-9.0. Discharges shall not cause any changes in pH detrimental to beneficial water uses.

F. DISSOLVED OXYGEN

The dissolved oxygen concentration shall not be reduced below the following minimum levels at any time:

Waters designated:

WARM ....5.0 mg/l

COLD .... 8.0 mg/l

WARM and COLD........................8.0 mg/l

G. SUSPENDED SOLIDS AND SETTLEABLE SOLIDS

Discharges of wastes or wastewater shall not contain suspended or settleable solids in concentrations which increase the turbidity of receiving waters, unless it can be demonstrated to the satisfaction of the Regional Board that such alteration in turbidity does not adversely affect beneficial uses.

H. TOTAL DISSOLVED SOLIDS

Discharges of wastes or wastewater shall not increase the total dissolved solids content of receiving waters, unless it can be demonstrated to the satisfaction of the Regional Board that such an increase in total dissolved solids does not adversely affect beneficial uses of receiving waters.

Additionally, any discharge, excepting discharges from agricultural sources, shall not cause concentration of total dissolved solids (TDS) in surface waters to exceed the following limits:

[1] Certain exceptions for herbicides apply to irrigation supply canals which are discussed under the heading "Irrigation Supply Canals" in this Chapter.

	TDS (mg/L) Annual Ave.	Maximum
New River	4000	4500
Alamo River	4000	4500
Imperial Valley Drains	4000	4500
Coachella Valley Drains	2000	2500
Palo Verde Valley Drains	2000	2500

I. BACTERIA

In waters designated for water contact recreation (REC I) or noncontact water recreation (REC II), the following bacterial objectives apply. Although the objectives are expressed as fecal coliforms, E. coli, and enterococci bacteria, they address pathogenic microorganisms in general[1] (e.g., bacteria, viruses, and fungi).

Based on a statistically sufficient number of samples (generally not less than five samples equally spaced over a 30-day period), the geometric mean of the indicated bacterial densities should not exceed one or the other of the following:

	REC I	REC II
E. coli	126 per 100 ml	630 per 100 ml
enterococci	33 per 100 ml	165 per 100 ml

nor shall any sample exceed the following maximum allowables:

	REC I	REC II
E. coli	400 per 100 ml	2000 per 100 ml
enterococci	100 per 100 ml	500 per 100 ml

except that for the Colorado River, the following maximum allowables shall apply:

	REC I	REC II
E. coli	235 per 100 ml	1175 per 100ml
enterococci	61 per 100 ml	305 per 100 ml

In addition to the objectives above, in waters designated for water contact recreation (REC I), the fecal coliform concentration based on a minimum of not less than five samples for any 30-day period, shall not exceed a log mean of 200 MPN per 100 ml, nor shall more than ten percent of total samples during any 30-day period exceed 400 MPN per 100 ml.

[1] Fecal coliforms and E. coli bacteria are being used as the indicator microorganisms in the Region until better and similarly practical tests become readily available in the region to more specifically target pathogens.

J. BIOSTIMULATORY SUBSTANCES

Waters shall not contain biostimulatory substances in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect beneficial uses. Nitrate and phosphate limitations will be placed on industrial discharges to New and Alamo Rivers and irrigation basins on a case-by-case basis, taking into consideration the beneficial uses of these streams.

K. SEDIMENT

The suspended sediment load and suspended sediment discharge rate to surface waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses.

L. TURBIDITY

Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses.

M. RADIOACTIVITY

Radionuclides shall not be present in waters in concentrations which are deleterious to human, plant, animal or aquatic life or that result in the accumulation of radionuclides in the food web to an extent which presents a hazard to human, plant, animal or aquatic life.

Waters designated for use as domestic or municipal supply (MUN) shall not contain concentrations of radionuclides in excess of the limits specified in the California Code of Regulations, Title 22, Chapter 15, Article 5, Section 64443, as listed below:

Constituent	Maximum Contaminant Level, pci/L
Combined Radium-226 and Radium-228	5
Gross Alpha particle activity (including Radium-226 but excluding Radon and Uranium)	15
Tritium	20,000
Strontium-90	8
Gross Beta particle activity	50
Uranium	20

N. CHEMICAL CONSTITUENTS

No individual chemical or combination of chemicals shall be present in concentrations that adversely affect beneficial uses. There shall be no increase in hazardous chemical concentrations found in bottom sediments or aquatic life. Waters designated for use as domestic or municipal supply (MUN) shall not contain concentrations of chemical constituents in excess of the limits specified below:

Maximum Contaminant Levels* (MCLs)
for Organic and Inorganic Chemicals

Inorganic Chemical Constituents:	MCL*, mg/L
Arsenic	0.05
Barium	1.0
Cadmium	0.010
Chromium	0.05
Lead	0.005
Mercury	0.002
Nitrate (as Nitrogen)	10.0
Selenium	0.01
Silver	0.05

Organic Chemical Constituents	MCL*, mg/L
(a) Chlorinated Hydrocarbons	
Endrin	0.002
Lindane	0.004
Methoxychlor	0.1
Toxaphene	0.005
(b) Chlorophenoxys	
2,4-D	0.1
2,4,5-TP Silvex	0.01

Limiting Concentrations of Fluoride

Annual Average of Maximum Daily Air Temperature		Fluoride Concentrations mg/l			
Degrees Fahrenheit	Degrees Celsius	Lower*	Optimum	Upper*	MCL
below 53.8	below 12.1	0.9	1.2	1.7	2.4
53.8 to 58.3	12.1 to 14.6	0.8	1.1	1.5	2.2
58.4 to 63.8	14.7 to 17.6	0.8	1.0	1.3	2.0
63.9 to 70.6	17.7 to 21.4	0.7	0.9	1.2	1.8
70.7 to 79.2	21.5 to 26.2	0.7	0.8	1.0	1.6
79.3 to 90.5	26.3 to 32.5	0.6	0.7	0.8	1.4

O. PESTICIDE WASTES

The discharge of pesticidal wastes from pesticide manufacturing processing or cleaning operations to any surface water is prohibited.

III. SPECIFIC SURFACE WATER OBJECTIVES

A. COLORADO RIVER

1. Colorado River (Above Imperial Dam)

   In response to requirements in Section 303 of the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500), the Seven States Colorado River Salinity Control Forum developed water quality standards in 1975 for salinity consisting of numeric criteria and a basinwide plan of implementation for salinity control. The Forum recommended that each of the Basin States adopt the proposed standards. California along with the other Basin States adopted the Forum's recommended standards which were subsequently approved by the U.S. Environmental Protection Agency. The standards were reviewed in 1978, 1981, 1984, 1987, and 1990. While the numeric criteria have not changed, the plan of implementation was updated in those years to reflect changes in the salinity control program since 1975.

   The flow-weighted average annual numeric criteria for salinity (total dissolved solids) were established at three locations on the lower Colorado River:

	Salinity in mg/l
Below Hoover Dam, AZ-NV	723
Below Parker Dam, AZ-CA	747
Imperial Dam, AZ-CA	879

The plan of implementation consists of a number of federal and non-federal measures throughout the Colorado River system to maintain the adopted numeric criteria while the Basin states continue to develop their compact apportioned waters. There are four areas of the implementation plan which have direct applicability to California. The first is the control of the discharge of total dissolved solids from point sources through the NPDES Permit program on industrial and municipal discharges. The plan's policy has as its primary objective no-salt return from industrial sources wherever practicable. Reasonable incremental increases of salinity from municipal sources shall be permitted so long as they do not exceed 400 mg/l above the flow-weighted average salinity of the supply water. The second recommends that each state encourage and promote the use of brackish and/or saline waters for industrial purposes. The third deals with an improved water delivery system and on-farm water management system. Finally, the plan encompasses those portions of the 208 Water Quality Management plans dealing with salinity control once adopted by the State and approved by USEPA.

2. Colorado River (Below Imperial Dam)

Below Imperial Dam, the River's salinity will be controlled to meet the terms of the agreement with Mexico on salinity in Minute No. 242 of the International Boundary and Water Commission, entitled "Permanent and Definitive Solution to the International Problem of the Salinity of the Colorado River". This agreement states that measures will be taken to assure that the waters delivered to Mexico upstream from Morelos Dam will have annual average salinity concentration of no more than 115 ppm ($\pm$ 30 ppm) total dissolved solids greater than the annual average salinity concentration of Colorado River water arriving at Imperial Dam. Title I of Public Law 93-320 is the legislation which implements the provisions of Minute No. 242. Minute No. 242 and Title I constitute a federal numeric criterion and plan of implementation for the River below Imperial Dam.

B. NEW RIVER

Minute No. 264 of the Mexican-American Water Treaty titled "Recommendations for Solution of the New River Border Sanitation Problem at Calexico, California - Mexicali, Baja California Norte" was approved by the Governments of the United States and Mexico effective on December 4, 1980. Minute No. 264 specifies qualitative and quantitative standards for the New River at the International Boundary and upstream of the International Boundary in Mexico.

The quantitative standards of Minute No. 264 are contained in Table 3-1. Following are the qualitative standards of Minute No. 264 for the New River at the locations specified below (interim solution).

1. The waters of the River shall be free of untreated domestic and industrial waste waters.

2. The waters shall be free from substances that may be discharged into the River as a result of human activity in concentrations which are toxic or harmful to human, animal or aquatic life or which may significantly impair the beneficial uses of such waters.

3. The waters of the River shall be essentially free from trash, oil, scum, or other floating materials resulting from human activity in amounts sufficient to be injurious, unsightly, or to cause adverse effects on human life, fish, and wildlife. Persistent foaming shall be avoided.

4. The waters of the River shall be free of pesticides in concentrations which could cause harmful effects to human life, fish, and wildlife.

5. The channel of the River shall be free of residual sludge deposits from domestic or industrial wastes.

TABLE 3-1: NEW RIVER AT INTERNATIONAL BOUNDARY

Quantitative Standards per Minute 264[1] of the Mexican/American Water Treaty
(Applicable at Indicated Sampling Location)

Sampling Locations:	New River at Boundary[2]	Lagoon Discharge Canal	New River Upstream of Discharge Canal
Parameters			
BOD_5	-	30 mg/l filtered (Monthly grab sample)	30 mg/l unfiltered (Monthly 12-hr. composite sample)[3]
COD	-	70 mg/l filtered	100 mg/l unfiltered (Monthly 12-hr. composite sample)[3]
pH	6.0 to 9.0 (Weekly grab sample)	-	-
DO	5.0 mg/l (Daily grab sample)	- (weekly grab sample)	-
Fecal Coliform Organisms	-	-	30,000 colonies per 100 ml, with no single sample to exceed 60,000 colonies per 100 ml.

Footnotes for Table 3-1

1. It is the intent of the Regional Board to pursue long-range quantitative water quality standards for New River at the International Boundary beyond those contained in Minute No. 264. Such standards are anticipated to include further reduction of fecal coliform organisms and of pesticidal and toxic discharges.

2. For necessary and adequate monitoring, samples should be taken of the New River waters at the International Boundary monthly or more frequently if necessary, and these should be analyzed for BOD_5, COD, pH, DO, and fecal coliform organisms. Samples should also be analyzed for toxic substances as considered necessary.

3. Twelve consecutive hourly samples once a month (24-hour composite to be taken as needed to establish correlation with 12-hour composite).

Monitoring data collected by the Regional Board and the United States section of the International Boundary and Water Commission indicate that with the exception of pH, all quantitative and qualitative standards of Minute No. 264 have been violated since they were established. Moreover, with the exception of pH and DO, the standards do not protect or achieve the New River water quality given that: (1) they are inconsistent with the General Surface Water Objectives of this Basin Plan (p. 3-1), and (2) they are actually applicable to the New River in Mexico, not at the International Boundary. It is therefore appropriate for the Regional Board, as the agency responsible for protecting the quality of the waters in this region of the United States, to develop and enforce water quality objectives for the New River that are consistent with State and USEPA criteria for surface waters and that protect the waters of the region as follows:

Bacteria Water Quality Objectives

1. The bacterial standards identified in the General Surface Water Objectives section of this Basin Plan (p. 3-3) are applicable to the entire stretch of the New River in the United States.

2. The Pathogen Total Maximum Daily Load (TMDL) and associated implementation actions are described in Chapter 4, Section V(A). Compliance Monitoring activities for the TMDL are described in Chapter 6, Section II(B).

C. SALTON SEA

1. Total Dissolved Solids (Salinity)

   The total dissolved solids concentration of Salton Sea in 1992 was approximately 44,000 mg/l.

   The water quality objective for Salton Sea is to reduce the present level of salinity, and stabilize it at 35,000 mg/l unless it can be demonstrated that a different level of salinity is optimal for the sustenance of the Sea's wild and aquatic life (California Department of Fish and Game is attempting to make this determination). However, the achievement of this water quality objective shall be accomplished without adversely affecting the primary purpose of the Sea which is to receive and store agricultural drainage, seepage, and storm waters. Also, because of economic considerations, 35,000 mg/l may not be realistically achievable. In such case, any reduction in salinity which still allows for survival of the sea's aquatic life shall be deemed an acceptable alternative or interim objective. Because of the difficulty and predicted costliness of achieving salinity stabilization of Salton Sea, it is unreasonable for the Regional Board to assume responsibility for implementation of this objective. That responsibility must be shared jointly by all of the agencies which have direct influence on the Sea's fate. Additionally, there must be considerable public support for achieving this objective, without which it is unlikely that the necessary funding for Salton Sea salinity control will ever be realized.

2. Selenium

   The beneficial use of the Salton Sea for recreation has been impaired due to elevated levels of selenium in tissues of resident wildlife and aquatic life (See page 4-10 for a more detailed discussion of this). The following objectives apply to all surface waters that are tributaries to the Salton Sea:

   a. A four day average value of selenium shall not exceed .005 mg/L;

   b. A one hour average value of selenium shall not exceed .02 mg/L.

   These numerical limits are based on the United States Environmental Protection Agency's National Ambient Water Quality Criteria.

D. IRRIGATION SUPPLY CANALS

Herbicide spraying in irrigation canals must be conducted in coordination with the County Agricultural Commissioner, California Department of Fish and Game (DFG), and California Department of Health Services. In canals used for domestic supply, no herbicides shall be applied in concentrations which are toxic or otherwise harmful to humans; also no herbicides shall be applied in concentrations which are toxic or otherwise harmful to aquatic life, except that herbicides may be used in cases where the herbicide only impacts the targeted species, is a legally registered product, and is used in accordance with label requirements and in accordance with all applicable laws and regulations.

IV. GROUND WATER OBJECTIVES

Establishment of numerical objectives for ground water involves complex considerations since the quality of ground water varies significantly with depth of well perforations, existing water levels, geology, hydrology and several other factors. Unavailability of adequate historical data compounds this problem. The Regional Board believes that detailed investigation of the ground water basins should be conducted before establishing specific ground water quality objectives.

Ideally the Regional Board's goal is to maintain the existing water quality of all nondegraded ground water basins. However, in most cases ground water that is pumped generally returns to the basin after use with an increase in mineral concentrations such as total dissolved solids (TDS), nitrate etc., that are picked up by water during its use. Under these circumstances, the Regional Board's objective is to minimize the quantities of contaminants reaching any ground water basin. This could be achieved by establishing management practices for major discharges to land. Until the Regional Board can complete investigations for the establishment of management practices, the objective will be to maintain the existing water quality where feasible.

A. TASTE AND ODORS

Ground waters for use as domestic or municipal supply shall not contain taste or odor-producing substances in concentrations that adversely affect beneficial uses as a result of human activity.

B. BACTERIOLOGICAL QUALITY

In ground waters designated for use as domestic or municipal supply (MUN), the concentration of coliform organisms shall not exceed the limits specified in California Code of Regulations, Title 22, Chapter 15, Article 3.

C. CHEMICAL AND PHYSICAL QUALITY

Ground waters designated for use as domestic or municipal supply (MUN) shall not contain concentrations of chemical constituents in excess of the limits specified in California Code of Regulations, Title 22, Chapter 15, Article 4, Section 64435, Tables 2, 3, and 4 as a result of human activity.

D. BRINES

Discharges of water softener regeneration brines, other mineralized wastes, and toxic wastes to disposal facilities which ultimately discharge in areas where such wastes can percolate to ground waters usable for domestic and municipal purposes are prohibited.

E. RADIOACTIVITY

Ground waters designated for use as domestic or municipal supply (MUN) shall not contain radioactive material in excess of the limits specified in California Code of Regulations, Title 22, Chapter 15, Article 5, Sections 64441 and 64443. The limits contained in Section 64443 are included under item "II.M. Radioactivity", in this Chapter.

F. GROUND WATER OVERDRAFT

A number of ground water basins in the Region are in overdraft, and in some areas there have been indications of possible increase of mineral content of the ground water. Investigative studies will be conducted to develop ground water objectives and implementation plans for the following ground water basins:

- Indio Subarea of the Whitewater Hydrologic Unit
- Warren Subunit of the Joshua Tree Hydrologic Unit
- Twentynine Palms Subunit of the Dale Hydrologic Unit
- Borrego Subarea of the Anza-Borrego Hydrologic Unit
- Lucerne Hydrologic Unit
- Terwilliger Subarea of the Anza-Borrego Hydrologic Unit
- Ocotillo Subunit of the Anza-Borrego Hydrologic Unit

CHAPTER 4 - IMPLEMENTATION

I. INTRODUCTION

The Porter-Cologne Water Quality Control Act states that basin plans consist of Beneficial Uses, Water Quality Objectives and an Implementation Program for achieving the water quality objectives. The Implementation Program is required to include, but is not limited to:

- A description of the nature of actions which are necessary to achieve the water quality objectives, including any recommendations for appropriate action by any entity, public or private;

- A time schedule for actions to be taken;

- A description of surveillance to be undertaken to determine compliance with the objectives.

A. REGIONAL BOARD GOALS AND MANAGEMENT PRINCIPALS

The regulatory activities of the Regional Boards are the primary mechanism for water quality control. In view of this, and in view of the limited water resources in the Colorado River Basin Region and their increasing use, the Regional Board directs its actions toward the following goals and management principles:

- Preserve and enhance the quality of waters, both ground and surface, fresh and saline, for present and anticipated beneficial uses, taking social and economic factors into consideration.

- Encourage reclamation of wastewaters, wherever feasible, in order to preserve freshwater supplies and to protect water quality to the maximum extent possible.

- Preserve the integrity of ground water basins, so that the basins remain capable of storing water for beneficial uses.

- Seek improvement in the quality of international and interstate waters entering the Region.

- Waste collection, treatment, and discharge systems in addition to their primary function, shall also be oriented towards optimization of the quality of state waters and the reclamation of wastewaters for beneficial use.

- The optimization of water quality, where feasible, will be considered in relation to environmental goals.

- Controllable water quality factors will be regulated to ensure preservation of the integrity of usable ground water basins.

- Source control and pretreatment of wastes will be required wherever necessary to minimize degradation of water quality.

- The transport of hazardous materials should be controlled to prevent spillage and leakage.

- Wastes which have a long-term capability of polluting water will be disposed of at approved sites, and in such a manner as to not enter usable waters of the State.

- The administration of grants and loans to public entities shall be in accordance with applicable rules and regulations, including determination of implementation of adequate source control and industrial waste control ordinances.

- Ground water recharge with water of adequate quality is encouraged, wherever feasible.

- Evaporative loss of reclaimable wastewater is to be minimized.

B. GENERAL IMPLEMENTATION

The Regional Board will implement this Water Quality Control Plan by taking the following actions:

- Encourage water conservation and reuse of reclaimable water in situations where water quality and beneficial uses are not adversely impacted. The Regional Board considers that by proper management of reclaimable wastewater, possible adverse impacts on ground water quality as well as potential ground water overdraft could be minimized. The Regional Board encourages local agencies responsible for water supply and/or wastewater treatment and disposal to investigate conservation measures, and to maximize utilization of reclaimed water for greenbelt irrigation where socially and economically feasible.

- Protect ground waters against land operations, particularly discharges of soluble minerals, toxicants, and taste-producing materials on permeable soils, so that beneficial uses will not be impaired. This is normally accomplished by prescription and enforcement of Waste Discharge Requirements.

- Review local ordinances relating to individual waste treatment and disposal systems and request that local agencies adopt ordinances which are compatible with State Board and Regional Board policies and guidelines for those systems.

- Eliminate discharges of wastes that threaten water quality or create nuisance conditions. This includes elimination of discharges from individual subsurface sewage disposal facilities, unless Regional Board policies and/or guidelines are followed.

II. POINT SOURCE CONTROLS

Section 13263 of the California Code of Regulations (Porter-Cologne Act) requires that Waste Discharge Requirements be prescribed for any discharge or proposed discharge that could affect the quality of the waters of the state, other than into a community sewer system. All industrial discharges that meet this definition are regulated with Waste Discharge Requirements.

In addition to Waste Discharge Requirements (WDRs), a National Pollutant Discharge Elimination System (NPDES) permit may be required for the discharge. Section 122 of Title 40 of the Code of Federal Regulations (40 CFR) requires that NPDES permits be obtained for all point source discharges to "waters of the United States". Waters of the United States is defined in Section 122.2 and is generally interpreted to mean any surface water in the State, including lakes, rivers, streams, wetlands, mudflats, sandflats, sloughs, or playa lakes.

The NPDES program objective is to regulate the discharge of wastewaters and storm waters to surface waters of the State so that the beneficial uses of these waters are protected and enhanced. NPDES permits are federal permits, but California has been delegated authority by the USEPA to administer NPDES permits.

In order to implement the above stated objective, individual and general NPDES permits are developed and adopted by the Regional Board. The Regional Board has adopted a general NPDES permit to regulate the discharge of extracted and treated ground water resulting from the cleanup of ground water polluted by fuel and other related waste leaks. Also, the discharge of hydrostatic test water to surface waters is regulated through a general NPDES permit. The State Board adopted general NPDES permits to regulate the discharge of stormwater resulting from industrial and construction sites to surface waters. The issuance of general permits provide for more efficient and economical regulation of discharges of wastewaters that require the same type of control and monitoring, as opposed to issuing individual permits for each discharger.

In addition to regulating discharges of wastewater to surface waters, NPDES permits also require municipal sewage treatment systems to conduct pretreatment programs if their design capacity is greater than 5 million gallons-per-day. Smaller municipal treatment systems may be required to conduct pretreatment programs if there are significant industrial users of their systems. The pretreatment programs must comply with the federal regulations in 40 CFR 403.

The NPDES program involves the issuance of new permits, reissuance of expired permits, conducting compliance inspections, review of monitoring reports, and taking enforcement actions against dischargers who fail to comply with the conditions of their permit. Potential enforcement actions include letters of noncompliance, notices of violation, cleanup and abatement orders, cease and desist orders, imposition of administrative civil liabilities, and referral to the State Attorney General.

A. GEOTHERMAL DISCHARGES

The Regional Board closely monitors the activities of those companies that are developing geothermal resources. The Regional Board issues waste discharge requirements that regulate the drilling of geothermal wells, the operations at the power plants, and the disposal of geothermal wastes produced during these operations. The Regional Board works closely with the California Division of Oil and Gas to regulate these facilities in accordance with the Memorandum of Agreement between the State Water Resources Control Board and the Department of Conservation, Division of Oil and Gas, as amended by State Board Resolution No. 88-61. This agreement generally requires the Division of Oil and Gas to issue permits to regulate subsurface discharges and requires the Regional Board to issue waste discharge requirements to regulate surface discharges.

B. SLUDGE APPLICATION

The U.S. Environmental Protection Agency recently promulgated new regulations for sludge use and disposal. These regulations are applicable to land application, surface disposal, and incineration of municipal sludge. These regulations are contained in 40 CFR, Section 503.

There is increasing interest in the beneficial use of municipal wastewater treatment plant sludges as an agricultural soil amendment. State and Federal regulations establish heavy metals application rates for sludge used in the growing of crops. The new federal regulations establish heavy metals and pathogen limitations for "clean" sludge.

The Regional Board's primary concerns related to sludge are contamination of groundwater by sludge composting facilities and potential contamination of surface waters from tailwater discharges off fields where sludge has been applied. Sludge composting facilities are attracted to this Region because of the sunny climate, low cost of land, relatively low population density, and close proximity to major Southern California population centers.

Regional Board measures for regulating sludge use are as follows:

- Permits issued to domestic wastewater treatment facilities will be modified to incorporate the requirements of 40 CFR 503.
- Sludge composting facilities will be regulated through the prescription and enforcement of WDRs.
- Waste Discharge Requirements or waivers will be issued to land appliers of sludge on a case by case basis, although properly composted sludge may be exempted.

C. MUNICIPAL WASTEWATER TREATMENT PLANTS

Regulating discharges from municipal wastewater treatment plants is done through either the issuance of National Pollutant Discharge Elimination System (NPDES) permits where the discharge is to surface water or through Waste Discharge Requirements (WDRs) where the discharge is to land. The discharge of wastewater effluent to surface water will meet the effluent limitations prescribed by the U.S. Environmental Protection Agency. The current USEPA effluent limitations for secondary treatment are as follows:

Constituent	30-Day Arithmetic Mean Discharge Rate	7-Day ArithmeticMean Discharge Rate
$20^{o}C$ BOD_5	30 mg/L	45 mg/L
Suspended Solids	30 mg/L	45 mg/L

pH - The effluent values for pH shall remain within the limits of 6.0 to 9.0

The arithmetic mean of the values for effluent samples collected for $20^{0}C$ BOD_5 and Suspended Solids (SS) in a period of 30 consecutive days shall not exceed 15 percent of the arithmetic mean of the values for influent samples collected at approximately the same times during the same period (85 percent removal).

D. WASTEWATER RECLAMATION AND REUSE

Wastewater reclamation and reuse is encouraged by this Regional Board. However, for wastewater reclamation and reuse facilities it is necessary to meet the water quality standards set by the Regional Board. Also, all state, federal, and local standards must be adhered to when reclaimed wastewater is used in this Region. Waste Discharge Requirements would be necessary where potential public and worker contact is high and where reclaimed water is used in large amounts. Currently, the primary use of reclaimed wastewater is golf course irrigation.

E. CONFINED ANIMAL FACILITIES

The State and Regional Boards have adequate authority under federal regulations and under the California Water Code (in general), and regulations contained in Title 23, Chapter 15, Article 6 (in particular), to fully regulate waste disposal activities at confined animal facilities. Additional and/or more stringent measures may be required in those areas overlying threatened or impaired sources of drinking water.

There are three types of confined animal facilities operating in this Region: fish farms, dairies, and feedlots. City and county offices have been notified to provide information to the Regional Board about the location of facilities in this Region. All these facilities are required to submit a Report of Waste Discharge to the Regional Board. Facilities may request a waiver from Waste Discharge Requirements which may be granted as long as the discharge does not create pollution, contamination, or nuisance as described by Section 13050 of the California Water Code. Periodic inspections are conducted to observe the performance of the facilities under the program.

F. STORMWATER

Federal regulations require National Pollutant Discharge Elimination System (NPDES) permits for discharges of stormwater associated with:

- municipalities with populations of 100,000 persons or more;

- construction activities that disturb five or more acres of land; and

- certain specified industrial activities.

California is a delegated NPDES state, and has authority to administer the NPDES program within its borders. Two general NPDES stormwater permits have been adopted by the State Water Resources Control Board to administer two parts of the stormwater program; one for industrial activity discharges and one for construction activity discharges. Discharges of stormwater from municipalities are regulated with individual NPDES permits.

Enforcement of the two general NPDES stormwater permits is the responsibility of the Regional Board. The number of facilities and projects applicable to these permits is expected to be large. The first priority of the Regional Board is to assure that all applicable industrial facilities and construction projects have filed for their respective general NPDES permits. The next priority is to assist the dischargers in achieving and maintaining compliance with the general NPDES permits. Emphasis will be placed on maintaining a cooperative approach with the dischargers.

Municipalities with over 100,000 persons who own and operate stormwater sewer systems are required to obtain municipal NPDES stormwater permits. Although there are currently no individual municipalities that exceed this population in this region, the Coachella Valley area contains approximately 250,000 persons. Therefore, the cities and other authorities in the Coachella Valley who own and operate storm drainage systems have been designated by the Regional Board as municipalities required to have a municipal NPDES stormwater permit. The cities located in the Coachella Valley, along with the County of Riverside, Riverside County Flood Control and Water Conservation District, and the Coachella Valley Water District, have formed a group to apply as co-applicants for a single areawide municipal NPDES stormwater permit. Part 1 of their application was submitted in May 1992. Part 2 is due in May 1994. The permit should be issued by January 1995. Other municipalities may be required to have a permit as their populations grow or as smaller municipalities are phased into the regulations.

Caltrans has filed an application to discharge stormwater from their highways in the Region. This permit is expected to be issued by January 1994.

G. BRINE DISCHARGES

Discharges of water softener regeneration brine are prohibited to facilities which ultimately discharge in areas where such wastes can percolate to ground water usable for domestic and municipal purposes. The Regional Board requests that local agencies adopt ordinances to prohibit discharges of these brines to ground waters, surface waters, or into community sewers.

H. SEPTIC SYSTEMS

Pursuant to Section 13224, Article 2, Chapter 4 of the California Water Code, the Colorado River Basin Region may issue policy statements relating to any water quality matter within its jurisdiction. Septic systems (all on-site wastewater treatment systems) have the potential to degrade the water within the Region's jurisdiction if improperly used. For this reason, the Regional Board has established guidelines and a general permit for such systems.

The 1979 "Guidelines for Sewage Disposal From Land Developments" (herein referred to as the guidelines) describe the appropriate use of septic tank systems. Also discussed is the role which the county governments have in the placement and allowance of these systems. The guidelines describe what types of discharges need Waste Discharge Requirements and what types of discharges qualify for a waiver under Water Code Sections 13260 and 13269, respectively. To eliminate confusion, systems which should adhere to the guidelines are also described. However, the bulk of the guidelines describe minimum design criteria where septic systems can be placed to protect groundwater quality.

The guidelines are reviewed and revised as necessary. At this time some local governments in the Region have prohibitions on septic systems.

Since January 1993, the Regional Board has required all new vehicle maintenance facilities which use septic systems as a wastewater disposal method to file for a general discharge permit. It has been shown that some septic systems for auto maintenance facilities have been contaminated with petroleum hydrocarbons. The general permit describes appropriate designs for septic systems used at vehicle maintenance shops and requires analysis, monitoring and reporting. By requiring these items, it is anticipated that pollution from these systems can be identified and stopped prior to extensive contamination.

Cathedral City Cove

On and after January 1, 2012, the discharge of wastewater into the ground through the use of individual subsurface disposal systems in the Cove area of Cathedral City in Riverside County is prohibited. Cathedral City Cove is that area of the city bound to the south by Cathedral City city limits as of January 1, 2012, to the east by the East Cathedral Canyon Channel, to the west by the West Cathedral Canyon Channel, and to the north east by the extension of the West Cathedral Canyon Channel, as depicted in the USGS Cathedral City Quad Map photorevised in 1981.

Cathedral City Cove - Reports

On October 17, 2002, the State Water Resources Control Board approved a $2,809,000.00 grant to the city of Cathedral City for Cove area septic system elimination. Pursuant to Section 13225 of the Water Code, by May 21, 2004 the City of Cathedral City shall submit to the Regional Board a report describing an implementation plan to comply with the January 1, 2012 prohibition date. Thereafter, the city shall submit annual reports to the Regional Board regarding any actions taken by the city of Cathedral City or any other person or entity in order to achieve compliance by January 1, 2012.

Mission Creek or Desert Hot Springs Aquifers

The following language implements Porter-Cologne Water Quality Control Act Section 13281.

Effective January 21, 2005:

(1) The discharge of waste from new or existing individual disposal systems on parcels of less than one-half acre that overlie the Mission Creek Aquifer or the Desert Hot Springs Aquifer in Riverside County is prohibited, if a sewer system is available.

(2) For parcels of one-half acre or greater that overlie the Mission Creek Aquifer or the Desert Hot Springs Aquifer in Riverside County, the maximum number of equivalent dwelling units with individual disposal systems shall be two per acre, if a sewer system is available. The discharge of waste from additional new or existing individual disposal systems is prohibited, if a sewer system is available. The term “equivalent dwelling unit” means a building designed to be used as a home by the owner of such building, which shall be the only dwelling located on a parcel of ground with the usual

accessory buildings. This definition is from Section 221.0 of the 1997 edition of the Uniform Plumbing Code of the International Association of Plumbing and Mechanical Officials, and any authority interpreting that section shall be relevant in interpreting this prohibition.

If a sewer system becomes available after January 21, 2005, Prohibitions (1) and (2) in the preceding paragraph shall apply to discharges of waste from all new or existing individual disposal systems on all parcels to which the sewer system becomes available.

A sewer system is “available” if a sewer system, or a building connected to a sewer system, is within 200 feet of the existing or proposed dwelling unit, in accordance with Section 713.4 of the 1997 edition of the Uniform Plumbing Code of the International Association of Plumbing and Mechanical Officials.

State Water Resources Control Board awarded two grants to Mission Springs Water District for a total of $2,800,000 for the elimination of disposal systems (septic tanks) on parcels less than one-half acre overlying the Desert Hot Springs and Mission Creek Aquifers if sewer is available. Pursuant to Section 13225 of the Water Code, by November 18, 2005, the Mission Springs Water District shall submit to the Regional Board a report describing actions taken to implement the subject prohibition.

III. NONPOINT SOURCE CONTROLS

Despite California's significant achievements in controlling point source discharges, such as wastewater from municipal treatment plants and industrial facilities, many of the State's valuable water resources continue to be polluted by nonpoint sources (NPS). NPS water pollution is generally caused by poor land use practices and the collective effects of individual behavior. It is distinguished from point sources which discharge wastewater of predictable concentrations and volumes. NPS pollution is diffuse throughout a watershed, variable in nature, and most significant in its cumulative effects. Management of NPS water pollution is also distinguished from point source management because it requires an array of control techniques customized to local watershed conditions, rather than relying exclusively on waste discharge requirements as with individual point source facilities. Land uses associated with NPS water pollution include agriculture, forestry, urban development, grazing, water development, inactive mines, and boating and marinas.

Impacts from land uses to California's water resources continue. Unless these uses are managed in a way which will minimize NPS impacts, the resource values will diminish, lowering land values and discouraging future use. The challenge of nonpoint source pollution management is to implement economically achievable protections which will preserve the resources upon which California's quality of life and economic vitality depend.

The Federal Clean Water Act, as amended in 1987, includes Section 319 titled "Nonpoint Source Management Programs". Section 319 requires the States to develop assessment reports and management programs describing the States' nonpoint source problems and setting forth a program to address the problems. The State Water Resources Control Board (State Board) adopted its "Nonpoint Source Management Plan" in November 1988. The Plan was updated in December 1999 with adoption of the "Plan For California’s Nonpoint Source Pollution Control Program," (hereafter referred to as "State NPS Program"), including "Volume I: Nonpoint Source Program Strategy and Implementation Plan for 1998-2013 (PROSIP)" and "Volume II: California Management Measures for Polluted Runoff (CAMMPR)" (adopted December 14, 1999, SWRCB Resolution No. 99-114). This Plan has an approach to NPS water quality control whereby the following are implemented as needed:

1. Self-determined implementation of Management Practices (MPs);
2. Regulatory-based encouragement of Management Practices; and
3. Effluent requirements.

Depending on water quality impacts and severity of NPS problem, the Regional Board may move directly to full regulatory and complementary enforcement actions. It is the preference of the Regional Board to regulate nonpoint sources of pollution using the least stringent methods possible, while attaining water quality standards.

The Porter-Cologne Water Quality Control Act is also used by the State Board and Regional Boards to direct nonpoint source pollution control activities. The

Porter-Cologne Act is California's comprehensive water quality control program and applies to both ground waters and surface waters. Its principal means of implementing water quality controls is through issuance of waste discharge requirements which can be applied to both point source and nonpoint source discharges.

There is close cooperation between the State Board's Nonpoint Source Program and this Region's Nonpoint Source Program. Much of the funding for these programs comes from federal grants which are designed to assist in implementation of the federal Clean Water Act provisions on nonpoint source pollution control. Some of the important activities of these nonpoint source programs include development of water quality assessments, development and oversight of NPS pollution control demonstration projects, active cooperation with other affected state, local and federal agencies, identification, development and implementation of MPs, program development activities, public participation, and educational outreach activities.

The Regional Board adopted an updated Clean Water Act Section 303(d) list, which, in part, identifies the quality of the waters of the Salton Sea, Alamo River, New River, and Imperial Valley agricultural drains as being impaired by discharges of wastes from nonpoint sources, primarily of agricultural origin.. The Alamo River and New River are the two largest drains in this Region that are significantly impaired by agricultural pollution. Nonpoint source pollution in this Region also originates from sources other than agriculture including abandoned mines, stormwater runoff, boating activities, alterations to land (e.g. urban development), and animal production activities. Storm water discharges have been discussed earlier in this chapter. Alterations to land are discussed below under "State Water Quality Certification". The other sources of nonpoint source pollution will be investigated and appropriate actions taken pending the availability of funding.

Consistent with the 1999 State NPS Program, the Regional NPS Management Program includes:

- Implementation of the “Plan for California’s Nonpoint Source Pollution Control Program”
- Implementation of this Basin Plan
- Implementation of other applicable statewide plans and policies
- Development and implementation of Total Maximum Daily loads for impaired and threatened surface waters
- Implementation of Regional planning and prioritization through the California Watershed Management Initiative
- Completion of annual workplans
- Public participation and coordination with stakeholders and cooperating agencies
- Coordination with local governments in the development of General Plans
- Formal agreements (Memoranda of Understanding and Management Agency Agreements)
- Implementation of the NPS Regulation
- Financial and technical assistance
- Water Quality Monitoring and Assessment and Regular Reporting
- Assessment of Management Measure Effectiveness

A. AGRICULTURE

Agricultural discharges, primarily irrigation return flows, constitute the largest volume of pollution entering surface waters in this Region. The agricultural drains/drain systems in this Region support significant beneficial uses as identified in Chapter 2 of this Plan. In an effort to protect and enhance these uses, the Regional Board adopted the "Agricultural Drainage Management (ADM) Report for the Colorado River Basin Region" in March 1992. This report established priorities for dealing with the drain systems based on a watershed approach. Drainage entities (e.g. water districts), including Imperial Irrigation District, Coachella Valley Water District, and Palo Verde Irrigation District, were identified in each of four watersheds, and the Regional Board will work closely with these entities to implement agricultural pollution controls.

The preferred approach toward addressing nonpoint source pollution is to deal with the problem on a watershed basis. The Salton Sea Transboundary Watershed has been identified as this Region's highest priority for control of agricultural pollution, based mainly on its relatively large size, the beneficial uses of waters in the watershed, the volume of discharge, and the severity of water quality degradation. California's 1998 Unified Watershed Assessment identified the Salton Sea Transboundary Watershed as a Category 1 (impaired) watershed.

The effectiveness over time of agricultural pollution controls is much more likely if all involved parties (e.g. farmers, local officials, the public) are informed of these activities and play a role in their development and implementation. In recognition of this, the state and federal nonpoint source programs contain significant outreach and educational components. In addition to working with the identified drainage entities, the Regional Board will continue to work with local Resource Conservation Districts, the U.S. Natural Resource Conservation Service, the State Department of Pesticide Regulation, the State Department of Food and Agriculture, County Agricultural Commissioners, college and university agricultural extension services, local Farm Bureaus, and stakeholder groups. The Regional Board also has the responsibility of coordinating and overseeing implementation of federal and state grants and loans programs that provide resources to local entities for control of nonpoint source pollution. The Regional Board will provide technical and educational assistance on pollution control as requested by local groups and will collect and make available information on successful pollution control activities in other regions and other states.

B. STATE WATER QUALITY CERTIFICATION

The Water Quality Certification program is authorized by Clean Water Act Section 401. Certification, or waiver of Certification is required for any activity which requires a federal permit or license and which may result in a discharge to waters of the United States. Issuance or waiver of Certification is based on a determination that state water quality standards will not be violated. Federal regulations define water quality standards as including a state's water quality objectives, designated beneficial uses, and anti-degradation policy, which requires that "existing instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected" (40 CFR 131). Section 13160 of the Porter-Cologne Water Quality Control Act designates the State Board as the state's water pollution control agency for all purposes stated in the Federal Clean Water Act (CWA) and any other federal act, including issuance of Certification. Section 13160.1 authorizes the state to establish a reasonable fee schedule to cover the cost of processing Certification requests.

Except for discharges associated with hydroelectric activities, the State Board has delegated to the Regional Board the authority to evaluate projects for Certification. The Regional Boards have been delegated the authority to determine whether or not to waive Certification, or to recommend that the State Board issue Certification, a denial of Certification, or a conditional Certification for the project. This delegated authority covers U.S. Army Corps of Engineers (ACOE) CWA 404 Permits which consist of Individual and General Permits covering dredge and fill operations to waters of the United States.

Implementation of the 401 Water Quality Certification Program in this Region starts with a review of the following documentation for each activity for which Certification is required:

- A formal request for CWA 401 Water Quality Certification for the project submitted by the applicant.

- A copy of the final environmental document prepared in compliance with the California Environmental Quality Act (CEQA).

- A full description of the project.

- A complete copy of the application for the federal permit or license.

- A copy of the California Department of Fish and Game Streambed Alteration permit.

- The filing fee specified in the California Code of Regulations.

IV. SPECIFIC IMPLEMENTATION ACTIONS

A. NEW RIVER POLLUTION BY MEXICO

The New River rises in Mexico, flows northward across the International Boundary and through California's Imperial Valley before ultimately discharging into the Salton Sea. The River conveys agricultural drainage from the Imperial and Mexicali Valleys to the Salton Sea. The River also conveys community and industrial wastewaters. In Imperial Valley, waste discharge requirements are prescribed and enforced by this Regional Board for discharges of treated community and industrial wastewater. However, Mexico discharges raw and inadequately treated sewage, toxic industrial wastes, garbage and other solid wastes, animal wastes, and occasionally geothermal wastewaters from the Mexicali area into the United States via the New River. These discharges of raw and inadequately treated sewage and industrial wastes have continued for over 40 years. The resulting pollution of the New River at the International Boundary is such that sewage solids continue to be plainly visible in the River at the International Boundary. Also, toxic chemicals have been detected in the River water. Responsibility within the United States for dealing with Mexico on the New River pollution problem is with the United States Section of the International Boundary and Water Commission (IBWC) and the USEPA

The IBWC is a US-Mexican federal agency with roots in the "Treaty of Guadalupe Hidalgo of Peace, Limits and Settlement," which was signed by both Countries in February 1848. IBWC was established as the "International Boundary Commission" (IBC) in 1889 to deal with boundary issues. In 1944, the US and Mexico signed the Treaty entitled "Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande" (a.k.a. the "Mexican-American Water Treaty"), which was ratified by the US Congress in 1945. The Mexican-American Water Treaty changed the name of IBC to IBWC, and expanded their jurisdiction and responsibilities. The IBWC's jurisdiction extends along the boundary and into both countries where international projects have been constructed. The agencies responsibilities include the implementation of boundary and water treaties and mediating disputes that arise in their application. The treaty specifically charged the IBWC with solving border sanitation and water quality problems.

In August 1983, the Presidents of Mexico and the United States signed the La Paz Agreement to protect and improve the environment in the border area. The La Paz Agreement designates the USEPA as the US coordinator for pursuing practical, legal, institutional and technical measures necessary to protect the environment. The agreement originally named Mexican Secretaría de Desarrollo Urbano y Ecologia (SEDUE) as the coordinator for Mexico. In 1992, Mexico transferred responsibility for border problems to the Secretaría de Desarrollo Social (SEDESOL). Currently, the Comision Nacional del Agua (CNA) has primary responsibility for water quality problems along the border for Mexico..

For over 30 years, this Regional Board has been encouraging the United States Commissioner on the IBWC to obtain corrections of this gross problem. Since 1975, the Regional Board has monitored water pollution in the New River in an effort to identify the pollutants coming from Mexico. This information has been forwarded to the United States Commissioner and to others to aid and encourage Mexico in implementing corrective actions.

For sewage service purposes, the Mexicali metropolitan area is divided into the Mexicali I and Mexicali II areas. Mexicali I includes most of the old, well established neighborhoods to the west, the existing municipal sewage collection and treatment system,(excluding the Gonzalez-Ortega lagoon system) and the Zaragoza lagoons. The Mexicali II service area includes the new residential and industrial development to the east of the Gonzalez-Ortega lagoons, and the proposed new 20-mgd WWTF. The City of Mexicali is undergoing unprecedented growth. In the year 2000, the “Instituto Nacional de Estadisticas Geografia e Informatica” (INEGI) estimated the population within the Municipality of Mexicali to be 765,000 people, and projected a 2.6% annual growth rate. Based on this, the production of domestic and industrial wastewater is projected to increase to 58-67 mgd over the next 20 years. However, Mexicali lacks an adequate sewage collection, conveyance, and treatment system for current and projected flows. It is currently served by two stabilization lagoon systems, which lack disinfection facilities. The systems have a combined design capacity of about 20-25 mgd, however sewage flows calculated by CH2M Hill in 1997 ranged from 35 to 40 mgd.

The Regional Board staff has conducted investigations of the New River watershed in Mexico to determine the type(s) and extent of waste discharges into the New River and its tributaries so that possible corrective measures could be considered. The investigations have been successful in identifying the problems that must be addressed to obtain adequate corrections. These problems include the following:

- Breakdowns in Mexicali's sewer system from either occasional pump failure or line incapacity/collapse resulting in the discharge of raw sewage to the River;

- Discharge of untreated industrial wastes to the River including highly toxic chemical wastes, many of which are on EPA's list of 129 priority pollutants and some of which are carcinogens;

- Inadequate treatment of sewage and industrial wastes by the Mexicali lagoon systems;

- Discharge of solid waste in or near the River and its tributaries;

- Discharge of raw sewage to the River from adjacent unsewered residences;

- Occasional discharge of wastes to the River by septic tank pumpers;

- Periodic direct discharges of untreated wastes from a slaughterhouse, dairy, and hog farms;

- Discharges from residential hog and cattle pens located adjacent to the River and its tributaries; and

- Occasional discharges of geothermal wastes to the River.

Described below is a summary of actions taken by various agencies (Federal and State) to correct the international pollution problems in the New River watershed.

In August 1980, Minute No. 264 to the Mexican-American Water Treaty was signed which specified time schedules for completing works that were to result in a full cleanup of the river. In addition, minimal water quality standards were specified for New River water quality at the International Boundary. Unfortunately, the specified schedules and standards of Minute No. 264 were not met and the need for further improvements to Mexicali's sewage work became evident.

In 1987, Montgomery Engineers Inc., was contracted by the Regional Board to investigate pollution abatement measures within the United States for the New and Alamo Rivers. A final report entitled New River Pollution Abatement Report - Recommended Projects, December 1987, recommended that a screening device and chlorination/aeration facility be constructed near the International Boundary. A proposed appropriation of $1,525,000 for follow-up work including actual engineering designs was rejected by the Governor of California on July 8, 1988. The Administration's position was that pollution emanating from Mexico is a complex international problem which demands an international solution and that the Federal Government must address this issue rather than the State.

On April 15, 1987, Minute No. 274 to the Mexican-American Water Treaty was approved by the governments of Mexico and the United States. The Minute provided for a $1,200,000 United States/Mexico jointly funded project to construct certain works in Mexico to reduce pollution in the New River. The project included construction of a major new pumping plant and sewer line, placement of standby pumps and rehabilitation of existing pumps at Pumping Plants No. 1 and 2, and purchase of sewer line cleaning equipment. Although efforts were made by the Government of Mexico to rehabilitate and expand the sewage system in Mexicali, the accelerated urban growth surpassed the capacity of these works and discharges of untreated industrial and domestic wastewaters into the New River continued.

Minute No. 288 was signed by the Commissioners in October of 1992 titled "Conceptual Plan for the Long Term Solution to the Border Sanitation Problem of the New River at Calexico, CA - Mexicali, Baja California". It was the result of a recommendation by the United States and Mexico at the IXth US/Mexico Binational Commission that priority attention should be given to the cleanup of the New River. Minute No. 288 established short and long-term solutions for the sanitation of the New River at the International Boundary. These short-term measures, known as "Quick Fixes," were designed to be compatible with the long-term solution, and were funded through a cost sharing agreement between both countries. The U.S. and Mexico funded 55% and 45% respectively, of the total $7.5 million required for the Quick Fixes. The Binational Technical Advisory Committee (BTAC) implemented the quick fix and is comprised of representatives from IBWC, Mexican Section(CILA), State Public Services Commission of Mexicali (CESPM) , National Water Commission (CAN) (, Secretary of Human Settlements and Public Works (SAHOPE) , the Municipality of Mexicali for Mexico, the United States IBWC Section, US EPA, California State Water Resources Control Board, Regional Board, Imperial County, and the Imperial Irrigation District. The BTAC improved communication and technology transfer between the two countries. The Quick Fixes are summarized below:

- Improvements to the sewage collection system, either by lining or replacing existing sewer pipes and acquiring modern sewer line cleaning equipment;

- Rehabilitation and upgrading of pumping facilities that lift and deliver wastewater to treatment facilities; and

- Improvements to the existing lagoons at the Ignacio Zaragoza (Mexicali I) and Gonzalez-Ortega wastewater treatment facilities in Mexicali to increase their reliability and capacity.

As of May 2000, nearly 100% of the Quick Fixes were completed and operating successfully

The long-term strategy consists of a series of sewage infrastructure projects for Mexicali I and Mexicali II service areas to address New River pollution. The Mexicali I projects consist of the replacement/rehabilitation of about 44,000 feet of sewage pipes, rehabilitation of sewage pump stations, and expansion of the Mexicali I wastewater treatment plant to 30 mgd. The Mexicali II projects entail the construction of a new 20-mgd wastewater treatment plant (a.k.a. Mexicali II WWTP), the sewage Pumping Plant No. 4 for the new WWTP, installation of telemetry equipment for the WWTP and pumping plants, construction of 31,170 feet of discharge forcemain[2] for Pumping Plant No. 4, construction/rehabilitation of about 96,000 feet of sewer lines, and rehabilitation of two sewage lift stations. The proposed projects have an estimated cost of $50 million dollars. The USEPA will fund 55% and the Mexican government the remaining 45% of the total cost. The projects received conditional certification by the Border Environment Cooperation Commission on December 5, 1997, and final certification as of January 7, 1998. In November 1999, the NADBank developed and submitted a financing plan for the projects to USEPA and the Mexican Government for approval. The plan was approved by both entities and includes Federal, State, and local funds to pay for project costs. Construction of the projects is underway, and should improve the overall quality of the New River, when properly operated and maintained. The construction of the WWTP has been delayed due to a law suit in Mexico and construction is now expected to be completed in 2004. However, the existing lagoon systems and the proposed 20-mgd facility do not include disinfection .

The Regional Board will continue to work with State and Federal authorities in an effort to bring about a solution to this longstanding problem. However, the cooperation of Mexico is crucial in solving this problem. The Regional Board presently supports correction of the problem in Mexico as the most viable solution. The successful implementation of Minutes No. 264 and 288 to the Mexican American Water Treaty would represent an important step in progressing toward this goal.

Water quality sampling and analyses of the New River at the International Boundary by the Regional Board will continue as funding permits. However, the conditions and characteristics of the river at the International Boundary are a federal responsibility. Since the data is forwarded to all the agencies in Mexico and the United States that share responsibility for corrective action, it serves as a constant reminder that there is concern to keep the river clean, and that pressure will continue to be administered by the Regional Board. Monitoring results will be utilized as follows:

- Informing the United States Environmental Protection Agency and other appropriate agencies of pollution problems in the New River at the International Boundary requiring attention;

- Gauging the effectiveness of cleanup measures in Mexico;

[2] CNA is responsible for this project. As of December 1997, a CNA contractor had already installed approximately 1.5 miles of the force main, a 54-inch steel pipe. However, as of January 1998, the project has been on hold reportedly due to problems between CNA and its contractor.

- Evaluating Mexico's compliance with the standards set forth in Minute No. 264;

- Formulating plans for construction and operation of facilities needed to assure permanent correction of this New River pollution problem;

- Providing information on the appropriateness of New River water for specific beneficial uses;

- Alerting the State and local health authorities of health hazards associated with New River water; and

- Identifying new pollutants

- Determining compliance with the waste load and load allocation.

B. SALTON SEA

At present the primary water quality problem facing Salton Sea is increasing salinity. Salinity and total dissolved solids are considered equivalent for this discussion. The salinity of the sea was approximately 44,000 mg/l in 1992. Most of the recreationally important species of fish inhabiting the sea were originally transplanted from the Gulf of California where the salinity level is approximately 35,000 mg/l. Previous tests have indicated that spawning of these transplanted fishes is adversely affected at salinity levels above 40,000 mg/l. When salinity increases above 45,000 mg/l it is very questionable if a viable fishery will continue to exist.

Because the Salton Sea is in a closed basin and is replenished primarily by agricultural drainage water containing approximately 3,000 mg/l total dissolved solids, the salinity will continue to rise at about 1-2% per year unless a means of salinity control is devised and implemented. Any reduction in inflows to the sea will cause the salinity to rise more rapidly. The volumes of flow contributed from Mexico and from stormwater runoff will also have a bearing on the rate of salinity increase in Salton Sea.

Another water quality issue facing Salton Sea is the significant input of selenium from agriculture return flows. Relatively elevated levels were first analyzed for and detected in Salton Sea fish during 1984, and have continued to be detected in similar concentrations through 1991 (the last year for which data is available). On May 6, 1986, the California Department of Health Services issued the following advisory on selenium:

"1. Total consumption by adults of croaker, orangemouth corvina, sargo and tilapia from the Salton Sea should be limited to one 4-ounce portion per two weeks, or one 8-ounce portion per month.

2. Consumption of croaker, orangemouth corvina, sargo and tilapia from the Salton Sea should be avoided altogether by women of child-bearing age and by children under the age of 15 years."

These recommendations were issued to guard against the effects of excessive selenium ingestion by humans which could include growth and developmental effects in children, and reproductive, neurologic, gastrointestinal, and dermatologic effects in adults. Selenium bioaccumulates in fish and wildlife and poses threats to many species including migratory birds, endangered species, and resident waterfowl and is a significant concern to the Salton Sea Wildlife Refuge and other adjacent parks and refuges.

Most of the selenium entering the Salton Sea comes originally from the Colorado River water which flows into the Salton Sea watershed via the All American Canal and via Mexican canals. The majority of this selenium becomes concentrated by agricultural usage and is discharged from subsurface tile drains in the Imperial Valley into surface drains which eventually flow into Salton Sea.

1. Salinity Control

   Many studies have been conducted over the last 25 years in an effort to identify methods to maintain the salinity of Salton Sea at a level that would sustain the Sea's fishery. The Regional Board has been involved with many of these studies and has been an active member of the Salton Sea Task Force. The Task Force was created to bring together local, state, and federal agencies that had an interest in maintaining and improving the environment of the Salton Sea. The Task Force was formed and operated with the assistance of the California Department of Fish and Game. A variety of strategies to control salinity levels in the Sea were reviewed by the Task Force. Three strategies received the most attention and are summarized as follows:

a. Pumpout Options

Since approximately 4 million tons per year of salt are added to the Sea by its tributaries, removing an equal amount of salt from the Sea would be necessary to stabilize the salinity level of the Sea. This could be done by removing about 120,000 acre feet of salty water from the Sea per year. Removing additional salt would begin to lower the salinity to a desired level. One option for salt removal is to pump this salty water to the Gulf of California (or alternately Laguna Salada). Preliminary technical and cost estimates for this option have been developed by the U.S. Bureau of Reclamation. However, the Gulf of California is in Mexico and such a project would require an agreement with that country. Alternate locations for disposal of the salty water include the Pacific Ocean, underground injection, and pumping to other enclosed desert basins, although the technical difficulties and costs would be significantly higher.

Another option would pump Sea water into constructed ponds where an enhanced evaporation system would be utilized to concentrate salt. Theoretically these ponds could generate electricity through solar heat trapping. To stabilize the salinity levels in the Sea, at least 4-5 square miles would be needed for such ponds, in addition to disposal of up to 5 million tons of salt per year.

b. In-Sea Impoundments

This option would divide the Sea into basins separated by dikes. Parts of the Sea would then be allowed to get very salty while other areas would receive most of the freshwater inflows and could maintain a favorable salinity. It would be very costly to construct and maintain the dikes. As with the solar pond option, salt disposal would have to be dealt with at some point.

The last meeting of the Salton Sea Task Force was in 1992. A recommendation was made at that time that in order to proceed with any large scale salinity control project, it would be necessary for appropriate local agencies to establish a single operating entity with the authority to manage such a project. In June of 1993 the Salton Sea Authority was formed for this purpose. The four member agencies of the Authority are Riverside County, Imperial County, Imperial Irrigation District, and Coachella Valley Water District. The Regional Board will support the Authority in its efforts to improve water quality in the Salton Sea.

2. Pollution Control

Investigations by the Regional Board, U.S. Geological Survey, U.S. Fish and Wildlife Service, California Department of Fish and Game, and others have identified pollutants from upstream sources which threaten the beneficial uses of the Sea. These pollutants include selenium, nutrients, pesticides, bacteria, and silt. Most of these pollutants are from agricultural runoff from farmlands in the Salton Sea Watershed. The largest contribution is from the Imperial Valley with smaller amounts coming from the Coachella and Mexicali Valleys. Controls on these pollutants are most effectively implemented at their source. The major control activity will be implementation of Management Practices (MPs) on farmlands which will be conducted in accordance with the State's Nonpoint Source Program as discussed in Chapter 4. The Regional Board will also work with the USEPA, U.S. Bureau of Reclamation, Colorado River Basin Salinity Control Forum, and upstream states to identify sources of pollutants, especially selenium, entering the Colorado River from locations upstream of California. Pending the availability of funding, the Regional Board will continue to monitor water quality at the Salton Sea and its tributaries as described in Chapter 6.

C. TOXICITY OBJECTIVE COMPLIANCE

Compliance with the Regional Board's toxicity objective (see Chapter 3) will be determined through the use of bioassays utilizing standard/approved methodology. A three part biomonitoring program to determine compliance is described in Chapter 6 (Section II.B.). Compliance may also be determined by reviewing data generated by the Toxic Substances Monitoring Program (see Chapter 6, Section II.E.) and other water quality monitoring programs. Implementation measures to address violations of the toxicity objective will be conducted in compliance with applicable state and federal policies and regulations.

D. DISPOSAL OF WASTE TO INDIAN LAND

In an effort to protect the Region's water quality it is proposed that resources be requested to undertake the following tasks:

- Identification of Indian Reservation land within the Region where disposal of wastes could threaten Regional surface and ground waters off the Reservation.

- Creation of a Regional Board liaison to communicate with the Bureau of Indian Affairs, USEPA, and appropriate tribal representatives pertaining to disposal of wastes on Indian land.

- In conjunction with the California Environmental Protection Agency cooperative agreements could be made with tribes to address water quality protection from construction and operation of hazardous waste and solid waste facilities on the Reservation. The agreements would provide for the regulation of the facility at a level that is functionally equivalent to that provided under State Law.

- Address other non-hazardous waste discharges on tribal land which may threaten the waters of the State, but for which State law presently does not apply for the purposes of entering into cooperative agreements.

V. TOTAL MAXIMUM DAILY LOADS (TMDLs) AND IMPLEMENTATION PLANS

A. NEW RIVER PATHOGEN TMDL

1. <u>TMDL Elements</u>

New River pathogen TMDL elements are shown on Table A-1 (see following pages).

Table A-1: New River Pathogen TMDL Elements

ELEMENT	DESCRIPTION (Table A-1)
Problem Statement (Impaired water quality standard)	The New River headwaters start about 12-16 miles south of Calexico in the Mexicali Valley, Mexico. Bacteria, which are pathogen-indicator organisms, impair the entire segment of the New River in the United States. Pollution is severest at the International Boundary due to discharges of wastes from Mexico. The bacterial concentrations exceed the water quality objectives established to protect mainly the water contact and non-contact water recreational beneficial uses of the New River.
Numeric Target	The following are the in-stream numeric water quality targets for this TMDL: **Indicator Parameters** — **30-day Geometric Mean[a]** — **Maximum** Fecal Coliforms — 200 MPN[b]/100 ml — c E. Coli — 126 MPN/100 ml — 400 MPN/100 ml Enterococci — 33 MPN/100 ml — 100 MPN/100 ml ______________ a. Based on a minimum of no less than 5 samples equally spaced over a 30-day period. b. Most probable number. c. No more than 10% of total samples during any 30-day period shall exceed 400 MPN/100 ml.
Source Analysis	The main sources of pathogens as indicated by fecal coliforms and E. coli bacteria in the New River are discharges of municipal wastes from the Mexicali Valley, Mexico and undisinfected but treated wastewater discharges from five domestic wastewater treatment plants in the Imperial Valley. Natural sources of pathogens appear to play a relatively insignificant role, but their actual contribution, and contributions from other nonpoint sources of pollution in general require proper characterization.

ELEMENT	DESCRIPTION (Table A-1)
Allocations and Margin of Safety	Discharges from point sources and nonpoint sources of pollution shall not exceed the following waste load allocations (WLAs) and load allocations (LAs), respectively: **WLAs and LAs** **Indicator Parameters** / **30-Day Geometric Mean[a]** / **Maximum** Fecal Coliforms / 200 MPN[b]/100ml / c E. coli / 126 MPN/100 ml / 400 MPN/100 ml Enterococci / 33 MPN/100 ml / 100 MPN/100 ml a. Based on a minimum of no less than 5 samples equally spaced over a 30-day period. b. Most probable number. c. No more than 10% of total samples during any 30-day period shall exceed 400 MPN/100 ml. The allocations are applicable throughout the entire stretch of the New River in the U.S. The numeric target concentrations are based on extensive epidemiological studies conducted by the USEPA and others. By setting the TMDL and each of the load and waste load allocations equal to the standards, the proposed TMDL approach results in very limited uncertainty about whether attainment of the TMDL and the individual allocations will result in attainment of the applicable numeric standards. Moreover, the TMDL analysis takes a conservative approach of providing load and wasteload allocations even for relatively minor loading sources, which helps to ensure that the selected source control approach will result in attainment of the numeric objectives. Finally, to help address uncertainty concerning the bacterial die-off and regrowth dynamics in the River, the TMDL provides implicit margin of safety by including a relatively aggressive monitoring and review plan which will help ensure that needed data are collected and that, if necessary, the TMDL will be revised in the relatively near future.

Indicator Parameters	30-Day Geometric Mean[a]	Maximum
Fecal Coliforms	200 MPN[b]/100ml	c
E. coli	126 MPN/100 ml	400 MPN/100 ml
Enterococci	33 MPN/100 ml	100 MPN/100 ml

2. Implementation Actions for Attainment of TMDL

The pathogen load allocations, waste load allocations, and water quality objectives shall be applicable to the New River for the protection of the REC-I and REC-II beneficial uses and shall be achieved within three years of USEPA approval of the TMDL. To this end, the following actions shall be implemented.

2.1 Wastewater Treatment Plants

All point source dischargers discharging, potentially discharging, or proposing to discharge waste with bacteria into the New River and/or surface waters tributary to the New River, at concentrations that violate or threaten to violate waste load allocations (WLAs), shall provide adequate disinfection to meet the WLAs specified in Table A-1.

Currently, there are five (5) NPDES permitted facilities discharging undisinfected municipal wastewater into the New River: the City of Brawley WWTP, Seeley County Water District (SCWD) WWTP; Date Gardens Mobile Home Park (DGMHP) WWTP; City of Westmorland WWTP, and McCabe Union School District (MCUSD) WWTP. Both the City of Westmorland and City of Brawley have been issued Time Schedule Orders (TSOs) requiring them to upgrade their WWTPs by January 2002 and March 2002, respectively. The City of Westmorland is already upgrading its WWTP and expects to complete the upgrade by 2002. The City of Brawley is securing financing from the North America Development Bank to upgrade its WWTP. The NPDES permit for the City of Brawley already prescribes effluent disinfection limits consistent with this TMDL. However, neither the TSO nor the NPDES permits for the City of Westmorland contains requirements for disinfection.

It is essential that the referenced facilities that are not disinfecting provide adequate effluent disinfection at the earliest possible date. Towards this end, the Executive Officer shall direct staff to draft revised NPDES permits for these facilities incorporating the WLAs prescribed in Table A-1 and monitoring requirements for the WLAs. Draft revised permits shall be ready for Regional Board consideration in accordance with the following schedule (see Table A-2) or sooner as resources allow.

Table A-2. Schedule for Draft revised NPDES Permits.

Facility Name	NPDES Permit No.	Expiration Date	Revision Date
City of Westmorland WWTP	CA0105007	1/28/03	{Year 1}*
Seeley County Water District WWTP	CA0105023	6/25/02	{Year 1}*
Date Gardens Mobile Home Park WWTP	CAO104841	9/24/02	{Year 1}*
McCabe Union High School District WWTP	CA0104281	11/29/00	{Year 1}*

*Year 1 refers to the effective date to revise the permits for these plants, which shall be 30 days after USEPA approval of the TMDL. (USEPA approval date August 14, 2002)

Additionally, SCWD, DGMHP, and MCUSD shall each:

a. By November 14, 2002 and pursuant to Section 13267 of the California Water Code, submit a technical report in the form of plans, specifications, and proposed measures to be taken to secure funds to comply with their WLAs by no later than May 14, 2005.

b. Submit quarterly reports to the Executive Officer describing their progress towards meeting their WLAs. Quarterly reports shall be due on the 15th day of the month following the reporting calendar quarter, and begin the first calendar quarter immediately following USEPA approval.

2.2 United States Government

Neither the existing lagoon systems nor the proposed wastewater treatment facilities for the Mexicali metropolitan area include disinfection. Also, there are a significant number of unregulated point and nonpoint sources of bacteria which discharge directly into the New River watershed in Mexicali, and an unknown number of raw sewage bypasses, which are not addressed by the certified projects. Therefore, the projects by themselves will not result in attainment of the bacterial load allocations downstream of the International Boundary. Consequently, it is necessary for the U.S. Government to pursue additional steps to ensure this TMDL complies with the requirements of Section 303(d) of the Clean Water Act and ensure discharges of wastes from Mexico will not cause or contribute to a violation of this TMDL. Therefore, pursuant to Section 13225 of the California Water Code, the U.S. Section of the International Boundary and Water Commission and USEPA shall:

a. By February 14, 2003, submit a technical report to the Regional Board with proposed measures (e.g., plans and specifications for disinfection facilities) to ensure that discharges of wastes from Mexico do not cause or contribute to a violation of this TMDL. The report shall specify the parties responsible for implementation of the measures and include a time schedule for implementation and completion of the measures within three years of USEPA approval of this TMDL.

b. By May 14, 2003, submit a report identifying financial options for implementation of the measures discussed in Task No. "a," above.

c. Submit semi-annual progress reports to the Regional Board regarding progress towards completion of the measures. The semi-annual reports shall be due by the 15th day of the month, and shall begin in the 6th month following submission of the technical report required in 2.2, a.

B. ALAMO RIVER SEDIMENTATION/ SILTATION TMDL

1. <u>TMDL Elements</u>

SUMMARY

This TMDL was adopted by:
The California Regional Water Quality Control Board, Colorado River Basin Region on June 27, 2001.
The California State Water Resources Control Board on February 19, 2002.
The Office of Administrative Law on May 3, 2002.
The U.S. Environmental Protection Agency on June 28, 2002.

Table B-1: Alamo River Sedimentation/Siltation TMDL Elements[1]

ELEMENT	
Problem Statement (impaired water quality standard)	Excess delivery of sediment to the Alamo River has resulted in degraded conditions that impair the following designated beneficial uses: warm freshwater habitat; wildlife habitat; preservation of threatened, rare, and endangered species habitat; contact- and non-contact recreation; freshwater replenishment. As the Alamo River discharges into the Salton Sea, sediment also threatens the same beneficial uses of the Salton Sea. Specifically, sediment serves as a carrier for DDT, DDT metabolites, and other insoluble pesticides including toxaphene, which pose a threat to aquatic and avian communities and people feeding on fish from the Alamo River; and suspended solids concentrations, sediment loads, and turbidity levels are in violation of water quality objectives. These current concentrations, loads, and levels are also forming objectionable bottom deposits, which are also adversely affecting the beneficial uses of Alamo River.

(This table is continued on the following page. Table footnotes are contained at the bottom of the Table)

Table B-1: Alamo River Sedimentation/Siltation TMDL Elements[1] (continued)

ELEMENT	
Numeric Target	200 mg/L Total Suspended Solids (annual average)[2]
Source Analysis	**Source** — **tons/year** Agricultural Drain Discharges: 322,493 In-Stream Erosion & Wind Deposition: 6,623 NPDES Permitted Facilities: 215 International Boundary 146 Total: 329,477
Margin of Safety	8,737 tons/year (corresponds to 10 mg/L)[3]
Seasonal Variations and Critical Conditions	Both the flow and sedimentation regimes within the Alamo River watershed are relatively stable, and the sediment and water sources within the watershed are relatively uniform and widespread; therefore, this TMDL does not include provisions other than the established load allocations and implementation plan for seasonal variations or critical conditions. Staff's analysis of potential water transfers out of the watershed indicate that the transfers are not likely to affect compliance with this TMDL, but could cause other water quality problems that will need to be addressed by the parties responsible for the transfers.
Loading Capacity	177,247 tons/year[4]

(This table is continued on the following page. Table footnotes are contained at the bottom of the Table)

Table B-1: Alamo River Sedimentation/Siltation TMDL Elements[1] (continued)

ELEMENT			
Load Allocations and Wasteload Allocations	**Load Allocations:** • Natural sources of sediment to the Alamo River, including erosion and wind deposition, are allocated 8,737 tons/year. • Waste discharges from nonpoint sources into the Alamo River shall not exceed the load allocations specified below:		
	River Reach	# of IID Drains Identified within Reach	Sediment Load Allocation (tons/year)[5,6]
	Alamo River immediately downstream of the International Boundary, at the IID gauging station just north of the All American Canal, a point identified hereafter at “AR-0”	None	146
	Reach 1: Downstream from the International Boundary to a point approximately 100 feet downstream of the Ninth Street Drain outfall into the river, a point identified hereafter as "AR-1"	8	17,488
	Reach 2: This reach encompasses the river from AR-1 to a point downsteam of the Pomello Drain outfall into the river and upstream of the Graeser Drain outfall into the river, a point hereafter referred to as "AR-2".	7	25,255
	Reach 3: This reach covers the river from AR-2 to a point downstream of the Holtville Main Drain outfall into the river and upstream of the Olive Drain outfall into the river, a point hereafter referred to as "AR-3";	8	24,501
	Reach 4: This reach covers from AR-3 to a point downstream of the Wills Drain outfall into the river and upstream of the Moss Drain outfall into the river, a point hereafter referred to as "AR-4";	12	31,887
	Reach 5: This reach covers the river from AR-4 to a point downstream of Rockwood Drain outfall into the river and upstream of the C Drain outfall into the river, a point hereafter referred to as "AR-5";	22	30,002

(This table is continued on the following page. Table footnotes are contained at the bottom of the Table)

Table B-1: Alamo River Sedimentation/Siltation TMDL Elements[1] (continued)

ELEMENT			
Load Allocations and Wasteload Allocations	River Reach	# of IID Drains Identified within Reach	Sediment Load Allocation (tons/year)[5,6]
	Reach 6: This reach covers the river from AR-5 to the point where it intersects the Garst Road, a point hereafter referred to as "AR-Outlet."	12	19,469
	Tailwater outfalls discharging directly to the Alamo River.	[a]	7,830
	Natural Sources		8,737
	Waste Load Allocations: The discharge from point sources shall not exceed the total suspended limits specified under 40 CFR 122 et seq., and the corresponding mass loading rates.	N/A	3,196

Footnotes for Table No. B-1:

1 For purposes of measuring compliance, all samples will be analyzed for volatile suspended solids at locations where organic loading represents a significant proportion of the total suspended solids or turbidity. The volatile suspended solids component will be subtracted for determining compliance.

2 The numeric target is a goal that translates current silt/sediment-related Basin Plan narrative objectives and shall not be used for enforcement purposes.

3 The margin of safety is roughly equal to the estimated load from natural sources to the Alamo River. This margin of safety allows for the loading of sediment from natural sources to the river to be double the natural source loading estimated in the Source Analysis without exceeding the Numeric Target.

4 Previously reported as 174,747 due to typographical error.

5 The sediment load allocation for any particular reach shall be distributed proportionately amongst the agricultural drains within that particular reach based on the relative flow contribution of each drain to the total flow contribution to the reach from the drains within the reach. The sediment load allocation will be reviewed every three years following TMDL implementation. The sediment load allocation will vary depending on drain flow.

6 The sediment load allocations herein have been calculated based on the estimated individual average drain flows within the reach for the 1994-1999 period. At lower or higher drain flows, the average annual load allocation for a particular reach shall not exceed the load given by:
$LA_R = (180)*(Q_R)*(0.0013597)$, where:
LA_R = Load Allocation for any of the Alamo River reaches identified above (tons/yr).
Q_R = Reach Flow (ac-ft) = Total flow contribution to the reach from the drains within the reach (ac-ft)

[a] The number of outfalls has not been determined.

Table B-1A[1] : Waste Load Allocations for Point Sources in the Alamo River Watershed

Facility	NPDES #	Discharge Location	NPDES Permit Limits as of 6-2001[2] (tons of suspended solids per year)	Waste Load Allocation[3] (tons of suspended solids per year)
City of Calipatria WWTP	CA 0105015	G Drain	246.0	491.9
City of El Centro WWTP	CA 104426	Central Drain	365.5	731.1
City of Holtville WWTP	CA 0104361	Pear (Palmetto) Drain	38.8	77.7
City of Imperial MWTP	CA 0104400	Rose Drain	64.0	127.9
Heber Public Utilities District WWTP	CA 0104370	Central Drain	20.6	41.1
Imperial Community College District WWTP	CA 104299	Central Drain	4.6	9.1
Sunset Mutual Water Co	CA 104345	Central Drain	2.3	4.6
Country Life MHP	CA 0104264	Central Drain	5.7	11.4
Covanta Heber Geothermal	CA 0104965	Central Drain	195.6	391.1
El Centro Steam Plant	CA 104248	Central Drain	NA	95.0
New Charleston Power Plant	CA 101990	Rose Drain	6.9	13.7
IID Grass Carp Hatchery	CA 7000004	Central Drain	NA	182.8
Rockwood Gas Turbine Station	CA 0104949	Bryant Drain	1.3	2.6
Imperial Valley Resources Biomass Waste Fuel Power Plant	CA 0105066	Rose Drain	NA	15.5
Future Point Sources	NA	NA	NA	1000.0
TOTAL			1098	3196

Footnotes for Table No. B-1A:

1 Does not include volatile suspended solids determination.

2 Calculated using design flows and 30-day mean TSS limits.

3 Determined using double the current effluent limits to allow for facility expansion. For the three energy generating facilities without current TSS limits, a 30 mg/L TSS limit is used for current effluent limit in this calculation.

2. IMPLEMENTATION ACTIONS FOR ATTAINMENT OF TMDL

TMDL attainment shall be in accordance with the schedule contained in Table B-2:

Table B-2: Interim Numeric Targets for Attainment of the TMDL[1]

Phase	Time Period[2]	Estimated Percent Load Reduction[3]	Interim Target (mg/L)[4]
Phase 1	Years 1 – 3	15%	320
Phase 2	Years 4 – 7	25%	240
Phase 3	Years 8 – 10	10%	216
Phase 4	Years 11 – 13	8%	200

Footnotes for Table No. B-2:

1 For purposes of measuring compliance, all samples will be analyzed for volatile suspended solids at locations where organic loading represents a significant proportion of the total suspended solids or turbidity. The volatile suspended solids will be subtracted for determining compliance.

2 Year 1 refers to the effective date to start TMDL implementation, which shall be one year after USEPA approves the TMDL. For example, if USEPA approves the TMDL on November 15, 2001, Year 1 is November 15, 2002, which makes Year 3 November 15, 2005, which makes Year 4 November 15, 2006, and so on.

3 Percent reductions indicate the reduction required in total suspended sediment load from the average concentration of the Alamo River at the beginning of each phase, beginning with the 1980-2000 average concentration of 377 mg/L.

4 These interim targets are goals which translate current silt/sediment related Basin Plan narrative objectives and are not intended to specifically be used for enforcement purposes.

C. NEW RIVER SEDIMENTATION/SILTATION TMDL

SUMMARY

This TMDL was adopted by the California Regional Water Quality Control Board, Colorado River Basin Region in June 2002; approved by the Office of Administrative Law in January 2003; and approved by the U.S. Environmental Protection Agency on March 31, 2003.

1. TMDL ELEMENTS

Table C-1: New River Sedimentation/Siltation TMDL Elements

ELEMENT	
<u>Problem Statement</u> <u>(impaired water quality standard)</u>	Excess delivery of sediment to the New River has resulted in degraded conditions that impairs designated beneficial uses: warm freshwater habitat; wildlife habitat; preservation of threatened, rare, and endangered species habitat; contact- and non-contact recreation; freshwater replenishment. As the New River discharges into the Salton Sea, sediment also threatens the same beneficial uses of the Salton Sea. Sediment serves as a carrier for DDT, DDT metabolites, and other insoluble pesticides including toxaphene, which pose a threat to aquatic and avian communities and people feeding on fish from the New River; and suspended solids concentrations, sediment loads, and turbidity levels are in violation of water quality objectives. These current concentrations, loads, and levels are also forming objectionable bottom deposits, which are also adversely affecting the beneficial uses of New River.

Table C-1: New River Sedimentation/Siltation TMDL Elements (continued)

ELEMENT	CURRENT CONDITIONS
Numeric Target	200 mg/L Total Suspended Solids (annual average)[3]
Source Analysis	**Source** / **tons/year** Agricultural Drain Discharges: 137,715 In-Stream Erosion & Wind Deposition: 6,409 NPDES Permitted Facilities: 356 International Boundary 11,265 Total: 155,745

ELEMENT	LOAD ALLOCATIONS
Margin of Safety	6,409 tons/year (corresponds to 10 mg/L)
Seasonal Variations and Critical Conditions	Both the flow and sedimentation regimes within the New River watershed are relatively stable, and the sediment and water sources within the watershed are relatively uniform and widespread; therefore, this TMDL does not include provisions other than the established load allocations and implementation plan for seasonal variations or critical conditions. Staff's analysis of potential water transfers out of the watershed indicate that the transfers are not likely to affect compliance with this TMDL, but could cause other water quality problems that will need to be addressed by the parties responsible for the transfers.
Loading Capacity	127,881 tons/year

(This table is continued on the following page.)

3 The numeric target is a goal that translates current silt/sediment-related Basin Plan narrative objectives and shall not be used for enforcement purposes.

Table C-1: New River Sedimentation/Siltation TMDL Elements (continued)

ELEMENT			
Load Allocations and Wasteload Allocations	**Load Allocations:** • Natural sources of sediment to the New River, including erosion and wind deposition, are allocated 6,409 tons/year. • Waste discharges from nonpoint sources into the New River shall not exceed the load allocations specified below:		
	River Reach	# of IID Drains Identified within Reach	Sediment Load Allocation (tons/year)[1,2]
	New River immediately downstream of the International Boundary, at the USGS gauging station, a point identified hereafter at “NR-0”	None	11,265
	Reach 1: Downstream from the International Boundary to the intersection of the Evan Hewes Road Bridge and the New River Channel, a point identified hereafter as "NR-1"	14	20,730
	Reach 2: This reach encompasses the river from NR-1 to Drop Structure 2, a point upstream of the Rutheford Road Bridge hereafter referred to as "NR-2".	17	32,350

(This table is continued on the following page.)

Table C-1: **New River Sedimentation/Siltation TMDL Elements (continued)**

ELEMENT			
Load Allocations and Wasteload Allocations	Reach 3: This reach covers the river from NR-2 to the point where it intersects the Lack Road Bridge, a point hereafter referred to as "NR-Outlet."	23	35,835
	Direct Outfalls to River	# of IID Drains Identified	Sediment Load Allocation (tons/year)[1,2]
	Tailwater outfalls discharging directly to the New River.	[a]	14,884
	Natural Sources		
	Natural Sources		6,409
	Waste Load Allocations: • The discharge from point sources (NPDES permits) shall not exceed the total suspended solids limits specified under 40 CFR 122 et seq., and the corresponding mass loading rates.		

Footnotes for Table No. C-1:

1 The sediment load allocation for any particular applicable reach shall be distributed proportionately amongst the agricultural drains within that particular reach based on the relative flow contribution of each drain to the total flow contribution to the reach from the drains within the reach. The sediment load allocation will be reviewed every three years following TMDL implementation. The sediment load allocation will vary depending on drain flow.

2 The sediment load allocations have been calculated based on the estimated individual average drain flows within the reach for the 1995-2000 period. At lower or higher drain flows, the average annual load allocation for a particular reach shall not exceed the load given by:
$LA_R = (180)*(Q_R)*(0.0013597)$, where:
LA_R = Load Allocation for any of the New River reaches identified above (tons/yr).
Q_R = Reach Flow (ac-ft) = Total flow contribution to the reach from the drains within the reach (ac-ft). The sediment load allocation will be reviewed by the Executive Officer every three years following TMDL implementation.

[a]. The number of outfalls has not been determined.

2. Implementation Actions for Attainment of TMDL

TMDL attainment shall be in accordance with the schedule contained in Table C-2A:

Table C-2: Interim Numeric Targets for Attainment of the TMDL

Phase	Time Period[1]	Estimated Percent Load Reduction[2]	Interim Target (mg/L)[3]
Phase 1	Years 1 – 3	5%	229
Phase 2	Years 4 – 6	7%	213
Phase 3	Years 7 – 9	4%	204
Phase 4	Years 10 – 12	2%	200

Footnotes for Table No. C-2:

1 Year 1 refers to the effective date to start TMDL implementation, which shall be one year after USEPA approves the TMDL. For example, if USEPA approves the TMDL on November 15, 2002, Year 1 is November 15, 2003, which makes Year 3 November 15, 2005, which makes Year 4 November 15, 2006, and so on.

2 Percent reductions indicate the reduction required in total suspended sediment load from the average concentration of the New River at the beginning of each phase, beginning with the 1980-2001 average concentration of 306 mg/L.

3 These interim targets are goals which translate current silt/sediment related Basin Plan narrative objectives and are not intended to specifically be used for enforcement purposes.

D. IMPERIAL VALLEY DRAINS SEDIMENTATION/SILTATION TMDL

SUMMARY

This TMDL was adopted by the California Regional Water Quality Control Board, Colorado River Basin Region in January 2005.

1. TMDL ELEMENTS

The Imperial Valley Drains Sedimentation/Siltation TMDL contains allocations that apply to three Imperial Valley drains (Niland 2, P, and Pumice) and their tributary drains (Vail 4A, Vail 4, Vail 3A, Vail 3, and Vail 2A feed into Pumice). These drains (among others) empty directly into the Salton Sea. Figure D-1 is a map of the three drains (and their tributary drains) for which allocations have been specified in this TMDL.

Figure D-1: Drains (Niland 2, P, and Pumice and Their Tributary Drains) for Which Allocations Have Been Specified in this TMDL

Table D-1: Imperial Valley Drains (Niland 2, P, and Pumice) Sedimentation/Siltation TMDL Elements

ELEMENT	
Problem Statement (impaired water quality standard)	Excess delivery of sediment to Niland 2, P, and Pumice Imperial Valley drains has resulted in degraded conditions that impairs designated beneficial uses: warm freshwater habitat; wildlife habitat; preservation of threatened, rare, or endangered species; water contact and non-contact water recreation; and freshwater replenishment. As the drains discharge into the Salton Sea, sediment also threatens the same beneficial uses of the Salton Sea. Sediment serves as a carrier for DDT, DDT metabolites, and other insoluble pesticides including toxaphene, which pose a threat to aquatic and avian communities and people feeding on fish from the drains. Suspended solids concentrations, sediment loads, and turbidity levels are in violation of water quality objectives. These current concentrations, loads, and levels also are forming objectionable bottom deposits, which are adversely affecting the beneficial uses .

(This table is continued on the following page.)

Table D-1: Imperial Valley Drains (Niland 2, P, and Pumice) Sedimentation/Siltation TMDL Elements (continued)

ELEMENT	CURRENT CONDITIONS
Numeric Target	200 mg/L Total Suspended Solids (annual average)[4]
Source Analysis	**Source** — **tons/year** Agricultural Tailwater — 11,602.4 Natural Sources (In-Stream Erosion, Wind Deposition, Wildlife) — 277.4 Storm Event Runoff from Farm Land — 50.5 Total — 11,930.3

ELEMENT	LOAD ALLOCATIONS
Margin of Safety	277.4 tons/year (corresponds to TSS of 10 mg/L)
Seasonal Variations and Critical Conditions	Seasonal differences exist regarding local water flow, but not local climate (e.g., rainfall). Sediment becomes suspended in tailwater regardless of the season. However, more flow at certain times of year means that more sediment becomes suspended in drains at certain times of year. To address this seasonal variation, the numeric target is expressed in terms of an annual average. If data for certain months exceeds the load allocation, this may be tempered by low data readings in other months. Therefore, variability is accounted for and addressed by use of an annual average.
Loading Capacity (Total Assimilative Capacity**)**	5,547.2 tons/year (corresponds to TSS of 200 mg/L)

(This table is continued on the following page.)

[4] The numeric target is a goal that translates current sediment/silt-related Basin Plan narrative objectives and shall not be used for enforcement purposes.

Table D-1: Imperial Valley Drains (Niland 2, P, and Pumice) Sedimentation/Siltation TMDL Elements (continued)

<table>
<tr><th>ELEMENT</th><th colspan="3"></th></tr>
<tr><td rowspan="14">Load Allocations and Wasteload Allocations</td><td colspan="3">Load Allocations:

• Natural sources of sediment to Niland 2, P, and Pumice Imperial Valley Drains are allocated 277.4 tons/year.

• Waste discharges from nonpoint sources into Niland 2, P, and Pumice Imperial Valley Drains shall not exceed load allocations specified below:</td></tr>
<tr><td>Drain Sources</td><td># of Drains Included in Segment</td><td>Sediment Load Allocation (tons/year)[1]</td></tr>
<tr><td>Niland 2</td><td>1</td><td>300.1</td></tr>
<tr><td>P</td><td>1</td><td>638.2</td></tr>
<tr><td>Pumice, including 5 Vail drains (Vail 4A, Vail 4, Vail 3A, Vail 3, and Vail 2A) that drain into it</td><td>6</td><td>3,904.3</td></tr>
<tr><td>Future Growth</td><td>None</td><td>149.8</td></tr>
<tr><td>Total Load Allocation for drains (corresponds to TSS of 180 mg/L)</td><td>8</td><td>4,992.4</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Other Sources</td><td></td><td></td></tr>
<tr><td>Natural Sources</td><td>Not applicable</td><td>277.4</td></tr>
<tr><td>Margin of Safety</td><td>Not applicable</td><td>277.4</td></tr>
<tr><td>Total Load Allocation for other sources (corresponds to TSS of 20 mg/L)</td><td>Not applicable</td><td>554.8</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td colspan="3">Waste Load Allocations:

• The discharge from point sources (NPDES permits) shall not exceed the total suspended solids limits specified under 40 CFR 122 et seq., and the corresponding mass loading rates.</td></tr>
</table>

Footnotes for Table No. D-1:

1. The sediment load allocation for any particular drain shall be distributed proportionately amongst the agricultural drains in the project area, based on the relative flow contribution of each drain to the total flow contribution of all drains in the project area. The sediment load allocation will be reviewed every three years following TMDL implementation. The sediment load allocation will vary depending on drain flow.

2. IMPLEMENTATION ACTIONS FOR ATTAINMENT OF TMDL

The Implementation Plan for this TMDL applies not just to the three drains (Niland 2, P, and Pumice) for which allocations are specified, but to all Imperial Valley drains that empty directly into the Salton Sea. This is necessary because all of the drains contribute, albeit in varying degrees, to sediment/silt impacts on water quality standards of the drains and the Salton Sea, and are so listed pursuant to Section 303(d) of the Clean Water Act. This approach ensures Valley-wide consistency in controlling sediment in all drains that empty directly into the Salton Sea, prevents a piece-meal approach in controlling sediment, and will enable de-listing of all the drains simultaneously upon successful completion of the control measures.

TMDL attainment shall be in accordance with the schedule contained in Table D-2:

Table D-2: Interim Numeric Targets for Attainment of the TMDL

Phase	Time Period	Estimated Percent Load Reduction[1]	Interim Target (mg/L)[2]
Phase 1	2005 through 2006	10%	376
Phase 2	2007 through 2009	25%	282
Phase 3	2010 through 2012	20%	226
Phase 4	2013 through 2015	12%	200

Footnotes for Table No. D-2:

1 The reduction required in the average concentration at the end of each phase, beginning with the current (2002) average concentration of 418 mg/L.

2 The interim numeric target is a goal that translates current sediment/silt-related Basin Plan narrative objectives and shall not be used for enforcement purposes.

E. FURTHER IMPLEMENTATION ACTIONS AND REGULATIONS FOR ALL IMPERIAL VALLEY SEDIMENTATION/SILTATION TMDLs

1. DESIGNATED MANAGEMENT ACTIONS

Consistent with the State NPS Program, sediment pollution shall be controlled by responsible parties through implementation of Management Practices (MPs). For the purpose of this Section, responsible parties include:

- Farmers/landowners, renters/lessees, and operators/growers discharging waste into Imperial Valley Drains, New River, and Alamo River in a manner that causes or could cause violation of load allocations and/or exceedance of the Sediment/Silt numeric target;
- The Imperial Irrigation District;
- The United States Environmental Protection Agency and U.S. Section of the International Boundary and Water Commission, for wastes discharged from Mexico into the Alamo River and New River.

Responsible parties who already have complied with the requirements of previously-adopted Sedimentation/Siltation TMDLs are not required to re-submit reports, workplans, or other information already submitted to the Regional Board. Responsible parties who are subject to multiple TMDLs are encouraged, but not required, to combine submissions so that a single report or workplan satisfies the requirements of all applicable TMDLs. Early implementation of actions by responsible parties will be welcomed by the Regional Board, to simplify timelines between all Imperial Valley Sedimentation/Siltation TMDLs.

1.1 FARM LANDOWNERS, RENTERS/LESSEES, OPERATORS/GROWERS

Farm landowners, renters/lessees, and/or operators/growers shall submit self-determined Sediment Control Programs (Water Quality Management Plans) to the Regional Board by:

Table E-1 Sediment Control Program Due Dates

TMDL	Date
Alamo River	September 28, 2003
New River	June 30, 2004
Imperial Valley Drains	6 months after U.S. Environmental Protection Agency (USEPA) approval

and on an annual basis thereafter.

The Sediment Control Program may be submitted by an individual farm landowner, renter/lessee, or operator/grower (hereafter "Individual Program") or by a group of farm landowners, renters/lessees, and/or operators/growers (hereafter "Group Program"). Individual and Group Sediment Control Programs (Water Quality Management Plans) are required pursuant to CWC §13267. These programs are necessary to achieve compliance with these TMDLs and applicable water quality objectives, and to monitor/assess MP effectiveness. Regional Board staff strongly recommends that individual farm landowners, renters/lessess, and/or operators/growers work with the Imperial County Farm Bureau (ICFB) to submit a Group Plan through the ICFB's Watershed Program. Group Plans offer landowners the ability to work together to solve their erosion problems, while also affording a measure of privacy to the members of the Group. A Group Program must provide information on a drain- or drainshed basis regarding which responsible parties are enrolled in the program. Additionally, a group may provide a single monitoring and reporting plan as long as results are representative of the efficiency of the group's various control practices, in order to measure overall water quality improvements.

In either case (whether a Group or Individual Plan), the program shall, at a minimum, address the following in their Sediment Control Programs:

1. Name of farm landowner, business address, mailing address, and phone number
2. Name of farm operator/grower, business address, mailing address, and phone number
3. Problem assessment, including site conditions(s), crop(s), potential or current NPS problems, problem severity, and problem frequency
4. Statement of goals (measurable outcomes or products)
5. Existing and/or alternative sediment management practices (technical/economic feasibility, desired outcome, etc.)

6. Timetable for implementation of management practices (measured in either water quality improvement or level of implementation)
7. Monitoring, including progress toward goals, and effectiveness of management decisions
8. Mechanism for reporting planned and completed implementation actions to the Regional Board.

A group program may address Item Nos. 1 through 6, above, for the individuals enrolled in the program as a group. The program shall nevertheless provide sufficient information so that the Regional Board can: (a) determine at a minimum on a drain- or drainshed-basis which responsible parties are enrolled in the program; (b) the types of sediment problems (i.e., severity, magnitude, and frequency) either the group as a whole or the drain/drainshed face; (c) the proposed sediment management practices for the group; and (d) the time table for implementation of the management practices (measured in either water quality improvement and/or level of implementation). Regarding Item Nos. 7 and 8, a single monitoring and reporting plan may also be proposed for a group provided that the monitoring and reporting will provide results that are representative of the efficiency of various control practices within the group and representative enough to measure overall water quality improvements. Reported implementation of MPs shall be submitted to the Regional Board under penalty of perjury.

All programs and reports specified herein are requested pursuant to Section 13267 of the California Water Code. In accordance with Section 13267(b)(2) of the California Water Code, when requested by the responsible party or group furnishing a program, the portions of a program, which might disclose trade secrets or secret processes, shall not be made available for inspection by the public but shall be made available to governmental agencies for use in making studies. However, these portions of a program shall be available for use by the Regional Board or any state agency in judicial review or enforcement proceedings involving the person or group of persons furnishing the report.

1.2 IMPERIAL IRRIGATION DISTRICT

Table E-2 Revised DWQIP Due Dates

***TMDL**	**Date**
Alamo River	September 28, 2003
New River	June 30, 2004
Imperial Valley Drains	6 months after USEPA approval

The Imperial Irrigation District shall submit to the Regional Board a revised Drain Water Quality Improvement Plan (DWQIP) with a proposed program to control and monitor water quality impacts caused by drain maintenance operations within the Alamo and New River and Imperial Valley Drains Watersheds and dredging operations in the Alamo and New River and Imperial Valley Drains. The revised DWQIP shall be subject to the approval of the Executive Officer and shall address, but need not be limited to, items “a” and “b”, below:

a. Drain and River Deltas Maintenance
   - Reduction in drain cleaning and dredging activities to the practical extent allowed by the implementation of on- and off-field sediment control MPs by farmers landowners, renters/lessees, operators/growers and the MP effectiveness in reducing silt built up in the drains and the New and Alamo River Deltas and Imperial Valley Drains to avoid impacts on sensitive resources.
   - Mechanism(s) to assess effectiveness of such reduction

b. Drain Water Quality Monitoring Plan
   The revised DWQIP shall consist of a proposed program to monitor the New and Alamo Rivers and Imperial Valley Drains:
   - Water quality impacts caused by dredging operations in the drains and to monitor the effects that dredging operations in the New and Alamo River Deltas and Imperial Valley Drains have on compliance with the rivers' and drains’ water quality standards;
   - Representative samples from the water column of all major drains and a representative number of the small drains tributary to the New and Alamo Rivers and those drains emptying directly to the Salton Sea for analyses of flow, TSS, Turbidity, and nutrients. Samples collected from the last drain weir before the drain outfalls to the river shall be considered representative of the water column;
   - A representative number of source water locations for TSS;

- A representative number of drains at a location sufficiently upstream of the outfalls to the river so as to provide an idea of how much of the silt is being reduced by field MPs;
- Sediment impacts from storm events;

c. Information on Agricultural Dischargers

Table E-3 IID Submission of Data on Agricultural Dischargers Due Dates

TMDL	Date
Alamo River	October 28, 2003
New River	July 31, 2004
Imperial Valley Drains	6 months after USEPA approval

and on a semi-annual basis thereafter, the IID shall submit the following information to the Regional Board on the agricultural dischargers within the District:

The names and mailing addresses for all the owners of properties within the IID service area that are being used for irrigated agriculture, as well as the location of their properties. The names and mailing addresses for all water account holders within the IID service area, and the location of all fields that they irrigate. For each parcel within the IID service area, the location of the parcel, the irrigation canal and gates serving the parcel, the drop boxes draining the parcel, the drains that these drop boxes empty into, and the fields located within each parcel. For each field within the IID service area, the parcel within which each field is located, the area and location of each field within the parcel, the irrigation canal and gates serving each field, the drop boxes draining each field and the drains to which these drop boxes drain. The above information should be submitted in an electronic, tabular, and easily geo-referenced format.

No later than 60 days following the Executive Officer's approval of the revised DWQIP, the IID shall submit to the Executive Officer a Quality Assurance Project Plan (QAPP) prepared in accordance with *Requirements for Quality Assurance Project Plans for Environmental Data Operations*, EPA QA/R-5, 1994 for the revised DWQIP. The QAPP is subject to the approval of the Executive Officer. No later than 30 days following the Executive Officer's approval of the QAPP, the IID shall implement the QAPP and submit quarterly and annual monitoring reports to the Executive Officer. The quarterly reports shall be due on the month following the calendar's quarter and shall transmit a quarterly summary of the results for the previous three months. The annual reports shall be due on February 15 and summarize the year's data, quality control reports, and any trends in the data.

The DWQIP and QAPP are required pursuant to CWC §13225 and 13267. These are necessary to achieve compliance with this TMDL and the applicable water quality objectives and to monitor/assess effectiveness of MPs in a cost-effective manner. IID is required to provide this information because it operates and maintains the subject drains and because it is the only entity with access to some of the information required in the DWQIP.

All plans and reports requested herein are requested pursuant to Section 13267 of the California Water Code and shall be prepared under the direct supervision of a California registered civil engineer and/or agricultural engineer, with experience in the preparation of this type of program.

1.3 UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (USEPA) AND U.S. SECTION OF THE INTERNATIONAL BOUNDARY AND WATER COMMISSION (USIBWC)

The USEPA and USIBWC are *not* responsible parties for the Imperial Valley Drains Sedimentation/Siltation TMDL. The USEPA and USIBWC are responsible parties for the Alamo River and New River Sedimentation/Siltation TMDLs.

Table E-4 Technical Report Due Dates

TMDL	Date
Alamo River	September 28, 2003
New River	June 30, 2004

the USEPA and/or the U.S. Section of the IBWC shall submit to the Regional Board a technical report pursuant to Section 13225 of the California Water Code describing the proposed control measures, monitoring plan and reporting procedures, and quality assurance procedures the U.S. Government proposes to take to ensure that discharges of wastes from Mexico do not violate or contribute to a violation of these TMDLs, particularly a violation of the Load Allocation immediately downstream of the International Boundary, at the points identified as "AR-0." and "NR-0". The report shall be prepared under the direct supervision of a California registered civil engineer, with experience in the preparation of these types of reports and shall include a time schedule for implementation.

2. RECOMMENDED MANAGEMENT PRACTICES (MPs)

Implementation of MPs should normally include: (1) consideration of specific site conditions; (2) monitoring to assure that practices are properly applied and are effective; (3) improvement of a MP or implementation of additional MPs or other management practices when needed to resolve a deficiency and; (4) mitigation of a problem where practices are not effective. The practices listed herein are a compilation of MPs recommended by the Imperial Valley Sedimentation/Siltation TMDL Technical Advisory Committee (Silt TMDL TAC), Natural Resources Conservation Services Field Office Technical Guide (NRCS FOTG), IID, and University of California Cooperative Extension (Holtville Field Station). Inclusion of practices herein is not meant to imply or establish a prescriptive list of 'one size fits all' preferred practices for the Imperial Valley Drains, Salton Sea, and Alamo and New River Basins. These recommendations do not preclude dischargers from implementing other proven sediment management practices. Identification of the most appropriate controls to achieve the TMDL for site- and crop-specific conditions is best made by the dischargers relying on technical resource agencies and organizations. The listed practices are recommended because they have been documented to be effective under a variety of circumstances. Under many circumstances, implementation of a combination of MPs may be necessary to ensure that discharges do not adversely impact water quality. In addition, the effectiveness of many MPs can be greatly increased when used in conjunction with other MPs.

2.1 ON-FIELD SEDIMENT CONTROL MPs

The following practices have been recommended for implementation as on-field sediment-control MPs (references are in brackets):

- **Tailwater Drop Box with Raised Grade Board (Imperial Irrigation District Regulation No. 39)**
  This practice involves maintenance of the grade board at an elevation high enough to minimize erosion. In many situations the grade board elevation can be set higher than required by IID Regulations, especially when anticipated tailwater flows will not reach an elevation that will cause crop damage.

  Imperial Irrigation District's Regulation 39 (required by IID) calls for maintenance of field drainage structures, and states in part, "It is the responsibility of each water user to maintain a tailwater structure and approach channel in acceptable condition, in order to qualify for delivery of water. An acceptable structure shall have vertical walls and a permanent, level grade board set a maximum of 12 inches below the natural surface. If the situation warrants, and at the discretion of the district, 18 inches maximum may be allowed".

  See also: Imperial Irrigation District Regulation No. 39, NRCS FOTG Conservation Practice "Structure for Water Control" (Code 587).

- **Improved Drop Box with Widened Weir and Raised Grade Board**
  This practice involves widening the drop box overpour weir and maintaining the grade board at an elevation high enough to minimize erosion. Widening the drop box overpour weir enables the weir elevation to be set higher without raising the surface elevation of the water above the acceptable level. Higher weir elevations allow for an increased tailwater ditch cross section, and reduced erosion when water leaving the field enters the tailwater ditch. See also: NRCS FOTG Conservation Practice "Structure for Water Control" (Code 587).

- **Pan Ditch (Enlarged Tailwater Ditch Cross Section)**
  This practice involves widening the tailwater ditch and making it very shallow, which will result in decreased tailwater velocity and depth. The water must be checked downstream of the oversized area to make the cross section of the water as large as practical. The slower the velocity, the more sediment will settle out of the water and stay in the field, and the less will be picked up by the moving water. Effectiveness can be further improved by planting grass filter strips in the tailwater ditch and/or installing tailwater ditch checks.

- **Tailwater Ditch Checks or Check Dams**
  Tailwater Ditch Checks are temporary or permanent dams that hold the water level well above the ground. They can be placed at intervals in tailwater ditches, especially those with steeper slopes. They increase the cross section of the stream of water, decrease the water velocity and reduce erosion, and may cause sediment already in the water to settle out. Tailwater Ditch Checks can be constructed of

plastic, concrete, fiber, metal or other suitable material. If plastic sheets are used, care must be taken not to allow pieces of the plastic to be carried downstream with the water. In order to be effective, this practice must be utilized in condition where water velocities will not wash out the check dams or the sides of the tailwater ditch around the dams. Tailwater ditch checks or check dams are expected to work best in wide "pan ditches" where the width of tailwater stream can be effectively increased.

- **Field to Tailditch Transition**
  This practice involves use of spillways or pipes where water moves from fields into tailwater ditches, allowing the tailwater to fall down into the tailwater ditch from the field without washing across and eroding the soil. Spillways might be constructed of plastic, concrete, metal, or other suitable material. If plastic sheets are used, care must be taken not to allow deterioration to cause pieces of the plastic to be carried downstream with the water. This procedure may be useful on fields irrigated in bordered-strips and furrows. Care must be taken to address erosion that may be caused in the tailditch at the location where the spillway discharges to the tailditch.

- **Irrigation Land Leveling**
  This practice involves maintaining or adjusting field slope so as to avoid excessive slopes or low spots at the tail end of a field. In some cases it might be advantageous to maintain a reduced main or cross slope, which facilitates more uniform distribution of irrigation water and can result in reduced salt build-up in the soil, increased production, reduced tailwater, and decreased erosion. See also: NRCS FOTG Conservation Practice "Irrigation Land Leveling" (Code 464).

- **Filter Strips**
  This practice involves elimination of borders on the last 20 to 200 feet of the field. Planted crop is maintained to the end of the field and tailwater from upper lands is used to irrigate the crop at the ends of the adjacent lower lands. It is important that the main slope on the lower end of the field is no greater than on the balance of the field. A reduced slope might be better. With no tailwater ditch, there should be very little erosion as the water slowly moves across a wide area of the field to the tailwater box. Some sediment might settle out as the crop slows the water while it moves across the field. This could be used with water tolerant crops or special soil conditions. See also: NRCS FOTG Conservation Practice "Filter Strip" (Code 393).

- **Irrigation Water Management**
  Irrigation Water Management is defined as determining and controlling the rate, amount, and timing of irrigation water in a planned manner. Effective implementation of this practice can result in minimizing on-farm soil erosion and the subsequent transport of sediments into receiving waters. S Specific methods of Irrigation Water Management include: Surge Irrigation, Cut-Back Irrigation, Irrigation Scheduling, and the Runoff Reduction Method. In some cases, irrigation water management could include the employment of an additional irrigator to assist in better monitoring and managing irrigation water and addressing potential erosion problems. Irrigator Water Quality Training could provide irrigators with the knowledge necessarily to implement IWM and other sediment control practices. See also: NRCS FOTG Conservation Practice "Improved Water Application" (Code 197, CA Interim) and NRCS FOTG Conservation Practice "Irrigation Water Management" (Code 449).

- **Sprinkler Irrigation**
  Sprinkler irrigation involves water distribution by means of sprinklers or spray nozzles. The purpose of this practice is to efficiently and uniformly apply irrigation water to maintain adequate soils moisture for optimum plant growth without causing excessive water loss, erosion, or reduced water quality. See also: NRCS FOTG Conservation Practice "Irrigation System, Sprinkler" (Code 442).

- **Drip Irrigation**
  Drip irrigation consists of a network of pipes and emitters that apply water to the surface or subsurface of the soil in the form of spray or a small stream.

- **Reduced Tillage**
  This practice involves limiting the use of heavy farm machinery to only the operations required for crop growing and harvesting. The goal is to eliminate at least one cultivation per crop. Reduced tillage practices include working seed beds only enough to properly plant, avoiding work in wet soil, varying tillage depth from year to year, cultivating only to control weeds, and chiseling when dry to break up plow plan. Such

practices minimize erosion and sedimentation that may occur in furrows.

- **Furrow Dikes (also known as "C-Taps")**
  Furrow dikes are small dikes created in furrows to manage the velocity of the water in the furrow. They can be either constructed of earth and built with an attachment to tillage equipment, pre-manufactured "C-Taps," or other material, including rolled fiber mat, plastic, etc.

2.2 OFF-FIELD SEDIMENT CONTROL MPs

The following practices have been recommended as off-field sediment-control BMPs (references are in brackets):

- **Channel Vegetation/Grassed Waterway**
  This practice involves establishing and maintaining adequate plants on channel banks and associated areas to stabilize channel banks and adjacent areas and reduce erosion and sedimentation, and establishing maximum side slopes. This practice serves to stabilize the channel bank, reducing the potential for bank failure. See also: NRCS FOTG Conservation Practice "Channel Vegetation" (Code 322) and NRCS FOTG Conservation Practice "Grassed Waterway" (Code 412).

- **Irrigation Canal or Lateral**
  This practice applies to irrigation drainage channels. One objective of the practice is to prevent erosion or degradation of water quality. Drainage channels should be designed to develop velocities that are non-erosive for the soil materials of which the channel is constructed. .See also: NRCS FOTG Conservation Practice "Irrigation Canal or Lateral" (Code 320).

- **Sediment Basins**
  Sediment basins are constructed to collect and store debris or sediment. The capacity of the sediment basin should be sufficient to store irrigation tailwater flows for long enough to allow most of the sediments within the water to settle out. The sediment basins also must be cleaned regularly to maintain their capacity and effectiveness.

2.3 ESTIMATED COST OF IMPLEMENTATION AND SOURCES OF FINANCING FOR IMPERIAL VALLEY DRAINS, AND NEW AND ALAMO RIVERS

The estimated total cost of implementing MPs range from just over \$2.00 to \$52.50 per acre per year, which is estimated to be less than or about 2% of production cost. The development of Farm Water Quality Management Plans are estimated to be less than \$200.00 per field. Monitoring costs are estimated to range from \$100.00 to \$500.00 depending on the monitoring program. The preparation of the IID monitoring plan is estimated to be \$25,000. Implementation of the IID monitoring plan is estimated to be \$70,000 per year, and the characterization of dredging impacts is estimated to be \$20,000.

Potential sources of financing are: Private financing by individual sources; Bond indebtedness or loans from government institutions; Surcharge on water deliveries to lands contributing to the sediment pollution problem; Taxes and fees levied by the Irrigation District that provides drainage management; State and/or Federal grants and low-interest loans, including State Proposition 13 (Costa-Machado Act of 2000) grant funds and Federal Clean Water Act Section 319(h) grant funds; and, Single purpose appropriations from Federal and/or state legislative bodies.

2.4 RECOMMENDED ACTIONS FOR COOPERATING AGENCIES

2.4.1 IMPERIAL COUNTY FARM BUREAU WATERSHED PROGRAM

The Imperial County Farm Bureau (ICFB) initiated a "Watershed Program" in 1999, in which it committed to development of program elements, including "outreach programs and mechanisms to encourage and foster an effective self-determined approach to attainment of TMDL load applications." To implement the program, the ICFB has committed to make contact with every farm landowner, renter/lessee, and operator/grower, and to supply material related to the TMDL process, its ramifications, and implementation alternatives. The specific goals of the Watershed Program include: (1) coordination of grass roots educational program to make farmers aware of the TMDL process, and educate farmers on how to reduce sediment/silt leaving their fields, (2) maintenance of informational and data website, (3) coordination of workshops with local technical assistance agencies, and (4) cooperation with Regional Board staff to track and report MP effectiveness. The ICFB has designated the geographical areas for ten (10) subwatershed groups, each covering approximately 50,000 acres of irrigated land. These geographical designations are to be utilized in the ICFB Watershed Program's approach to education and implementation. Although the Imperial County Farm Bureau is not a regulatory agency, it has committed to develop and implement a "Watershed Program" that can play a vital role in achieving TMDL waste load allocations. Therefore, it is appropriate to recommend that the ICFB prepare, submit, and implement the following:

a. ICFB WATERSHED PROGRAM PLAN

The Imperial County Farm Bureau should:

Table E-5 Letter Issue Due Dates

TMDL	Date
Alamo River	July 28, 2003
New River	April 30, 2004
Imperial Valley Drains	3 months after USEPA approval

issue letters to all potential program participants within the project area that are enrolled in the ICFB Watershed Program, informing them that the TMDL is being implemented and stating what is required of them.

Table E-6 List of Program Participants Due Dates

TMDL	Date
Alamo River	September 28, 2003
New River	June 30, 2004
Imperial Valley Drains	5 months after USEPA approval

provide the Regional Board with a list of program participants, organized by subwatershed ("drainshed").

Table E-7 ICFB Watershed Program Plan Due Dates

TMDL	Date
Alamo River	September 28, 2003
New River	June 30, 2004
Imperial Valley Drains	6 months after USEPA approval

submit the ICFB Watershed Program Plan to the Regional Board. The Plan should (1) identify measurable environmental and programmatic goals; (2) describe aggressive, reasonable milestones and timelines for development and implementation of TMDL outreach plans; (3) describe aggressive, reasonable milestones and timelines for development of sub-watershed ("drainshed") plans; (4) describe a commitment to develop and implement a tracking and reporting program.

- Submit semi-annual reports to the Regional Board's Executive Officer that describe the progress of each subwatershed group, any technical assistance workshops that are planned or were conducted, and any other pertinent information.

b. ICFB TRACKING AND REPORTING PROCEDURES

The Imperial County Farm Bureau should also:

Table E-8 Tracking Implementation Plan Due Dates

TMDL	Date
Alamo River	October 28, 2003
New River	July 31, 2004
Imperial Valley Drains	7 months after USEPA approval

submit a plan to the Regional Board's Executive Officer describing tracking and reporting process for (1) implementation of MPs (and other proven management practices) and (2) MP performance.

- Implement the tracking and reporting procedures in accordance with the Implementation Plan.
- Submit a yearly summary report to the Regional Board's Executive Officer by 15th of February of each year.

2.4.2 UNIVERSITY OF CALIFORNIA COOPERATIVE EXTENSION

The Regional Board supports efforts of the University of California Cooperative Extension to provide interested growers information on sediment control MPs, implement projects qualitatively assessing MP performance, and develop farm water quality planning programs.

2.4.3 NRCS

The Regional Board recommends that the NRCS require control of irrigation-induced erosion as part of the Farm Plans developed under the Environmental Quality Incentives Program (EQIP) or other federal grant programs.

F. NEW RIVER AT THE INTERNATIONAL BOUNDARY TRASH TMDL

1. TMDL Elements

For the purpose of this TMDL, trash is defined as human-caused litter. “Litter” is defined in California Government Code §68055.1(g) as follows:

“Litter means all improperly discarded waste material, including, but not limited to, convenience food, beverage, and other product packages or containers constructed of steel, aluminum, glass, paper, plastic, and other natural and synthetic materials, thrown or deposited on the lands and waters of the state, but not including the properly discarded waste of the primary processing of agriculture, mining, logging, sawmilling or manufacturing […]."

2. Implementation Actions for Attainment of TMDL

TMDL attainment for interim and final numeric targets shall be in accordance with the schedule in Table F-2.

Implementation Plan measures should be sufficient to achieve the TMDL so long as the third parties mentioned above are willing to complete the requested tasks below within the timeframes specified.

Actions to be taken by third party cooperating agencies and organizations

Consistent with the California Porter-Cologne Water Quality Control Act, the Basin Plan may identify requested implementation actions for agencies other than the Regional Water Quality Control Board (CWC §13242(a)). Accordingly, the Regional Board requests that the following cooperating agencies sign a Memorandum of Understanding (MOU) to ensure coordination of International Boundary projects: U.S. members of the New River/ Mexicali Sanitation Program Binational Technical Advisory Committee (BTAC), North American Development Bank (NADBank), Border Environment Cooperation Commission (BECC), California Border Environment Cooperation Commission (CalBECC), City of Calexico New River Committee (CCNRC), and Citizens Congressional Task Force on the New River (CCRFNR). The MOU should address:

- Establishment of a coordination committee consisting of one representative from each agency and the Regional Board;

- Establishment of a coordination committee charter to ensure cooperation and communication between all agencies;

- Compilation of a list of potential/ongoing projects and funding sources to address pollution in the New River/ International Boundary area; and

- Submission of semi-annual progress reports to the Regional Board.

The MOU should be signed, and progress reports submitted, in accordance with the schedule in Table F-3.

Table F-1: New River at the International Boundary Trash TMDL Elements

ELEMENT	DESCRIPTION
Problem Statement (impaired water quality standard)	Trash deposited in the New River and its tributaries in Mexico has degraded U.S. water quality and impaired the following designated beneficial uses of the U.S. section of the New River: warm freshwater habitat; wildlife habitat; preservation of threatened rare, or endangered species; water contact recreation; non-contact water recreation; and freshwater replenishment. Trash adversely affects fish and wildlife communities. Trash also causes secondary water quality impacts to the River's terminus at the Salton Sea because trash serves as a carrier for pathogens, dissolved organic matter, and volatile organic compounds that pose a public health threat to people and fish and wildlife communities. Trash in the New River violates Basin Plan water quality objectives, including: (a) general surface water objectives (Aesthetic Qualities, Tainting Substances, Dissolved Oxygen, Suspended Solids and Settleable Solids, Biostimulatory Substances, and Turbidity), and (b) specific surface water objectives for the New River at the International Boundary (qualitative standards 1 through 5 of Minute No. 264 of the Mexican-American Water Treaty).
Numeric Target[1]	The numeric target established by this TMDL is zero pounds/day of trash.
Source Analysis	Source — pounds/year Mexican wastewater drains/reaches — 240,000 Natural Sources — 0 Total — 240,000 pounds/year (or 658 pounds/day)
Margin of Safety	There is an implicit margin of safety for this TMDL, meaning that the margin of safety is incorporated into the conservative processes used to develop the TMDL (i.e., numeric target is zero), and is not quantified.
Seasonal Variations and Critical Conditions	Strong seasonal differences do not exist regarding rainfall. Mexicali Valley irrigation practices differ between summer and winter. More irrigation water flow in summer months means that more trash may be carried by the New River in summer. Less irrigation water flow in winter means that concentrations of some pollutants (e.g., pathogens, dissolved organic matter, volatile organic compounds) may increase in winter.
Loading Capacity (Total Assimilative Capacity)	Zero pounds/day of trash
Load Allocations and Wasteload Allocations	As stated in 40 CFR 130.2, a TMDL is the sum of load allocations for nonpoint sources, individual wasteload allocations for point sources, and natural sources. In the New River, load allocations (e.g., wastewater drains) and wasteload allocations (e.g., wastewater treatment plants) are zero pounds of trash per day because the numeric target and loading capacity are zero. Load allocations apply to discharges at the Mexican border as well as to all nonpoint sources of trash along the New River in the United States. Each NPDES facility discharging to the New River in the United States has an individual wasteload allocation of zero pounds of trash per day.

Footnotes for Table No. F-1:
[1] The numeric target is a goal that translates current Basin Plan narrative objectives into quantitative values.

Table F-2: Time Schedule for Implementation Plan Phases and Numeric Targets for Trash in the New River at the International Boundary

Phase	Time Period	Reduction from Existing Conditions	Allowable Load* (pounds/day)
Phase I	Within 2 years of USEPA Approval of TMDL	75%	165 (Interim Numeric Target)
Phase II	Within 3 years of USEPA approval of TMDL	100%	0 (Final Numeric Target)

* Percent reduction required at the end of each phase, starting with the current (2005) average of 240,000 pounds/year or 658 pounds/day.

Table F-3: Requested Actions for Third Party Cooperating Agencies and Organizations

Task	Due Date
1. Submit signed MOU to the Regional Board.	Six (6) months after USEPA approval of TMDL
2. Submit progress reports (through coordination committee) to the Regional Board describing status of projects and recommend actions to address pollution in the New River at the International Boundary.	Semiannually, with the first report due 12 months after USEPA approval of TMDL

Actions requested to be taken by the U.S. Government

The Regional Board does not have the authority to require Mexico or the U.S. Government to reduce trash that crosses the International Boundary. Accordingly, this TMDL requests that the USIBWC and the USEPA:

- Specify and implement measures to ensure that trash discharges from Mexico do not violate or contribute to a violation of this TMDL;

- Remove trash from Mexico that has accumulated at Imperial County Calexico Landfill culverts; and

- Conducts water quality and trash monitoring in the New River at the International Boundary to evaluate for water quality impacts from trash.

- It is critical that the U.S. Government coordinates activities with the other third party coordinating agencies and organizations:

- to implement reasonable, timely measures to mitigate trash impacts on U.S. water

- quality in the New River/International Boundary area;

- to ensure bi-national standards of Minute No. 264 are met, and

- to persuade Mexico to prevent littering of Mexican surface waters that impact water quality in the New River/ International Boundary area2

The Regional Board requests that the USIBWC and USEPA complete the trash reduction actions listed in Table F-4.

[2] Removing trash from the New River at or immediately downstream of the International Boundary does not eliminate all water quality impacts because pollutants leached from trash in Mexico may contaminate the New River in the U.S. Pollutants dissolved from trash will be addressed if it is determined that water quality objectives at the International Boundary are still being exceeded after implementation of this TMDL and the New River TMDLs for VOCs, DO, and pathogens.

Table F-4: Requested Trash Reduction Actions for the USIBWC and USEPA

Task	Requested Target Date
Describe in a report* current and/or proposed measures to ensure Mexico complies with this TMDL. The report should specify parties responsible for implementation, financial options, and implementation time schedule.	Three (3) months after USEPA approval of TMDL
Describe in a report* the current and/or proposed measures to remove trash from Mexico that has accumulated at Imperial County Calexico Landfill culverts. The report should specify the parties responsible for implementation, financial options, and implementation time schedule.	Three (3) months after USEPA approval of TMDL
Begin implementation measures identified in Tasks 1 and 2.	Six (6) months after USEPA approval of TMDL
Describe in a report* the progress achieved towards completion of implementation measures identified in Tasks 1 and 2.	Semiannually, beginning 12 months after USEPA approval of TMDL
Complete implementation measures identified in Tasks 1 and 2.	Three (3) years after USEPA approval of TMDL

*The report should be prepared under the direct supervision of a California registered civil engineer, with experience in the preparation of these types of reports.

The Regional Board also requests that the USIBWC and the USEPA implement the water quality and trash monitoring in the New River at the International Boundary that is summarized in Table F-5 below, and submit monitoring reports to the Regional Board according to the schedule specified in the table. The Regional Board requests that monitoring be conducted in accordance with a Quality Assurance Project Plan (QAPP). Water Quality samples from the New River shall be collected at the closest practical site on the U.S. side of the International Boundary.3

[3] It may be impractical to take water quality samples immediately at the International Boundary because wastewater infrastructure (e.g., treatment lagoons, raw sewage bypasses, and drains) empties into the New River at this location, causing mixing/aeration of water that could yield misleading monitoring results. The closest water quality monitoring site currently in use (for International Boundary Line and the State Water Board's Surface Water Ambient Monitoring Program, SWAMP) is located in the New River at the Imperial Irrigation District Bridge, near the U.S. Geological Survey water quality gage, about 0.5 miles from the International Boundary. The party that conducts monitoring for this TMDL should explore using locations closer than the currently used water quality monitoring site.

Table F-5: Requested Monitoring Actions for the USIBWC and USEPA

Task	Requested Target Date
Prepare a monitoring plan and QAPP to monitor water quality and trash in the New River at the International Boundary.	Three (3) months after USEPA approval of TMDL
Implement water quality and trash monitoring in the New River at the International Boundary, pursuant to the QAPP.	Six (6) months after USEPA approval of TMDL
Submit monitoring data and reports to the Regional Board.	Semiannually, beginning 12 months after USEPA approval of TMDL

<u>3. Regional Board Monitoring and Tracking Program</u>

Regional Board staff will coordinate the TMDL Monitoring and Tracking Program. It is important to track TMDL implementation, monitor water quality progress, and modify TMDLs and Implementation Plans as necessary to:

- Address uncertainty that may have existed during TMDL development;
- Ensure that implementation is occurring; and
- Ensure TMDL effectiveness, given watershed changes that may have occurred after TMDL development.

Water Quality and Trash Monitoring

The Implementation Plan calls for water quality and trash monitoring to determine TMDL progress, and to revise the TMDL as needed. Monitoring program objectives include evaluation of:

- Water quality objectives attainment;
- Implementation of effectiveness;
- In-stream water quality; and
- Water quality temporal and spatial trends.

Regional Board staff requests that USIBWC and USEPA conduct water quality and trash monitoring of the New River at or immediately downstream of the International Boundary, and submit monitoring data and reports to the Regional Board.

Implementation Tracking Program

The Implementation Plan calls for a tracking program to assess implementation. Objectives include assessment and tracking of measures already in place, and evaluation of TMDL progress. Regional Board staff will evaluate data to determine when numeric targets are attained, and will present annual reports to the Regional Board describing progress.

Measures of Success, and Failure Scenarios

The primary measure of success for TMDL implementation is attainment of zero trash in the New River at the International Boundary within three years of USEPA approval of the TMDL. Another measure of success may be a substantially lower level of trash than currently exists, such as meeting the interim numeric target (i.e., 75% trash reduction within two years of USEPA approval of the TMDL.)

The primary failure scenario for TMDL implementation is the failure to achieve zero trash in the New River at the International Boundary, or the failure to substantially reduce trash if zero trash is not achieved. If either of these failure scenarios occurs, the Regional Board will consider taking further actions to achieve TMDL compliance.

<u>4. TMDL Review Schedule</u>

Annual Reports

Regional Board staff shall present annual reports to the Regional Board describing progress toward milestone attainment. The reports will assess:

- Water quality improvement, in terms of trash reduction at the International Boundary; Monitoring results;
- Control measures implemented to deal with pollution originating in Mexico;
- Whether milestones were met on time or at all. If milestones were not met, the reports will discuss the reasons; and
- Recommendations for further actions.

Triennial Review

The State must hold public hearings for reviewing applicable water quality standards (WQS), and modifying/adopting the standards as appropriate pursuant to Section 303 of the Clean Water Act and 40 CFR Part 130. The State also must formulate and periodically review (and update as necessary) regional water quality control plans pursuant to Section 13240 of the California Water Code. Following adoption by the Regional Board, Basin Plan amendments and supporting documents are submitted to the State Water Resources Control Board for review and approval, the State Office of Administrative Law for its concurrence that the amendments meet State Administrative Procedures Act requirements, and finally the USEPA.

The first TMDL review is scheduled to conclude three years after TMDL adoption to provide adequate time for implementation and data collection. At this time, TMDL compliance should be achieved. If the TMDL is not achieved, the Regional Board will consider taking further actions to achieve TMDL compliance. Subsequent reviews (if needed) will be conducted concurrently with the Triennial Review of the Basin Plan. The TMDL Review will include the same components assessed in annual reports, and will conform to the schedule in Table F-6.

Public hearings will be held at least every three years to review this TMDL. At these hearings, the Regional Board will:
- Review monitoring results;
- Review progress toward milestone attainment;
- Consider approval of proposed management practices for the control of pathogens from human-made nonpoint sources of pollution;
- Consider enforcement action; and
- Consider revision of TMDL components.

This proposed review schedule indicates the Regional Board’s commitment to periodic review and refinement of this TMDL via the Basin Plan amendment process.

Table F-6: TMDL Review Schedule

Activity	Date
USEPA Approval of TMDL	December 2006
Terminate First TMDL Review, Conduct Regional Board Public Hearing, and Begin Second TMDL Review	December 2009
Terminate Second TMDL Review, Conduct Regional Board Public Hearing, Begin Third TMDL Review, and Continue triennial review cycle	December 2012

*Dates are contingent upon USEPA approval

VI. ACTIONS OF OTHER AUTHORITIES

Within the Colorado River Basin Region, there are several water quality issues requiring actions that fall either wholly or in large part outside the direct authority of the State and Regional Boards. One particular issue involves recharge of the Coachella Valley ground water basin with imported water.

The Coachella Valley Water District (CVWD) and the Desert Water Agency (DWA) exchange their entitlements to State Water Project water for equal volumes of the Metropolitan Water District of Southern California's (MWD) water entitlement from the Colorado River. This water is delivered via the MWD's Colorado River Aqueduct for recharge purposes in the upper portion of the Coachella Valley. The recharge lessens the Valley's overdraft problem, although the total dissolved solids (TDS) concentration of Colorado River water is significantly higher than that of the native ground water in the greater portion of Coachella Valley.

In addition to importing water to augment available local supplies as required to lessen overdraft of ground water supplies within the Coachella Valley and to meet existing and future growth therein, the Regional Board encourages the CVWD and DWA to implement water conservation and reclamation practices within their respective jurisdictional areas of the Coachella Valley.

The water resources of the Coachella Valley are limited, and the demands on those resources have increased considerably. Every effort must be made to optimize the use of available water resources. The quantity of treated wastewaters produced by community sewerage systems is appreciable, and the TDS concentrations of the treated wastewaters is less than that of the Colorado River water which is purchased and spread for recharge in the upper valley areas. In recognition of this, the Regional Board supports the reuse of community wastewaters, wherever economically and socially feasible (See page 4-2).

VII. PROHIBITIONS

A. IMPERIAL VALLEY SEDIMENTATION/SILTATION

A prohibition of sediment/silt discharge is hereby established for the Imperial Valley, including the Alamo River, New River, all Imperial Valley Drains, and their tributaries. Specifically, beginning three months after USEPA approval, the direct or indirect discharge of sediment into the Imperial Valley is prohibited, unless:

1. The Discharger is:

a. In compliance with applicable Sedimentation/Siltation TMDL(s), including implementation provisions (e.g., Discharger is in good standing with the ICFB Watershed Program or has a Drain Water Quality Monitoring Plan (DWQMP) approved by the Executive Officer); or

b. Has a monitoring and surveillance program approved by the Executive Officer that demonstrates that discharges of sediment/silt into the aforementioned waters do not violate or contribute to a violation of the TMDL(s), the anti-degradation policy (State Board Resolution No. 68-16), or water quality objectives; or

c. Is covered by Waste Discharge Requirements (WDRs) or a Waiver of WDRs that applies to the discharge.

TMDL compliance groups have formed to address issues regarding wastewater discharge from irrigated lands to waters of the state. Individual Dischargers are not required by the Regional Board to join in TMDL compliance groups. Individual Dischargers who choose not to participate in TMDL compliance groups must file a Report of Waste Discharge for general or individual Waste Discharge Requirements. Compliance with the prohibition will be determined with respect to each individual Discharger, whether or not the Discharger is a member of a compliance group. The intent of this prohibition is to control to the degree practicable sediment/silt discharges from irrigated lands in amounts that violate or contribute to a violation of state water quality standards.

CHAPTER 5- PLANS, POLICIES AND ISSUES

In addition to the Basin Plan, many other plans and policies are applicable to Regional Board actions or clarify the Regional Boards intent. This Chapter contains a list of applicable State Board and Regional Board plans and policies for water quality control. This chapter also contains discussions of important water quality issues that the Regional Board will be addressing in the future.

I. STATE BOARD PLANS AND POLICIES

The applicable State Water Resources Control Board (State Board) Plans and Policy statements include:

A. RESOLUTION No. 68-16

"Statement of Policy with Respect to Maintaining High Quality of Waters in California" (adopted October 28, 1968).

B. WATER QUALITY CONTROL

"State Policy for Water Quality Control" (adopted July 6, 1972, by motion).

C. THERMAL PLAN

"Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California" (adopted on September 18, 1975; Resolution No. 75-89).

D. POWER PLANT COOLING

"Water Quality Control Policy on the Use and Disposal of Inland Waters Used for Powerplant Cooling" (adopted June 19, 1975; Resolution No. 75-58).

E. WATER RECLAMATION

"Policy with Respect to Water Reclamation in California" (adopted January 6, 1977; Resolution No. 77-1).

F. SHREDDER WASTE

"Policy on the Disposal of Shredder Waste" (adopted March 19, 1987; Resolution No. 87-22).

G. NON POINT SOURCE MANAGEMENT PLAN

"Nonpoint Source Management Plan" (adopted November 15, 1988; Resolution No. 88-123).

H. SOURCES OF DRINKING WATER POLICY

"Sources of Drinking Water" (adopted May 19, 1988; Resolution No. 88-63).

II. REGIONAL BOARD POLICIES

Adopted Regional Board Policies include the following:

A. SEWERAGE SYSTEMS

"Guidelines Regarding Grouped or Community Sewerage Systems" (adopted January 28, 1981; Resolution No. 81-35).

B. SEWAGE DISPOSAL FROM LAND DEVELOPMENTS

"Guidelines for Sewage Disposal from Land Developments" (adopted March 14, 1979; Resolution No. 79-42).

C. MOU WITH THE BUREAU OF LAND MANAGEMENT

"Memorandum of Understanding between California Desert District U.S. Bureau of Land Management and California Regional Water Quality Control Board Colorado River Basin Region" (adopted January 25, 1985; Resolution No. 85-24).

D. WATER QUALITY LIMITED SEGMENT

"Designating Water Quality Limited Segments in the Colorado River Basin Region" (adopted January 27, 1988; Resolution No. 88-37).

E. MOA's

"A Memorandum of Agreement between the California Regional Water Quality Control Board Colorado River Basin Region and the Department of Health Services for the Regulation of Low-Level Radioactive Waste" (adopted June 28, 1989; Resolution No. 89-060).

"A Memorandum of Agreement between the California Regional Water Quality Control Board Colorado River Basin Region's Executive Officer and Ibanez Farms and Chino Corona Farms" (adopted November 29, 1989; Resolution No. 89-078).

F. WATER QUALITY ASSESMENT

"Water Quality Assessment for the Colorado River Basin Region of California" (adopted November 20, 1991; Resolution No. 91-057).

G. AGRICULTURAL DRAINAGE

"Agricultural Drainage Management Report for the Colorado River Basin Region" (adopted March 11, 1992; Resolution No. 92-023).

H. WAIVER FOR WASTE DISCHARGES

"Waiving Waste Discharge Requirements for Specific Types of Discharges" (adopted March 31, 1993; Resolution No. 93-004).

III. REGIONAL BOARD ISSUES

The following issues will be considered by the Regional Board:

A. SEPTIC SYSTEM IMPACTS TO GROUND WATER BASINS

There are a number of unsewered communities in this Region which have the potential to have a negative impact on the groundwater. The Regional Board has identified some communities with high densities of septic systems. As staffing and finances permit, the Regional Board will conduct investigations to determine the relative priority for sewering the following communities:

- Communities in the Indio Hydrologic Subarea
- Yucca Valley
- Twentynine Palms
- Palo Verde
- Morongo Valley
- Lucerne Valley
- Borrego Springs
- Landers
- Joshua Tree

B. BENEFICIAL USE DESIGNATIONS OF AQUIFERS

The ground water Beneficial Use Designations for this Region are currently based on hydrologic units. In the next three years, Regional Board staff intend to review the appropriate groundwater data and propose changes to the Beneficial Use Designations so that they will correspond to individual groundwater aquifers within the various hydrologic units. The proposed changes in designations will also be based on the review of the "Sources of Drinking Water Policy" in Chapter 2. These changes would result in an updated version of Table 2-5 (Chapter 2) and a more detailed map of the groundwater aquifers in this Region.

C. GEOTHERMAL FLUIDS

Due to the extensive development of the geothermal industry in Imperial Valley, the Regional Board is assessing the potential of surface water and ground water contamination from geothermal brines. A Regional Board policy on geothermal development along with updated water quality objectives may be promulgated as necessary based on the findings obtained.

CHAPTER 6 - SURVEILLANCE, MONITORING AND WATER QUALITY ASSESSMENT

The effectiveness of a water quality control program cannot be judged without information supplied by a comprehensive surveillance and monitoring program. To protect California's water resources, the State Board and the Regional Boards closely monitor water quality throughout the state.

Historically, a wide variety of interested state, federal and local agencies have sampled, analyzed, and tracked water quality. Local agencies include county health departments, water districts, and irrigation districts. The State Board and Regional Board monitoring programs evaluate existing information, supplementing it where necessary to meet data needs.

I. STATEWIDE MONITORING

The Porter-Cologne Water Quality Control Act delegates primary responsibility for coordination and control of water quality in California to the State Board. Section 13163 of the Act states that in conducting this mission, the State Board shall coordinate water quality investigations, recognizing that other State agencies have primary statutory responsibility for such investigations, and shall consult with the concerned Regional Boards in implementing this section.

Pursuant to these mandates, the State Board in 1976 established a coordinated Primary Water Quality Monitoring Network for California. Participants in the Primary Network included the California Departments of Health, Water Resources, and Fish and Game; and the U.S. Bureau of Reclamation, the U.S. Geological Survey and the U.S. Environmental Protection Agency.

The goal of the Primary Network has been to provide an overall, continuing assessment of water quality in the State. This goal is to be achieved by statewide monitoring of water quality parameters that can affect beneficial uses of State waters. Among such parameters, toxic substances have received increasing attention in federal and state water pollution control activities, and accordingly, the Toxic Substances Monitoring Program is included in the Primary Network.

The State's surveillance and monitoring program is designed to assure the collection of data necessary to: establish and review water quality standards, goals and objectives; determine maximum daily loadings, wasteload allocations, and effluent limitations; perform segment classifications and rankings; and establish the relationship between water quality and individual point and nonpoint sources of pollutants. These data must be verified and properly interpreted to evaluate water quality trends in order to make the necessary changes in the enforcement and planning programs as needed to carry out program objectives. Output based upon data obtained from this program is used to prepare reports satisfying the requirements of the Federal Clean Water Act and the applicable portions of the Porter-Cologne Water Quality Control Act.

The overall objectives of the State's surveillance and monitoring program are:

- To measure the achievement of water quality goals and objectives specified in Water Quality Control Plans.
- To measure specific effects of water quality changes on beneficial uses.
- To measure background conditions of water quality and determine long-term trends in water quality.
- To locate and identify sources of water pollution that pose a threat to the environment.
- To provide information needed to relate receiving water quality to mass emissions of pollutants by waste dischargers.
- To provide data for determining waste discharger's compliance with permit conditions.
- To provide the documentation necessary to support the enforcement of permit conditions and waste discharge requirements.

- To provide data needed to carry on the continuing planning process.

- To measure the effects of water rights decisions on water quality and to guide the State Board in its responsibility to regulate unappropriated water for the control of quality.

- To prepare reports on water quality conditions as required by federal and state regulations or requested by others.

The surveillance and monitoring program is designed to meet the objectives set forth above. An optimum surveillance and monitoring program requires flexibility and must be able to respond to needs specified in the Basin Plan as it is implemented and revised. Statewide water quality assessments performed every two years provide a timely cycle to evaluate the program's effectiveness and make appropriate changes.

The surveillance and monitoring program provides for collection and analysis of samples and the reporting of water quality data. It includes laboratory support and quality assurance, storage of data for rapid and systematic retrieval, and preparation of reports and data summaries. Most importantly, it includes interpretation and evaluation of data leading to recommendations for action.

II. REGIONAL BOARD MONITORING

The Regional Board participates in the implementation of the statewide surveillance and monitoring program by conducting the following tasks:

A. Surface Water Monitoring
B. Compliance Monitoring
C. Complaint Investigation
D. Intensive Surveys
E. Toxic Substances Monitoring

A. SURFACE WATER MONITORING

The Regional Board's Surface Water Monitoring Program was developed in 1980 as an outgrowth of the State's Primary Monitoring Network. Its goal has been to characterize the water quality of the Region's surface water bodies. Quarterly sampling was conducted on major water bodies and annual sampling was conducted on other surface waters. Samples were collected by Regional Board staff as grab samples and were analyzed by either the Regional Board's in-house laboratory or the State Department of Health Services laboratory in Los Angeles. The samples were analyzed for several general water quality parameters but not for toxic substances. Analyses were conducted for pH, turbidity, total dissolved solids, suspended solids, volatile suspended solids, settleable solids, phosphate, nitrate, nitrite, ammonia, MBAS, BOD, COD, and fecal coliform. Field measurements were made for dissolved oxygen, temperature, pH, flow rate, and conductivity. Data from this program has been entered into the statewide database system (SWQIS) from which it is periodically entered into the federal water quality data system (STORET). A summary of historic sample collections at the surface water monitoring stations is included in Table 6-1. Continued sampling of these water bodies by the Regional Board is dependent on the availability of funding. Sampling of the New River at the International Boundary has been conducted as a separate investigation and is described in Section D. Intensive Surveys.

TABLE 6-1: PRIMARY NETWORK STATIONS

Station Name	Period of Record
Annual Stations	
Piute Creek	12/81-4/91
Millard Canyon Creek	11/81-4/91
Crystal Creek	12/81-4/91
Copper Basin	12/81-4/91
Azalea Creek	11/81-4/91
Antelope Creek	05/85-4/91
Boundary Creek	12/81-6/93
Walker Creek	12/81-6/93
Tule Creek	03/83-6/93
Carrizo Creek	12/81-6/93
Banner Creek	12/81-6/93
San Felipe Creek	12/81-6/93
Borrego Palm Canyon Creek	12/81-6/93
Coyote Creek	12/81-6/93
Salt Creek	12/81-6/93
Tahquitz Creek	11/93-6/93
Twin Pines Creek	11/81-6/93
Mission Creek	12/81-6/93
Big Morongo Creek	12/81-6/93
Little Morongo Creek	12/81-6/93
Arrastre Creek	12/81-6/93

TABLE 6-1 (Cont.)

<u>Quarterly Stations</u>	
Colorado River above Morelos Dam	2/80-6/93
Colorado River at Nevada State Line	2/80-5/93
Colorado River at Imperial Dam	2/80-5/93
Salton Sea at County Line	2/80-5/93
Central Drain Outlet	2/80-5/93
Alamo River Outlet	2/80-5/93
New River Outlet	2/80-5/93
Whitewater River above MWD outfall	2/80-5/93
Palo Verde Outfall Drain	2/80-5/93
Reservation Main Drain 4	2/80-5/93
Holtville Main Drain	9/88-5/93
Coachella Valley Stormwater Channel	2/80-5/93
Alamo River at International Boundary	2/80-5/93
Rose Drain at Outlet	2/80-8/89

B. COMPLIANCE MONITORING

1. Regulated Facilities

Data from facilities with waste discharge requirements including NPDES permits are collected and used to determine compliance with requirements and receiving water standards and to support enforcement actions. Data is retrieved from self monitoring reports generated by waste dischargers and from compliance monitoring reports prepared by Regional Board staff. These reports are reviewed and if violations are noted, appropriate action is taken, ranging from administrative enforcement to judicial abatement depending on the circumstances. Self monitoring report data have also been used to calculate pollutant loadings and to indicate the general improvement noted in the receiving water.

2. Recommended Biomonitoring (Toxicity Monitoring) Programs

Compliance with the Regional Board's toxicity objective (see Chapter 3) will be determined through the use of bioassays utilizing standard/approved methodology. For an initial two-year period, biomonitoring will be conducted primarily for informational purposes. The resulting data will be utilized to determine a specific compliance protocol, including methodology and enforcement procedures. Dischargers whose NPDES permits do not include biomonitoring requirements will be encouraged to voluntarily conduct bioassays during this initial two-year period to assist in developing said protocol. Dischargers who wish to experiment with other methods of determining toxicity compliance are welcome to do so and may submit such data to the Regional Board for review and consideration.

Although this initial two-year period would be utilized primarily to collect information, it would not preclude the possibility of enforcement action in cases where significant toxicity is exhibited. Such enforcement would be considered by the Regional Board on a case by case basis.

Pending appropriations of adequate resources, the following three biomonitoring programs are recommended for implementation:

<u>Program A</u>

Bioassay Type: Chronic

Frequency: Quarterly

Sampling Locations:

1. Colorado River near California/Nevada State Line
2. Palo Verde Outfall Drain near South Highway 78 Crossing
3. Colorado River at Imperial Dam
4. Reservation Main Drain near Outlet
5. Colorado River above Morelos Dam
6. Alamo River near International Boundary
7. New River near International Boundary
8. Central Drain near Outlet
9. Holtville Main Drain
10. Alamo River near Outlet
11. New River near Outlet
12. Whitewater River above MWD Outfall
13. Coachella Valley Storm Water Channel at Lincoln Street Crossing

The above-listed sites represent the more important waterways in the Region in regard to flow. Where chronic toxicity is exhibited at any of the above monitoring locations, an investigation would follow to determine the source of the toxicity.

<u>Program B</u>

Bioassay Type: Chronic

Frequency: Annually

Sampling Locations:

1. Tahquitz Creek
2. Twin Pines Creek
3. Boundary Creek
4. Walker Creek
5. Tule Creek
6. Mission Creek
7. Carrizo Creek
8. Big Morongo Creek
9. Banner Creek
10. Little Morongo Creek
11. San Felipe Creek
12. Arrastre Creek
13. Borrego Palm Canyon Creek
14. Coyote Creek
15. Salt Creek

Where chronic toxicity is exhibited at any of the above monitoring locations, an investigation would follow to determine the source of the toxicity.

Program C

Bioassay Type: Acute and/or Chronic

Frequency: To be determined by Regional Board staff on a case-by-case basis, but shall in no case be less frequent then annually.

It is recommended that at a minimum appropriate acute/chronic toxicity bioassays be required in all new or updated NPDES permits. For future permit holders, assignment of such testing will be determined on a case-by-case basis.

C. COMPLAINT INVESTIGATION

This task involves investigation of complaints of citizens and public or governmental agencies on the discharge of pollutants or creation of nuisance conditions. It is a Regional Board responsibility which may include preparation of reports, letters, and taking other necessary follow up actions to document observed conditions and to institute appropriate corrective actions.

D. INTENSIVE SURVEYS

Intensive monitoring surveys provide detailed water quality data which is used to locate and evaluate violations of receiving water standards and to develop waste load allocations. They usually involve localized, intermittent sampling at a higher than normal frequency. Intensive surveys should be repeated at appropriate intervals depending on the parameters involved, the variability of conditions, and changes in hydrologic or effluent regimes. The two main Regional Board studies are described below.

1. Imperial Valley Agricultural Drain Study

The agricultural drain study uses bioassays to monitor and assess toxicity in agricultural return flows and in receiving waters. The first samples were collected in September 1991. After the preliminary sampling results from various drains and rivers were reviewed (see Table 6-2), the study was primarily limited to the South Central Drain area in the Imperial Valley. This area was chosen because discharges to the drains in this area were primarily agricultural in nature and the potential for toxicity due to non-agricultural discharges would be reduced. Samples were collected from tailwaters and from the surface drains which received the tailwaters. Field measurements were made for temperature, pH, dissolved oxygen, and specific conductivity. Samples were analyzed at the Regional Board laboratory for TDS, alkalinity, hardness, and ammonia. Samples were shipped to the University of California, Davis for toxicity testing. Acute toxicity tests (48 hour) were conducted using Daphnia magna and Ceriodaphnia dubia. Samples identified as toxic by the acute testing were also analyzed for Organophosphate and Carbamate pesticides. Sample splits were collected on June 15 and 29, 1992 and analyzed by the U.S. Geological Survey laboratory for Organochlorine, Organophosphate, Carbamate, and Triazine pesticides.

During the second year of the study, the toxicity in Imperial Valley waterbodies will be assessed from a broader perspective. The Alamo River was selected for intensive surveying because it contains mainly agricultural runoff from Imperial Valley.

Presently, the upper and lower portions of the Alamo River are sampled once a month. The River is sampled at locations downstream of the major drains and other pertinent locations. Field measurements and analyses by the Regional Board laboratory remain the same as the previous year's study. Samples shipped to U.C. Davis have acute toxicity tests performed on them using Ceriodaphnia dubia and Neomysis. The State Department of Pesticide Regulation analyzes samples (upper or lower Alamo River) for Organophosphate and Carbamate pesticides.

TABLE 6-2: PRELIMINARY BIOMONITORING SCREENING LOCATIONS

Sample Sites

1. New River at outlet
2. Alamo River at outlet
3. Trifolium Drain No. 9
4. Vail 2A Drain at Sinclair Road
5. New River at Worthington Road
6. Alamo River at Worthington Road
7. Palo Verde Intake Canal
8. Palo Verde Outfall Drain
9. Lincoln Street Drain between Ave. 70 & 71
10. Coachella Valley Storm Water Channel (CVSWC) between Ave. 66 & 68
11. Avenue 66/68 Drain above CVSWC
12. Rose Drain
13. Newside Drain
14. South Central Drain #4
15. Barbara Worth Drain at Outlet

2. New River Monitoring

The New River is monitored at the International Boundary to evaluate discharges of untreated and partially treated wastewater from the City of Mexicali, Mexico. Other type of wastes discharged to the River include toxic industrial wastes from industries in the City of Mexicali, garbage from dumpsites within the City, runoff from agricultural land in the Mexicali Valley, and occasionally geothermal wastewater and slaughterhouse wastes.

The New River has been monitored on a quarterly basis since 1989. Prior to 1989, monitoring was done on a monthly basis for several years. Future monitoring will be conducted if funding is available.

Data is collected in the field on an hourly basis for temperature, pH, dissolved oxygen, specific conductance, and settleable solids. Additional samples for turbidity analysis are taken hourly. Samples for Fecal Coliform are taken on the hour during the last 4 hours of sampling.

The following additional analyses are performed on a composite sample comprised of grab samples taken at 60 minute intervals throughout the sampling period:

TDS
TSS
VSS
Total Phosphate
Ammonia
Nitrate
Nitrite
MBAS
BOD
COD
Total Cyanide
Phenol
Arsenic
Boron
Cadmium
Chromium
Copper
Lead
Zinc

The composites presently consist of samples taken over an 8-hour period. In the past, composites were generally taken over a 10-hour period and annually, a 24-hour composite was taken.

Additionally, 1 or 2 grab samples are taken during each sampling event for analysis by EPA Method 524.2 for Volatile Organic Analyses.

All samples are sent to the state Department of Health Services Southern California Laboratory for analyses except the following analysis which are performed at the Regional Board Laboratory:

Turbidity	VSS
Fecal Coliform	BOD
TDS	COD
TSS	

In January of 1992 the USEPA provided laboratory services for analysis of the following parameters:

Metals
Organophosphorus Pesticides
Volatile Organics
Semi-volatile Organics
Pesticides/PCPs
Chlorinated Herbicides
Triazine Herbicides

These analyses were performed on a grab sample taken during a regularly scheduled quarterly sampling run.

Additional sampling events have also been conducted at this location in the past for the parameters listed above or for additional parameters. These unscheduled sampling events will be conducted in response to unusual events noted at the New River, when funds or laboratory services are available for additional sampling or in response to specific needs for data.

E. TOXIC SUBSTANCES MONITORING

One method of monitoring for toxic substances is to collect and analyze water samples. A major problem with this approach is that toxic discharges are likely to occur in an intermittent fashion and are thus likely to be missed with "grab" sampling of the water. Another limitation to analyzing water samples is that, generally, harmful toxicants are present in low concentrations in the water. The process of bioaccumulation acts to concentrate toxicants through the aquatic food web. Therefore, in the Toxic Substances Monitoring Program the tissues of fish and other aquatic organisms are analyzed for toxic metals and synthetic organic compounds.

The Toxic Substances Monitoring (TSM) portion of the Primary Network has been integrated with other Primary Network monitoring. The toxic substances monitoring of resident organisms has been performed by the State Department of Fish and Game under a contract managed by the State Board with the assistance and oversight of the Regional Board. Continuation of this monitoring is dependent upon continued funding of this program.

The objectives of the Toxic Substance Monitoring Program are:

- To develop statewide baseline data and to demonstrate trends in the occurrence of toxic elements and organic substances in the aquatic biota.

- To assess impacts of accumulated toxicants upon the usability of State waters by man.

- To assess impacts of accumulated toxicants upon the aquatic biota.

- Where problem concentrations of toxicants are detected, to attempt to identify sources of toxicants and to relate concentrations found in the biota to concentrations found in the water.

The samples collected in the TSM program include benthic invertebrates and fish. Species collected in this Region include (by common name): bardiella, carp, channel catfish, flathead catfish, grass carp, mosquitofish, mozambique mouthbrooder, largemouth bass, orangemouth corvina, tilapia, red shiner, red swamp crayfish, sailfin molly, sargo, spiny soft shelled turtle, yellow bullhead, and zill's cichlid. The history of the TSM Program sampling in this Region through 1990 is summarized in Table 6-3.

TABLE 6-3:TSM PROGRAM – STATION SAMPLING HISTORIES

Station Name	Sample Years
Alamo River/Calipatria	1978-1985, 1987-1990
Alamo River/International Boundary	1985, 1987-88
Central Drain	1988
Coachella Canal	1987
Coachella Valley Stormwater Channel	1986-87
Colorado River/Cibola	1978-1981
Colorado River/International Boundary	1985, 1988
Colorado River/Needles	1987-88
Colorado River/Picacho	1984
Colorado River/u/s Imperial Dam	1987, 1989
Dixie Drain No. 1	1986
Dixie Drain No. 3	1986
Dixie Drain No. 5	1986
Fig Drain	1989-90
Fig Lake	1985, 1989-90
Fig Lake Outlet	1990
Forgetmenot Drain	1986
Greeson Drain	1985
Holtville Main Drain	1989-90
Lake Cahuilla	1987
Lake Havasu	1987
New River/Internat. Bound	1984-85, 87, 1989-90
New River/Westmorland	1978-1990
Palo Verde Outfall Drain	1986-87
Pumice Drain	1990
Reservation Main Drain	1986
Rice Drain	1985-86
Rose Drain	1988
Salt Creek Slough	1985-86
Salt Creek/Mouth	1987
Salton Sea/North	1981

Salton Sea/South	1980-81, 1985, 1987, 1989
Salton Sea/West Shore	1984, 1986
San Felipe Creek/d/s Highway 86 Bridge	1987
San Felipe Creek/San Sebastion Marsh	1986
South Central Drain	1990
Trifolium Drain 7	1985
Verde Drain	1989
Warren Drain	1989-90
West Side Drain	1986
Wiest Lake	1989

F. TOTAL MAXIMUM DAILY LOADS COMPLIANCE ASSURANCE AND ENFORCEMENT

The Executive Officer shall use, as the circumstances of the case may warrant, any combination of the following actions to ensure that the water pollution threats identified in TMDLs are promptly and effectively corrected:

- Implementation and enforcement of Section 13225, 13267, and 13268 of the California Water Code to ensure that all responsible parties submit in a prompt and complete manner, the Water Quality Management Plan defined in Chapter 4, Section V(E)(1.1).
- Require submission of reports of waste discharge pursuant to CWC §13260.
- Adoption of waste discharge requirements, pursuant to Section 13263 of the California Water Code, as appropriate (i.e., for any responsible party who fails to implement voluntary or regulatory-encouraged sediment controls).
- Adoption of enforcement orders pursuant to Section 13304 of the California Water Code against any responsible party who violates Regional Board waste discharge requirements and/or fails to implement voluntary or regulatory-encouraged sediment control measures to prevent and mitigate sediment pollution or threatened pollution of surface waters.
- Adoption of enforcement orders pursuant to Section 13301 of the California Water Code against those who violate Regional Board waste discharge requirements and/or prohibitions.
- Issuance of Administrative Civil Liability Complaints, pursuant to Section 13261, 13264, or 13268 of the California Water Code, against any responsible party who fails to comply with Regional Board orders, prohibitions, and requests.
- Adoption of referrals of recalcitrant violators of Regional Board orders and prohibitions to the District Attorney or Attorney General for criminal prosecution or civil enforcement.

1. PATHOGEN/BACTERIAL INDICATORS

A. New River

1.A.1. Additional Compliance Assurance and Enforcement

Implement and enforce Section 13267 of the California Water Code to ensure that all dischargers subject to Regional Water Quality Control Board, Colorado River Basin Region, Order No. 01-800, NPDES No. CA0017001, General National Pollutant Discharge Elimination System Permit and General Waste Discharge Requirements for Confined Animal feeding Operations (Order No. 01-800), submit, in a prompt and complete manner, the Engineered Waste Management Plan required by Order No. 01-800.

1.A.2. Water Quality Monitoring

Monitoring activities are contingent upon adequate programmatic funding. Monitoring activities for the New River Pathogen TMDL will be conducted by the Regional Board pursuant to a Regional Board Quality Assurance Project Plan for the New River (QAPP-NR). The QAPP-NR shall be developed by Regional Board staff and be ready for implementation within 180 days following USEPA approval of the TMDL. The objectives of the monitoring program shall include collection of water quality data for:

- assessment of water quality standards attainment,
- verification of pollution source allocations,
- calibration or modification of selected models (if any),
- evaluation of point and nonpoint source control implementation and effectiveness,
- evaluation of in-stream water quality,
- evaluation of temporal and spatial trends in water quality, and
- modification of the TMDL as necessary.

The monitoring program shall include a sufficient number of sampling locations and sampling points per location along the New River and major drain tributaries to the river. Monthly grab samples from the above-mentioned surface waters shall be collected and analyzed for the following parameters:

- Flow (to be obtained from IID or USGS)

- Dissolved Oxygen
- pH
- Temperature
- Fecal coliform organisms
- E. Coli
- Fecal streptococci
- Enterococci

Activities implemented by dischargers and responsible parties and surveillance conducted for the New River Pathogen TMDL will be tracked pursuant to a Regional Board implementation tracking plan (ITP). Regional Board staff will develop the ITP within 180 days following USEPA approval of the TMDL. The objectives of Regional Board surveillance and implementation tracking are:

- Assess/track/account for practices already in place;
- Measure the attainment of Milestones;
- Determine compliance with NPDES permits, WLAs, and LAs; and
- Report progress toward implementation of NPS water quality control, in accordance with the SWRCB NPS Program Plan (PROSIP).

2. SEDIMENTATION/SILTATION

A. Imperial Valley

2.A.1. Additional Compliance Assurance and Enforcement

As provided in the State Board's Water Quality Enforcement Policy, prompt, consistent, predictable, and fair enforcement are necessary to deter and correct violations of water quality standards, violations of the California Water Code, and to ensure that responsible parties carry out their responsibilities for meeting TMDL allocations. This is particularly necessary to adequately deal with those responsible parties who fail to implement self-determined or regulatory-encouraged sediment control measures, which are the cornerstone of the State's NPS Program.

From the standpoint of measuring progress, any cropland discharge with a concentration of suspended solids, measuring more than 375 mg/L (or about 270 NTU for turbidity) and absent reasonable implementation of MPs would be considered unsatisfactory. Samples will be analyzed for volatile suspended solids at locations where organic loading represents a significant proportion of the total suspended solids or turbidity. The volatile suspended solids component will be subtracted. Further, in assessing the status of compliance with Load Allocations of any responsible party, the Regional Board shall consider, in addition to water quality results, the degree to which the responsible party has implemented, or is implementing, sediment control measures. In the absence of true progress, the Regional Board directs the Executive Officer to draft requirements that will fulfill sediment control measures. The numeric target is a goal that translates current sediment/silt-related Basin Plan narrative objectives and shall not be used for enforcement purposes.

2.A.2. Monitoring and Tracking

Tracking TMDL and monitoring water quality progress, and modifying TMDLs and implementation plans as necessary to ensure attainment of water quality standards, are important to address uncertainty that may exist in aspects of TMDL development, oversee TMDL implementation to ensure that implementation is being carried out, and to ensure that the TMDL remains effective, given changes that may occur in the watershed after the TMDL is developed. (All monitoring activities are contingent on funding through fund-source specific work plans.)

2.A.3. Water Quality Monitoring and Assessment

Monitoring activities are contingent upon adequate programmatic funding. Regional Board staff will conduct monitoring activities for the Alamo River, New River, and Imperial Valley Drains Sedimentation/Siltation TMDLs pursuant to a Regional Board Quality Assurance Project Plan for the Alamo River (QAPP-AR), New River (QAPP-NR), and Imperial Valley Drains (QAPP-IV Sed) Sediment TMDLs. The QAPPs shall be developed by Regional Board staff. The QAPP-AR and QAPP-NR shall be ready for implementation within 180 days following USEPA approval of these TMDLs. The QAPP-IV Sed shall be ready for implementation by one month following USEPA approval of this TMDL. The Regional Board's Executive Officer shall approve the QAPPs and monitoring plans after determining that they satisfy the objectives and requirements of this Section. The objectives of the monitoring program shall include collection of water quality data for:

- Assessment of water quality standards attainment,
- Verification of pollution sources,
- Calibration or modification of selected models (if any),
- Evaluation of point and nonpoint source control implementation and effectiveness,
- Evaluation of in-stream water quality,

- Evaluation of temporal and spatial trends in water quality, and
- Modification of the TMDLs as necessary.

The monitoring program shall include a sufficient number of sampling locations and sampling points per location along the Alamo River, New River, Imperial Valley Drains, and major drain tributaries to the rivers and Salton Sea. The following parameters will be sampled and analyzed from the above-mentioned surface waters, contingent on funding. Data sources may be outside of the Regional Board. Frequency is in brackets.

- Flow [Quarterly]
- Field turbidity [Monthly]
- Laboratory turbidity (EPA Method No. 180.1) [Monthly]
- Total Suspended Solids (EPA Method No. 160.2) [Monthly]
- Total DDT and DDT metabolites [Quarterly]

The Regional Board will track activities implemented by dischargers and responsible parties and surveillance conducted for the Alamo River, New River, and Imperial Valley Drains Sedimentation/Siltation TMDLs pursuant to an implementation tracking plan (ITP). Regional Board staff will develop and implement the ITP within 180 days following USEPA approval of the Alamo River and New River TMDLs. Regional Board staff will develop and implement the ITP by one month following USEPA approval of the Imperial Valley Drains TMDL. The Regional Board's Executive Officer shall approve the ITP after determining that the ITP satisfies the objectives and requirements of this Section. The objectives of Regional Board Surveillance and implementation tracking are:

- Assess/track/account for practices already in place;
- Measure the attainment of Milestones;
- Report progress toward implementation of NPS water quality control, in accordance with the SWRCB NPS Program Plan (PROSIP).

2.A.4. TMDL Implementation Tracking
Implementation of sediment control activities shall be tracked by Regional Board staff and shall be reported to the Regional Board at least yearly.

2.A.5. TMDL Assessment and Reporting
On a yearly basis, Regional Board staff will prepare a report assessing compliance with the TMDL Goals and Milestones. In the report, staff will assess:

- Water quality improvement (in terms of total suspended sediments, total sediment loads, Total DDT, and DDT metabolites).
- Trends in MP implementation.
- MP effectiveness.
- Whether milestones were met on time or at all. If milestones were not met, provide a discussion of the reasons, and make recommendations.
- Level of compliance with measures and timelines agreed to in Program Plans and Drainshed Plans.

2.A.6. Regular Review
The Regional Board shall hold public hearings at least every three years to review the level of MP implementation, effectiveness of MPs, and overall progress of sediment control practices. At these hearings, the following shall be considered:

- Monitoring results
- Progress toward attainment of milestones
- Trends in implementation of MPs
- Modification/addition of management practices for the control of sediment discharges
- Revision of TMDL components and/or development of site-specific water quality objectives

Review of subcategories of water quality standards related to these TMDLs and/or attainability of the TMDLs also may be appropriate after the parties responsible for TMDL implementation submit appropriate documentation that sediment control practices (e.g., MPs) are being implemented on a widespread-basis in the watersheds, that the control practices are being properly implemented and maintained, and that additional controls would result in substantial and widespread economic and social impact. The Regional Board 303(d) listing of the sediment/silt impairment for the Alamo River, New River, Imperial Valley Drains and/or tributary drains shall also be re-evaluated.

III. WATER QUALITY ASSESSMENT ACTIVITIES

Section 305(b) of the federal Clean Water Act requires States to prepare and submit biennially to the USEPA a Water Quality Inventory. This Inventory report includes: (a) a description of the water quality of major navigable waters in the State during the preceding years; (b) an analysis of the extent to which significant navigable waters provide for the protection and propagation of a balanced population of shellfish, fish and wildlife, and allow recreational activities in and on the water; (c) an analysis of the extent to which elimination of the discharge of pollutants is being achieved or will be needed; and (d) an estimate of the environmental impact, the economic and social costs necessary to achieve the "no discharge" objective of the Clean Water Act, the economic and social benefits of such achievement, and estimates of the date of such achievement.

Data collection and analyses already being carried out by the State in the permitting, planning, monitoring, and enforcement programs is utilized in preparing the reports on the quality of the waters of California. The first report was published in 1975.

IV. QUALITY ASSURANCE AND QUALITY CONTROL

The purpose of the statewide Quality Assurance (QA) Program is to ensure that data generated from environmental studies are technically sound, scientifically valid, and legally defensible.

A federal regulation (EPA order 5360.1))requiring the State to develop and implement a Quality Assurance Program Plan (QAPP) was adopted in April 1993. The program mandate is identified in 40 CFR 30.503 (July 01, 1987).

The State Board has appointed a QA Program Manager to direct, coordinate and administer the State QAPP. Independently, each Regional Board has appointed a QA Officer to administer its Regional responsibilities. The State Board and the Regional Boards jointly administer the program but the State Board has lead responsibility for managing the overall program and for reporting to the USEPA. The duties of the Regional Board QA Officer include overseeing and implementing QA procedures conducted in the Regional Board laboratory, interacting with project managers on the required preparation of QA Project Plans, and evaluating compliance inspection data on all major dischargers.

The Regional Board Laboratory was started in June 1976. Its purpose is to perform water and wastewater analysis for the monitoring and surveillance, enforcement, and planning programs. In order for the laboratory to produce data that can be confidently used by this and other agencies in their programs, a QA Program Plan has been written and is being used by the laboratory. The QA Program Plan is designed to maintain Quality Assurance on the samples from the time of collection until the data is reported. This Plan will be reviewed annually and updated if necessary.

This Page

Intentionally

Left Blank

ASTM E1527 - 05

ASTM E1527 - 05 Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process

Active Standard ASTM E1527 Developed by Subcommittee: E50.02 | **Book of Standards Volume:** 11.05

Buy Standard (PDF)	more info	35 pages	$ 59.00
Buy Standard (Print)	more info	35 pages	$ 59.00
Buy Standard + Redline (PDF)	why redline?	70 pages	$ 70.80

Historical (view previous versions of standard)

ASTM License Agreement

Shipping & Handling

Translated Standard: Chinese
more info

More E50.02 Standards	Related Products
Copyright/Permissions	Standard References

ASTM E1527

1. Scope

1.1 PurposeThe purpose of this practice is to define good commercial and customary practice in the United States of America for conducting an environmental site assessment of a parcel of commercial real estate with respect to the range of contaminants within the scope of Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (42 U.S.C. 9601) and petroleum products. As such, this practice is intended to permit a user to satisfy one of the requirements to qualify for the innocent landowner, contiguous property owner, or bona fide prospective purchaser limitations on CERCLA liability (hereinafter, the "landowner liability protections," or "LLPs"): that is, the practice that constitutes "all

Standards Tracker

Standards Subscriptions

Customers frequently also buy:
E1903
E1528
E2247

Related Standards:
E2247
E1903
E2531
E2018
D6235
See All

Related Adjuncts:

ADJE152705

appropriate inquiry into the previous ownership and uses of the property consistent with good commercial or customary practice" as defined at 42 U.S.C. 9601(35)(B). (See for an outline of CERCLA's liability and defense provisions.) Controlled substances are not included within the scope of this standard. Persons conducting an environmental site assessment as part of an EPA Brownfields Assessment and Characterization Grant awarded under CERCLA 42 U.S.C. 9604(k)(2)(B) must include controlled substances as defined in the Controlled Substances Act (21 U.S.C. 802) within the scope of the assessment investigations to the extent directed in the terms and conditions of the specific grant or cooperative agreement. Additionally, an evaluation of business environmental risk associated with a parcel of commercial real estate may necessitate investigation beyond that identified in this practice (see Sections 1.3 and 13).

1.1.1 Recognized Environmental ConditionsIn defining a standard of good commercial and customary practice for conducting an environmental site assessment of a parcel of property, the goal of the processes established by this practice is to identify recognized environmental conditions. The term recognized environmental conditions means the presence or likely presence of any hazardous substances or petroleum products on a property under conditions that indicate an existing release, a past release, or a material threat of a release of any hazardous substances or petroleum products into structures on the property or into the ground, ground water, or surface water of the property. The term includes hazardous substances or petroleum products even under conditions in compliance with laws. The term is not intended to include de minimis conditions that generally do not present a threat to human health or the environment and that generally would not be the subject of an enforcement action if brought to the attention of appropriate governmental agencies. Conditions determined to be de minimis are not recognized environmental conditions.

1.1.2 Petroleum ProductsPetroleum products are included within the scope of this practice because they are of concern with respect to many parcels of commercial real estate and current custom and usage is to include an inquiry into the presence of petroleum products when doing an environmental site assessment of commercial real estate. Inclusion of petroleum products within the scope of this practice is not based upon the applicability, if any, of CERCLA to petroleum products. (See X1.7 for discussion of petroleum exclusion to CERCLA liability.)

1.1.3 CERCLA Requirements Other Than Appropriate InquiryThis practice does not address whether requirements in addition to all appropriate inquiry have been met in order to qualify for the LLPs (for example, the duties specified in 42 U.S.C. 9607(b)(3)(a) and (b) and cited in Appendix X1, including the continuing obligation not to impede the integrity and effectiveness of activity and use limitations (AULs), or the duty to take reasonable steps to prevent releases, or the duty to comply with legally required release reporting obligations).

1.1.4 Other Federal, State, and Local Environmental LawsThis practice does not address requirements of any state or local laws or of any federal laws other than the all appropriate inquiry provisions of the LLPs. Users are cautioned that federal, state, and local laws may impose environmental assessment obligations that are beyond the scope of this practice. Users should also be aware that there are likely to be other legal obligations with regard to hazardous substances or petroleum products discovered on the property that are not addressed in this practice and that may pose risks of civil and/or criminal sanctions for non-compliance.

1.1.5 Documentation The scope of this practice includes research and reporting requirements that support the user's ability to qualify for the LLPs. As such, sufficient documentation of all sources, records, and resources utilized in conducting the inquiry required by this practice must be provided in the written report (refer to 8.1.8 and 12.2).

1.2 ObjectivesObjectives guiding the development of this practice are (1) to synthesize and put in writing good commercial and customary practice for environmental site assessments for commercial real estate, (2) to facilitate high quality, standardized environmental site assessments, (3) to ensure that the standard of all appropriate inquiry is practical and reasonable, and (4) to clarify an industry standard for all appropriate inquiry in an effort to guide legal interpretation of the LLPs.

1.3 Considerations Beyond ScopeThe use of this practice is strictly limited to the scope set forth in this section. Section of this practice identifies, for informational purposes, certain environmental conditions (not an all-inclusive list) that may exist on a property that are beyond the scope of this practice but may warrant consideration by parties to a commercial real estate transaction. The need to include an investigation of any such conditions in the environmental professional's scope of services should be evaluated based upon, among other factors, the nature of the property and the reasons for performing the assessment (for example, a more comprehensive evaluation of business environmental risk) and should be agreed upon between the user and environmental professional as additional services beyond the scope of this practice prior to initiation of the environmental site assessment process.

1.4 Organization of This Practice This practice has thirteen sections and four appendixes. Section 1 is the Scope. Section 3 is Referenced Documents. Section , Terminology, has definitions of terms not unique to this practice, descriptions of terms unique to this practice, and acronyms. Section is Significance and Use of this practice. Section provides discussion regarding activity and use limitations. Section describes User's Responsibilities. Sections are the main body of the Phase I Environmental Site Assessment, including evaluation and report preparation. Section provides additional information regarding non-scope considerations (see). The appendixes are included for information and are not part of the procedures prescribed in this practice. explains the liability and defense provisions of CERCLA that will assist the user in understanding the user's responsibilities under CERCLA; it also contains other important information regarding CERCLA, the Brownfields Amendments, and this practice. provides the definition of the environmental professional responsible for the Phase I Environmental Site Assessment, as required in the "All Appropriate Inquiry" Final Rule (40 C.F.R. Part 312). provides an optional User Questionnaire to assist the user and the environmental professional in gathering information from the user that may be material to identifying recognized environmental conditions. provides a recommended table of contents and report format for a Phase I Environmental Site Assessment.

1.5 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1.6 This practice offers a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this practice may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title means only that the document has been approved through the ASTM consensus process.

2. Referenced Documents *(purchase separately)*

Other Federal Agency Document

OSHAHazardCommunicat 29 C.F.R. 1910.1200

Federal Statutes

ResourceConservation as amended (RCRA), 42 U.S.C 6901 et seq.

USEPA Documents

NationalOilandHazard 40 C.F.R. Part 300

ASTM Standards

E1528 Practice for Limited Environmental Due Diligence: Transaction Screen Process
E2091 Guide for Use of Activity and Use Limitations, Including Institutional and Engineering Controls

---

Keywords

ICS Code

ICS Number Code 13.020.30 (Environmental impact assessment)

DOI: 10.1520/E1527-05

ASTM E1527 (Environmental Assessment Standards and Risk Management Standards)

Citing ASTM Standards

[Back to Top]

Back to Environmental Assessment Standards and Risk Management Standards

Home | About ASTM | Site Map | Support | Contact | Policies | Link to Us | Copyright/Permissions

Construction Standards - Petroleum Standards -Steel Standards - Plastics Standards - Environmental Standards - Metals Standards - Rubber Standards - Textiles Standards - Paint Standards - Nuclear Standards

This Page

Intentionally

Left Blank

ASTM E1527 - 05

ASTM E1527 - 05 Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process

Active Standard ASTM E1527 Developed by Subcommittee: E50.02 | **Book of Standards Volume:** 11.05

Buy Standard (PDF)	more info	35 pages	$ 59.00
Buy Standard (Print)	more info	35 pages	$ 59.00
Buy Standard + Redline (PDF)	why redline?	70 pages	$ 70.80

Historical (view previous versions of standard)

ASTM License Agreement

Shipping & Handling

Translated Standard: **Chinese**
more info

More E50.02 Standards	Related Products
Copyright/Permissions	Standard References

ASTM E1527

1. Scope

1.1 PurposeThe purpose of this practice is to define good commercial and customary practice in the United States of America for conducting an environmental site assessment of a parcel of commercial real estate with respect to the range of contaminants within the scope of Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (42 U.S.C. 9601) and petroleum products. As such, this practice is intended to permit a user to satisfy one of the requirements to qualify for the innocent landowner, contiguous property owner, or bona fide prospective purchaser limitations on CERCLA liability (hereinafter, the "landowner liability protections," or "LLPs"): that is, the practice that constitutes "all appropriate inquiry into the previous ownership and uses of the property consistent with good commercial or customary practice" as defined at 42 U.S.C. 9601(35)(B). (See for an outline of CERCLA's liability and defense provisions.) Controlled substances are not included within the scope of this standard. Persons conducting an environmental site assessment as part of an EPA Brownfields Assessment and Characterization Grant awarded under CERCLA 42 U.S.C. 9604(k)(2)(B) must include controlled substances as defined in the Controlled Substances Act (21 U.S.C. 802) within the scope of the assessment investigations to the extent directed in the terms and conditions of the specific grant or cooperative agreement. Additionally, an evaluation of business environmental risk associated with a parcel of commercial real estate may necessitate investigation beyond that identified in this practice (see Sections 1.3 and 13).

1.1.1 Recognized Environmental ConditionsIn defining a standard of good commercial and customary practice for conducting an environmental site assessment of a parcel of property, the goal of the processes established by this practice is to identify recognized environmental conditions. The term recognized environmental conditions means the presence or likely presence of any hazardous substances or petroleum products on a property under conditions that indicate an existing release, a past release, or a material threat of a release of any hazardous substances or petroleum products into structures on the property or into the ground, ground water, or surface water of the property. The term includes hazardous substances or petroleum products even under conditions in compliance with laws. The term is not intended to include de minimis conditions that generally do not present a threat to human health or the environment and that generally would not be the subject of an enforcement action if brought to the attention of appropriate governmental agencies. Conditions determined to be de minimis are not recognized environmental conditions.

1.1.2 Petroleum ProductsPetroleum products are included within the scope of this practice because they are of concern with respect to many parcels of commercial real estate and current custom and usage is to include an inquiry into the presence of petroleum products when doing an environmental site assessment of commercial real estate. Inclusion of petroleum products within the scope of this practice is not based upon the applicability, if any, of CERCLA to petroleum products. (See X1.7 for discussion of petroleum exclusion to CERCLA liability.)

1.1.3 CERCLA Requirements Other Than Appropriate InquiryThis practice does not address whether requirements in addition to all appropriate inquiry have been met in order to qualify for the LLPs (for example, the duties specified in 42 U.S.C. 9607(b)(3)(a) and (b) and cited in Appendix X1, including the continuing obligation not to impede the integrity and effectiveness of activity and use limitations (AULs), or the duty to take reasonable steps to prevent releases, or the duty to comply with legally required release reporting obligations).

1.1.4 Other Federal, State, and Local Environmental LawsThis practice does not address requirements of any state or local laws or of any federal laws other than the all appropriate inquiry provisions of the LLPs. Users are cautioned that federal, state, and local laws may impose environmental assessment obligations that are beyond the scope of this practice. Users should also be aware that there are likely to be other legal obligations with regard to hazardous substances or petroleum products discovered on the property that are not addressed in this practice and that may pose risks of civil and/or criminal sanctions for non-compliance.

1.1.5 Documentation The scope of this practice includes research and reporting requirements that support the user's ability to qualify for the LLPs. As such, sufficient documentation of all sources, records, and resources utilized in conducting the inquiry required by this practice must be provided in the written report (refer to 8.1.8 and 12.2).

1.2 ObjectivesObjectives guiding the development of this practice are (1) to synthesize and put in writing good commercial and customary practice for environmental site assessments for commercial real estate, (2) to facilitate high quality, standardized environmental site assessments, (3) to ensure that the standard of all appropriate inquiry is practical and reasonable, and (4) to clarify an industry standard for all appropriate inquiry in an effort to guide legal interpretation of the LLPs.

1.3 Considerations Beyond ScopeThe use of this practice is strictly limited to the scope set forth in this section. Section of this practice identifies, for informational purposes, certain environmental conditions (not an all-inclusive list) that may exist on a property that are beyond the scope of this practice but may warrant consideration by parties to a commercial real estate transaction. The need to include an investigation of any such conditions in the environmental professional's scope of services should be evaluated based upon, among other factors, the nature of the property and the reasons for performing the assessment (for example, a more comprehensive evaluation of business environmental risk) and should be agreed upon between the user and environmental professional as additional services beyond the scope of this practice prior to initiation of the environmental site assessment process.

1.4 Organization of This Practice This practice has thirteen sections and four appendixes. Section 1 is the Scope. Section 3 is Referenced Documents. Section , Terminology, has definitions of terms not unique to this practice, descriptions of terms unique to this practice, and acronyms. Section is Significance and Use of this practice. Section provides discussion regarding activity and use limitations. Section describes User's Responsibilities. Sections are the main body of the Phase I Environmental Site Assessment, including evaluation and report preparation. Section provides additional information regarding non-scope considerations (see). The appendixes are included for information and are not part of the procedures prescribed in this practice. explains the liability and defense provisions of CERCLA that will assist the user in understanding the user's responsibilities under CERCLA; it also contains other important information regarding CERCLA, the Brownfields Amendments, and this practice. provides the definition of the environmental professional responsible for the Phase I Environmental Site Assessment, as required in the "All Appropriate Inquiry" Final Rule (40 C.F.R. Part 312). provides an optional User Questionnaire to assist the user and the environmental professional in gathering information from the user that may be material to identifying recognized environmental conditions. provides a recommended table of contents and report format for a Phase I Environmental Site Assessment.

1.5 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1.6 This practice offers a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this practice may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title means only that the document has been approved through the ASTM consensus process.

2. Referenced Documents *(purchase separately)*

Other Federal Agency Document

OSHAHazardCommunicat 29 C.F.R. 1910.1200

Federal Statutes

ResourceConservation as amended (RCRA), 42 U.S.C 6901 et seq.

USEPA Documents

NationalOilandHazard 40 C.F.R. Part 300

ASTM Standards

E1528 Practice for Limited Environmental Due Diligence: Transaction Screen Process
E2091 Guide for Use of Activity and Use Limitations, Including Institutional and Engineering Controls

---

Keywords

ICS Code

ICS Number Code 13.020.30 (Environmental impact assessment)

DOI: 10.1520/E1527-05

ASTM International is a member of CrossRef.

ASTM E1527 (Environmental Assessment Standards and Risk Management Standards)

Citing ASTM Standards

[Back to Top]

This Page

Intentionally

Left Blank

Appendix 5.14A
Draft Phase 1 Environmental Site Assessment
Prepared by URS

SolarReserve, LLC
Rice Airfield Solar Energy Project

Phase 1 Environmental Site Assessment

DECEMBER 2008

SolarReserve

DRAFT REPORT

PHASE I
ENVIRONMENTAL SITE ASSESSMENT
SOLARRESERVE RICE AIRFIELD SITE
SOUTH OF HIGHWAY 62 AT MILE MARKER 109
RICE, CALIFORNIA 92239

PREPARED FOR:

SOLARRESERVE, LLC

URS PROJECT NO. 27658096.00200

DECEMBER 9, 2008

DRAFT REPORT

PHASE I ENVIRONMENTAL SITE ASSESSMENT SOLARRESERVE RICE AIRFIELD SITE SOUTH OF HIGHWAY 62 AT MILE MARKER 109 RICE, CALIFORNIA 92239

Prepared for

SolarReserve, LLC
2425 Olympic Boulevard, Suite 500 East
Santa Monica, CA 90404

URS Project No. 27658096.00200

____
Lowell Woodbury, REA
Project Geologist

____
Tyree French, EIT
Senior Staff Engineer

December 9, 2008

URS

1615 Murray Canyon Road, Suite 1000
San Diego, CA 92108-4314
619.294.9400 Fax: 619.293.7920

December 9, 2008

Ms. Julie Way
SolarReserve, LLC
2425 Olympic Boulevard, Suite 500 East
Santa Monica, CA 90404

Subject: Draft Phase I Environmental Site Assessment
SolarReserve Rice Airfield Site
South of Highway 62 at Mile Marker 109
Rice, California 92239
URS Project No. 27658096.00200

Dear Ms. Way:

Please find enclosed with this letter two copies of our report titled "Phase I Environmental Site Assessment, SolarReserve Rice Airfield Site, South of Highway 62 at Mile Marker 109, Rice, California 92239." This project was conducted in accordance with the SolarReserve Contract Work Order 8096-01 to SolarReserve, LLC dated November 11, 2008.

We trust that this report provides you with the information required at this time. Should you have any questions regarding the content of this submittal, please do not hesitate to call. It has been a pleasure to be of assistance.

Sincerely,

URS CORPORATION

Tyree French, EIT
Senior Staff Engineer

TF:ml

Enclosures

TABLE OF CONTENTS

TABLE OF CONTENTS

Tables

Figures

Appendices

AAI	All Appropriate Inquiries
APN	Assessor Parcel Number
AQMD	Air Quality District
AT&SF	Atchison, Topeka, Santa Fe Railroad
bgs	below ground surface
BLM	Bureau of Land Management
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
Cal/EPA	California Environmental Protection Agency
CALTRANS	California Department of Transportation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CRFD	County of Riverside Fire Department
CDMG	California Division of Mines and Geology
DEIR/EIS	Environmental Impact Report/Environmental Impact Statement
DTC	Desert Training Center
DTSC	Department of Toxic Substances Control
ECI	Ecology Control Industries
EDR	Environmental Data Resources, Inc.,
ESA	Environmental Site Assessment
CRDEH	County of Riverside Department of Environmental Health
LUST	Leaky Underground Storage Tank
MCL	Maximum Contaminant Level
MTBE	Methyl Tertiary Butyl Ether
msl	mean sea level
N-A	Natural Assets
OS-RUR	Open Space/Rural
PCBs	polychlorinated biphenyls
pCi/l	pico Curies per liter of air
PSD	Pipeline Safety Division
RECs	Recognized Environmental Conditions
RWQCB	California Regional Water Quality Control Board
SBBM	San Bernardino Base Meridian
SR-62	Eligible Scenic Highway State Route 62
TDS	Total Dissolved Solids
TPHg	Total Purgeable Petroleum Hydrocarbons as Gasoline
TPHd	Total Purgeable Petroleum Hydrocarbons as Diesel
TRPH	Total Recoverable Petroleum Hydrocarbons
URS	URS Corporation
USACE	United States Army Corp of Engineers
USEPA	United States Environmental Protection Agency
USGS	U.S. Geological Survey
UST	Underground Storage Tank
UXO	unexploded ordnance
WWII	World War II

EXECUTIVE SUMMARY

URS Corporation (URS) conducted a Phase I Environmental Site Assessment (ESA) for SolarReserve, LLC of the former Rice Airfield (site or subject property) located south of California State Route 62 (SR-62) at mile marker 109, Rice, California 92239 (Figure 1). This assessment was accomplished by and limited to a site reconnaissance, survey of the site vicinity, and review of available pertinent documentation available through URS' standard resources regarding past and current land use for indications of the manufacture, generation, use, storage, and/or disposal of hazardous substances at the site.

The scope of services performed is in accordance with SolarReserve Contract Work Order 8096-01 dated November 11, 2008. The format and content of this report are in general accordance with the ASTM International Standard Practice for Environmental Site Assessments: Phase I Site Assessment Process E 1527-05 and the United States Environmental Protection Agency (USEPA) 40 CFR Part 312 Standards and Practices for All Appropriate Inquiries (AAI) – Final Rule effective November 1, 2006.

The subject property consists of approximately 3,324 acres of desert land. The site is presently zoned for Natural Assets (N-A) and Controlled Development Areas (W-2) according to Riverside County Zoning Ordinance (Ordinance 348).

The subject site is located approximately two miles east of the town of Rice and encompasses the historical Rice Army Airfield. Based on historical information reviewed, the airfield was used by the United States military from 1942 to 1944 as part of the Desert Training Center (DTC), which was part of the California-Arizona Maneuver Area (C-AMA). The site was a command post for General George Patton and was used to train soldiers and aircraft crews to support ground troops during World War II (WWII). A representative from the United States Army Corp of Engineers (USACE) indicated that documentation of site operations during this time is limited. Information regarding use of the site prior to 1942 is not well documented; however, the site may have been used as a civilian airport in the 1930s. The base was declared surplus in October of 1944 and was sold to a private owner in 1947. In 1949 the site reopened as a civilian airport until operations ceased sometime between 1955 and 1958.

Rice Army Airfield and the adjacent Camp Rice to the east consisted of army barracks, hangars, and other aircraft structures, recreation areas, mess, and other facilities with the capacity to house 3,000 troops. There were two runways made of oiled gravel, each approximately 5,000-feet by 150-feet. The buildings have been removed; however, some concrete pads, foundations, and other unidentified features remain onsite. Portions of the previous runways, taxiways, and access roads were present during a site field reconnaissance, with portions covered by soil and scrub brush. An oily residue is visible on portions of the former runways and vehicle access roads. Three groundwater wells were identified onsite. Two wells were recently installed, the other well is an older, unsecured well, reportedly used by Rice Airfield.

Development in the site vicinity identified on historic sources includes the adjacent SR-62, along with the Atchison, Topeka, and Santa Fe Railroad (AT&SF) and a Colorado River Aqueduct located to the north of the site across SR-62. A communication tower is located on an adjacent parcel to the east of the site. There were no offsite features identified that have the potential to create a Recognized Environmental Condition (REC) for the subject property

Based on available documentation and general topography across the site, groundwater in the site vicinity is anticipated to follow topography and flow generally toward the south.

Current hazardous materials use and generation of hazardous waste were not reported or identified onsite during the site visit. The site was not listed on the Environmental Data Resources (EDR) Radius Map Report. However, a site identified as Rice Camp (Army) was listed on the EDR Report unmapped, orphan sites as being listed in the Envirostor Database. Documents available for review indicated that multiple underground storage tanks (USTs) were historically located onsite. One UST removal report indicates that as many as seven USTs were historically in operation at the site. With the exception of one UST and three septic tanks, documentation of their removal and confirmation sampling could not be found. Several onsite areas were identified during the site visit where trash, generally consisting of cans, glass bottles, and other metal debris, had been burned.

Based on the scope of services performed to date, RECs were identified at the former Rice Army Airfield facility. Identified RECs include the lack of documentation regarding the removal of underground storage tanks reportedly used by Rice Army Airfield; the oily residue reported and observed on the former runways and access roads; the numerous piles of burned debris; the EDR Report listing of a site identified as Rice Camp (Army) on the Envirostor Database, and the unsecured historic well. These RECs indicate the need for additional investigation at the site.

SECTION 1 INTRODUCTION

Presented in this report are the results of the Phase I ESA conducted by URS of the SolarReserve Rice Airfield Site located adjacent to and south of SR-62 at mile marker 109 in Riverside County, California (Figure 1). Specifically, the subject site is located in Sections 19 and 30, Township 1 South, Range 21 East San Bernardino Base Meridian (SBBM); the eastern half of Sections 24 and 25, Township 1 South, Range 20 East SBBM; and the western half of Sections 20 and 29, Township 1 South, Range 21 East SBBM; on the Rice, California 7.5-minute series topographic quadrangle map (EDR, 2008; Figure 2A).

This assessment was accomplished by, and limited to a reconnaissance of the site, a drive-by survey of the site vicinity, and review of agency databases and other reasonably ascertainable information regarding past and current land use for indications of the manufacture, generation, use, storage and/or disposal of hazardous substances at the site.

1.1 ASTM STANDARD AND ALL APPROPRIATE INQUIRY

The format and content of this report are in general accordance with the ASTM Standard Practice for Environmental Site Assessments: Phase I Site Assessment Practice E 1527-05 and the United States Environmental Protection Agency's standards for AAI at 40 CFR Part 312.

1.1.1 All Appropriate Inquiry Standards

The United States Environmental Protection Agency (USEPA) Rule on AAI was developed to establish landowner liability protections to property owners under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as innocent landowners, bona fide prospective purchasers, and/or contiguous property owners. The Rule expands the records review requirements by increasing the search distances beyond the superseded ASTM Standard E 1527-00, incorporating mandatory searches for engineering and institutional controls, and mandatory review of local government and tribal records. The records review also requires a search of reasonable ascertainable land title and lien records to identify environmental liens or activity and use limitations, if any, that are recorded against the property. The historical sources review requires that a search of the property go as far back in history as it can be shown that the property contained structures or was first used for residential, agricultural, commercial, industrial, or governmental purposes. Data gaps identified for the property will be identified and their significance reported. The AAI Rule also requires taking into account commonly known or reasonably ascertainable information within a local community. AAI requires that inquiries be conducted by an environmental professional, which is specifically defined within the Rule.

1.1.2 ASTM Standard

The ASTM Standard Practice for Environmental Site Assessments (Standard E 1527-05) was approved November 1, 2005. ASTM Standard E 1527-05 was established and updated to reflect industry requirements brought about by AAI.

The goal of the ASTM Standard is to identify Recognized Environmental Conditions (RECs). By definition under ASTM designation E 1527-05, the term "recognized environmental condition" is defined as the presence or likely presence of any hazardous substances or petroleum products on a property under conditions that indicate an existing release, a past release, or a material threat of a release of any hazardous substances or petroleum products into structures on the property or into the ground, groundwater or surface water of the property. The term includes hazardous substances or petroleum products even under conditions in compliance with laws. The term is not intended to include *de minimis* conditions that generally do not present a threat to human health or the environment and that generally would not be the subject of an enforcement action if brought to the attention of appropriate governmental agencies. Conditions determined to be *de minimis* are not recognized environmental conditions.

1.2 PURPOSE

The purpose of the Phase I ESA is to gather information about the subject site and surrounding areas to identify conditions indicative of releases or threatened releases of hazardous substances, pollutants and contaminants, petroleum or petroleum products, and controlled substances.

1.3 SCOPE OF SERVICES

The Scope of Services performed is in accordance with the SolarReserve Contract Work Order 8096-01 dated November 11, 2008. The format and content of this Phase I ESA Report are in general accordance with the USEPA's standards for AAI and ASTM Standard Practice for Environmental Site Assessments: Phase I Site Assessment Process.

This Report was accomplished by, and limited to, a reconnaissance of the site and review of pertinent documentation available through URS' standard resources regarding past and current land use for indications of the manufacture, generation, use, storage, and/or disposal of hazardous substances at the site. The site reconnaissance included a driving tour of areas at the subject property that were accessible by existing paths and a drive-by survey of surrounding and adjacent properties visible from public right of way. To meet the objective of this Update, URS completed the following tasks:

- Performed a reconnaissance survey of the subject property to make visual observations of existing site conditions and activities, and a drive-by survey of the area within ¼-mile of the site to observe types of general land use. Photographs of the site are provided as Appendix A.
- Reviewed the federal, state, and local database list search provided by Environmental Data Resources, Inc., (EDR) of Milford, Connecticut of known or potential hazardous waste sites or landfills, and sites currently under investigation for environmental violations. The agency lists and search radii results (EDR Report) are provided in Appendix B.
- Conducted inquiries in person, by telephone, or in writing to the appropriate regulatory agencies for information regarding environmental permits, violations or incidents, and/or the status of enforcement actions at the subject property.
- Included review of pertinent available documents and maps regarding local physiographic and hydrogeologic conditions in the site vicinity including the potential presence of wetlands, floodplains, coastal zones, aquifer recharge areas, and nearby environmentally sensitive sites.

- Included review of available historical aerial photographs and archival U.S. Geological Survey (USGS) topographic maps of the site and vicinity available from EDR for evidence of previous site activities and development that would suggest the potential presence of hazardous substances at the site.
- Prepared this report describing the research performed and presenting URS' findings and professional opinions regarding the potential for adverse environmental impacts to the subject property.

1.4 USER RELIANCE

This report has been prepared for use by SolarReserve and shall not be relied upon by, or transferred to, any other party, or used for any other purpose, without the express written authorization of URS.

1.5 LIMITATIONS AND EXCEPTIONS

This report and associated work have been provided in accordance with the terms and conditions of the SolarReserve Contract Work Order 8096-01 between SolarReserve and URS Corporation Americas dated November 11, 2008. Based on the scope of services outlined in the proposals, the ESA specifically did not include testing for radon gas, asbestos, lead-based paint, testing of groundwater, or evaluation of wetlands or cultural resources. In addition, this ESA did not include a compliance audit and the environmental lien search was based solely on data provided by SolarReserve and EDR.

SECTION 2 SITE DESCRIPTION

2.1 LOCATION AND LEGAL DESCRIPTION

The site is located approximately 64 miles southwest of Needles, California, and 62 miles northwest of Blythe, California, on unincorporated land within the County of Riverside. The site is bounded by Bureau of Land Management (BLM)-managed lands on most of the southern border and by undeveloped private land on the remaining portion of the southern border and the surrounding sides. California Department of Transportation (Caltrans) Eligible Scenic Highway State Route 62 (SR-62) and the Colorado River Aqueduct, operated by the Metropolitan Water District of Southern California, are located several hundred feet north of the site. The sites legal descriptions are as follows:

Parcel 1**:**

"The east half of the northwest quarter; the east half of the east half of the southwest quarter, and all of the east half of Section 24, and all of the east half of Section 25, Township 1 South, Range 20 east, San Bernardino Base and Meridian, in the County of Riverside, State of California according to the official plat thereof approved by the surveyor general April 16, 1857" (North American Title Company, 2008).

Parcel 2:

"All of the Sections 19, 20, 29 and 30, Township 1 South, Range 21 East, San Bernardino Base and Meridian, in the County of Riverside, State of California, According to the official plat thereof approved by the surveyor general APRIL 16, 1857" (North American Title Company, 2008).

The reported Assessor's Parcel Numbers (APNs) for the site with associate owners are presented in Table 1 (North American Title Company, 2008).

Table 1
Site Assessor's Parcel Numbers and Owners

APN	Owner / Agency / Jurisdiction
801-042-004-9	Rice Development, LLC
801-062-012-8	Rice Development, LLC
801-070-003-5	Rice Development, LLC
801-070-004-6	Rice Development, LLC
801-100-005-9	Rice Development, LLC
801-100-006-0	Rice Development, LLC

2.2 FEATURES / USE

The site encompasses the historic Rice Army Airfield, a part of DTC from WWII. Visible remnants of the former airfield consisted of two 5,000-feet runways and numerous dispersal pads extending beyond the runways to the south (Freeman, 2008). There are no standing buildings onsite; however, some concrete building foundations remain. The most prominent remaining former airfield feature is the concrete area in the north-central portion of the site. Piping was observed at several concrete structures that may extend below the surface. The site and vicinity generally consist of gently sloping creosote bush scrub, with a dry wash to the west and sand dunes to the south and northwest. Except for SR-62 to the south, the site boundaries are not physically marked or fenced. Views of the property are shown in Photographs 1 through 6 presented in Appendix A.

According to the Riverside County General Plan Land Use Element, land within the site is classified as Open Space/Rural (OS-RUR). Areas designated as Open Space/Rural are characterized by remote, privately owned open space areas with limited access and a lack of public services. Single-family residential uses are permitted at a density of one dwelling unit per 20 acres (Riverside County, 2003). The site is zoned for Natural Assets (N-A) and Controlled Development Areas (W-2) according to Riverside County Zoning Ordinance (Ordinance 348). The Natural Assets zone permits one-family dwellings, guest dwellings, automobile storage garages, accessory buildings, field and tree crops, and the grazing of cattle, horses, sheep, or goats. Controlled Development Areas allow housing, farming, public utilities, and mining (Riverside County, 2008).

2.3 SITE VICINITY AND ADJACENT PROPERTIES

The subject site is located within primarily undeveloped desert land in the vicinity of Rice, California (Figure 1). Prominent adjoining land uses are as follows:

North: SR-62 bounds the northern side of the site beyond which lie the Colorado River Aqueduct and AT&SF Railroad.

South: Vacant desert land lies beyond the site's undefined southern boundary.

East: Vacant desert land lies beyond the site's undefined eastern boundary. A communication tower is located on the adjacent parcel.

West: Vacant desert land lies beyond the site's undefined western boundary. The AT&SF railroad runs from north to south to the west of the subject site.

SECTION 3 PHYSICAL SETTING

3.1 TOPOGRAPHY

The site is mapped in Sections 19 and 30, Township 1 South, Range 21 East, the eastern half of Sections 24 and 25, Township 1 South, Range 20 East, and the western half of Sections 20 and 29, Township 1 South, Range 21 East on the Rice, California 7.5-minute series topographic quadrangle (EDR, 2008). The site is located at approximately 230 to 280 feet above mean sea level (MSL) and slopes gently towards the south. The proposed site area is within the Colorado Desert in an area characterized by basin and range geomorphology. The site is south of the Turtle Mountains within the broad Rice Valley. The valley is contiguous with Ward Valley to the northwest and Vidal Valley to the northeast, which wrap around the Turtle Mountains. The West Riverside Mountains are about 10 miles east of the site. The study area is characterized by gently sloping southerly facing alluvial fans that emanate from the Turtle Mountains.

3.2 SURFACE WATER

Based on review of the USGS topographic map, there are four 'blue-line' ephemeral drainages that run through the site from north to south. The drainages were dry at the time of the site visit.

3.3 GEOLOGY AND HYDROGEOLOGY

The site is mapped as underlain primarily by Quaternary alluvium that is described as unconsolidated and semi-consolidated non-marine, lake, playa and terrace deposits consisting of sand, silt and gravel with outcrops of loosely consolidated Pliocene to Pleistocene sandstone, shale and gravel deposits (CDMG, 1977). During UST removal activities, Ecology Control Industries (ECI) reported that the soil encountered consisted of silty and gravelly sand and was very dense below a depth of 15 feet (ECI, 1999).

The site lies within the Southern Mojave Watershed within the Rice Hydrologic Unit. Existing beneficial groundwater uses have been designated for municipal and industrial purposes [Regional Water Quality Control Board (RWQCB), 1994]. The watershed is approximately 12 square miles. An offsite upgradient area of approximately 7.4 square miles is tributary to the site. The watershed originates from the Turtle Mountains to the north. The offsite runoff flows south toward a series of dikes and siphons. The runoff crosses the AT&SF and SR- 62 before impacting the northern border of the site. The runoff continues southward through the site towards the Rice Valley sand dunes, which lie approximately 3 miles south of the site.

Three groundwater wells are located onsite. Two eight inch diameter wells were located in the northeastern portion of the site. A review of well completion reports for the wells described as Kennedy Well @ Rice (Well 1) and Kennedy Well @ Rice #2 (Well 2) indicate that the wells were installed in June and August of 2008. The total depths of Well 1 and Well 2 were reported at 455 and 985 feet below ground surface (bgs), respectively. The depth to water measured in Well 1 and Well 2 were reported at 285 and 364 feet bgs, respectively. The well completion reports indicate the wells were installed for potential irrigation use. A third well is located west of the service road and north of the concrete apron. Review of available historic documentation indicates that this well dates from the time of the former Rice Airfield operation. These wells are discussed further in Section 5.12.

SECTION 4 SITE HISTORY

URS reviewed readily available historical data pertaining to the subject property. These references were reviewed for evidence of activities that would suggest the potential presence of hazardous substances at the subject property, and to evaluate the potential for the subject property to be impacted by offsite sources of contamination. The following subsections are a summary of the review.

4.1 HISTORIC SANBORN FIRE INSURANCE MAPS

URS requested historic Sanborn Fire Insurance maps of the subject property and vicinity from EDR. EDR reported that historical Sanborn Fire Insurance maps are not available for the vicinity of the subject property.

4.2 HISTORIC CITY DIRECTORIES

Due to the remote location of the site, there are no historic city directories for the site and vicinity (EDR, 2008). Based on review of present conditions of the site and vicinity and review of available historic topographic maps (discussed below), the former Rice Airfield (located on the subject property) was the only facility identified within the search area.

4.4 HISTORIC USGS TOPOGRAPHIC MAPS

URS reviewed historic USGS topographic quadrangle maps of "Rice, California" dated 1954 and 1983 which were provided by EDR. The following is a summary of the review.

The 1954 map shows the former Rice Airfield located at the site. The map shows the immediate vicinity of the site as generally vacant undeveloped land. SR-62 and beyond which lies a Colorado River Aqueduct and AT&SF railroad tracks bound the northern side of the site. The AT&SF railroad tracks also run along the western boundary of the site. Several dikes and siphons are shown at the property to the north of the site. Dikes are also shown on the subject site on the eastern and western edges of Rice Airfield.

No significant changes were noted in the 1983 map compared to the 1954 map except that Rice Airfield is identified as "abandoned".

4.5 HISTORIC AERIAL PHOTOGRAPHS

URS reviewed historic aerial photographs from 1972, 1996, 2002, and 2005 which were provided by EDR. A summary of the relevant interpretation of these photographs is presented below. The photographs are provided in Appendix C.

The aerial photographs from 1972 show the site and the location of the former Rice Army Airfield. The former runways and access roads are clearly visible in the photo. A concrete covered area located in the northern portion of the property is visible. Additional areas located near the northern portion of the property to the east and west of the service road show what appear to be concrete pads. Other access roads, dispersal pads, and aircraft parking aprons are present at the southern portion of the former airfield.

SR-62, the Colorado River Aqueduct, and the AT&SF railroad tracks that form the northern boundary of the site are all visible. The dikes and siphons on the property across SR-62 to the north of the site are present. Patches of dark surface material are visible on the northern portion of the property on the east and west sides of the service road. Similar dark patches were observed during the site visit (Figure 2A; Photograph 7). Other neighboring properties appear as undeveloped, vacant land.

The photographs from 1996 and 2002 show few changes onsite compared to the 1972 photographs with the exception of less defined features related to the former Rice Airfield likely due to increased erosion on the surface of the site.

The photograph from 2005 shows only the eastern portion of the site. The concrete apron and majority of the runways and taxiways are not included in the area covered by the photo. Portions of the eastern runway and some access roads are visible; however, they are less defined than in the 1996 and 2002 photographs.

Based on our aerial photograph review, the subject site is located at the former Rice Army Airfield. The majority of the buildings and aircraft support structures have been removed. However, materials associated with concrete pads and road surface materials from the former runways, taxiways, and access roads remain at the site.

4.6 EDR HISTORICAL DATABASE REVIEW

URS reviewed the results of the EDR Proprietary Historical Database search for manufactured gas plants presented in the EDR Radius Map report in order to identify past and current occupants of the subject property and surrounding area that may have had the potential to generate, use or store hazardous materials. No manufactured gas plants were reported at the site address in the EDR report reviewed. The EDR Radius Map Report is presented in Section 6.1 below and included as Appendix B.

4.7 USER PROVIDED INFORMATION

The site is currently owned by Rice Development, LLC. According to information provided by Mr. Greg Jabin (one of the managing members), the site is currently unused vacant land. There were no structures reported to be currently onsite except for concrete slabs and asphalt runways. Mr. Jabin stated that empty Cosmoline (a product commonly used during WWII to prevent rust) cans and an automobile chassis with bullet holes were reportedly at the site. Mr. Jabin reported that three water wells; two new and one abandoned are located at the subject property. Additionally, Mr. Jabin reported that information regarding historical USTs at the site are documented in a UST Storage Tank Closure report conducted for the USACE.

Limited information regarding present and historic uses of the site was provided to URS by site owners. Information from these sources and the interview with Mr. Jabin is presented in the following sections.

4.7.1 Title Records

Title records for the site were provided by Mr. Marc Sabine, a SolarReserve representative. The title records which began in 1947 consisted of a chain of grant deeds for the project site. A quitclaim deed from the sale of the property in 1947 indicated the presence of two runways, taxiways, spur track, 37 buildings, drainage, sewer, water, electric, and gas fueling systems which included three 25,000 gallon USTs. No additional pertinent information was identified in the provided title records for the site.

4.7.2 Environmental Liens

A review of the title records provided by Mr. Marc Sabine did not identify environmental liens for the site.

Based on review of the EDR database report (see Section 6.0 of this report), no Federal NPL (Superfund) liens or deed restrictions were identified associated with the site.

The subject property contacts indicated that to the best of their knowledge no environmental liens are associated with the site or any use limitations affecting the subject property.

4.7.3 Other Activity and Use Limitations

Current property owner contacts interviewed reported that the site had historically been used by General George Patton as an airfield during World War II. Rice Development, LLC purchased the property from Rice Properties Inc., in October 2005. According to the current owner representative, the previous owner did not use the site.

Site contacts indicated that, to the best of their knowledge, there are no other activities or land use limitations, such as engineering and institutional controls, that are in place on the site or that have been filed or recorded in a registry.

4.7.4 Valuation Reduction for Environmental Issues

Site contacts did not indicate that the property value of the site has decreased due to environmental issues.

4.7.5 Previous Environmental Reports

URS reviewed a UST closure report for the site titled “Removal and Disposal of One 5,000 Gallon Steel Underground Storage Tank and One 350 Gallon and Two 500 Gallon Concrete Septic Tanks” prepared by ECI. According to the ECI report, ECI was contracted by the USACE to remove seven USTs. The USACE indicated that seven USTs were installed at three separate locations on site. The areas believed to be the locations of the historical USTs were excavated and no USTs were reportedly found. In the report, ECI stated that the USTs appeared to have been previously excavated and disposed offsite. Based on these findings and discussions with the USACE and the County of Riverside Health Service Agency and Department of Environmental Health, it was established that USTs may be located in other areas throughout the airfield. The ECI report, stated that a search of the entire airfield was performed by ECI to ensure that all USTs had been removed. In February 1999, one 5,000 gallon steel UST and three concrete septic tanks (one 350 gallon and two 500 gallon) were reportedly found and removed from the site. The report indicated that the septic tanks had been used for fuel storage in the past (ECI, 1999).

Soil and concrete samples collected from the excavation areas and concrete foundations were analyzed by Calscience Environmental Laboratories, Inc. for total petroleum hydrocarbons as gasoline and diesel (TPHg and TPHd) by EPA Method 8015, total recoverable petroleum hydrocarbons (TRPH) by EPA Method 418.1, and benzene, toluene, ethylbenzene, and total xylenes (BTEX), methyl tertiary butyl ether (MTBE) by EPA Method 8021A, and lead by EPA Method 7420. The ECI report, stated that soil samples collected from the known and suspected UST dispenser and pipeline locations had not been impacted by fuels contained in the USTs. ECI stated, concentrations of TRPH, lead, and total xylenes were detected in a small number of samples at insignificant concentrations and soil samples collected beneath two of the removed septic tanks exhibited non-detect at or below laboratory detection limits or very low levels of TRPH. Soil samples collected from septic tank #2 detected TRPH and TPHd concentrations of 435 and 426 milligrams per kilogram (mg/kg), respectively. In March 1999, ECI staff excavated the contaminated soil from septic tank #2 to approximately 15 feet bgs. The ECI report stated that confirmation soil samples collected from the side walls and the bottom of the excavation determined that all of the contaminated soil was removed (ECI, 1999).

In a letter dated March 17, 1999, the County of Riverside Department of Environmental Health (CRDEH) issued a letter confirming the completion of the UST closure of one tank at the site and that no further action for that UST be required at that time (CRDEH, 1999).

4.8 DATA GAPS

Historical documentation for the site prior to the development of the Rice Airfield was not available. Mr. George Okumura, a representative from the USACE who was interview by URS, indicated that historical information and documentation of Rice Army Airfield was limited. Mr. Okumura said that General Patton, whose headquarters were at Rice Army Airfield, feared an attack on the United States and therefore operations at the site were not well documented.

With the exception of the one UST and three septic tanks discussed in section 4.7.5, URS was unable to confirm the removal or presence of USTs at the site. Based on information obtained from a variety of sources, URS considers the lack of documentation regarding the removal of historical USTs and septic tanks as a REC for the subject site.

SECTION 5 SITE RECONNAISSANCE

On November 20, 2008, URS representatives, Mr. Lowell Woodbury and Ms. Tyree French, conducted a reconnaissance of the site to observe and document existing site conditions. URS' site reconnaissance included a driving reconnaissance of the areas of the site accessible by existing roads, and a drive-by survey of surrounding and adjacent properties within ¼-mile of the site. Site photographs are provided in Appendix A.

The subject site consists generally of vacant desert land (Photographs 1 to 6). The site is accessed from an unpaved road leading off of SR-62 on the north-central boundary of the site. The interior of the site is accessible from portions of former access roads, as well as portions of the two runways of former Rice Army Airfield. Accessible roads driven during the site reconnaissance are shown on Figures 2A and 2B. Development onsite consists solely of the remnants of the former airfield including concrete pads, foundations of former buildings, oiled gravel and/or concrete in areas of the access roads, taxiways, runways, concrete, and an unidentified below grade structure. Except for SR-62 to the north, no physical marker or fence lines delineate the site boundaries. A site plan is included in Figures 2A and 2B.

5.1 HAZARDOUS SUBSTANCES

The site is located on generally undeveloped desert land. Use, storage, or generation of hazardous substances was not observed at the site.

5.2 STORAGE TANKS

Evidence of USTs was not observed onsite during the site visit. However, historical USTs were reportedly at the site and are discussed in Section 4.7.5.

5.3 POLYCHLORINATED BIPHENYLS (PCBS)

Evidence of electrical transformers was not observed onsite at the time of the site visit. Based on URS' experience with similar historical military facilities, it was not uncommon to use waste oil and used solvents for dust control, in which case PCBs may be present at the site. No other sources of potential PCBs or PCB-containing equipment were reported or observed at the time of the site visit.

5.4 WASTE DISPOSAL

The site is vacant and no waste generating activities were observed at the time of the site visit.

5.5 WETLANDS, FLOODPLAIN, COASTAL ZONE

Federal Wetland Inventory map coverage does not include the site and vicinity (EDR, 2008). Wetland areas were not observed on the subject property at the time of the site visit. However, the site is mapped as lying within a FEMA Flood Plain Panel denoting a 500-year flood zone (EDR, 2008).

Dikes were observed onsite and on properties adjacent to the site (Photograph 8). Siphons are mapped on the adjacent property north of the site, across SR-62 (Figure 2A). The dikes appear to concentrate and divert surface flow away from the former Rice Airfield area. The site is not located in a coastal zone.

5.6 DRUMS/OTHER CHEMICAL CONTAINERS

Several empty drums and what appeared to be old metal oil containers were observed at numerous dump areas onsite (Photographs 9 and 10). These dump areas are discussed in the following section.

5.7 DUMPING

Trash, metal cans, empty drums, and other metal debris were observed at numerous locations onsite. Ash and burned debris was present at several of the dumping locations (Photograph 11)

Several piles of broken glass and rusty cans were observed at several locations on site. The cans appeared to be primarily food containers although several larger one gallon cans with a distinctive oil spout hole were identified. An abandoned car was found on the concrete on the northern portion of the site. Other miscellaneous metal objects that appeared to have been used for target practice were observed in interior portions of the site.

5.8 PITS, PONDS, LAGOONS, SEPTIC SYSTEMS, CISTERNS, SUMPS, DRAINS, AND CLARIFIERS

Two rock filled pits were observed near remnant building foundations west of the service road and north of the concrete (Figure 2A; Photograph 12). The historical use of these pits is unknown. However, based on URS' experience, such pits may have been used as dry wells for gray water dispersal associated with domestic activities.

Evidence of ponds, lagoons, cisterns, sumps or clarifies was not observed onsite at the time of the site visit. A wooden plank-lined subsurface vault structure was observed near the northeastern side of the concrete (Figure 2A; Photograph 13). Subsurface piping entered the vault on the east and west sides. Other potential piping structures identified were located on concrete pads near the north entrance of the property. The structures consisted of piping connected to the flooring of concrete pads to the subsurface. The extent of the piping which remains onsite could not be determined during the site visit.

5.9 STAINING AND DISCOLORED SOILS

Stained soil and oily gravel were observed at the locations of the former runways, taxiways, and access roads (Photograph 14). References to taxiways having "once been oil over gravel" were identified in historical research of the former Rice Airfield (Freeman, 2008). The oiled gravel observed varied from loose stained soil to an asphaltic texture (Photograph 15). What remains of the former runways and taxiways appears to be a combination of asphalt and oily dirt. It is URS' experience with similar old military facilities that it was not uncommon to use waste oil and used solvents for dust control.

5.10 STRESSED VEGETATION

Limited vegetative growth was observed in portions of the former airfield, particularly in locations near the former runways, taxiways, and access roads (Photograph 16).

5.11 UNUSUAL ODORS

Unusual odors were not noted during the reconnaissance.

5.12 ONSITE WELLS

Three groundwater wells were observed onsite during the site visit. Two wells, discussed in Section 3.3, were reportedly recently installed for potential irrigation use (Photographs 17 and 18). The surface casings of these wells were welded shut preventing access. Water quality data was provided by Mr. Marc Sabine for groundwater samples identified as Kennedy Well at Rice (8070216-01) Drinking Water and Well Head (80817696-01) Drinking Water. Analysis included microbiology consisting of total coliforms and E.coli bacterium; total metals consisting of arsenic, copper, lead and sodium; and inorganic chemistry consisting of nitrates, nitrites, pH, temperature and total dissolved solids (TDS). Neither total coliform nor E.coli bacterium were detected above the practical reporting limits. Detected metals concentrations were below the Primary Maximum Contaminant Levels (MCLs) set for drinking water standards by the Environmental Protection Agency. However, nitrite and TDS concentrations exceeded Secondary MCL standards for drinking water.

One additional well that appears to have been associated with former airfield operations was located west of the service road, near the northwest corner of the concrete (Photograph 19). The well was not secure, as the steel surface casing had been cut and pried open. URS measured the depth of the well at 271 feet bgs; however an obstruction may be present in the well and therefore the well may be deeper. Water was not encountered in the well.

5.13 NEARBY ENVIRONMENTALLY SENSITIVE SITES

Environmentally sensitive sites, such as hospitals or day-care centers, were not observed within one-quarter mile of the subject property.

5.14 ASBESTOS

An asbestos survey was not included in the Scope of Services performed for this Phase I ESA. Due to the time period in which the Rice Airfield was constructed and operated, it is likely that historical structures onsite were constructed with asbestos-containing building materials. However, the majority of these structures have since been removed leaving only concrete and foundations. Potentially asbestos containing materials were not observed at the time of the site visit.

5.15 LEAD-BASED PAINT

A lead-based paint survey was not included in the scope of this Phase I ESA. There were no current or historic structures observed onsite that could potentially contain lead-based paint.

5.16 RADON

A radon survey by county and state of indoor radon concentrations indicated the radon zone level for Riverside County, California is 2. Zone 2 areas are predicted to have an indoor radon screening potential of greater than or equal to 2 pico Curies per liter of air (pCi/l) and less than or equal to 4 pCi/l. The USEPA action level for radon is 4.0 pCi/l. further assessment for radon appears unwarranted (EDR, 2007).

5.17 OTHER CONCERNS

Oiled gravel was observed over former runways and taxiways throughout the project site with portions covered by soil and brush. The extent to which these materials remain onsite is unknown at this time. Based on URS' experience with similar historical military facilities, it was not uncommon to use waste oil and used solvents for dust control, in which case metals, polychlorinated biphenyls, and dioxin and furans may be present at the site.

A large dirt mound located in the northeastern portion of the property was observed. The origin of this pile is unknown and it appears that the mound is not a natural feature of the site.

Several concrete structures and foundations from what remains of the former Rice Airfield are located at the project site (Photographs 20 and 21). URS was unable to find historical site maps for Rice Airfield. The historical use of these structures is unknown. Pipes were observed in the foundations that extended to the subsurface. These pipes may have been part of the sanitary system for the airfield.

References to bombing ranges or bombing practice was not identified in the historical references reviewed for Rice Airfield operations, and no records regarding the finding of unexploded ordinance (UXO) were reported for the site vicinity during the investigation. However, remnant munitions may be associated with the former military airfield.

SECTION 6 GOVERNMENT AGENCY INFORMATION

URS reviewed readily available records regarding past and current site use, contacted applicable agencies regarding potential environmental concerns at the site, and reviewed the agency database list search for potential environmental concerns at surrounding properties. The information obtained during the records review is provided in the following sections.

6.1 DATABASE LIST SEARCH

URS contracted the environmental database firm EDR to conduct a search for facilities listed by regulatory agencies as potentially having environmental concerns. The search was extended up to 1.0 mile (i.e., ASTM and AAI standards) from the subject property to assess whether activities on or near the subject property have the potential to create RECs at the subject property. The complete list of databases reviewed is provided in the EDR Radius Map Report (included as Appendix B) and is summarized in the table presented in Section 6.1. It should be noted that this information is reported as URS received it from EDR, which in turn reports information as it is provided in various government databases. It is not possible for either URS or EDR to verify the accuracy or completeness of information contained in these databases. However, the use of and reliance on this information is a generally accepted practice in the conduct of environmental due diligence. The databases searched and the information obtained is summarized in Sections 6.1.1 and 6.1.2.

The following table summarizes the number of facilities in the site vicinity that were identified in the indicated agency databases within the indicated survey distances.

Table 2
Agency Database

Agency Database	Survey Distance: All 1.0 mile from site boundary	Number of Sites Identified
United States Environmental Protection Agency (EPA) National Priority List (NPL) for Superfund Sites	1.0	0
U.S. Proposed NPL List	1.0	0
U.S. National Priority List Deletions (Delisted NPL) List	1.0	0
NPL Recovery List (Federal Superfund Liens)	1.0	0
U.S. EPA Comprehensive Environmental Response, Compensation and Liability Index System (CERCLIS) List	1.0	0
U.S. EPA CERCLIS – No Further Remedial Action Planned (CERCLIS-NFRAP)	1.0	0
U.S. EPA Resource Conservation and Recovery Act (RCRA) Corrective Action (CORRACTS) List	1.0	0
U.S. EPA RCRA Permitted Treatment, Storage, and Disposal (TSD) Facilities	1.0	0

Table 2
Agency Database
(Continued)

Agency Database	Survey Distance: All 1.0 mile from site boundary	Number of Sites Identified
U.S. EPA RCRA Registered Large Generators of Hazardous Waste (RCRIS LQG)	1.0	0
U.S. EPA RCRA Registered Small Generators of Hazardous Waste (RCRIS SQG)	1.0	0
U.S. EPA Emergency Response Notification System (ERNS) List	1.0	0
U.S. Hazardous Materials Incident Reporting System (HMIRS)	1.0	0
U.S. Engineering Controls Sites (ENG Controls) List	1.0	0
U.S. Sites with Institutional Controls (INST Controls) List	1.0	0
U.S. Record of Decision (ROD) List	1.0	0
State Hazardous Waste Sites (Cal-Sites)	1.0	0
State Hazardous Material Incidents, Including Accidental Releases and Spills (CHMIRS)	1.0	0
State Hazardous Waste and Substances Sites (Cortese)	1.0	0
State Proposition 65 Database (Notify 65)	1.0	0
State Toxic Pits Cleanup Act Sites (Toxic Pits)	1.0	0
State Permitted Solid Waste Landfill, Incinerators or Transfer Stations (SWF/LF) List	1.0	0
State Waste Management Unit Database System (WMUDS/SWAT)	1.0	0
State Leaking Underground Storage Tank (LUST) List	1.0	0
State Bond Expenditure Plan (CA Bond Exp. Plan)	1.0	0
State Underground Storage Tanks (UST) List	1.0	0
State Site Cleanup (SLIC) List	1.0	0
State Voluntary Cleanup Program (VCP)	1.0	0
State Underground Storage Tanks on Indian Land (Indian UST)	1.0	0
State Leaking Underground Storage Tanks on Indian Land (Indian LUST)	1.0	0
State Facility Inventory Database of historic active and inactive UST locations (CA FID UST)	1.0	0
State Hazardous Substance Storage Container Database of historic UST sites (HIST UST)	1.0	0
State SWEEPS UST database	1.0	0
State Site Mitigation and Brownfields Reuse Program (ENVIROSTOR) database	1.0	0

Table 2
Agency Database
(Continued)

Agency Database	Survey Distance: All 1.0 mile from site boundary	Number of Sites Identified
County of Imperial, Department of Environmental Health	1.0	0
EDR Proprietary Records: Manufactured Gas Plants	1.0	0
Other Local, State, and/or Federal Databases including, but not limited to, Brownfield listings, Current and Former Department of Defense Sites, Consent Decrees, Records of Decision, Deed Restrictions, Hazardous Materials or Waste Tracking Systems and Facility Registries, and Enforcement Activities (see EDR report for complete listing of databases and search radii)	1.0	0

6.1.1 Subject Property

The subject property was not identified in the EDR Radius Map Report.

6.1.2 Adjacent Properties

There were no adjacent properties within the radius search reported in the EDR Radius Map Report.

6.1.3 Site Vicinity

URS reviewed the EDR database report to identify offsite facilities that have suspected or documented environmental concerns or RECs that may negatively impact the subject property. URS' criteria for further evaluating the potential impact of a listed offsite facility are summarized below:

- The listed offsite facility is documented or assumed to be hydrogeologically upgradient and a likely pathway exists for known releases of environmentally mobile contaminants to reach the subject property; or, contaminants from the listed offsite facility can reach the subject through other pathways (i.e., surface runoff); and,
- The offsite facility is listed as an open case on one of the following databases: Federal NPL, Federal CORRACTS, Federal CERCLIS, Federal ERNS, and State-Specific lists including, but not limited to State Hazardous Waste Sites, State SCL, State LUST, State Deed Restrictions, State Toxic Pits, Landfill (excluding transfer stations); or
- The facility is a known or suspected concern based on URS' experience or observations made during the site reconnaissance (i.e., dry cleaning operations that may or may not be listed as RCRA-SQG or a non-adjacent UST site that appears to have a remediation system in place).

No properties within the search radius were listed in the EDR Radius Map Report.

6.1.4 Unmapped or "Orphan Site" Facilities

"Orphan sites" are facilities listed in the EDR Report that have not been geocoded based on lack of sufficient data regarding their exact location within the general area. A site identified as Rice Camp (Army) was named on the unmapped, orphan sites as being listed in the Envirostor Database. Envirostor is a Department of Toxic Substances Control (DTSC) database which identifies sites that have known contamination or sites for which there may be reasons to investigate further. It is typical for military facilities to be listed on the Envirostor Database. No further information was provided.

No other facilities identified on the EDR Report as "orphan sites" appear to have the potential to significantly impact the subject property with hazardous materials. A full summary of agency databases can be found in the EDR Database Report provided as Appendix B.

6.2 REGULATORY CONTACTS

URS contacted local and state agencies to obtain information regarding the site, such as the status of environmental permits, violations, or corrective actions. Agencies contacted regarding the subject property and a summary of the information obtained are provided below.

California Environmental Protection Agency (Cal/EPA), Department of Toxic Substances Control (DTSC), Cypress Office – The DTSC reported that they have no records for the site address (Barrio, 2008).

Cal/EPA, DTSC, Chatsworth Office – The DTSC reported that they have no records for the site address (Tutaan, 2008).

Cal/EPA, DTSC, San Diego Office – The DTSC reported that they have no records for the site address (Munoz, 2008).

California Regional Water Quality Control Board (RWQCB) – The Colorado River Basin RWQCB searched Geotracker for pertinent information regarding the site. There were no records reported for the subject site (Vasquez, 2008).

Office of the California Fire Marshal Pipeline Safety Division (PSD) – The PSD reported that there are no pipelines under their jurisdiction in the vicinity of the subject property address (Dowdy, 2008).

Mojave Desert Air Quality Management District (AQMD) – The AQMD reported that they have no records for the site (Weese, 2008).

County of Riverside Department of Environmental Health (CRDEH) – The CRDEH has not responded to our request at the time this report was prepared.

Riverside County Fire Department (RCFD) – The RCFD reported that information regarding underground storage tanks and hazardous materials usage or releases is maintained at the County of Riverside Department of Environmental Health (Ake, 1999).

SECTION 7 CONCLUSIONS

URS conducted a Phase I ESA of the SolarReserve Rice Airfield Site located south of SR-62 at mile marker 109 near Rice in Riverside County, California. The subject property is identified by the APNs listed in Table 1 and contains approximately 3,324 acres. The property encompasses the former Rice Army Airfield, a portion of the World War II era Desert Training Center. Structures including concrete pads and foundations, portions of the former runways, taxiways, and access roads remain onsite. Oily gravel historically reported as runway and taxiway pavement was observed onsite at the locations of the former runways, taxiways, and access roads. Several piles of burned debris were also noted onsite. A subsurface vault structure and two rockfilled pits were observed during the field reconnaissance. The historical use of these subsurface features remains unknown at this time.

Reviewed documents indicate that Rice Airfield historically utilized USTs to store fuel to support aircraft operations during World War II. With the exception of one UST and three septic tanks, documentation of their removal could not be found. It is unknown if USTs remain onsite or contamination associated with their use exists.

One unsecured well at the site may be a potential source for groundwater contamination and vandalism. It is recommended the well be destroyed in accordance with state and local regulations.

A site identified as Rice Camp (Army) was listed in the EDR Report as an orphan site listed on the Envirostor Database. No specific data regarding Rice Camp (Army) was provided.

Based on the scope of services performed to date, RECs associated with the historic Rice Airfield were identified. Identified RECs include: the lack of documentation regarding the removal of underground storage and septic tanks reportedly used by Rice Army Airfield; the oily gravel reported and observed on the former runways and access roads; the numerous piles of burned debris, the potential for UXO at the site, and a site identified as Rice Camp (Army) listed in the Envirostor Database . Further research of the operations of the historical Rice Airfield is recommended to evaluate the potential for impact to soil or groundwater beneath the subject site. No adjacent properties were identified as RECs for the site.

SECTION 8 PREPARER SIGNATURE AND QUALIFICATIONS

This section includes qualification statements of the environmental professionals responsible for conducting the ESA and preparing this report.

The report was written by Ms. Tyree French of the URS office in San Diego, California. Ms. French has over four of experience in environmental site investigations, characterizations, and assessments, respectively.

The site reconnaissance was performed and the work was conducted by Ms. Tyree French and the report was reviewed by Mr. Kurt Myers C.Hg., Principal Geologist, with over 20 years experience in the environmental field, including 16 years experience with Phase I Environmental Site Assessments.

Mr. Myers declares that, to the best of his professional knowledge and belief, he meets the definition of Environmental Professional as defined in §312.10 of 40 CFR 312.

Mr. Myers has the specific qualifications based on education, training, and experience to assess a property of the nature, history, and setting of the subject property. With the assistance of Ms. French, he has developed and performed the all appropriate inquiries in conformance with the standards and practices set forth in 40 CFR Part 312.

Kurt Myers, P.G., C.E.G.
Principal Geologist

SECTION 9 REFERENCES

Ake, Norm, 1999, County of Riverside Fire Department, Hazardous Materials Division, personal communication, July 13.

American Society for Testing Materials International, 2005, Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process: Designation E 1527-05, 27 pp.

California Department of Water Resources, 1967. "Groundwater Occurrence and Quality: San Diego Region," Bulletin No. 106-2.

California Division of Mines & Geology (CDMG), 1977. "Geologic Map of California," Charles Jenkins, 1:750,000.

California's Groundwater Bulletin 118. Rice Valley Groundwater Basin. February 2004. www.dpla2.water.ca.gov/publications/groundwater/bulletin118/basins/pdfs_desc/7-4.pdf.

California Regional Water Quality Control Board, 1994. Water Quality Control Plan for the Colorado River Basin - Region 7, November 17.

County of Riverside Department of Environmental Health, 1999. Underground Storage Tank Closure Plan Check #98-647 for 1 Tank at Rice Airfield located on the south side of Highway 62 at mile marker number 109, March 17.

Dowdy, Lisa, 2008. Research Analyst I, Office of the State Fire Marshal, written communication, November 25.

Ecology Control Industries (ECI), 1999. UST Closure Report (Draft), Former Rice Field, Rice, California, 92239, June 22.

Environmental Data Resources, Inc., 2008. EDR Historical Topographic Map Report, Former Rice Field, Rice, California, 92239, Inquiry No. 2366316.5, November 19.

Environmental Data Resources, Inc., 2008. EDR Radius Map with GeoCheck, Former Rice Field, Rice, California, 92239, Inquiry No. 2366316.2s, November 18.

Environmental Data Resources, Inc., 2008. EDR Aerial Photo Decade Package, Former Rice Field, Rice, California, 92239, Inquiry No. 2366316.5, November 20.

Environmental Data Resources, Inc., 2008. Certified Sanborn Map Report, Former Rice Field, Rice, California, 92239, Inquiry No. 2366316.3, November 18.

Environmental Data Resources, Inc., 2008. Property Tax Map Report, Former Rice Field, Rice, California, 92239, Inquiry No. 2366316.8, November 18.

Freeman, Paul, 2008, Abandoned & Little-Known Airfields: California: Southeastern San Bernardino County, http://www.airfieldsfreeman.com/CA/Airfields_CA_SanBernardino_SE.htm, accessed November 21.

Munoz, Cleo, 2008. Regional Records Coordinator, California Department of Toxic Substances Control, San Diego, CA office, written communication, November 19.

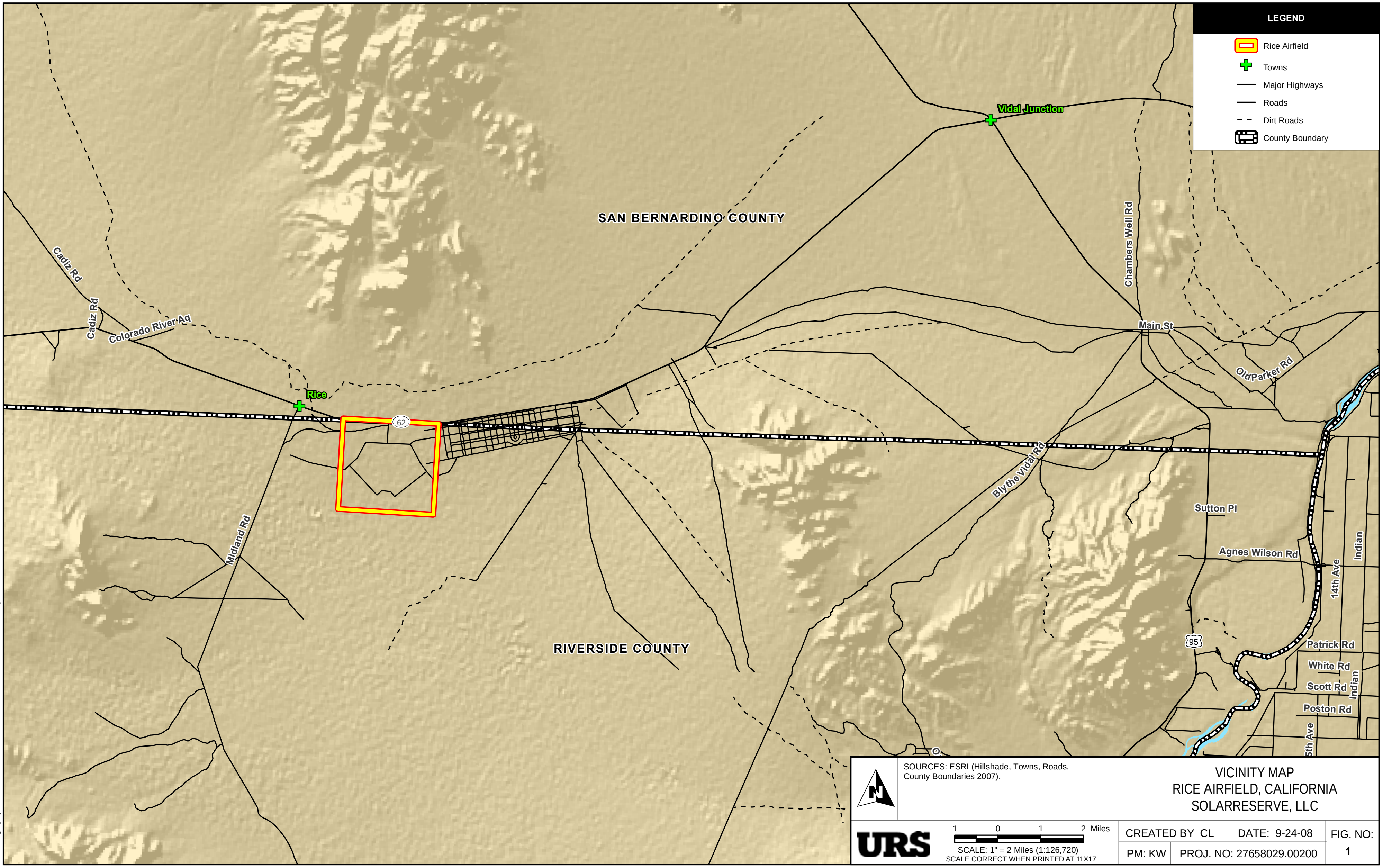
North American Title Company, 2008. Rice Development 7005252-27, Orange, California, title records, January 16.

Okumura, George, 2008. United States Army Corp of Engineers (USACE), telephone communication to Lowell Woodbury, November 21.

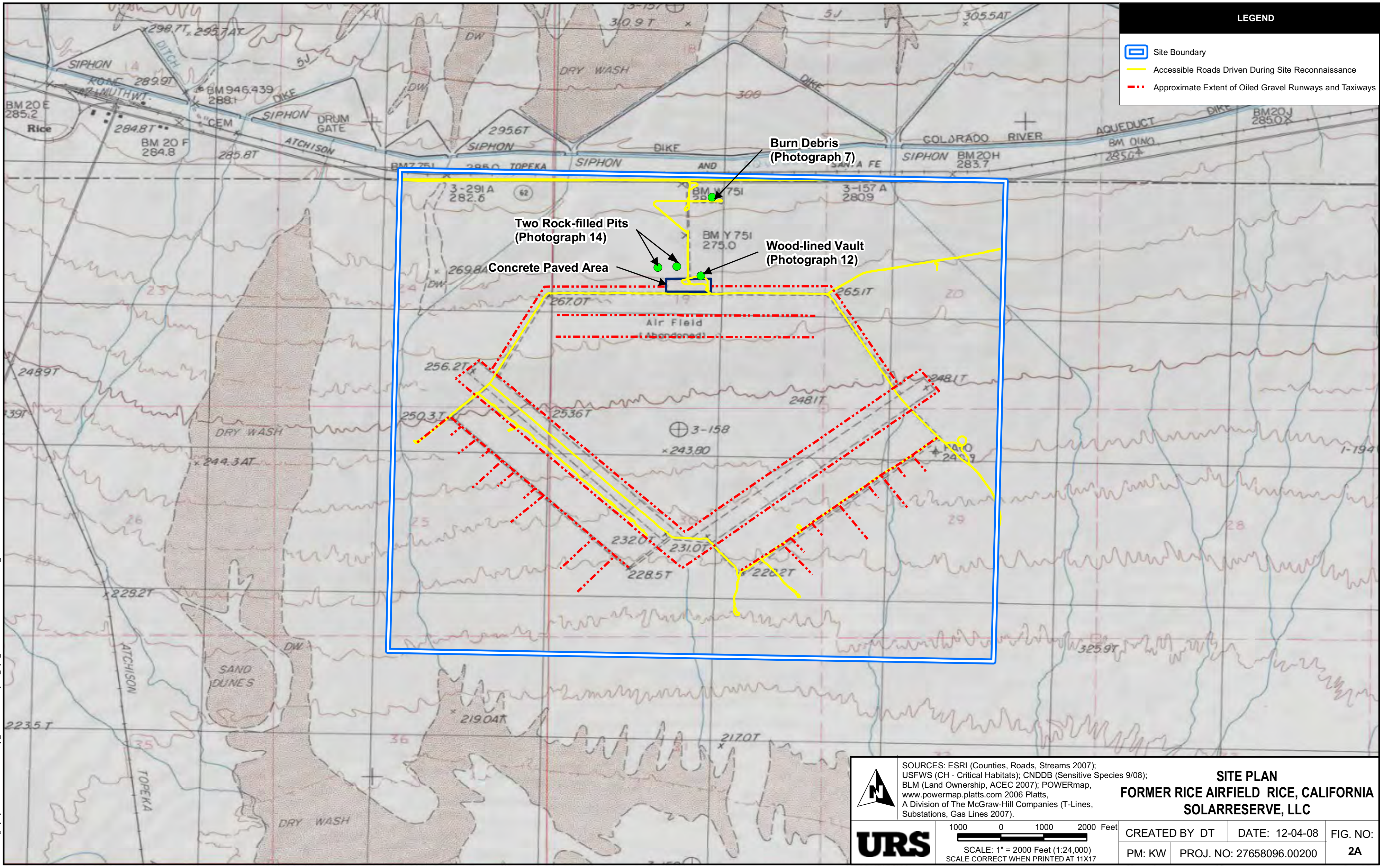
Riverside County, 2003. General Plan.

Riverside County, 2008. Riverside County Zoning Ordinance (Ordinance 348).

Weese, 2008. Mojave Desert Air Quality Management District, written communication, December 3.



Path: G:\gis\projects\1577\22239518\mxd\SolarReserve\Fatal Flaws\Rice Airfield\Vicinity.mxd, 09/24/08, camille_lill



SOURCES: ESRI (Counties, Roads, Streams 2007); USFWS (CH - Critical Habitats); CNDDB (Sensitive Species 9/08); BLM (Land Ownership, ACEC 2007); POWERmap, www.powermap.platts.com 2006 Platts, A Division of The McGraw-Hill Companies (T-Lines, Substations, Gas Lines 2007).

SITE PLAN
FORMER RICE AIRFIELD RICE, CALIFORNIA
SOLARRESERVE, LLC

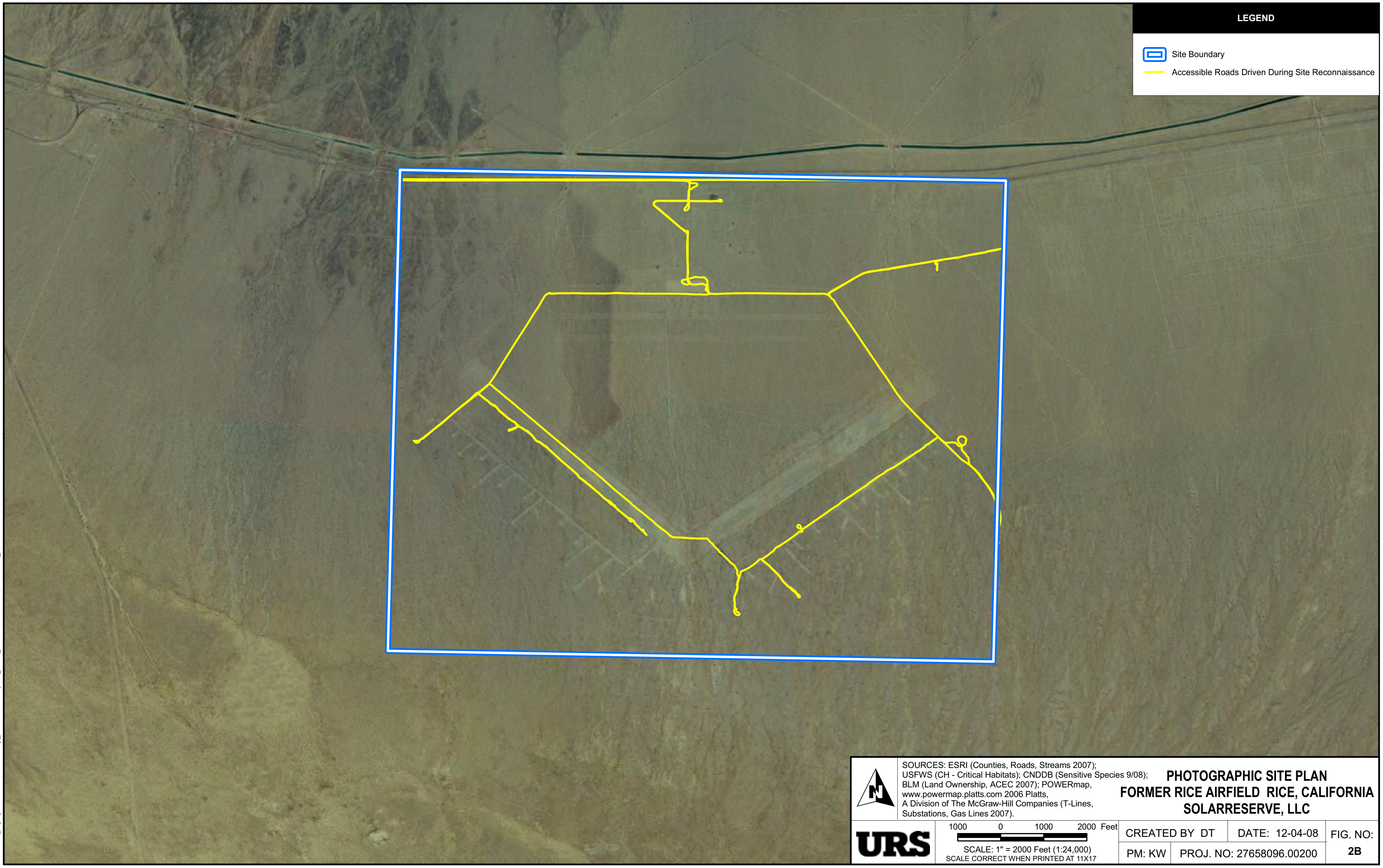
URS

1000 0 1000 2000 Feet

SCALE: 1" = 2000 Feet (1:24,000)
SCALE CORRECT WHEN PRINTED AT 11X17

CREATED BY DT	DATE: 12-04-08	FIG. NO:
PM: KW	PROJ. NO: 27658096.00200	2A

Path: G:\gis\projects\1577\27658096\map_docs\mxd\riceairfield_topo_REVISED.mxd, 12/05/08, Paul_Moreno



SOURCES: ESRI (Counties, Roads, Streams 2007); USFWS (CH - Critical Habitats); CNDDB (Sensitive Species 9/08); BLM (Land Ownership, ACEC 2007); POWERmap, www.powermap.platts.com 2006 Platts, A Division of The McGraw-Hill Companies (T-Lines, Substations, Gas Lines 2007).

PHOTOGRAPHIC SITE PLAN
FORMER RICE AIRFIELD RICE, CALIFORNIA
SOLARRESERVE, LLC

URS

1000 0 1000 2000 Feet

SCALE: 1" = 2000 Feet (1:24,000)
SCALE CORRECT WHEN PRINTED AT 11X17

CREATED BY DT	DATE: 12-04-08	FIG. NO:
PM: KW	PROJ. NO: 27658096.00200	2B

Path: G:\gis\projects\1577\27658096\map_docs\mxd\riceairfield_aerial_REVISED.mxd, 12/05/08, Paul_Moreno

	**Photograph 1** **Comments:** View to the southwest from near the northeast corner of the site.
	**Photograph 2** **Comments:** View to the south across the southern and central portions of the site from near the northeastern corner of the site.

<table>
<tr><td></td><td>Photograph 3

Comments:
View to the southwest across the western boundary of the site from near the western-central portion of the site.</td></tr>
<tr><td></td><td>Photograph 4

Comments:
View to southeast from the southwestern corner of the site.</td></tr>
</table>

	**Photograph 5** **Comments:** View to the northeast from the southwestern portion of the site. Note the concrete pad present in the background of the photo and the communication tower located on the adjacent property to the east of the site..
	**Photograph 6** **Comments:** View to the northeast along the access road on site. State Route 62 is visible in the background.

	**Photograph 7** **Comments:** View facing east of a dark patch of burn debris located on the northeastern portion of the property and east of the service road. Similar dark patches are visible on the aerial photos of the site.
	**Photograph 8** **Comments:** View facing southeast of the dike located onsite to the east of the former airfield.

	**Photograph 9** **Comments:** Pile of rusted cans and other metal debris taken in the southwestern portion of the site. Several such piles of debris were observed at various locations on site.
	**Photograph 10** **Comments:** Two rusted steel drums located in the northeastern portion of the property.

	**Photograph 11** **Comments:** View facing south in the northeastern section of the site. Pile of trash consisting of glass, metal cans, and other metal debris.
	**Photograph 12** **Comments:** View facing northeast of two rock filled pits located west of the service road and north of the concrete tarmac.

	**Photograph 13** **Comments:** Open pit located onsite northeast of the concrete apron and east of the service road. Note the pipe on the wall of structure. A similar pipe exists on the opposite wall.
	**Photograph 14** **Comments:** View facing south along the access road on the west side of the airfield.

	**Photograph 15** **Comments:** Photo taken of asphalt uncovered beneath the location of the former access road located in the central-eastern portion of the property. The extent at which such material remains onsite is unknown.
	**Photograph 16** **Comments:** View facing south along the access road east of the former airfield. Note the limited vegetative growth in areas of the former road.

Photograph 17

Comments:
View facing north of a groundwater well located in the northeastern portion of the property.

Photograph 18

Comments:
View facing south of a groundwater well located in the northeastern portion of the property.

	**Photograph 19** **Comments:** Groundwater well located near the concrete tarmac, west of the service road. The well was reportedly used by the former Rice Airfield**.**
	**Photograph 20** **Comments:** View facing northeast of a concrete pad and foundation located east of the service road.

	**Photograph 21** **Comments:** Remnants of a former structure associated with the former Rice Airfield.

Former Rice Field
South Side Higway 62 at Mile Marker 109
Rice, CA 92239

Inquiry Number: 2366316.2s
November 18, 2008

The EDR Radius Map™ Report with GeoCheck®

EDR® Environmental Data Resources Inc

440 Wheelers Farms Road
Milford, CT 06461
Toll Free: 800.352.0050
www.edrnet.com

TABLE OF CONTENTS

SECTION **PAGE**

GEOCHECK ADDENDUM

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc (EDR). The report was designed to assist parties seeking to meet the search requirements of EPA's Standards and Practices for All Appropriate Inquiries (40 CFR Part 312), the ASTM Standard Practice for Environmental Site Assessments (E 1527-05) or custom requirements developed for the evaluation of environmental risk associated with a parcel of real estate.

TARGET PROPERTY INFORMATION

ADDRESS

SOUTH SIDE HIGWAY 62 AT MILE MARKER 109
RICE, CA 92239

COORDINATES

Latitude (North):	34.065260 - 34˚ 3' 54.9''
Longitude (West):	114.814860 - 114˚ 48' 53.5''
Universal Tranverse Mercator:	Zone 11
UTM X (Meters):	701661.4
UTM Y (Meters):	3771351.8
Elevation:	819 ft. above sea level

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property Map:	34114-A7 RICE, CA
Most Recent Revision:	1983

TARGET PROPERTY SEARCH RESULTS

The target property was not listed in any of the databases searched by EDR.

DATABASES WITH NO MAPPED SITES

No mapped sites were found in EDR's search of available ("reasonably ascertainable ") government records either on the target property or within the search radius around the target property for the following databases:

FEDERAL RECORDS

NPL	National Priority List
Proposed NPL	Proposed National Priority List Sites
Delisted NPL	National Priority List Deletions
NPL LIENS	Federal Superfund Liens
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CERC-NFRAP	CERCLIS No Further Remedial Action Planned
LIENS 2	CERCLA Lien Information
CORRACTS	Corrective Action Report
RCRA-TSDF	RCRA - Transporters, Storage and Disposal
RCRA-LQG	RCRA - Large Quantity Generators

EXECUTIVE SUMMARY

RCRA-SQG	RCRA - Small Quantity Generators
RCRA-CESQG	RCRA - Conditionally Exempt Small Quantity Generator
RCRA-NonGen	RCRA - Non Generators
US ENG CONTROLS	Engineering Controls Sites List
US INST CONTROL	Sites with Institutional Controls
ERNS	Emergency Response Notification System
HMIRS	Hazardous Materials Information Reporting System
DOT OPS	Incident and Accident Data
US CDL	Clandestine Drug Labs
US BROWNFIELDS	A Listing of Brownfields Sites
DOD	Department of Defense Sites
FUDS	Formerly Used Defense Sites
LUCIS	Land Use Control Information System
CONSENT	Superfund (CERCLA) Consent Decrees
ROD	Records Of Decision
UMTRA	Uranium Mill Tailings Sites
ODI	Open Dump Inventory
DEBRIS REGION 9	Torres Martinez Reservation Illegal Dump Site Locations
MINES	Mines Master Index File
TRIS	Toxic Chemical Release Inventory System
TSCA	Toxic Substances Control Act
FTTS	FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
HIST FTTS	FIFRA/TSCA Tracking System Administrative Case Listing
SSTS	Section 7 Tracking Systems
ICIS	Integrated Compliance Information System
PADS	PCB Activity Database System
MLTS	Material Licensing Tracking System
RADINFO	Radiation Information Database
FINDS	Facility Index System/Facility Registry System
RAATS	RCRA Administrative Action Tracking System
SCRD DRYCLEANERS	State Coalition for Remediation of Drycleaners Listing

STATE AND LOCAL RECORDS

HIST Cal-Sites	Historical Calsites Database
CA BOND EXP. PLAN	Bond Expenditure Plan
SCH	School Property Evaluation Program
Toxic Pits	Toxic Pits Cleanup Act Sites
SWF/LF	Solid Waste Information System
WMUDS/SWAT	Waste Management Unit Database
CA WDS	Waste Discharge System
Cortese	"Cortese" Hazardous Waste & Substances Sites List
SWRCY	Recycler Database
LUST	Geotracker's Leaking Underground Fuel Tank Report
CA FID UST	Facility Inventory Database
SLIC	Statewide SLIC Cases
UST	Active UST Facilities
HIST UST	Hazardous Substance Storage Container Database
LIENS	Environmental Liens Listing
AST	Aboveground Petroleum Storage Tank Facilities
SWEEPS UST	SWEEPS UST Listing
CHMIRS	California Hazardous Material Incident Report System
Notify 65	Proposition 65 Records
DEED	Deed Restriction Listing

EXECUTIVE SUMMARY

VCP - Voluntary Cleanup Program Properties
DRYCLEANERS - Cleaner Facilities
WIP - Well Investigation Program Case List
CDL - Clandestine Drug Labs
RESPONSE - State Response Sites
HAZNET - Facility and Manifest Data
EMI - Emissions Inventory Data
HAULERS - Registered Waste Tire Haulers Listing
ENVIROSTOR - EnviroStor Database

TRIBAL RECORDS

INDIAN RESERV - Indian Reservations
INDIAN ODI - Report on the Status of Open Dumps on Indian Lands
INDIAN LUST - Leaking Underground Storage Tanks on Indian Land
INDIAN UST - Underground Storage Tanks on Indian Land
INDIAN VCP - Voluntary Cleanup Priority Listing

EDR PROPRIETARY RECORDS

Manufactured Gas Plants - EDR Proprietary Manufactured Gas Plants
EDR Historical Auto Stations - EDR Proprietary Historic Gas Stations
EDR Historical Cleaners - EDR Proprietary Historic Dry Cleaners

SURROUNDING SITES: SEARCH RESULTS

Surrounding sites were not identified.

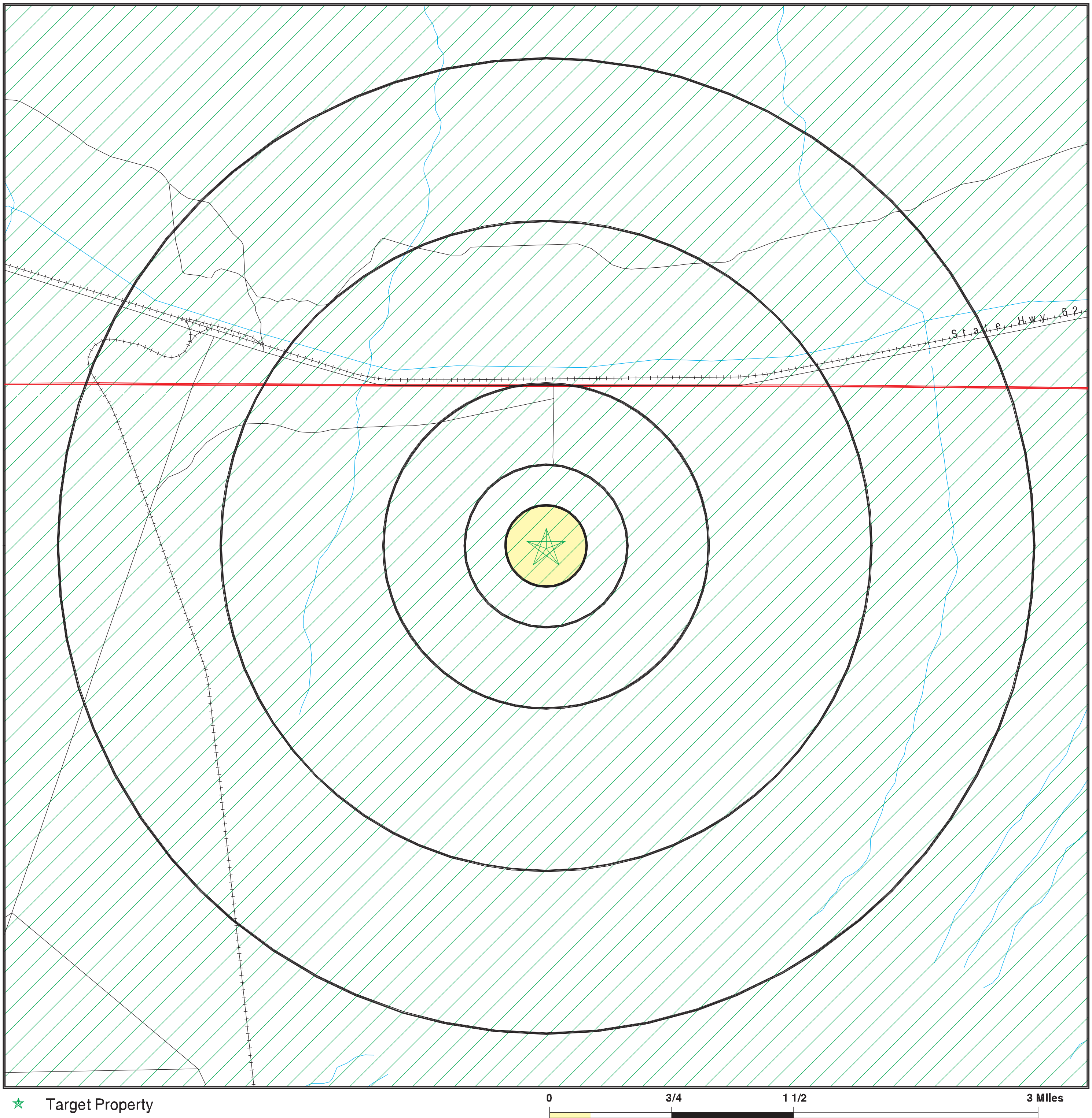
Unmappable (orphan) sites are not considered in the foregoing analysis.

EXECUTIVE SUMMARY

Due to poor or inadequate address information, the following sites were not mapped:

Site Name	Database(s)
DESERT OUTPOST STANDARD	SWEEPS UST
JOES SHELL	SWEEPS UST
D.O.T. VIDAL MAINTENANCE STA.	SWEEPS UST
I-10, 3 MILES W OF STATE ROUTE 177	CDL
KAISER EAGLE MOUNTAIN	CERC-NFRAP
CALTRANS DESERT CENTER	LUST
DESERT OUTPOST VIDAL GAS	UST
DESERT CENTER	HIST UST
DESERT OUTPOST STANDARD	HIST UST
DESERT CENTER AIRPORT	HAZNET
1X FED AVIATION ADMIN/PARKER VORTAC	HAZNET
JEFFRIES BROTHERS INC	HAZNET
VIDAL TEXACO	San Bern. Co. Permit
VIDAL MINI MART	San Bern. Co. Permit
AT&T MOBILITY- VIDAL JUNCT #16461	San Bern. Co. Permit
FEDERAL AVIATION ADMIN	San Bern. Co. Permit
CAL TRANS VIDAL JUNCTION	San Bern. Co. Permit
CAMP RICE (ARMY)	ENVIROSTOR

OVERVIEW MAP - 2366316.2s

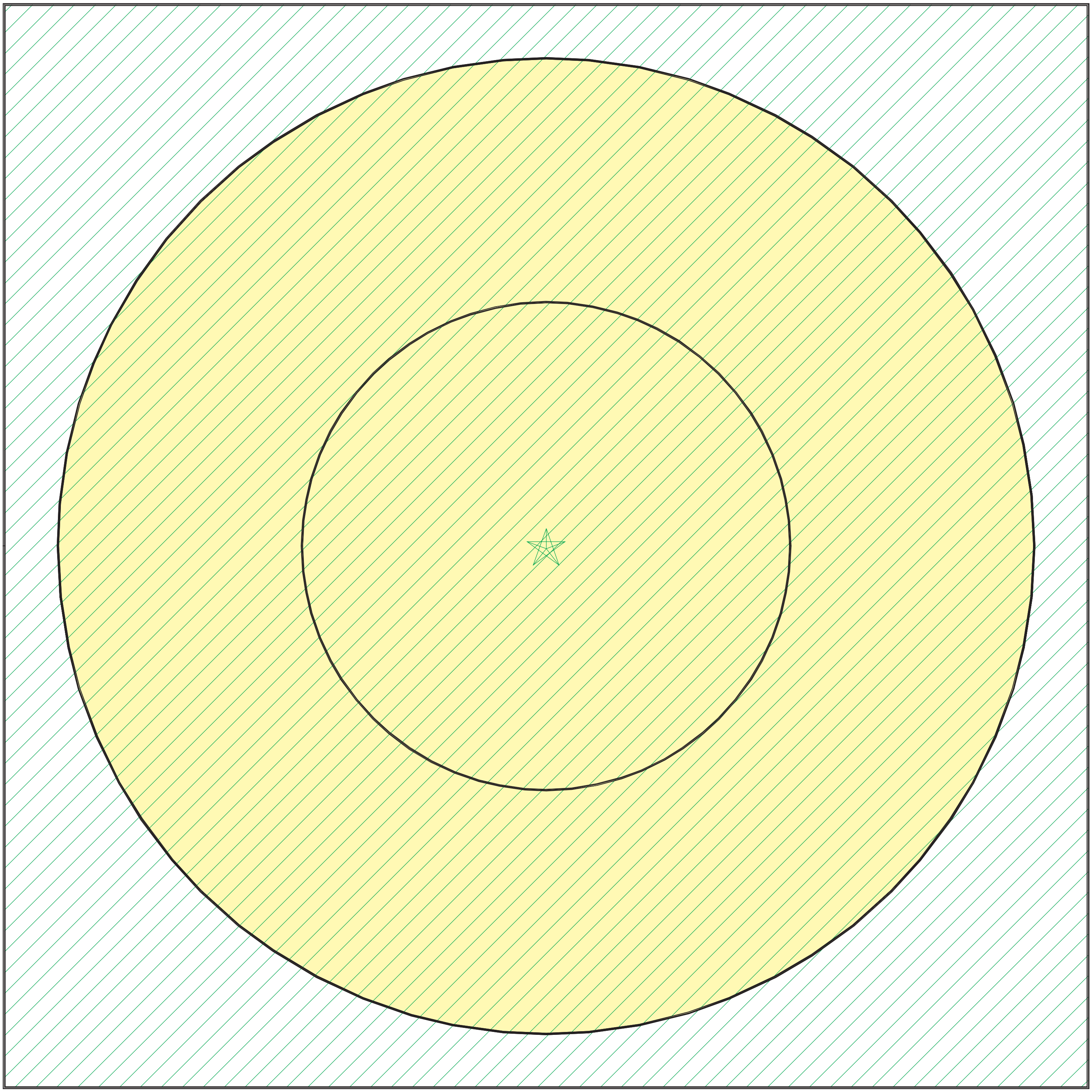


- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- National Priority List Sites
- Dept. Defense Sites
- Indian Reservations BIA
- County Boundary
- Oil & Gas pipelines
- 100-year flood zone
- 500-year flood zone
- Areas of Concern

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME: Former Rice Field	CLIENT: URS Corporation
ADDRESS: South Side Higway 62 at Mile Marker 109	CONTACT: Lowell Woodbury
Rice CA 92239	INQUIRY #: 2366316.2s
LAT/LONG: 34.0653 / 114.8149	DATE: November 18, 2008 6:33 pm

DETAIL MAP - 2366316.2s



- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- Sensitive Receptors
- National Priority List Sites
- Dept. Defense Sites

- Indian Reservations BIA
- Oil & Gas pipelines
- 100-year flood zone
- 500-year flood zone

- Areas of Concern

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME:	Former Rice Field	CLIENT:	URS Corporation
ADDRESS:	South Side Higway 62 at Mile Marker 109	CONTACT:	Lowell Woodbury
	Rice CA 92239	INQUIRY #:	2366316.2s
LAT/LONG:	34.0653 / 114.8149	DATE:	November 18, 2008 6:33 pm

000305

MAP FINDINGS SUMMARY

Database	Target Property	Search Distance (Miles)	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
FEDERAL RECORDS								
NPL		3.000	0	0	0	0	0	0
Proposed NPL		3.000	0	0	0	0	0	0
Delisted NPL		3.000	0	0	0	0	0	0
NPL LIENS		2.000	0	0	0	0	0	0
CERCLIS		2.500	0	0	0	0	0	0
CERC-NFRAP		2.500	0	0	0	0	0	0
LIENS 2		2.000	0	0	0	0	0	0
CORRACTS		3.000	0	0	0	0	0	0
RCRA-TSDF		2.500	0	0	0	0	0	0
RCRA-LQG		2.250	0	0	0	0	0	0
RCRA-SQG		2.250	0	0	0	0	0	0
RCRA-CESQG		2.250	0	0	0	0	0	0
RCRA-NonGen		2.250	0	0	0	0	0	0
US ENG CONTROLS		2.500	0	0	0	0	0	0
US INST CONTROL		2.500	0	0	0	0	0	0
ERNS		2.000	0	0	0	0	0	0
HMIRS		2.000	0	0	0	0	0	0
DOT OPS		2.000	0	0	0	0	0	0
US CDL		2.000	0	0	0	0	0	0
US BROWNFIELDS		2.500	0	0	0	0	0	0
DOD		3.000	0	0	0	0	0	0
FUDS		3.000	0	0	0	0	0	0
LUCIS		2.500	0	0	0	0	0	0
CONSENT		3.000	0	0	0	0	0	0
ROD		3.000	0	0	0	0	0	0
UMTRA		2.500	0	0	0	0	0	0
ODI		2.500	0	0	0	0	0	0
DEBRIS REGION 9		2.500	0	0	0	0	0	0
MINES		2.250	0	0	0	0	0	0
TRIS		2.000	0	0	0	0	0	0
TSCA		2.000	0	0	0	0	0	0
FTTS		2.000	0	0	0	0	0	0
HIST FTTS		2.000	0	0	0	0	0	0
SSTS		2.000	0	0	0	0	0	0
ICIS		2.000	0	0	0	0	0	0
PADS		2.000	0	0	0	0	0	0
MLTS		2.000	0	0	0	0	0	0
RADINFO		2.000	0	0	0	0	0	0
FINDS		2.000	0	0	0	0	0	0
RAATS		2.000	0	0	0	0	0	0
SCRD DRYCLEANERS		2.500	0	0	0	0	0	0
STATE AND LOCAL RECORDS								
HIST Cal-Sites		3.000	0	0	0	0	0	0
CA BOND EXP. PLAN		3.000	0	0	0	0	0	0
SCH		2.250	0	0	0	0	0	0
Toxic Pits		3.000	0	0	0	0	0	0

MAP FINDINGS SUMMARY

Database	Target Property	Search Distance (Miles)	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
SWF/LF		2.500	0	0	0	0	0	0
WMUDS/SWAT		2.500	0	0	0	0	0	0
CA WDS		2.000	0	0	0	0	0	0
Cortese		2.500	0	0	0	0	0	0
SWRCY		2.500	0	0	0	0	0	0
LUST		2.500	0	0	0	0	0	0
CA FID UST		2.250	0	0	0	0	0	0
SLIC		2.500	0	0	0	0	0	0
UST		2.250	0	0	0	0	0	0
HIST UST		2.250	0	0	0	0	0	0
LIENS		2.000	0	0	0	0	0	0
AST		2.250	0	0	0	0	0	0
SWEEPS UST		2.250	0	0	0	0	0	0
CHMIRS		2.000	0	0	0	0	0	0
Notify 65		3.000	0	0	0	0	0	0
DEED		2.500	0	0	0	0	0	0
VCP		2.500	0	0	0	0	0	0
DRYCLEANERS		2.250	0	0	0	0	0	0
WIP		2.250	0	0	0	0	0	0
CDL		2.000	0	0	0	0	0	0
RESPONSE		3.000	0	0	0	0	0	0
HAZNET		2.000	0	0	0	0	0	0
EMI		2.000	0	0	0	0	0	0
HAULERS		2.000	0	0	0	0	0	0
ENVIROSTOR		3.000	0	0	0	0	0	0
TRIBAL RECORDS								
INDIAN RESERV		3.000	0	0	0	0	0	0
INDIAN ODI		2.500	0	0	0	0	0	0
INDIAN LUST		2.500	0	0	0	0	0	0
INDIAN UST		2.250	0	0	0	0	0	0
INDIAN VCP		2.500	0	0	0	0	0	0
EDR PROPRIETARY RECORDS								
Manufactured Gas Plants		3.000	0	0	0	0	0	0
EDR Historical Auto Stations		2.250	0	0	0	0	0	0
EDR Historical Cleaners		2.250	0	0	0	0	0	0

NOTES:

TP = Target Property

NR = Not Requested at this Search Distance

Sites may be listed in more than one database

MAP FINDINGS

Map ID Direction Distance Elevation	Site	Database(s)	EDR ID Number EPA ID Number
	NO SITES FOUND		

City	EDR ID	Site Name	Site Address	Zip	Database(s)
DESERT CENTER	S108746295	DESERT CENTER AIRPORT	HWY 10 / RICE RD 4.5 MI N	92239	HAZNET
DESERT CENTER	S108407375		I-10, 3 MILES W OF STATE ROUTE 177	92239	CDL
DESERT CENTER	S104816282	CALTRANS DESERT CENTER	129476 HIGHWAY 60	92239	LUST
DESERT CENTER	U001615083	DESERT CENTER	129476 US HWY 60	92239	HIST UST
DESERT CENTER	1003879899	KAISER EAGLE MOUNTAIN	N OF HWY 10 8M OFF KAISER RD.	92239	CERC-NFRAP
RICE	S107736046	CAMP RICE (ARMY)	(3 MILES EAST OF)		ENVIROSTOR
VIDAL	S105698446	VIDAL TEXACO	HWY 62 / 95-S/E CORNER	92280	San Bern. Co. Permit
VIDAL	S109117921	VIDAL MINI MART	HWY 62 / 95-N/W CORNER	92280	San Bern. Co. Permit
VIDAL	U004050715	DESERT OUTPOST VIDAL GAS	HWY 62 & 95-N/W CORNER	92280	UST
VIDAL	S106910658	AT&T MOBILITY- VIDAL JUNCT #16461	3612 HWY 95	92280	San Bern. Co. Permit
VIDAL	S106925338	DESERT OUTPOST STANDARD	HIGHWAY 95 / 62	92280	SWEEPS UST
VIDAL	S106927851	JOES SHELL	4700 HIGHWAY 95	92280	SWEEPS UST
VIDAL	U001574277	DESERT OUTPOST STANDARD	HWY 95 / 62	92280	HIST UST
VIDAL	S106925121	D.O.T. VIDAL MAINTENANCE STA.	JCT SR 62 / US 95	92280	SWEEPS UST
VIDAL JUNCTION	S102043603	1X FED AVIATION ADMIN/PARKER VORTAC	HWY 62	92280	HAZNET
VIDAL JUNCTION	S106910837	FEDERAL AVIATION ADMIN	HWY 62	92280	San Bern. Co. Permit
VIDAL JUNCTION	S108419355	CAL TRANS VIDAL JUNCTION	JUNCTION HWY 62 / 95	92280	San Bern. Co. Permit
WASCO	S105799386	JEFFRIES BROTHERS INC	750 HIGHWAY 46	92280	HAZNET

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

To maintain currency of the following federal and state databases, EDR contacts the appropriate governmental agency on a monthly or quarterly basis, as required.

Number of Days to Update: Provides confirmation that EDR is reporting records that have been updated within 90 days from the date the government agency made the information available to the public.

FEDERAL RECORDS

NPL: National Priority List

National Priorities List (Superfund). The NPL is a subset of CERCLIS and identifies over 1,200 sites for priority cleanup under the Superfund Program. NPL sites may encompass relatively large areas. As such, EDR provides polygon coverage for over 1,000 NPL site boundaries produced by EPA's Environmental Photographic Interpretation Center (EPIC) and regional EPA offices.

Date of Government Version: 08/13/2008
Date Data Arrived at EDR: 08/27/2008
Date Made Active in Reports: 09/23/2008
Number of Days to Update: 27

Source: EPA
Telephone: N/A
Last EDR Contact: 09/29/2008
Next Scheduled EDR Contact: 01/26/2009
Data Release Frequency: Quarterly

NPL Site Boundaries

Sources:

EPA's Environmental Photographic Interpretation Center (EPIC)
Telephone: 202-564-7333

EPA Region 1
Telephone 617-918-1143

EPA Region 3
Telephone 215-814-5418

EPA Region 4
Telephone 404-562-8033

EPA Region 5
Telephone 312-886-6686

EPA Region 10
Telephone 206-553-8665

EPA Region 6
Telephone: 214-655-6659

EPA Region 7
Telephone: 913-551-7247

EPA Region 8
Telephone: 303-312-6774

EPA Region 9
Telephone: 415-947-4246

Proposed NPL: Proposed National Priority List Sites

A site that has been proposed for listing on the National Priorities List through the issuance of a proposed rule in the Federal Register. EPA then accepts public comments on the site, responds to the comments, and places on the NPL those sites that continue to meet the requirements for listing.

Date of Government Version: 04/30/2008
Date Data Arrived at EDR: 05/06/2008
Date Made Active in Reports: 06/09/2008
Number of Days to Update: 34

Source: EPA
Telephone: N/A
Last EDR Contact: 09/29/2008
Next Scheduled EDR Contact: 01/26/2009
Data Release Frequency: Quarterly

DELISTED NPL: National Priority List Deletions

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) establishes the criteria that the EPA uses to delete sites from the NPL. In accordance with 40 CFR 300.425.(e), sites may be deleted from the NPL where no further response is appropriate.

Date of Government Version: 08/14/2008
Date Data Arrived at EDR: 08/27/2008
Date Made Active in Reports: 09/23/2008
Number of Days to Update: 27

Source: EPA
Telephone: N/A
Last EDR Contact: 09/29/2008
Next Scheduled EDR Contact: 01/26/2009
Data Release Frequency: Quarterly

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

NPL LIENS: Federal Superfund Liens

Federal Superfund Liens. Under the authority granted the USEPA by CERCLA of 1980, the USEPA has the authority to file liens against real property in order to recover remedial action expenditures or when the property owner received notification of potential liability. USEPA compiles a listing of filed notices of Superfund Liens.

Date of Government Version: 10/15/1991
Date Data Arrived at EDR: 02/02/1994
Date Made Active in Reports: 03/30/1994
Number of Days to Update: 56

Source: EPA
Telephone: 202-564-4267
Last EDR Contact: 11/17/2008
Next Scheduled EDR Contact: 02/16/2009
Data Release Frequency: No Update Planned

CERCLIS: Comprehensive Environmental Response, Compensation, and Liability Information System

CERCLIS contains data on potentially hazardous waste sites that have been reported to the USEPA by states, municipalities, private companies and private persons, pursuant to Section 103 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLIS contains sites which are either proposed to or on the National Priorities List (NPL) and sites which are in the screening and assessment phase for possible inclusion on the NPL.

Date of Government Version: 07/09/2008
Date Data Arrived at EDR: 07/22/2008
Date Made Active in Reports: 08/25/2008
Number of Days to Update: 34

Source: EPA
Telephone: 703-412-9810
Last EDR Contact: 10/16/2008
Next Scheduled EDR Contact: 01/12/2009
Data Release Frequency: Quarterly

CERCLIS-NFRAP: CERCLIS No Further Remedial Action Planned

Archived sites are sites that have been removed and archived from the inventory of CERCLIS sites. Archived status indicates that, to the best of EPA's knowledge, assessment at a site has been completed and that EPA has determined no further steps will be taken to list this site on the National Priorities List (NPL), unless information indicates this decision was not appropriate or other considerations require a recommendation for listing at a later time. This decision does not necessarily mean that there is no hazard associated with a given site; it only means that, based upon available information, the location is not judged to be a potential NPL site.

Date of Government Version: 12/03/2007
Date Data Arrived at EDR: 12/06/2007
Date Made Active in Reports: 02/20/2008
Number of Days to Update: 76

Source: EPA
Telephone: 703-412-9810
Last EDR Contact: 09/15/2008
Next Scheduled EDR Contact: 12/15/2008
Data Release Frequency: Quarterly

LIENS 2: CERCLA Lien Information

A Federal CERCLA ('Superfund') lien can exist by operation of law at any site or property at which EPA has spent Superfund monies. These monies are spent to investigate and address releases and threatened releases of contamination. CERCLIS provides information as to the identity of these sites and properties.

Date of Government Version: 08/19/2008
Date Data Arrived at EDR: 08/29/2008
Date Made Active in Reports: 09/09/2008
Number of Days to Update: 11

Source: Environmental Protection Agency
Telephone: 202-564-6023
Last EDR Contact: 11/17/2008
Next Scheduled EDR Contact: 02/16/2009
Data Release Frequency: Varies

CORRACTS: Corrective Action Report

CORRACTS identifies hazardous waste handlers with RCRA corrective action activity.

Date of Government Version: 09/11/2008
Date Data Arrived at EDR: 09/19/2008
Date Made Active in Reports: 10/16/2008
Number of Days to Update: 27

Source: EPA
Telephone: 800-424-9346
Last EDR Contact: 09/02/2008
Next Scheduled EDR Contact: 12/01/2008
Data Release Frequency: Quarterly

RCRA-TSDF: RCRA - Transporters, Storage and Disposal

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Transporters are individuals or entities that move hazardous waste from the generator offsite to a facility that can recycle, treat, store, or dispose of the waste. TSDFs treat, store, or dispose of the waste.

Date of Government Version: 09/10/2008
Date Data Arrived at EDR: 09/23/2008
Date Made Active in Reports: 10/16/2008
Number of Days to Update: 23

Source: Environmental Protection Agency
Telephone: (415) 495-8895
Last EDR Contact: 11/18/2008
Next Scheduled EDR Contact: 02/16/2009
Data Release Frequency: Quarterly

RCRA-LQG: RCRA - Large Quantity Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Large quantity generators (LQGs) generate over 1,000 kilograms (kg) of hazardous waste, or over 1 kg of acutely hazardous waste per month.

Date of Government Version: 09/10/2008
Date Data Arrived at EDR: 09/23/2008
Date Made Active in Reports: 10/16/2008
Number of Days to Update: 23

Source: Environmental Protection Agency
Telephone: (415) 495-8895
Last EDR Contact: 11/18/2008
Next Scheduled EDR Contact: 02/16/2009
Data Release Frequency: Quarterly

RCRA-SQG: RCRA - Small Quantity Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Small quantity generators (SQGs) generate between 100 kg and 1,000 kg of hazardous waste per month.

Date of Government Version: 09/10/2008
Date Data Arrived at EDR: 09/23/2008
Date Made Active in Reports: 10/16/2008
Number of Days to Update: 23

Source: Environmental Protection Agency
Telephone: (415) 495-8895
Last EDR Contact: 11/18/2008
Next Scheduled EDR Contact: 02/16/2009
Data Release Frequency: Quarterly

RCRA-CESQG: RCRA - Conditionally Exempt Small Quantity Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Conditionally exempt small quantity generators (CESQGs) generate less than 100 kg of hazardous waste, or less than 1 kg of acutely hazardous waste per month.

Date of Government Version: 09/10/2008
Date Data Arrived at EDR: 09/23/2008
Date Made Active in Reports: 10/16/2008
Number of Days to Update: 23

Source: Environmental Protection Agency
Telephone: (415) 495-8895
Last EDR Contact: 11/18/2008
Next Scheduled EDR Contact: 02/16/2009
Data Release Frequency: Varies

RCRA-NonGen: RCRA - Non Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Non-Generators do not presently generate hazardous waste.

Date of Government Version: 09/10/2008
Date Data Arrived at EDR: 09/23/2008
Date Made Active in Reports: 10/16/2008
Number of Days to Update: 23

Source: Environmental Protection Agency
Telephone: (415) 495-8895
Last EDR Contact: 11/18/2008
Next Scheduled EDR Contact: 02/16/2009
Data Release Frequency: Varies

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

US ENG CONTROLS: Engineering Controls Sites List

A listing of sites with engineering controls in place. Engineering controls include various forms of caps, building foundations, liners, and treatment methods to create pathway elimination for regulated substances to enter environmental media or effect human health.

Date of Government Version: 07/23/2008
Date Data Arrived at EDR: 07/29/2008
Date Made Active in Reports: 08/25/2008
Number of Days to Update: 27

Source: Environmental Protection Agency
Telephone: 703-603-0695
Last EDR Contact: 09/29/2008
Next Scheduled EDR Contact: 12/29/2008
Data Release Frequency: Varies

US INST CONTROL: Sites with Institutional Controls

A listing of sites with institutional controls in place. Institutional controls include administrative measures, such as groundwater use restrictions, construction restrictions, property use restrictions, and post remediation care requirements intended to prevent exposure to contaminants remaining on site. Deed restrictions are generally required as part of the institutional controls.

Date of Government Version: 07/23/2008
Date Data Arrived at EDR: 07/29/2008
Date Made Active in Reports: 08/25/2008
Number of Days to Update: 27

Source: Environmental Protection Agency
Telephone: 703-603-0695
Last EDR Contact: 06/30/2008
Next Scheduled EDR Contact: 09/29/2008
Data Release Frequency: Varies

ERNS: Emergency Response Notification System

Emergency Response Notification System. ERNS records and stores information on reported releases of oil and hazardous substances.

Date of Government Version: 12/31/2007
Date Data Arrived at EDR: 01/23/2008
Date Made Active in Reports: 03/17/2008
Number of Days to Update: 54

Source: National Response Center, United States Coast Guard
Telephone: 202-267-2180
Last EDR Contact: 10/21/2008
Next Scheduled EDR Contact: 01/19/2009
Data Release Frequency: Annually

HMIRS: Hazardous Materials Information Reporting System

Hazardous Materials Incident Report System. HMIRS contains hazardous material spill incidents reported to DOT.

Date of Government Version: 04/30/2008
Date Data Arrived at EDR: 07/15/2008
Date Made Active in Reports: 08/25/2008
Number of Days to Update: 41

Source: U.S. Department of Transportation
Telephone: 202-366-4555
Last EDR Contact: 10/16/2008
Next Scheduled EDR Contact: 01/12/2009
Data Release Frequency: Annually

DOT OPS: Incident and Accident Data

Department of Transporation, Office of Pipeline Safety Incident and Accident data.

Date of Government Version: 05/14/2008
Date Data Arrived at EDR: 05/28/2008
Date Made Active in Reports: 08/08/2008
Number of Days to Update: 72

Source: Department of Transporation, Office of Pipeline Safety
Telephone: 202-366-4595
Last EDR Contact: 08/29/2008
Next Scheduled EDR Contact: 11/24/2008
Data Release Frequency: Varies

CDL: Clandestine Drug Labs

A listing of clandestine drug lab locations. The U.S. Department of Justice ("the Department") provides this web site as a public service. It contains addresses of some locations where law enforcement agencies reported they found chemicals or other items that indicated the presence of either clandestine drug laboratories or dumpsites. In most cases, the source of the entries is not the Department, and the Department has not verified the entry and does not guarantee its accuracy. Members of the public must verify the accuracy of all entries by, for example, contacting local law enforcement and local health departments.

Date of Government Version: 09/01/2007
Date Data Arrived at EDR: 12/03/2007
Date Made Active in Reports: 12/28/2007
Number of Days to Update: 25

Source: Drug Enforcement Administration
Telephone: 202-307-1000
Last EDR Contact: 10/31/2008
Next Scheduled EDR Contact: 12/22/2008
Data Release Frequency: Quarterly

US BROWNFIELDS: A Listing of Brownfields Sites

Included in the listing are brownfields properties addresses by Cooperative Agreement Recipients and brownfields properties addressed by Targeted Brownfields Assessments. Targeted Brownfields Assessments-EPA's Targeted Brownfields Assessments (TBA) program is designed to help states, tribes, and municipalities--especially those without EPA Brownfields Assessment Demonstration Pilots--minimize the uncertainties of contamination often associated with brownfields. Under the TBA program, EPA provides funding and/or technical assistance for environmental assessments at brownfields sites throughout the country. Targeted Brownfields Assessments supplement and work with other efforts under EPA's Brownfields Initiative to promote cleanup and redevelopment of brownfields. Cooperative Agreement Recipients-States, political subdivisions, territories, and Indian tribes become Brownfields Cleanup Revolving Loan Fund (BCRLF) cooperative agreement recipients when they enter into BCRLF cooperative agreements with the U.S. EPA. EPA selects BCRLF cooperative agreement recipients based on a proposal and application process. BCRLF cooperative agreement recipients must use EPA funds provided through BCRLF cooperative agreement for specified brownfields-related cleanup activities.

Date of Government Version: 07/01/2008
Date Data Arrived at EDR: 08/25/2008
Date Made Active in Reports: 09/09/2008
Number of Days to Update: 15

Source: Environmental Protection Agency
Telephone: 202-566-2777
Last EDR Contact: 10/16/2008
Next Scheduled EDR Contact: 01/12/2009
Data Release Frequency: Semi-Annually

DOD: Department of Defense Sites

This data set consists of federally owned or administered lands, administered by the Department of Defense, that have any area equal to or greater than 640 acres of the United States, Puerto Rico, and the U.S. Virgin Islands.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 11/10/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 62

Source: USGS
Telephone: 703-692-8801
Last EDR Contact: 11/07/2008
Next Scheduled EDR Contact: 02/02/2009
Data Release Frequency: Semi-Annually

FUDS: Formerly Used Defense Sites

The listing includes locations of Formerly Used Defense Sites properties where the US Army Corps of Engineers is actively working or will take necessary cleanup actions.

Date of Government Version: 12/31/2007
Date Data Arrived at EDR: 09/05/2008
Date Made Active in Reports: 09/23/2008
Number of Days to Update: 18

Source: U.S. Army Corps of Engineers
Telephone: 202-528-4285
Last EDR Contact: 09/05/2008
Next Scheduled EDR Contact: 12/29/2008
Data Release Frequency: Varies

LUCIS: Land Use Control Information System

LUCIS contains records of land use control information pertaining to the former Navy Base Realignment and Closure properties.

Date of Government Version: 12/09/2005
Date Data Arrived at EDR: 12/11/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 31

Source: Department of the Navy
Telephone: 843-820-7326
Last EDR Contact: 09/09/2008
Next Scheduled EDR Contact: 12/08/2008
Data Release Frequency: Varies

CONSENT: Superfund (CERCLA) Consent Decrees

Major legal settlements that establish responsibility and standards for cleanup at NPL (Superfund) sites. Released periodically by United States District Courts after settlement by parties to litigation matters.

Date of Government Version: 04/25/2008
Date Data Arrived at EDR: 06/12/2008
Date Made Active in Reports: 08/25/2008
Number of Days to Update: 74

Source: Department of Justice, Consent Decree Library
Telephone: Varies
Last EDR Contact: 10/20/2008
Next Scheduled EDR Contact: 01/19/2009
Data Release Frequency: Varies

ROD: Records Of Decision

Record of Decision. ROD documents mandate a permanent remedy at an NPL (Superfund) site containing technical and health information to aid in the cleanup.

Date of Government Version: 06/18/2008
Date Data Arrived at EDR: 07/11/2008
Date Made Active in Reports: 08/25/2008
Number of Days to Update: 45

Source: EPA
Telephone: 703-416-0223
Last EDR Contact: 09/29/2008
Next Scheduled EDR Contact: 12/29/2008
Data Release Frequency: Annually

UMTRA: Uranium Mill Tailings Sites

Uranium ore was mined by private companies for federal government use in national defense programs. When the mills shut down, large piles of the sand-like material (mill tailings) remain after uranium has been extracted from the ore. Levels of human exposure to radioactive materials from the piles are low; however, in some cases tailings were used as construction materials before the potential health hazards of the tailings were recognized.

Date of Government Version: 07/13/2007
Date Data Arrived at EDR: 12/03/2007
Date Made Active in Reports: 01/24/2008
Number of Days to Update: 52

Source: Department of Energy
Telephone: 505-845-0011
Last EDR Contact: 09/15/2008
Next Scheduled EDR Contact: 12/15/2008
Data Release Frequency: Varies

ODI: Open Dump Inventory

An open dump is defined as a disposal facility that does not comply with one or more of the Part 257 or Part 258 Subtitle D Criteria.

Date of Government Version: 06/30/1985
Date Data Arrived at EDR: 08/09/2004
Date Made Active in Reports: 09/17/2004
Number of Days to Update: 39

Source: Environmental Protection Agency
Telephone: 800-424-9346
Last EDR Contact: 06/09/2004
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

DEBRIS REGION 9: Torres Martinez Reservation Illegal Dump Site Locations

A listing of illegal dump sites location on the Torres Martinez Indian Reservation located in eastern Riverside County and northern Imperial County, California.

Date of Government Version: 03/25/2008
Date Data Arrived at EDR: 04/17/2008
Date Made Active in Reports: 05/15/2008
Number of Days to Update: 28

Source: EPA, Region 9
Telephone: 415-972-3336
Last EDR Contact: 09/22/2008
Next Scheduled EDR Contact: 12/22/2008
Data Release Frequency: Varies

MINES: Mines Master Index File

Contains all mine identification numbers issued for mines active or opened since 1971. The data also includes violation information.

Date of Government Version: 08/07/2008
Date Data Arrived at EDR: 09/23/2008
Date Made Active in Reports: 10/16/2008
Number of Days to Update: 23

Source: Department of Labor, Mine Safety and Health Administration
Telephone: 303-231-5959
Last EDR Contact: 09/23/2008
Next Scheduled EDR Contact: 12/22/2008
Data Release Frequency: Semi-Annually

TRIS: Toxic Chemical Release Inventory System

Toxic Release Inventory System. TRIS identifies facilities which release toxic chemicals to the air, water and land in reportable quantities under SARA Title III Section 313.

Date of Government Version: 12/31/2006
Date Data Arrived at EDR: 02/29/2008
Date Made Active in Reports: 04/18/2008
Number of Days to Update: 49

Source: EPA
Telephone: 202-566-0250
Last EDR Contact: 09/19/2008
Next Scheduled EDR Contact: 12/15/2008
Data Release Frequency: Annually

TSCA: Toxic Substances Control Act

Toxic Substances Control Act. TSCA identifies manufacturers and importers of chemical substances included on the TSCA Chemical Substance Inventory list. It includes data on the production volume of these substances by plant site.

Date of Government Version: 12/31/2002
Date Data Arrived at EDR: 04/14/2006
Date Made Active in Reports: 05/30/2006
Number of Days to Update: 46

Source: EPA
Telephone: 202-260-5521
Last EDR Contact: 10/14/2008
Next Scheduled EDR Contact: 01/12/2009
Data Release Frequency: Every 4 Years

FTTS: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)

FTTS tracks administrative cases and pesticide enforcement actions and compliance activities related to FIFRA, TSCA and EPCRA (Emergency Planning and Community Right-to-Know Act). To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 07/12/2008
Date Data Arrived at EDR: 07/18/2008
Date Made Active in Reports: 08/25/2008
Number of Days to Update: 38

Source: EPA/Office of Prevention, Pesticides and Toxic Substances
Telephone: 202-566-1667
Last EDR Contact: 09/15/2008
Next Scheduled EDR Contact: 12/15/2008
Data Release Frequency: Quarterly

FTTS INSP: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)

A listing of FIFRA/TSCA Tracking System (FTTS) inspections and enforcements.

Date of Government Version: 07/12/2008
Date Data Arrived at EDR: 07/18/2008
Date Made Active in Reports: 08/25/2008
Number of Days to Update: 38

Source: EPA
Telephone: 202-566-1667
Last EDR Contact: 09/15/2008
Next Scheduled EDR Contact: 12/15/2008
Data Release Frequency: Quarterly

HIST FTTS: FIFRA/TSCA Tracking System Administrative Case Listing

A complete administrative case listing from the FIFRA/TSCA Tracking System (FTTS) for all ten EPA regions. The information was obtained from the National Compliance Database (NCDB). NCDB supports the implementation of FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) and TSCA (Toxic Substances Control Act). Some EPA regions are now closing out records. Because of that, and the fact that some EPA regions are not providing EPA Headquarters with updated records, it was decided to create a HIST FTTS database. It included records that may not be included in the newer FTTS database updates. This database is no longer updated.

Date of Government Version: 10/19/2006
Date Data Arrived at EDR: 03/01/2007
Date Made Active in Reports: 04/10/2007
Number of Days to Update: 40

Source: Environmental Protection Agency
Telephone: 202-564-2501
Last EDR Contact: 12/17/2007
Next Scheduled EDR Contact: 03/17/2008
Data Release Frequency: No Update Planned

HIST FTTS INSP: FIFRA/TSCA Tracking System Inspection & Enforcement Case Listing

A complete inspection and enforcement case listing from the FIFRA/TSCA Tracking System (FTTS) for all ten EPA regions. The information was obtained from the National Compliance Database (NCDB). NCDB supports the implementation of FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) and TSCA (Toxic Substances Control Act). Some EPA regions are now closing out records. Because of that, and the fact that some EPA regions are not providing EPA Headquarters with updated records, it was decided to create a HIST FTTS database. It included records that may not be included in the newer FTTS database updates. This database is no longer updated.

Date of Government Version: 10/19/2006
Date Data Arrived at EDR: 03/01/2007
Date Made Active in Reports: 04/10/2007
Number of Days to Update: 40

Source: Environmental Protection Agency
Telephone: 202-564-2501
Last EDR Contact: 12/17/2008
Next Scheduled EDR Contact: 03/17/2008
Data Release Frequency: No Update Planned

SSTS: Section 7 Tracking Systems

Section 7 of the Federal Insecticide, Fungicide and Rodenticide Act, as amended (92 Stat. 829) requires all registered pesticide-producing establishments to submit a report to the Environmental Protection Agency by March 1st each year. Each establishment must report the types and amounts of pesticides, active ingredients and devices being produced, and those having been produced and sold or distributed in the past year.

Date of Government Version: 12/31/2006
Date Data Arrived at EDR: 03/14/2008
Date Made Active in Reports: 04/18/2008
Number of Days to Update: 35

Source: EPA
Telephone: 202-564-4203
Last EDR Contact: 10/14/2008
Next Scheduled EDR Contact: 01/12/2009
Data Release Frequency: Annually

ICIS: Integrated Compliance Information System

The Integrated Compliance Information System (ICIS) supports the information needs of the national enforcement and compliance program as well as the unique needs of the National Pollutant Discharge Elimination System (NPDES) program.

Date of Government Version: 07/31/2008
Date Data Arrived at EDR: 08/13/2008
Date Made Active in Reports: 09/09/2008
Number of Days to Update: 27

Source: Environmental Protection Agency
Telephone: 202-564-5088
Last EDR Contact: 10/14/2008
Next Scheduled EDR Contact: 01/12/2009
Data Release Frequency: Quarterly

PADS: PCB Activity Database System

PCB Activity Database. PADS Identifies generators, transporters, commercial storers and/or brokers and disposers of PCB's who are required to notify the EPA of such activities.

Date of Government Version: 12/04/2007
Date Data Arrived at EDR: 02/07/2008
Date Made Active in Reports: 03/17/2008
Number of Days to Update: 39

Source: EPA
Telephone: 202-566-0500
Last EDR Contact: 09/18/2008
Next Scheduled EDR Contact: 11/03/2008
Data Release Frequency: Annually

MLTS: Material Licensing Tracking System

MLTS is maintained by the Nuclear Regulatory Commission and contains a list of approximately 8,100 sites which possess or use radioactive materials and which are subject to NRC licensing requirements. To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 07/08/2008
Date Data Arrived at EDR: 08/05/2008
Date Made Active in Reports: 08/25/2008
Number of Days to Update: 20

Source: Nuclear Regulatory Commission
Telephone: 301-415-7169
Last EDR Contact: 09/29/2008
Next Scheduled EDR Contact: 12/29/2008
Data Release Frequency: Quarterly

RADINFO: Radiation Information Database

The Radiation Information Database (RADINFO) contains information about facilities that are regulated by U.S. Environmental Protection Agency (EPA) regulations for radiation and radioactivity.

Date of Government Version: 07/29/2008
Date Data Arrived at EDR: 07/31/2008
Date Made Active in Reports: 08/25/2008
Number of Days to Update: 25

Source: Environmental Protection Agency
Telephone: 202-343-9775
Last EDR Contact: 10/29/2008
Next Scheduled EDR Contact: 01/26/2009
Data Release Frequency: Quarterly

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

FINDS: Facility Index System/Facility Registry System

Facility Index System. FINDS contains both facility information and 'pointers' to other sources that contain more detail. EDR includes the following FINDS databases in this report: PCS (Permit Compliance System), AIRS (Aerometric Information Retrieval System), DOCKET (Enforcement Docket used to manage and track information on civil judicial enforcement cases for all environmental statutes), FURS (Federal Underground Injection Control), C-DOCKET (Criminal Docket System used to track criminal enforcement actions for all environmental statutes), FFIS (Federal Facilities Information System), STATE (State Environmental Laws and Statutes), and PADS (PCB Activity Data System).

Date of Government Version: 07/01/2008	Source: EPA
Date Data Arrived at EDR: 07/09/2008	Telephone: (415) 947-8000
Date Made Active in Reports: 08/25/2008	Last EDR Contact: 09/29/2008
Number of Days to Update: 47	Next Scheduled EDR Contact: 12/29/2008
	Data Release Frequency: Quarterly

RAATS: RCRA Administrative Action Tracking System

RCRA Administration Action Tracking System. RAATS contains records based on enforcement actions issued under RCRA pertaining to major violators and includes administrative and civil actions brought by the EPA. For administration actions after September 30, 1995, data entry in the RAATS database was discontinued. EPA will retain a copy of the database for historical records. It was necessary to terminate RAATS because a decrease in agency resources made it impossible to continue to update the information contained in the database.

Date of Government Version: 04/17/1995	Source: EPA
Date Data Arrived at EDR: 07/03/1995	Telephone: 202-564-4104
Date Made Active in Reports: 08/07/1995	Last EDR Contact: 06/02/2008
Number of Days to Update: 35	Next Scheduled EDR Contact: 09/01/2008
	Data Release Frequency: No Update Planned

BRS: Biennial Reporting System

The Biennial Reporting System is a national system administered by the EPA that collects data on the generation and management of hazardous waste. BRS captures detailed data from two groups: Large Quantity Generators (LQG) and Treatment, Storage, and Disposal Facilities.

Date of Government Version: 12/31/2005	Source: EPA/NTIS
Date Data Arrived at EDR: 03/06/2007	Telephone: 800-424-9346
Date Made Active in Reports: 04/13/2007	Last EDR Contact: 09/12/2008
Number of Days to Update: 38	Next Scheduled EDR Contact: 12/08/2008
	Data Release Frequency: Biennially

SCRD DRYCLEANERS: State Coalition for Remediation of Drycleaners Listing

The State Coalition for Remediation of Drycleaners was established in 1998, with support from the U.S. EPA Office of Superfund Remediation and Technology Innovation. It is comprised of representatives of states with established drycleaner remediation programs. Currently the member states are Alabama, Connecticut, Florida, Illinois, Kansas, Minnesota, Missouri, North Carolina, Oregon, South Carolina, Tennessee, Texas, and Wisconsin.

Date of Government Version: 09/08/2008	Source: Environmental Protection Agency
Date Data Arrived at EDR: 09/10/2008	Telephone: 615-532-8599
Date Made Active in Reports: 09/23/2008	Last EDR Contact: 11/10/2008
Number of Days to Update: 13	Next Scheduled EDR Contact: 02/09/2009
	Data Release Frequency: Varies

STATE AND LOCAL RECORDS

HIST CAL-SITES: Calsites Database

The Calsites database contains potential or confirmed hazardous substance release properties. In 1996, California EPA reevaluated and significantly reduced the number of sites in the Calsites database. No longer updated by the state agency. It has been replaced by ENVIROSTOR.

Date of Government Version: 08/08/2005	Source: Department of Toxic Substance Control
Date Data Arrived at EDR: 08/03/2006	Telephone: 916-323-3400
Date Made Active in Reports: 08/24/2006	Last EDR Contact: 08/25/2008
Number of Days to Update: 21	Next Scheduled EDR Contact: 11/24/2008
	Data Release Frequency: No Update Planned

CA BOND EXP. PLAN: Bond Expenditure Plan

Department of Health Services developed a site-specific expenditure plan as the basis for an appropriation of Hazardous Substance Cleanup Bond Act funds. It is not updated.

Date of Government Version: 01/01/1989
Date Data Arrived at EDR: 07/27/1994
Date Made Active in Reports: 08/02/1994
Number of Days to Update: 6

Source: Department of Health Services
Telephone: 916-255-2118
Last EDR Contact: 05/31/1994
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

SCH: School Property Evaluation Program

This category contains proposed and existing school sites that are being evaluated by DTSC for possible hazardous materials contamination. In some cases, these properties may be listed in the CalSites category depending on the level of threat to public health and safety or the environment they pose.

Date of Government Version: 08/25/2008
Date Data Arrived at EDR: 08/27/2008
Date Made Active in Reports: 09/03/2008
Number of Days to Update: 7

Source: Department of Toxic Substances Control
Telephone: 916-323-3400
Last EDR Contact: 08/27/2008
Next Scheduled EDR Contact: 11/24/2008
Data Release Frequency: Quarterly

TOXIC PITS: Toxic Pits Cleanup Act Sites

Toxic PITS Cleanup Act Sites. TOXIC PITS identifies sites suspected of containing hazardous substances where cleanup has not yet been completed.

Date of Government Version: 07/01/1995
Date Data Arrived at EDR: 08/30/1995
Date Made Active in Reports: 09/26/1995
Number of Days to Update: 27

Source: State Water Resources Control Board
Telephone: 916-227-4364
Last EDR Contact: 11/04/2008
Next Scheduled EDR Contact: 01/26/2009
Data Release Frequency: No Update Planned

SWF/LF (SWIS): Solid Waste Information System

Active, Closed and Inactive Landfills. SWF/LF records typically contain an inve ntory of solid waste disposal facilities or landfills. These may be active or i nactive facilities or open dumps that failed to meet RCRA Section 4004 criteria for solid waste landfills or disposal sites.

Date of Government Version: 09/08/2008
Date Data Arrived at EDR: 09/09/2008
Date Made Active in Reports: 09/18/2008
Number of Days to Update: 9

Source: Integrated Waste Management Board
Telephone: 916-341-6320
Last EDR Contact: 09/09/2008
Next Scheduled EDR Contact: 12/08/2008
Data Release Frequency: Quarterly

CA WDS: Waste Discharge System

Sites which have been issued waste discharge requirements.

Date of Government Version: 06/19/2007
Date Data Arrived at EDR: 06/20/2007
Date Made Active in Reports: 06/29/2007
Number of Days to Update: 9

Source: State Water Resources Control Board
Telephone: 916-341-5227
Last EDR Contact: 09/29/2008
Next Scheduled EDR Contact: 12/15/2008
Data Release Frequency: Quarterly

WMUDS/SWAT: Waste Management Unit Database

Waste Management Unit Database System. WMUDS is used by the State Water Resources Control Board staff and the Regional Water Quality Control Boards for program tracking and inventory of waste management units. WMUDS is composed of the following databases: Facility Information, Scheduled Inspections Information, Waste Management Unit Information, SWAT Program Information, SWAT Report Summary Information, SWAT Report Summary Data, Chapter 15 (formerly Subchapter 15) Information, Chapter 15 Monitoring Parameters, TPCA Program Information, RCRA Program Information, Closure Information, and Interested Parties Information.

Date of Government Version: 04/01/2000
Date Data Arrived at EDR: 04/10/2000
Date Made Active in Reports: 05/10/2000
Number of Days to Update: 30

Source: State Water Resources Control Board
Telephone: 916-227-4448
Last EDR Contact: 10/14/2008
Next Scheduled EDR Contact: 12/01/2008
Data Release Frequency: Quarterly

CORTESE: "Cortese" Hazardous Waste & Substances Sites List
The sites for the list are designated by the State Water Resource Control Board (LUST), the Integrated Waste Board (SWF/LS), and the Department of Toxic Substances Control (Cal-Sites). This listing is no longer updated by the state agency.

Date of Government Version: 04/01/2001
Date Data Arrived at EDR: 05/29/2001
Date Made Active in Reports: 07/26/2001
Number of Days to Update: 58

Source: CAL EPA/Office of Emergency Information
Telephone: 916-323-3400
Last EDR Contact: 10/20/2008
Next Scheduled EDR Contact: 01/19/2009
Data Release Frequency: No Update Planned

SWRCY: Recycler Database
A listing of recycling facilities in California.

Date of Government Version: 07/09/2008
Date Data Arrived at EDR: 07/10/2008
Date Made Active in Reports: 07/31/2008
Number of Days to Update: 21

Source: Department of Conservation
Telephone: 916-323-3836
Last EDR Contact: 10/08/2008
Next Scheduled EDR Contact: 01/05/2009
Data Release Frequency: Quarterly

LUST: Geotracker's Leaking Underground Fuel Tank Report
Leaking Underground Storage Tank Incident Reports. LUST records contain an inventory of reported leaking underground storage tank incidents. Not all states maintain these records, and the information stored varies by state. For more information on a particular leaking underground storage tank sites, please contact the appropriate regulatory agency.

Date of Government Version: 07/03/2008
Date Data Arrived at EDR: 07/11/2008
Date Made Active in Reports: 07/31/2008
Number of Days to Update: 20

Source: State Water Resources Control Board
Telephone: see region list
Last EDR Contact: 11/04/2008
Next Scheduled EDR Contact: 01/05/2009
Data Release Frequency: Quarterly

LUST REG 1: Active Toxic Site Investigation
Del Norte, Humboldt, Lake, Mendocino, Modoc, Siskiyou, Sonoma, Trinity counties. For more current information, please refer to the State Water Resources Control Board's LUST database.

Date of Government Version: 02/01/2001
Date Data Arrived at EDR: 02/28/2001
Date Made Active in Reports: 03/29/2001
Number of Days to Update: 29

Source: California Regional Water Quality Control Board North Coast (1)
Telephone: 707-570-3769
Last EDR Contact: 11/17/2008
Next Scheduled EDR Contact: 02/16/2009
Data Release Frequency: No Update Planned

LUST REG 2: Fuel Leak List
Leaking Underground Storage Tank locations. Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, Sonoma counties.

Date of Government Version: 09/30/2004
Date Data Arrived at EDR: 10/20/2004
Date Made Active in Reports: 11/19/2004
Number of Days to Update: 30

Source: California Regional Water Quality Control Board San Francisco Bay Region (2)
Telephone: 510-622-2433
Last EDR Contact: 10/06/2008
Next Scheduled EDR Contact: 01/05/2009
Data Release Frequency: Quarterly

LUST REG 3: Leaking Underground Storage Tank Database
Leaking Underground Storage Tank locations. Monterey, San Benito, San Luis Obispo, Santa Barbara, Santa Cruz counties.

Date of Government Version: 05/19/2003
Date Data Arrived at EDR: 05/19/2003
Date Made Active in Reports: 06/02/2003
Number of Days to Update: 14

Source: California Regional Water Quality Control Board Central Coast Region (3)
Telephone: 805-542-4786
Last EDR Contact: 11/10/2008
Next Scheduled EDR Contact: 02/02/2009
Data Release Frequency: No Update Planned

LUST REG 4: Underground Storage Tank Leak List

Los Angeles, Ventura counties. For more current information, please refer to the State Water Resources Control Board's LUST database.

Date of Government Version: 09/07/2004
Date Data Arrived at EDR: 09/07/2004
Date Made Active in Reports: 10/12/2004
Number of Days to Update: 35

Source: California Regional Water Quality Control Board Los Angeles Region (4)
Telephone: 213-576-6710
Last EDR Contact: 09/23/2008
Next Scheduled EDR Contact: 12/22/2008
Data Release Frequency: No Update Planned

LUST REG 5: Leaking Underground Storage Tank Database

Leaking Underground Storage Tank locations. Alameda, Alpine, Amador, Butte, Colusa, Contra Costa, Calveras, El Dorado, Fresno, Glenn, Kern, Kings, Lake, Lassen, Madera, Mariposa, Merced, Modoc, Napa, Nevada, Placer, Plumas, Sacramento, San Joaquin, Shasta, Solano, Stanislaus, Sutter, Tehama, Tulare, Tuolumne, Yolo, Yuba counties.

Date of Government Version: 07/01/2008
Date Data Arrived at EDR: 07/22/2008
Date Made Active in Reports: 07/31/2008
Number of Days to Update: 9

Source: California Regional Water Quality Control Board Central Valley Region (5)
Telephone: 916-464-4834
Last EDR Contact: 07/22/2008
Next Scheduled EDR Contact: 10/20/2008
Data Release Frequency: Quarterly

LUST REG 6L: Leaking Underground Storage Tank Case Listing

For more current information, please refer to the State Water Resources Control Board's LUST database.

Date of Government Version: 09/09/2003
Date Data Arrived at EDR: 09/10/2003
Date Made Active in Reports: 10/07/2003
Number of Days to Update: 27

Source: California Regional Water Quality Control Board Lahontan Region (6)
Telephone: 530-542-5572
Last EDR Contact: 09/02/2008
Next Scheduled EDR Contact: 12/01/2008
Data Release Frequency: No Update Planned

LUST REG 6V: Leaking Underground Storage Tank Case Listing

Leaking Underground Storage Tank locations. Inyo, Kern, Los Angeles, Mono, San Bernardino counties.

Date of Government Version: 06/07/2005
Date Data Arrived at EDR: 06/07/2005
Date Made Active in Reports: 06/29/2005
Number of Days to Update: 22

Source: California Regional Water Quality Control Board Victorville Branch Office (6)
Telephone: 760-241-7365
Last EDR Contact: 09/29/2008
Next Scheduled EDR Contact: 12/29/2008
Data Release Frequency: No Update Planned

LUST REG 7: Leaking Underground Storage Tank Case Listing

Leaking Underground Storage Tank locations. Imperial, Riverside, San Diego, Santa Barbara counties.

Date of Government Version: 02/26/2004
Date Data Arrived at EDR: 02/26/2004
Date Made Active in Reports: 03/24/2004
Number of Days to Update: 27

Source: California Regional Water Quality Control Board Colorado River Basin Region (7)
Telephone: 760-776-8943
Last EDR Contact: 11/17/2008
Next Scheduled EDR Contact: 02/16/2009
Data Release Frequency: No Update Planned

LUST REG 9: Leaking Underground Storage Tank Report

Orange, Riverside, San Diego counties. For more current information, please refer to the State Water Resources Control Board's LUST database.

Date of Government Version: 03/01/2001
Date Data Arrived at EDR: 04/23/2001
Date Made Active in Reports: 05/21/2001
Number of Days to Update: 28

Source: California Regional Water Quality Control Board San Diego Region (9)
Telephone: 858-637-5595
Last EDR Contact: 10/14/2008
Next Scheduled EDR Contact: 01/12/2009
Data Release Frequency: No Update Planned

LUST REG 8: Leaking Underground Storage Tanks

California Regional Water Quality Control Board Santa Ana Region (8). For more current information, please refer to the State Water Resources Control Board's LUST database.

Date of Government Version: 02/14/2005
Date Data Arrived at EDR: 02/15/2005
Date Made Active in Reports: 03/28/2005
Number of Days to Update: 41

Source: California Regional Water Quality Control Board Santa Ana Region (8)
Telephone: 909-782-4496
Last EDR Contact: 11/04/2008
Next Scheduled EDR Contact: 02/02/2009
Data Release Frequency: Varies

CA FID UST: Facility Inventory Database

The Facility Inventory Database (FID) contains a historical listing of active and inactive underground storage tank locations from the State Water Resource Control Board. Refer to local/county source for current data.

Date of Government Version: 10/31/1994
Date Data Arrived at EDR: 09/05/1995
Date Made Active in Reports: 09/29/1995
Number of Days to Update: 24

Source: California Environmental Protection Agency
Telephone: 916-341-5851
Last EDR Contact: 12/28/1998
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

SLIC: Statewide SLIC Cases

The SLIC (Spills, Leaks, Investigations and Cleanup) program is designed to protect and restore water quality from spills, leaks, and similar discharges.

Date of Government Version: 07/03/2008
Date Data Arrived at EDR: 07/11/2008
Date Made Active in Reports: 07/31/2008
Number of Days to Update: 20

Source: State Water Resources Control Board
Telephone: 866-480-1028
Last EDR Contact: 11/04/2008
Next Scheduled EDR Contact: 01/05/2009
Data Release Frequency: Varies

SLIC REG 1: Active Toxic Site Investigations

The SLIC (Spills, Leaks, Investigations and Cleanup) program is designed to protect and restore water quality from spills, leaks, and similar discharges.

Date of Government Version: 04/03/2003
Date Data Arrived at EDR: 04/07/2003
Date Made Active in Reports: 04/25/2003
Number of Days to Update: 18

Source: California Regional Water Quality Control Board, North Coast Region (1)
Telephone: 707-576-2220
Last EDR Contact: 11/17/2008
Next Scheduled EDR Contact: 11/17/2008
Data Release Frequency: No Update Planned

SLIC REG 2: Spills, Leaks, Investigation & Cleanup Cost Recovery Listing

The SLIC (Spills, Leaks, Investigations and Cleanup) program is designed to protect and restore water quality from spills, leaks, and similar discharges.

Date of Government Version: 09/30/2004
Date Data Arrived at EDR: 10/20/2004
Date Made Active in Reports: 11/19/2004
Number of Days to Update: 30

Source: Regional Water Quality Control Board San Francisco Bay Region (2)
Telephone: 510-286-0457
Last EDR Contact: 10/06/2008
Next Scheduled EDR Contact: 01/05/2009
Data Release Frequency: Quarterly

SLIC REG 3: Spills, Leaks, Investigation & Cleanup Cost Recovery Listing

The SLIC (Spills, Leaks, Investigations and Cleanup) program is designed to protect and restore water quality from spills, leaks, and similar discharges.

Date of Government Version: 05/18/2006
Date Data Arrived at EDR: 05/18/2006
Date Made Active in Reports: 06/15/2006
Number of Days to Update: 28

Source: California Regional Water Quality Control Board Central Coast Region (3)
Telephone: 805-549-3147
Last EDR Contact: 11/10/2008
Next Scheduled EDR Contact: 02/09/2009
Data Release Frequency: Semi-Annually

SLIC REG 4: Spills, Leaks, Investigation & Cleanup Cost Recovery Listing
The SLIC (Spills, Leaks, Investigations and Cleanup) program is designed to protect and restore water quality from spills, leaks, and similar discharges.

Date of Government Version: 11/17/2004
Date Data Arrived at EDR: 11/18/2004
Date Made Active in Reports: 01/04/2005
Number of Days to Update: 47

Source: Region Water Quality Control Board Los Angeles Region (4)
Telephone: 213-576-6600
Last EDR Contact: 10/20/2008
Next Scheduled EDR Contact: 01/19/2009
Data Release Frequency: Varies

SLIC REG 5: Spills, Leaks, Investigation & Cleanup Cost Recovery Listing
The SLIC (Spills, Leaks, Investigations and Cleanup) program is designed to protect and restore water quality from spills, leaks, and similar discharges.

Date of Government Version: 04/01/2005
Date Data Arrived at EDR: 04/05/2005
Date Made Active in Reports: 04/21/2005
Number of Days to Update: 16

Source: Regional Water Quality Control Board Central Valley Region (5)
Telephone: 916-464-3291
Last EDR Contact: 09/29/2008
Next Scheduled EDR Contact: 12/29/2008
Data Release Frequency: Semi-Annually

SLIC REG 6V: Spills, Leaks, Investigation & Cleanup Cost Recovery Listing
The SLIC (Spills, Leaks, Investigations and Cleanup) program is designed to protect and restore water quality from spills, leaks, and similar discharges.

Date of Government Version: 05/24/2005
Date Data Arrived at EDR: 05/25/2005
Date Made Active in Reports: 06/16/2005
Number of Days to Update: 22

Source: Regional Water Quality Control Board, Victorville Branch
Telephone: 619-241-6583
Last EDR Contact: 09/29/2008
Next Scheduled EDR Contact: 12/29/2008
Data Release Frequency: Semi-Annually

SLIC REG 6L: SLIC Sites
The SLIC (Spills, Leaks, Investigations and Cleanup) program is designed to protect and restore water quality from spills, leaks, and similar discharges.

Date of Government Version: 09/07/2004
Date Data Arrived at EDR: 09/07/2004
Date Made Active in Reports: 10/12/2004
Number of Days to Update: 35

Source: California Regional Water Quality Control Board, Lahontan Region
Telephone: 530-542-5574
Last EDR Contact: 09/02/2008
Next Scheduled EDR Contact: 12/01/2008
Data Release Frequency: No Update Planned

SLIC REG 7: SLIC List
The SLIC (Spills, Leaks, Investigations and Cleanup) program is designed to protect and restore water quality from spills, leaks, and similar discharges.

Date of Government Version: 11/24/2004
Date Data Arrived at EDR: 11/29/2004
Date Made Active in Reports: 01/04/2005
Number of Days to Update: 36

Source: California Regional Quality Control Board, Colorado River Basin Region
Telephone: 760-346-7491
Last EDR Contact: 11/17/2008
Next Scheduled EDR Contact: 02/16/2009
Data Release Frequency: No Update Planned

SLIC REG 8: Spills, Leaks, Investigation & Cleanup Cost Recovery Listing
The SLIC (Spills, Leaks, Investigations and Cleanup) program is designed to protect and restore water quality from spills, leaks, and similar discharges.

Date of Government Version: 04/03/2008
Date Data Arrived at EDR: 04/03/2008
Date Made Active in Reports: 04/14/2008
Number of Days to Update: 11

Source: California Region Water Quality Control Board Santa Ana Region (8)
Telephone: 951-782-3298
Last EDR Contact: 09/29/2008
Next Scheduled EDR Contact: 12/29/2008
Data Release Frequency: Semi-Annually

SLIC REG 9: Spills, Leaks, Investigation & Cleanup Cost Recovery Listing

The SLIC (Spills, Leaks, Investigations and Cleanup) program is designed to protect and restore water quality from spills, leaks, and similar discharges.

Date of Government Version: 09/10/2007
Date Data Arrived at EDR: 09/11/2007
Date Made Active in Reports: 09/28/2007
Number of Days to Update: 17

Source: California Regional Water Quality Control Board San Diego Region (9)
Telephone: 858-467-2980
Last EDR Contact: 08/25/2008
Next Scheduled EDR Contact: 11/24/2008
Data Release Frequency: Annually

UST: Active UST Facilities

Active UST facilities gathered from the local regulatory agencies

Date of Government Version: 07/10/2008
Date Data Arrived at EDR: 07/10/2008
Date Made Active in Reports: 07/25/2008
Number of Days to Update: 15

Source: SWRCB
Telephone: 916-480-1028
Last EDR Contact: 11/04/2008
Next Scheduled EDR Contact: 01/05/2009
Data Release Frequency: Semi-Annually

UST MENDOCINO: Mendocino County UST Database

A listing of underground storage tank locations in Mendocino County.

Date of Government Version: 10/06/2008
Date Data Arrived at EDR: 10/06/2008
Date Made Active in Reports: 10/16/2008
Number of Days to Update: 10

Source: Department of Public Health
Telephone: 707-463-4466
Last EDR Contact: 10/06/2008
Next Scheduled EDR Contact: 12/22/2008
Data Release Frequency: Varies

HIST UST: Hazardous Substance Storage Container Database

The Hazardous Substance Storage Container Database is a historical listing of UST sites. Refer to local/county source for current data.

Date of Government Version: 10/15/1990
Date Data Arrived at EDR: 01/25/1991
Date Made Active in Reports: 02/12/1991
Number of Days to Update: 18

Source: State Water Resources Control Board
Telephone: 916-341-5851
Last EDR Contact: 07/26/2001
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

AST: Aboveground Petroleum Storage Tank Facilities

Registered Aboveground Storage Tanks.

Date of Government Version: 11/01/2007
Date Data Arrived at EDR: 11/27/2007
Date Made Active in Reports: 02/14/2008
Number of Days to Update: 79

Source: State Water Resources Control Board
Telephone: 916-341-5712
Last EDR Contact: 10/27/2008
Next Scheduled EDR Contact: 01/26/2009
Data Release Frequency: Quarterly

LIENS: Environmental Liens Listing

A listing of property locations with environmental liens for California where DTSC is a lien holder.

Date of Government Version: 08/04/2008
Date Data Arrived at EDR: 08/08/2008
Date Made Active in Reports: 09/03/2008
Number of Days to Update: 26

Source: Department of Toxic Substances Control
Telephone: 916-323-3400
Last EDR Contact: 11/03/2008
Next Scheduled EDR Contact: 02/02/2009
Data Release Frequency: Varies

SWEEPS UST: SWEEPS UST Listing

Statewide Environmental Evaluation and Planning System. This underground storage tank listing was updated and maintained by a company contacted by the SWRCB in the early 1990's. The local agency is the contact for more information on a site on the SWEEPS list.

Date of Government Version: 06/01/1994
Date Data Arrived at EDR: 07/07/2005
Date Made Active in Reports: 08/11/2005
Number of Days to Update: 35

Source: State Water Resources Control Board
Telephone: N/A
Last EDR Contact: 06/03/2005
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

CHMIRS: California Hazardous Material Incident Report System

California Hazardous Material Incident Reporting System. CHMIRS contains information on reported hazardous material incidents (accidental releases or spills).

Date of Government Version: 12/31/2007
Date Data Arrived at EDR: 05/09/2008
Date Made Active in Reports: 06/20/2008
Number of Days to Update: 42

Source: Office of Emergency Services
Telephone: 916-845-8400
Last EDR Contact: 11/17/2008
Next Scheduled EDR Contact: 02/16/2009
Data Release Frequency: Varies

NOTIFY 65: Proposition 65 Records

Proposition 65 Notification Records. NOTIFY 65 contains facility notifications about any release which could impact drinking water and thereby expose the public to a potential health risk.

Date of Government Version: 10/21/1993
Date Data Arrived at EDR: 11/01/1993
Date Made Active in Reports: 11/19/1993
Number of Days to Update: 18

Source: State Water Resources Control Board
Telephone: 916-445-3846
Last EDR Contact: 10/14/2008
Next Scheduled EDR Contact: 01/12/2009
Data Release Frequency: No Update Planned

DEED: Deed Restriction Listing

Site Mitigation and Brownfields Reuse Program Facility Sites with Deed Restrictions & Hazardous Waste Management Program Facility Sites with Deed / Land Use Restriction. The DTSC Site Mitigation and Brownfields Reuse Program (SMBRP) list includes sites cleaned up under the program’s oversight and generally does not include current or former hazardous waste facilities that required a hazardous waste facility permit. The list represents deed restrictions that are active. Some sites have multiple deed restrictions. The DTSC Hazardous Waste Management Program (HWMP) has developed a list of current or former hazardous waste facilities that have a recorded land use restriction at the local county recorder’s office. The land use restrictions on this list were required by the DTSC HWMP as a result of the presence of hazardous substances that remain on site after the facility (or part of the facility) has been closed or cleaned up. The types of land use restriction include deed notice, deed restriction, or a land use restriction that binds current and future owners.

Date of Government Version: 09/30/2008
Date Data Arrived at EDR: 09/30/2008
Date Made Active in Reports: 10/13/2008
Number of Days to Update: 13

Source: Department of Toxic Substances Control
Telephone: 916-323-3400
Last EDR Contact: 09/30/2008
Next Scheduled EDR Contact: 12/29/2008
Data Release Frequency: Semi-Annually

VCP: Voluntary Cleanup Program Properties

Contains low threat level properties with either confirmed or unconfirmed releases and the project proponents have request that DTSC oversee investigation and/or cleanup activities and have agreed to provide coverage for DTSC’s costs.

Date of Government Version: 08/25/2008
Date Data Arrived at EDR: 08/27/2008
Date Made Active in Reports: 09/03/2008
Number of Days to Update: 7

Source: Department of Toxic Substances Control
Telephone: 916-323-3400
Last EDR Contact: 08/27/2008
Next Scheduled EDR Contact: 11/24/2008
Data Release Frequency: Quarterly

DRYCLEANERS: Cleaner Facilities

A list of drycleaner related facilities that have EPA ID numbers. These are facilities with certain SIC codes: power laundries, family and commercial; garment pressing and cleaner’s agents; linen supply; coin-operated laundries and cleaning; drycleaning plants, except rugs; carpet and upholster cleaning; industrial launderers; laundry and garment services.

Date of Government Version: 09/23/2008
Date Data Arrived at EDR: 09/24/2008
Date Made Active in Reports: 09/29/2008
Number of Days to Update: 5

Source: Department of Toxic Substance Control
Telephone: 916-327-4498
Last EDR Contact: 09/23/2008
Next Scheduled EDR Contact: 12/29/2008
Data Release Frequency: Annually

WIP: Well Investigation Program Case List
Well Investigation Program case in the San Gabriel and San Fernando Valley area.

Date of Government Version: 02/26/2008
Date Data Arrived at EDR: 04/23/2008
Date Made Active in Reports: 05/06/2008
Number of Days to Update: 13

Source: Los Angeles Water Quality Control Board
Telephone: 213-576-6726
Last EDR Contact: 11/03/2008
Next Scheduled EDR Contact: 01/19/2009
Data Release Frequency: Varies

CDL: Clandestine Drug Labs
A listing of drug lab locations. Listing of a location in this database does not indicate that any illegal drug lab materials were or were not present there, and does not constitute a determination that the location either requires or does not require additional cleanup work.

Date of Government Version: 09/30/2008
Date Data Arrived at EDR: 10/06/2008
Date Made Active in Reports: 10/13/2008
Number of Days to Update: 7

Source: Department of Toxic Substances Control
Telephone: 916-255-6504
Last EDR Contact: 09/29/2008
Next Scheduled EDR Contact: 01/19/2009
Data Release Frequency: Varies

RESPONSE: State Response Sites
Identifies confirmed release sites where DTSC is involved in remediation, either in a lead or oversight capacity. These confirmed release sites are generally high-priority and high potential risk.

Date of Government Version: 08/25/2008
Date Data Arrived at EDR: 08/27/2008
Date Made Active in Reports: 09/03/2008
Number of Days to Update: 7

Source: Department of Toxic Substances Control
Telephone: 916-323-3400
Last EDR Contact: 08/27/2008
Next Scheduled EDR Contact: 11/24/2008
Data Release Frequency: Quarterly

HAZNET: Facility and Manifest Data
Facility and Manifest Data. The data is extracted from the copies of hazardous waste manifests received each year by the DTSC. The annual volume of manifests is typically 700,000 - 1,000,000 annually, representing approximately 350,000 - 500,000 shipments. Data are from the manifests submitted without correction, and therefore many contain some invalid values for data elements such as generator ID, TSD ID, waste category, and disposal method.

Date of Government Version: 12/31/2006
Date Data Arrived at EDR: 10/04/2007
Date Made Active in Reports: 11/07/2007
Number of Days to Update: 34

Source: California Environmental Protection Agency
Telephone: 916-255-1136
Last EDR Contact: 11/07/2008
Next Scheduled EDR Contact: 02/02/2008
Data Release Frequency: Annually

EMI: Emissions Inventory Data
Toxics and criteria pollutant emissions data collected by the ARB and local air pollution agencies.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 04/17/2007
Date Made Active in Reports: 05/10/2007
Number of Days to Update: 23

Source: California Air Resources Board
Telephone: 916-322-2990
Last EDR Contact: 10/16/2008
Next Scheduled EDR Contact: 01/12/2009
Data Release Frequency: Varies

HAULERS: Registered Waste Tire Haulers Listing
A listing of registered waste tire haulers.

Date of Government Version: 09/22/2008
Date Data Arrived at EDR: 09/22/2008
Date Made Active in Reports: 09/29/2008
Number of Days to Update: 7

Source: Integrated Waste Management Board
Telephone: 916-341-6422
Last EDR Contact: 09/08/2008
Next Scheduled EDR Contact: 12/08/2008
Data Release Frequency: Varies

ENVIROSTOR: EnviroStor Database

The Department of Toxic Substances Control's (DTSC's) Site Mitigation and Brownfields Reuse Program's (SMBRP's) EnviroStor database identifes sites that have known contamination or sites for which there may be reasons to investigate further. The database includes the following site types: Federal Superfund sites (National Priorities List (NPL)); State Response, including Military Facilities and State Superfund; Voluntary Cleanup; and School sites. EnviroStor provides similar information to the information that was available in CalSites, and provides additional site information, including, but not limited to, identification of formerly-contaminated properties that have been released for reuse, properties where environmental deed restrictions have been recorded to prevent inappropriate land uses, and risk characterization information that is used to assess potential impacts to public health and the environment at contaminated sites.

Date of Government Version: 08/25/2008
Date Data Arrived at EDR: 08/27/2008
Date Made Active in Reports: 09/03/2008
Number of Days to Update: 7

Source: Department of Toxic Substances Control
Telephone: 916-323-3400
Last EDR Contact: 08/27/2008
Next Scheduled EDR Contact: 11/24/2008
Data Release Frequency: Quarterly

TRIBAL RECORDS

INDIAN RESERV: Indian Reservations

This map layer portrays Indian administered lands of the United States that have any area equal to or greater than 640 acres.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 12/08/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 34

Source: USGS
Telephone: 202-208-3710
Last EDR Contact: 11/07/2008
Next Scheduled EDR Contact: 02/02/2009
Data Release Frequency: Semi-Annually

INDIAN ODI: Report on the Status of Open Dumps on Indian Lands

Location of open dumps on Indian land.

Date of Government Version: 12/31/1998
Date Data Arrived at EDR: 12/03/2007
Date Made Active in Reports: 01/24/2008
Number of Days to Update: 52

Source: Environmental Protection Agency
Telephone: 703-308-8245
Last EDR Contact: 08/25/2008
Next Scheduled EDR Contact: 11/24/2008
Data Release Frequency: Varies

INDIAN LUST R8: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in Colorado, Montana, North Dakota, South Dakota, Utah and Wyoming.

Date of Government Version: 08/21/2008
Date Data Arrived at EDR: 09/04/2008
Date Made Active in Reports: 09/09/2008
Number of Days to Update: 5

Source: EPA Region 8
Telephone: 303-312-6271
Last EDR Contact: 11/17/2008
Next Scheduled EDR Contact: 02/16/2009
Data Release Frequency: Quarterly

INDIAN LUST R7: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in Iowa, Kansas, and Nebraska

Date of Government Version: 03/17/2008
Date Data Arrived at EDR: 03/27/2008
Date Made Active in Reports: 05/06/2008
Number of Days to Update: 40

Source: EPA Region 7
Telephone: 913-551-7003
Last EDR Contact: 08/18/2008
Next Scheduled EDR Contact: 11/17/2008
Data Release Frequency: Varies

INDIAN LUST R4: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Florida, Mississippi and North Carolina.

Date of Government Version: 03/17/2008
Date Data Arrived at EDR: 03/27/2008
Date Made Active in Reports: 05/06/2008
Number of Days to Update: 40

Source: EPA Region 4
Telephone: 404-562-8677
Last EDR Contact: 11/17/2008
Next Scheduled EDR Contact: 02/16/2009
Data Release Frequency: Semi-Annually

INDIAN LUST R1: Leaking Underground Storage Tanks on Indian Land
A listing of leaking underground storage tank locations on Indian Land.

Date of Government Version: 03/12/2008
Date Data Arrived at EDR: 03/14/2008
Date Made Active in Reports: 03/20/2008
Number of Days to Update: 6

Source: EPA Region 1
Telephone: 617-918-1313
Last EDR Contact: 11/17/2008
Next Scheduled EDR Contact: 02/16/2009
Data Release Frequency: Varies

INDIAN LUST R9: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Arizona, California, New Mexico and Nevada

Date of Government Version: 10/10/2008
Date Data Arrived at EDR: 10/10/2008
Date Made Active in Reports: 10/16/2008
Number of Days to Update: 6

Source: Environmental Protection Agency
Telephone: 415-972-3372
Last EDR Contact: 11/17/2008
Next Scheduled EDR Contact: 02/16/2009
Data Release Frequency: Quarterly

INDIAN LUST R10: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Alaska, Idaho, Oregon and Washington.

Date of Government Version: 08/22/2008
Date Data Arrived at EDR: 08/22/2008
Date Made Active in Reports: 09/09/2008
Number of Days to Update: 18

Source: EPA Region 10
Telephone: 206-553-2857
Last EDR Contact: 11/17/2008
Next Scheduled EDR Contact: 02/16/2009
Data Release Frequency: Quarterly

INDIAN LUST R6: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in New Mexico and Oklahoma.

Date of Government Version: 09/05/2008
Date Data Arrived at EDR: 09/05/2008
Date Made Active in Reports: 09/23/2008
Number of Days to Update: 18

Source: EPA Region 6
Telephone: 214-665-6597
Last EDR Contact: 11/17/2008
Next Scheduled EDR Contact: 02/16/2009
Data Release Frequency: Varies

INDIAN UST R1: Underground Storage Tanks on Indian Land
A listing of underground storage tank locations on Indian Land.

Date of Government Version: 03/12/2008
Date Data Arrived at EDR: 03/14/2008
Date Made Active in Reports: 03/20/2008
Number of Days to Update: 6

Source: EPA, Region 1
Telephone: 617-918-1313
Last EDR Contact: 11/17/2008
Next Scheduled EDR Contact: 02/16/2009
Data Release Frequency: Varies

INDIAN UST R4: Underground Storage Tanks on Indian Land
No description is available for this data

Date of Government Version: 03/17/2008
Date Data Arrived at EDR: 03/27/2008
Date Made Active in Reports: 05/06/2008
Number of Days to Update: 40

Source: EPA Region 4
Telephone: 404-562-9424
Last EDR Contact: 11/17/2008
Next Scheduled EDR Contact: 02/16/2009
Data Release Frequency: Semi-Annually

INDIAN UST R5: Underground Storage Tanks on Indian Land
No description is available for this data

Date of Government Version: 09/08/2008
Date Data Arrived at EDR: 09/19/2008
Date Made Active in Reports: 10/16/2008
Number of Days to Update: 27

Source: EPA Region 5
Telephone: 312-886-6136
Last EDR Contact: 11/17/2008
Next Scheduled EDR Contact: 02/16/2009
Data Release Frequency: Varies

INDIAN UST R6: Underground Storage Tanks on Indian Land
No description is available for this data

Date of Government Version: 09/05/2008
Date Data Arrived at EDR: 09/05/2008
Date Made Active in Reports: 09/23/2008
Number of Days to Update: 18

Source: EPA Region 6
Telephone: 214-665-7591
Last EDR Contact: 11/17/2008
Next Scheduled EDR Contact: 02/16/2009
Data Release Frequency: Semi-Annually

INDIAN UST R7: Underground Storage Tanks on Indian Land
No description is available for this data

Date of Government Version: 06/01/2007
Date Data Arrived at EDR: 06/14/2007
Date Made Active in Reports: 07/05/2007
Number of Days to Update: 21

Source: EPA Region 7
Telephone: 913-551-7003
Last EDR Contact: 08/18/2008
Next Scheduled EDR Contact: 11/17/2008
Data Release Frequency: Varies

INDIAN UST R8: Underground Storage Tanks on Indian Land
No description is available for this data

Date of Government Version: 08/21/2008
Date Data Arrived at EDR: 09/04/2008
Date Made Active in Reports: 09/09/2008
Number of Days to Update: 5

Source: EPA Region 8
Telephone: 303-312-6137
Last EDR Contact: 11/17/2008
Next Scheduled EDR Contact: 02/16/2009
Data Release Frequency: Quarterly

INDIAN UST R9: Underground Storage Tanks on Indian Land
No description is available for this data

Date of Government Version: 09/05/2008
Date Data Arrived at EDR: 09/19/2008
Date Made Active in Reports: 10/16/2008
Number of Days to Update: 27

Source: EPA Region 9
Telephone: 415-972-3368
Last EDR Contact: 11/17/2008
Next Scheduled EDR Contact: 02/16/2009
Data Release Frequency: Quarterly

INDIAN UST R10: Underground Storage Tanks on Indian Land
No description is available for this data

Date of Government Version: 08/22/2008
Date Data Arrived at EDR: 08/22/2008
Date Made Active in Reports: 09/09/2008
Number of Days to Update: 18

Source: EPA Region 10
Telephone: 206-553-2857
Last EDR Contact: 11/17/2008
Next Scheduled EDR Contact: 02/16/2009
Data Release Frequency: Quarterly

INDIAN VCP R1: Voluntary Cleanup Priority Listing
A listing of voluntary cleanup priority sites located on Indian Land located in Region 1.

Date of Government Version: 04/02/2008
Date Data Arrived at EDR: 04/22/2008
Date Made Active in Reports: 05/19/2008
Number of Days to Update: 27

Source: EPA, Region 1
Telephone: 617-918-1102
Last EDR Contact: 10/20/2008
Next Scheduled EDR Contact: 01/19/2009
Data Release Frequency: Varies

INDIAN VCP R7: Voluntary Cleanup Priority Lisitng

A listing of voluntary cleanup priority sites located on Indian Land located in Region 7.

Date of Government Version: 03/20/2008
Date Data Arrived at EDR: 04/22/2008
Date Made Active in Reports: 05/19/2008
Number of Days to Update: 27

Source: EPA, Region 7
Telephone: 913-551-7365
Last EDR Contact: 10/20/2008
Next Scheduled EDR Contact: 01/19/2009
Data Release Frequency: Varies

EDR PROPRIETARY RECORDS

Manufactured Gas Plants: EDR Proprietary Manufactured Gas Plants

The EDR Proprietary Manufactured Gas Plant Database includes records of coal gas plants (manufactured gas plants) compiled by EDR's researchers. Manufactured gas sites were used in the United States from the 1800's to 1950's to produce a gas that could be distributed and used as fuel. These plants used whale oil, rosin, coal, or a mixture of coal, oil, and water that also produced a significant amount of waste. Many of the byproducts of the gas production, such as coal tar (oily waste containing volatile and non-volatile chemicals), sludges, oils and other compounds are potentially hazardous to human health and the environment. The byproduct from this process was frequently disposed of directly at the plant site and can remain or spread slowly, serving as a continuous source of soil and groundwater contamination.

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: EDR, Inc.
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

EDR Historical Auto Stations: EDR Proprietary Historic Gas Stations

EDR has searched selected national collections of business directories and has collected listings of potential gas station/filling station/service station sites that were available to EDR researchers. EDR's review was limited to those categories of sources that might, in EDR's opinion, include gas station/filling station/service station establishments. The categories reviewed included, but were not limited to gas, gas station, gasoline station, filling station, auto, automobile repair, auto service station, service station, etc.

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: EDR, Inc.
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

EDR Historical Cleaners: EDR Proprietary Historic Dry Cleaners

EDR has searched selected national collections of business directories and has collected listings of potential dry cleaner sites that were available to EDR researchers. EDR's review was limited to those categories of sources that might, in EDR's opinion, include dry cleaning establishments. The categories reviewed included, but were not limited to dry cleaners, cleaners, laundry, laundromat, cleaning/laundry, wash & dry etc.

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: EDR, Inc.
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

COUNTY RECORDS

ALAMEDA COUNTY:

Contaminated Sites

A listing of contaminated sites overseen by the Toxic Release Program (oil and groundwater contamination from chemical releases and spills) and the Leaking Underground Storage Tank Program (soil and ground water contamination from leaking petroleum USTs).

Date of Government Version: 08/21/2008
Date Data Arrived at EDR: 08/22/2008
Date Made Active in Reports: 09/03/2008
Number of Days to Update: 12

Source: Alameda County Environmental Health Services
Telephone: 510-567-6700
Last EDR Contact: 10/20/2008
Next Scheduled EDR Contact: 01/19/2009
Data Release Frequency: Semi-Annually

Underground Tanks
Underground storage tank sites located in Alameda county.

Date of Government Version: 08/21/2008
Date Data Arrived at EDR: 08/22/2008
Date Made Active in Reports: 08/29/2008
Number of Days to Update: 7

Source: Alameda County Environmental Health Services
Telephone: 510-567-6700
Last EDR Contact: 10/20/2008
Next Scheduled EDR Contact: 01/19/2009
Data Release Frequency: Semi-Annually

CONTRA COSTA COUNTY:

Site List
List includes sites from the underground tank, hazardous waste generator and business plan/2185 programs.

Date of Government Version: 09/03/2008
Date Data Arrived at EDR: 09/04/2008
Date Made Active in Reports: 09/18/2008
Number of Days to Update: 14

Source: Contra Costa Health Services Department
Telephone: 925-646-2286
Last EDR Contact: 08/25/2008
Next Scheduled EDR Contact: 11/24/2008
Data Release Frequency: Semi-Annually

FRESNO COUNTY:

CUPA Resources List
Certified Unified Program Agency. CUPA's are responsible for implementing a unified hazardous materials and hazardous waste management regulatory program. The agency provides oversight of businesses that deal with hazardous materials, operate underground storage tanks or aboveground storage tanks.

Date of Government Version: 08/07/2008
Date Data Arrived at EDR: 08/08/2008
Date Made Active in Reports: 09/03/2008
Number of Days to Update: 26

Source: Dept. of Community Health
Telephone: 559-445-3271
Last EDR Contact: 11/03/2008
Next Scheduled EDR Contact: 02/02/2009
Data Release Frequency: Semi-Annually

KERN COUNTY:

Underground Storage Tank Sites & Tank Listing
Kern County Sites and Tanks Listing.

Date of Government Version: 09/15/2008
Date Data Arrived at EDR: 09/16/2008
Date Made Active in Reports: 10/01/2008
Number of Days to Update: 15

Source: Kern County Environment Health Services Department
Telephone: 661-862-8700
Last EDR Contact: 09/15/2008
Next Scheduled EDR Contact: 12/01/2008
Data Release Frequency: Quarterly

LOS ANGELES COUNTY:

San Gabriel Valley Areas of Concern
San Gabriel Valley areas where VOC contamination is at or above the MCL as designated by region 9 EPA office.

Date of Government Version: 12/31/1998
Date Data Arrived at EDR: 07/07/1999
Date Made Active in Reports: N/A
Number of Days to Update: 0

Source: EPA Region 9
Telephone: 415-972-3178
Last EDR Contact: 10/14/2008
Next Scheduled EDR Contact: 01/12/2009
Data Release Frequency: No Update Planned

HMS: Street Number List
Industrial Waste and Underground Storage Tank Sites.

Date of Government Version: 04/30/2008
Date Data Arrived at EDR: 06/24/2008
Date Made Active in Reports: 07/31/2008
Number of Days to Update: 37

Source: Department of Public Works
Telephone: 626-458-3517
Last EDR Contact: 11/10/2008
Next Scheduled EDR Contact: 02/02/2009
Data Release Frequency: Semi-Annually

List of Solid Waste Facilities
Solid Waste Facilities in Los Angeles County.

Date of Government Version: 08/12/2008
Date Data Arrived at EDR: 08/22/2008
Date Made Active in Reports: 09/03/2008
Number of Days to Update: 12

Source: La County Department of Public Works
Telephone: 818-458-5185
Last EDR Contact: 11/13/2008
Next Scheduled EDR Contact: 02/09/2009
Data Release Frequency: Varies

City of Los Angeles Landfills
Landfills owned and maintained by the City of Los Angeles.

Date of Government Version: 03/01/2008
Date Data Arrived at EDR: 03/20/2008
Date Made Active in Reports: 04/14/2008
Number of Days to Update: 25

Source: Engineering & Construction Division
Telephone: 213-473-7869
Last EDR Contact: 09/08/2008
Next Scheduled EDR Contact: 12/08/2008
Data Release Frequency: Varies

Site Mitigation List
Industrial sites that have had some sort of spill or complaint.

Date of Government Version: 02/14/2008
Date Data Arrived at EDR: 04/10/2008
Date Made Active in Reports: 05/06/2008
Number of Days to Update: 26

Source: Community Health Services
Telephone: 323-890-7806
Last EDR Contact: 11/10/2008
Next Scheduled EDR Contact: 02/02/2009
Data Release Frequency: Annually

City of El Segundo Underground Storage Tank
Underground storage tank sites located in El Segundo city.

Date of Government Version: 09/19/2008
Date Data Arrived at EDR: 10/06/2008
Date Made Active in Reports: 10/16/2008
Number of Days to Update: 10

Source: City of El Segundo Fire Department
Telephone: 310-524-2236
Last EDR Contact: 11/10/2008
Next Scheduled EDR Contact: 02/02/2009
Data Release Frequency: Semi-Annually

City of Long Beach Underground Storage Tank
Underground storage tank sites located in the city of Long Beach.

Date of Government Version: 03/28/2003
Date Data Arrived at EDR: 10/23/2003
Date Made Active in Reports: 11/26/2003
Number of Days to Update: 34

Source: City of Long Beach Fire Department
Telephone: 562-570-2563
Last EDR Contact: 11/17/2008
Next Scheduled EDR Contact: 02/16/2009
Data Release Frequency: Annually

City of Torrance Underground Storage Tank

Underground storage tank sites located in the city of Torrance.

Date of Government Version: 08/26/2008
Date Data Arrived at EDR: 09/11/2008
Date Made Active in Reports: 10/01/2008
Number of Days to Update: 20

Source: City of Torrance Fire Department
Telephone: 310-618-2973
Last EDR Contact: 11/10/2008
Next Scheduled EDR Contact: 02/02/2009
Data Release Frequency: Semi-Annually

MARIN COUNTY:

Underground Storage Tank Sites

Currently permitted USTs in Marin County.

Date of Government Version: 08/04/2008
Date Data Arrived at EDR: 08/29/2008
Date Made Active in Reports: 09/15/2008
Number of Days to Update: 17

Source: Public Works Department Waste Management
Telephone: 415-499-6647
Last EDR Contact: 10/27/2008
Next Scheduled EDR Contact: 01/26/2009
Data Release Frequency: Semi-Annually

NAPA COUNTY:

Sites With Reported Contamination

A listing of leaking underground storage tank sites located in Napa county.

Date of Government Version: 07/09/2008
Date Data Arrived at EDR: 07/09/2008
Date Made Active in Reports: 07/31/2008
Number of Days to Update: 22

Source: Napa County Department of Environmental Management
Telephone: 707-253-4269
Last EDR Contact: 09/22/2008
Next Scheduled EDR Contact: 12/22/2008
Data Release Frequency: Semi-Annually

Closed and Operating Underground Storage Tank Sites

Underground storage tank sites located in Napa county.

Date of Government Version: 01/15/2008
Date Data Arrived at EDR: 01/16/2008
Date Made Active in Reports: 02/08/2008
Number of Days to Update: 23

Source: Napa County Department of Environmental Management
Telephone: 707-253-4269
Last EDR Contact: 09/22/2008
Next Scheduled EDR Contact: 12/22/2008
Data Release Frequency: Annually

ORANGE COUNTY:

List of Industrial Site Cleanups

Petroleum and non-petroleum spills.

Date of Government Version: 09/02/2008
Date Data Arrived at EDR: 09/16/2008
Date Made Active in Reports: 09/29/2008
Number of Days to Update: 13

Source: Health Care Agency
Telephone: 714-834-3446
Last EDR Contact: 09/04/2008
Next Scheduled EDR Contact: 12/01/2008
Data Release Frequency: Annually

List of Underground Storage Tank Cleanups

Orange County Underground Storage Tank Cleanups (LUST).

Date of Government Version: 09/02/2008
Date Data Arrived at EDR: 09/17/2008
Date Made Active in Reports: 09/29/2008
Number of Days to Update: 12

Source: Health Care Agency
Telephone: 714-834-3446
Last EDR Contact: 09/04/2008
Next Scheduled EDR Contact: 12/01/2008
Data Release Frequency: Quarterly

List of Underground Storage Tank Facilities
Orange County Underground Storage Tank Facilities (UST).

Date of Government Version: 09/02/2008
Date Data Arrived at EDR: 09/25/2008
Date Made Active in Reports: 10/01/2008
Number of Days to Update: 6

Source: Health Care Agency
Telephone: 714-834-3446
Last EDR Contact: 09/04/2008
Next Scheduled EDR Contact: 12/01/2008
Data Release Frequency: Quarterly

PLACER COUNTY:

Master List of Facilities
List includes aboveground tanks, underground tanks and cleanup sites.

Date of Government Version: 07/23/2007
Date Data Arrived at EDR: 07/23/2007
Date Made Active in Reports: 08/09/2007
Number of Days to Update: 17

Source: Placer County Health and Human Services
Telephone: 530-889-7312
Last EDR Contact: 09/15/2008
Next Scheduled EDR Contact: 12/15/2008
Data Release Frequency: Semi-Annually

RIVERSIDE COUNTY:

Listing of Underground Tank Cleanup Sites
Riverside County Underground Storage Tank Cleanup Sites (LUST).

Date of Government Version: 07/15/2008
Date Data Arrived at EDR: 07/18/2008
Date Made Active in Reports: 07/31/2008
Number of Days to Update: 13

Source: Department of Public Health
Telephone: 951-358-5055
Last EDR Contact: 10/14/2008
Next Scheduled EDR Contact: 01/12/2009
Data Release Frequency: Quarterly

Underground Storage Tank Tank List
Underground storage tank sites located in Riverside county.

Date of Government Version: 07/02/2008
Date Data Arrived at EDR: 07/29/2008
Date Made Active in Reports: 08/29/2008
Number of Days to Update: 31

Source: Health Services Agency
Telephone: 951-358-5055
Last EDR Contact: 10/14/2008
Next Scheduled EDR Contact: 01/12/2009
Data Release Frequency: Quarterly

SACRAMENTO COUNTY:

Contaminated Sites
List of sites where unauthorized releases of potentially hazardous materials have occurred.

Date of Government Version: 08/08/2008
Date Data Arrived at EDR: 08/08/2008
Date Made Active in Reports: 09/03/2008
Number of Days to Update: 26

Source: Sacramento County Environmental Management
Telephone: 916-875-8406
Last EDR Contact: 10/29/2008
Next Scheduled EDR Contact: 01/26/2009
Data Release Frequency: Quarterly

ML - Regulatory Compliance Master List
Any business that has hazardous materials on site - hazardous material storage sites, underground storage tanks, waste generators.

Date of Government Version: 08/08/2008
Date Data Arrived at EDR: 08/08/2008
Date Made Active in Reports: 09/03/2008
Number of Days to Update: 26

Source: Sacramento County Environmental Management
Telephone: 916-875-8406
Last EDR Contact: 10/29/2008
Next Scheduled EDR Contact: 01/26/2009
Data Release Frequency: Quarterly

SAN BERNARDINO COUNTY:

Hazardous Material Permits

This listing includes underground storage tanks, medical waste handlers/generators, hazardous materials handlers, hazardous waste generators, and waste oil generators/handlers.

Date of Government Version: 10/01/2008
Date Data Arrived at EDR: 10/06/2008
Date Made Active in Reports: 10/13/2008
Number of Days to Update: 7

Source: San Bernardino County Fire Department Hazardous Materials Division
Telephone: 909-387-3041
Last EDR Contact: 09/02/2008
Next Scheduled EDR Contact: 12/01/2008
Data Release Frequency: Quarterly

SAN DIEGO COUNTY:

Hazardous Materials Management Division Database

The database includes: HE58 - This report contains the business name, site address, business phone number, establishment 'H' permit number, type of permit, and the business status. HE17 - In addition to providing the same information provided in the HE58 listing, HE17 provides inspection dates, violations received by the establishment, hazardous waste generated, the quantity, method of storage, treatment/disposal of waste and the hauler, and information on underground storage tanks. Unauthorized Release List - Includes a summary of environmental contamination cases in San Diego County (underground tank cases, non-tank cases, groundwater contamination, and soil contamination are included.)

Date of Government Version: 05/16/2005
Date Data Arrived at EDR: 05/18/2005
Date Made Active in Reports: 06/16/2005
Number of Days to Update: 29

Source: Hazardous Materials Management Division
Telephone: 619-338-2268
Last EDR Contact: 10/29/2008
Next Scheduled EDR Contact: 12/29/2008
Data Release Frequency: Quarterly

Solid Waste Facilities

San Diego County Solid Waste Facilities.

Date of Government Version: 08/01/2007
Date Data Arrived at EDR: 02/05/2008
Date Made Active in Reports: 02/14/2008
Number of Days to Update: 9

Source: Department of Health Services
Telephone: 619-338-2209
Last EDR Contact: 11/17/2008
Next Scheduled EDR Contact: 11/17/2008
Data Release Frequency: Varies

Environmental Case Listing

The listing contains all underground tank release cases and projects pertaining to properties contaminated with hazardous substances that are actively under review by the Site Assessment and Mitigation Program.

Date of Government Version: 06/04/2008
Date Data Arrived at EDR: 07/25/2008
Date Made Active in Reports: 07/31/2008
Number of Days to Update: 6

Source: San Diego County Department of Environmental Health
Telephone: 619-338-2371
Last EDR Contact: 09/30/2008
Next Scheduled EDR Contact: 12/29/2008
Data Release Frequency: Varies

SAN FRANCISCO COUNTY:

Local Oversite Facilities

A listing of leaking underground storage tank sites located in San Francisco county.

Date of Government Version: 09/19/2008
Date Data Arrived at EDR: 09/19/2008
Date Made Active in Reports: 09/29/2008
Number of Days to Update: 10

Source: Department Of Public Health San Francisco County
Telephone: 415-252-3920
Last EDR Contact: 09/15/2008
Next Scheduled EDR Contact: 12/01/2008
Data Release Frequency: Quarterly

Underground Storage Tank Information
Underground storage tank sites located in San Francisco county.

Date of Government Version: 09/19/2008
Date Data Arrived at EDR: 09/19/2008
Date Made Active in Reports: 10/01/2008
Number of Days to Update: 12

Source: Department of Public Health
Telephone: 415-252-3920
Last EDR Contact: 09/15/2008
Next Scheduled EDR Contact: 12/01/2008
Data Release Frequency: Quarterly

SAN JOAQUIN COUNTY:

San Joaquin Co. UST
A listing of underground storage tank locations in San Joaquin county.

Date of Government Version: 08/26/2008
Date Data Arrived at EDR: 08/27/2008
Date Made Active in Reports: 09/15/2008
Number of Days to Update: 19

Source: Environmental Health Department
Telephone: N/A
Last EDR Contact: 10/14/2008
Next Scheduled EDR Contact: 01/12/2009
Data Release Frequency: Semi-Annually

SAN MATEO COUNTY:

Business Inventory
List includes Hazardous Materials Business Plan, hazardous waste generators, and underground storage tanks.

Date of Government Version: 06/18/2008
Date Data Arrived at EDR: 06/18/2008
Date Made Active in Reports: 06/20/2008
Number of Days to Update: 2

Source: San Mateo County Environmental Health Services Division
Telephone: 650-363-1921
Last EDR Contact: 10/06/2008
Next Scheduled EDR Contact: 01/05/2009
Data Release Frequency: Annually

Fuel Leak List
A listing of leaking underground storage tank sites located in San Mateo county.

Date of Government Version: 10/06/2008
Date Data Arrived at EDR: 10/07/2008
Date Made Active in Reports: 10/13/2008
Number of Days to Update: 6

Source: San Mateo County Environmental Health Services Division
Telephone: 650-363-1921
Last EDR Contact: 10/06/2008
Next Scheduled EDR Contact: 01/05/2009
Data Release Frequency: Semi-Annually

SANTA CLARA COUNTY:

HIST LUST - Fuel Leak Site Activity Report
A listing of open and closed leaking underground storage tanks. This listing is no longer updated by the county. Leaking underground storage tanks are now handled by the Department of Environmental Health.

Date of Government Version: 03/29/2005
Date Data Arrived at EDR: 03/30/2005
Date Made Active in Reports: 04/21/2005
Number of Days to Update: 22

Source: Santa Clara Valley Water District
Telephone: 408-265-2600
Last EDR Contact: 09/22/2008
Next Scheduled EDR Contact: 12/22/2008
Data Release Frequency: No Update Planned

LOP Listing
A listing of leaking underground storage tanks located in Santa Clara county.

Date of Government Version: 09/24/2008
Date Data Arrived at EDR: 09/25/2008
Date Made Active in Reports: 09/29/2008
Number of Days to Update: 4

Source: Department of Environmental Health
Telephone: 408-918-3417
Last EDR Contact: 09/22/2008
Next Scheduled EDR Contact: 12/22/2008
Data Release Frequency: Varies

Hazardous Material Facilities

Hazardous material facilities, including underground storage tank sites.

Date of Government Version: 09/02/2008
Date Data Arrived at EDR: 09/04/2008
Date Made Active in Reports: 09/18/2008
Number of Days to Update: 14

Source: City of San Jose Fire Department
Telephone: 408-277-4659
Last EDR Contact: 09/02/2008
Next Scheduled EDR Contact: 12/01/2008
Data Release Frequency: Annually

SOLANO COUNTY:

Leaking Underground Storage Tanks

A listing of leaking underground storage tank sites located in Solano county.

Date of Government Version: 09/22/2008
Date Data Arrived at EDR: 10/06/2008
Date Made Active in Reports: 10/13/2008
Number of Days to Update: 7

Source: Solano County Department of Environmental Management
Telephone: 707-784-6770
Last EDR Contact: 09/22/2008
Next Scheduled EDR Contact: 12/22/2008
Data Release Frequency: Quarterly

Underground Storage Tanks

Underground storage tank sites located in Solano county.

Date of Government Version: 06/22/2008
Date Data Arrived at EDR: 07/03/2008
Date Made Active in Reports: 07/25/2008
Number of Days to Update: 22

Source: Solano County Department of Environmental Management
Telephone: 707-784-6770
Last EDR Contact: 09/22/2008
Next Scheduled EDR Contact: 12/22/2008
Data Release Frequency: Quarterly

SONOMA COUNTY:

Leaking Underground Storage Tank Sites

A listing of leaking underground storage tank sites located in Sonoma county.

Date of Government Version: 07/01/2008
Date Data Arrived at EDR: 07/22/2008
Date Made Active in Reports: 07/31/2008
Number of Days to Update: 9

Source: Department of Health Services
Telephone: 707-565-6565
Last EDR Contact: 10/20/2008
Next Scheduled EDR Contact: 01/19/2009
Data Release Frequency: Quarterly

SUTTER COUNTY:

Underground Storage Tanks

Underground storage tank sites located in Sutter county.

Date of Government Version: 05/04/2007
Date Data Arrived at EDR: 05/04/2007
Date Made Active in Reports: 05/24/2007
Number of Days to Update: 20

Source: Sutter County Department of Agriculture
Telephone: 530-822-7500
Last EDR Contact: 09/29/2008
Next Scheduled EDR Contact: 12/29/2008
Data Release Frequency: Semi-Annually

VENTURA COUNTY:

Business Plan, Hazardous Waste Producers, and Operating Underground Tanks

The BWT list indicates by site address whether the Environmental Health Division has Business Plan (B), Waste Producer (W), and/or Underground Tank (T) information.

Date of Government Version: 05/29/2008	Source: Ventura County Environmental Health Division
Date Data Arrived at EDR: 06/24/2008	Telephone: 805-654-2813
Date Made Active in Reports: 07/31/2008	Last EDR Contact: 09/10/2008
Number of Days to Update: 37	Next Scheduled EDR Contact: 12/08/2008
	Data Release Frequency: Quarterly

Inventory of Illegal Abandoned and Inactive Sites

Ventura County Inventory of Closed, Illegal Abandoned, and Inactive Sites.

Date of Government Version: 08/01/2008	Source: Environmental Health Division
Date Data Arrived at EDR: 09/04/2008	Telephone: 805-654-2813
Date Made Active in Reports: 09/18/2008	Last EDR Contact: 11/17/2008
Number of Days to Update: 14	Next Scheduled EDR Contact: 02/16/2009
	Data Release Frequency: Annually

Listing of Underground Tank Cleanup Sites

Ventura County Underground Storage Tank Cleanup Sites (LUST).

Date of Government Version: 05/29/2008	Source: Environmental Health Division
Date Data Arrived at EDR: 06/24/2008	Telephone: 805-654-2813
Date Made Active in Reports: 07/31/2008	Last EDR Contact: 09/09/2008
Number of Days to Update: 37	Next Scheduled EDR Contact: 09/08/2008
	Data Release Frequency: Quarterly

Underground Tank Closed Sites List

Ventura County Operating Underground Storage Tank Sites (UST)/Underground Tank Closed Sites List.

Date of Government Version: 10/01/2008	Source: Environmental Health Division
Date Data Arrived at EDR: 10/08/2008	Telephone: 805-654-2813
Date Made Active in Reports: 10/16/2008	Last EDR Contact: 10/08/2008
Number of Days to Update: 8	Next Scheduled EDR Contact: 01/05/2009
	Data Release Frequency: Quarterly

YOLO COUNTY:

Underground Storage Tank Comprehensive Facility Report

Underground storage tank sites located in Yolo county.

Date of Government Version: 08/11/2008	Source: Yolo County Department of Health
Date Data Arrived at EDR: 08/29/2008	Telephone: 530-666-8646
Date Made Active in Reports: 09/15/2008	Last EDR Contact: 11/10/2008
Number of Days to Update: 17	Next Scheduled EDR Contact: 01/12/2009
	Data Release Frequency: Annually

OTHER DATABASE(S)

Depending on the geographic area covered by this report, the data provided in these specialty databases may or may not be complete. For example, the existence of wetlands information data in a specific report does not mean that all wetlands in the area covered by the report are included. Moreover, the absence of any reported wetlands information does not necessarily mean that wetlands do not exist in the area covered by the report.

CT MANIFEST: Hazardous Waste Manifest Data

Facility and manifest data. Manifest is a document that lists and tracks hazardous waste from the generator through transporters to a tsd facility.

Date of Government Version: 12/31/2005	Source: Department of Environmental Protection
Date Data Arrived at EDR: 06/15/2007	Telephone: 860-424-3375
Date Made Active in Reports: 08/20/2007	Last EDR Contact: 09/12/2008
Number of Days to Update: 66	Next Scheduled EDR Contact: 12/08/2008
	Data Release Frequency: Annually

NJ MANIFEST: Manifest Information
Hazardous waste manifest information.

Date of Government Version: 09/30/2007
Date Data Arrived at EDR: 12/04/2007
Date Made Active in Reports: 12/31/2007
Number of Days to Update: 27

Source: Department of Environmental Protection
Telephone: N/A
Last EDR Contact: 11/07/2008
Next Scheduled EDR Contact: 02/02/2009
Data Release Frequency: Annually

NY MANIFEST: Facility and Manifest Data
Manifest is a document that lists and tracks hazardous waste from the generator through transporters to a TSD facility.

Date of Government Version: 07/23/2008
Date Data Arrived at EDR: 08/28/2008
Date Made Active in Reports: 09/11/2008
Number of Days to Update: 14

Source: Department of Environmental Conservation
Telephone: 518-402-8651
Last EDR Contact: 08/28/2008
Next Scheduled EDR Contact: 11/24/2008
Data Release Frequency: Annually

PA MANIFEST: Manifest Information
Hazardous waste manifest information.

Date of Government Version: 12/31/2007
Date Data Arrived at EDR: 09/11/2008
Date Made Active in Reports: 10/02/2008
Number of Days to Update: 21

Source: Department of Environmental Protection
Telephone: N/A
Last EDR Contact: 09/08/2008
Next Scheduled EDR Contact: 12/08/2008
Data Release Frequency: Annually

RI MANIFEST: Manifest information
Hazardous waste manifest information

Date of Government Version: 10/07/2008
Date Data Arrived at EDR: 10/10/2008
Date Made Active in Reports: 10/28/2008
Number of Days to Update: 18

Source: Department of Environmental Management
Telephone: 401-222-2797
Last EDR Contact: 09/15/2008
Next Scheduled EDR Contact: 12/15/2008
Data Release Frequency: Annually

WI MANIFEST: Manifest Information
Hazardous waste manifest information.

Date of Government Version: 12/31/2007
Date Data Arrived at EDR: 08/22/2008
Date Made Active in Reports: 09/08/2008
Number of Days to Update: 17

Source: Department of Natural Resources
Telephone: N/A
Last EDR Contact: 10/06/2008
Next Scheduled EDR Contact: 01/05/2009
Data Release Frequency: Annually

Oil/Gas Pipelines: This data was obtained by EDR from the USGS in 1994. It is referred to by USGS as GeoData Digital Line Graphs from 1:100,000-Scale Maps. It was extracted from the transportation category including some oil, but primarily gas pipelines.

Electric Power Transmission Line Data
Source: PennWell Corporation
Telephone: (800) 823-6277
This map includes information copyrighted by PennWell Corporation. This information is provided on a best effort basis and PennWell Corporation does not guarantee its accuracy nor warrant its fitness for any particular purpose. Such information has been reprinted with the permission of PennWell.

Sensitive Receptors: There are individuals deemed sensitive receptors due to their fragile immune systems and special sensitivity to environmental discharges. These sensitive receptors typically include the elderly, the sick, and children. While the location of all sensitive receptors cannot be determined, EDR indicates those buildings and facilities - schools, daycares, hospitals, medical centers, and nursing homes - where individuals who are sensitive receptors are likely to be located.

AHA Hospitals:
Source: American Hospital Association, Inc.
Telephone: 312-280-5991
The database includes a listing of hospitals based on the American Hospital Association's annual survey of hospitals.

Medical Centers: Provider of Services Listing
Source: Centers for Medicare & Medicaid Services
Telephone: 410-786-3000
A listing of hospitals with Medicare provider number, produced by Centers of Medicare & Medicaid Services, a federal agency within the U.S. Department of Health and Human Services.

Nursing Homes
Source: National Institutes of Health
Telephone: 301-594-6248
Information on Medicare and Medicaid certified nursing homes in the United States.

Public Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on elementary and secondary public education in the United States. It is a comprehensive, annual, national statistical database of all public elementary and secondary schools and school districts, which contains data that are comparable across all states.

Private Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on private school locations in the United States.

Daycare Centers: Licensed Facilities
Source: Department of Social Services
Telephone: 916-657-4041

Flood Zone Data: This data, available in select counties across the country, was obtained by EDR in 1999 from the Federal Emergency Management Agency (FEMA). Data depicts 100-year and 500-year flood zones as defined by FEMA.

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 2002 and 2005 from the U.S. Fish and Wildlife Service.

Scanned Digital USGS 7.5' Topographic Map (DRG)
Source: United States Geologic Survey
A digital raster graphic (DRG) is a scanned image of a U.S. Geological Survey topographic map. The map images are made by scanning published paper maps on high-resolution scanners. The raster image is georeferenced and fit to the Universal Transverse Mercator (UTM) projection.

STREET AND ADDRESS INFORMATION

GEOCHECK ®- PHYSICAL SETTING SOURCE ADDENDUM

TARGET PROPERTY ADDRESS

FORMER RICE FIELD
SOUTH SIDE HIGWAY 62 AT MILE MARKER 109
RICE, CA 92239

TARGET PROPERTY COORDINATES

Latitude (North):	34.06526 - 34˚ 3’ 54.9’’
Longitude (West):	114.81486 - 114˚ 48’ 53.5’’
Universal Tranverse Mercator:	Zone 11
UTM X (Meters):	701661.4
UTM Y (Meters):	3771351.8
Elevation:	819 ft. above sea level

USGS TOPOGRAPHIC MAP

Target Property Map:	34114-A7 RICE, CA
Most Recent Revision:	1983

EDR’s GeoCheck Physical Setting Source Addendum is provided to assist the environmental professional in forming an opinion about the impact of potential contaminant migration.

Assessment of the impact of contaminant migration generally has two principle investigative components:

1. Groundwater flow direction, and
2. Groundwater flow velocity.

Groundwater flow direction may be impacted by surface topography, hydrology, hydrogeology, characteristics of the soil, and nearby wells. Groundwater flow velocity is generally impacted by the nature of the geologic strata.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

GROUNDWATER FLOW DIRECTION INFORMATION

Groundwater flow direction for a particular site is best determined by a qualified environmental professional using site-specific well data. If such data is not reasonably ascertainable, it may be necessary to rely on other sources of information, such as surface topographic information, hydrologic information, hydrogeologic data collected on nearby properties, and regional groundwater flow information (from deep aquifers).

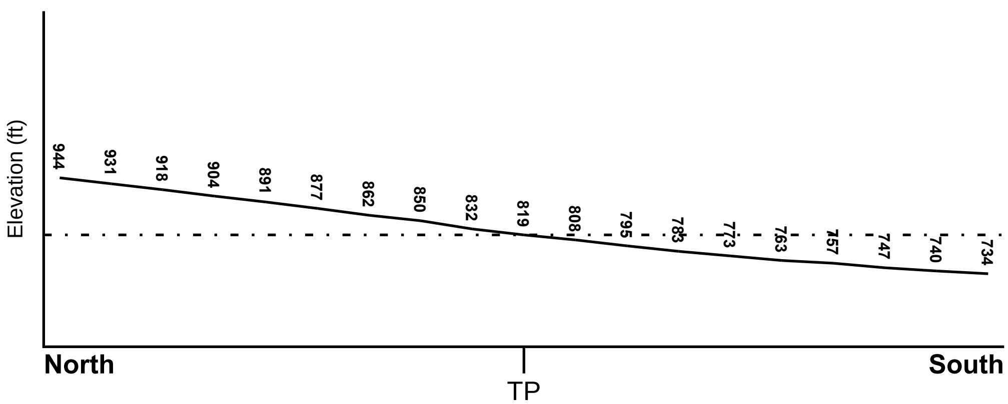
TOPOGRAPHIC INFORMATION

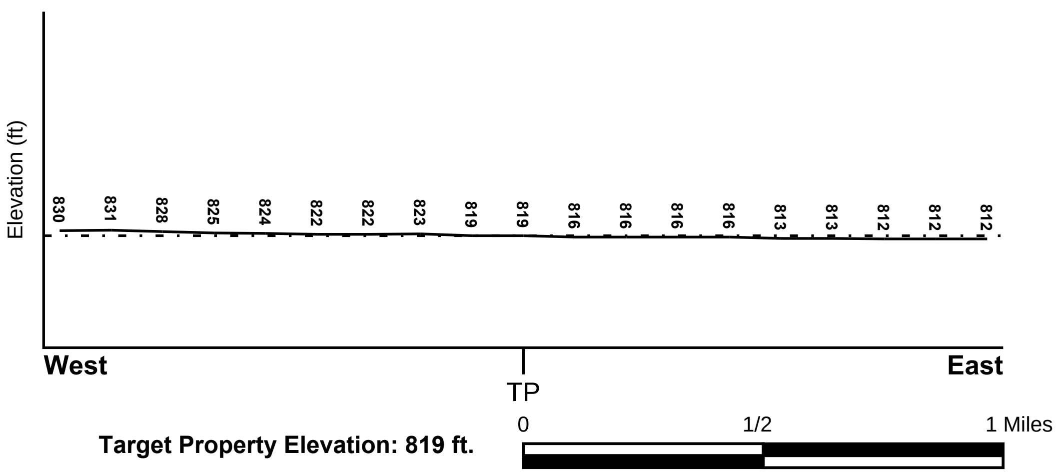
Surface topography may be indicative of the direction of surficial groundwater flow. This information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

TARGET PROPERTY TOPOGRAPHY

General Topographic Gradient: General South

SURROUNDING TOPOGRAPHY: ELEVATION PROFILES





Target Property Elevation: 819 ft.

Source: Topography has been determined from the USGS 7.5' Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified.

HYDROLOGIC INFORMATION

Surface water can act as a hydrologic barrier to groundwater flow. Such hydrologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

Refer to the Physical Setting Source Map following this summary for hydrologic information (major waterways and bodies of water).

FEMA FLOOD ZONE

Target Property County	FEMA Flood Electronic Data
RIVERSIDE, CA	YES - refer to the Overview Map and Detail Map

Flood Plain Panel at Target Property: 0602450575A

Additional Panels in search area: 06071C9200F

NATIONAL WETLAND INVENTORY

NWI Quad at Target Property	NWI Electronic Data Coverage
RICE	Not Available

HYDROGEOLOGIC INFORMATION

Hydrogeologic information obtained by installation of wells on a specific site can often be an indicator of groundwater flow direction in the immediate area. Such hydrogeologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

Site-Specific Hydrogeological Data*:

Search Radius: 1.25 miles
Status: Not found

AQUIFLOW®

Search Radius: 1.000 Mile.

EDR has developed the AQUIFLOW Information System to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted by environmental professionals to regulatory authorities at select sites and has extracted the date of the report, groundwater flow direction as determined hydrogeologically, and the depth to water table.

MAP ID	LOCATION FROM TP	GENERAL DIRECTION GROUNDWATER FLOW
Not Reported		

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

GROUNDWATER FLOW VELOCITY INFORMATION

Groundwater flow velocity information for a particular site is best determined by a qualified environmental professional using site specific geologic and soil strata data. If such data are not reasonably ascertainable, it may be necessary to rely on other sources of information, including geologic age identification, rock stratigraphic unit and soil characteristics data collected on nearby properties and regional soil information. In general, contaminant plumes move more quickly through sandy-gravelly types of soils than silty-clayey types of soils.

GEOLOGIC INFORMATION IN GENERAL AREA OF TARGET PROPERTY

Geologic information can be used by the environmental professional in forming an opinion about the relative speed at which contaminant migration may be occurring.

ROCK STRATIGRAPHIC UNIT

Era:	Cenozoic
System:	Quaternary
Series:	Quaternary
Code:	Q *(decoded above as Era, System & Series)*

GEOLOGIC AGE IDENTIFICATION

Category: Stratifed Sequence

Geologic Age and Rock Stratigraphic Unit Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - a digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

DOMINANT SOIL COMPOSITION IN GENERAL AREA OF TARGET PROPERTY

The U.S. Department of Agriculture's (USDA) Soil Conservation Service (SCS) leads the National Cooperative Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. Soil maps for STATSGO are compiled by generalizing more detailed (SSURGO) soil survey maps. The following information is based on Soil Conservation Service STATSGO data.

Soil Component Name:	CARRIZO
Soil Surface Texture:	extremely gravelly - sandy loam
Hydrologic Group:	Class A - High infiltration rates. Soils are deep, well drained to excessively drained sands and gravels.
Soil Drainage Class:	Excessively. Soils have very high and high hydraulic conductivity and low water holding capacity. Depth to water table is more than 6 feet.

Hydric Status: Soil does not meet the requirements for a hydric soil.

Corrosion Potential - Uncoated Steel:	HIGH
Depth to Bedrock Min:	> 60 inches
Depth to Bedrock Max:	> 60 inches

Soil Layer Information							
	Boundary			Classification			
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil	Permeability Rate (in/hr)	Soil Reaction (pH)
1	0 inches	10 inches	extremely gravelly - sandy loam	Granular materials (35 pct. or less passing No. 200), Stone Fragments, Gravel and Sand.	COARSE-GRAINED SOILS, Gravels, Clean gravels, Poorly Graded Gravel. COARSE-GRAINED SOILS, Gravels, Gravels with fines, Silty Gravel.	Max: 6.00 Min: 2.00	Max: 8.40 Min: 7.90
2	10 inches	60 inches	stratified	Granular materials (35 pct. or less passing No. 200), Stone Fragments, Gravel and Sand.	COARSE-GRAINED SOILS, Gravels, Clean gravels, Poorly Graded Gravel.	Max: 20.00 Min: 20.00	Max: 8.40 Min: 7.90
3	60 inches	70 inches	stratified	Granular materials (35 pct. or less passing No. 200), Stone Fragments, Gravel and Sand.	COARSE-GRAINED SOILS, Gravels, Clean gravels, Poorly Graded Gravel.	Max: 20.00 Min: 20.00	Max: 8.40 Min: 7.90

OTHER SOIL TYPES IN AREA

Based on Soil Conservation Service STATSGO data, the following additional subordinant soil types may appear within the general area of target property.

Soil Surface Textures: loamy fine sand
gravelly - loamy sand
very gravelly - sand
loamy coarse sand
sand
fine sandy loam
very gravelly - silt loam
gravelly - sandy loam
sandy loam

Surficial Soil Types: loamy fine sand
gravelly - loamy sand
very gravelly - sand
loamy coarse sand
sand
fine sandy loam
very gravelly - silt loam
gravelly - sandy loam
sandy loam

Shallow Soil Types: fine sandy loam

	coarse sandy loam
Deeper Soil Types:	sand extremely gravelly - coarse sand very gravelly - loam loamy fine sand sandy clay loam very gravelly - sand sandy loam clay fine sand

LOCAL / REGIONAL WATER AGENCY RECORDS

EDR Local/Regional Water Agency records provide water well information to assist the environmental professional in assessing sources that may impact ground water flow direction, and in forming an opinion about the impact of contaminant migration on nearby drinking water wells.

WELL SEARCH DISTANCE INFORMATION

DATABASE	SEARCH DISTANCE (miles)
Federal USGS	1.000
Federal FRDS PWS	Nearest PWS within 1 mile
State Database	1.000

FEDERAL USGS WELL INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
A1	USGS3087434	1/2 - 1 Mile North

FEDERAL FRDS PUBLIC WATER SUPPLY SYSTEM INFORMATION

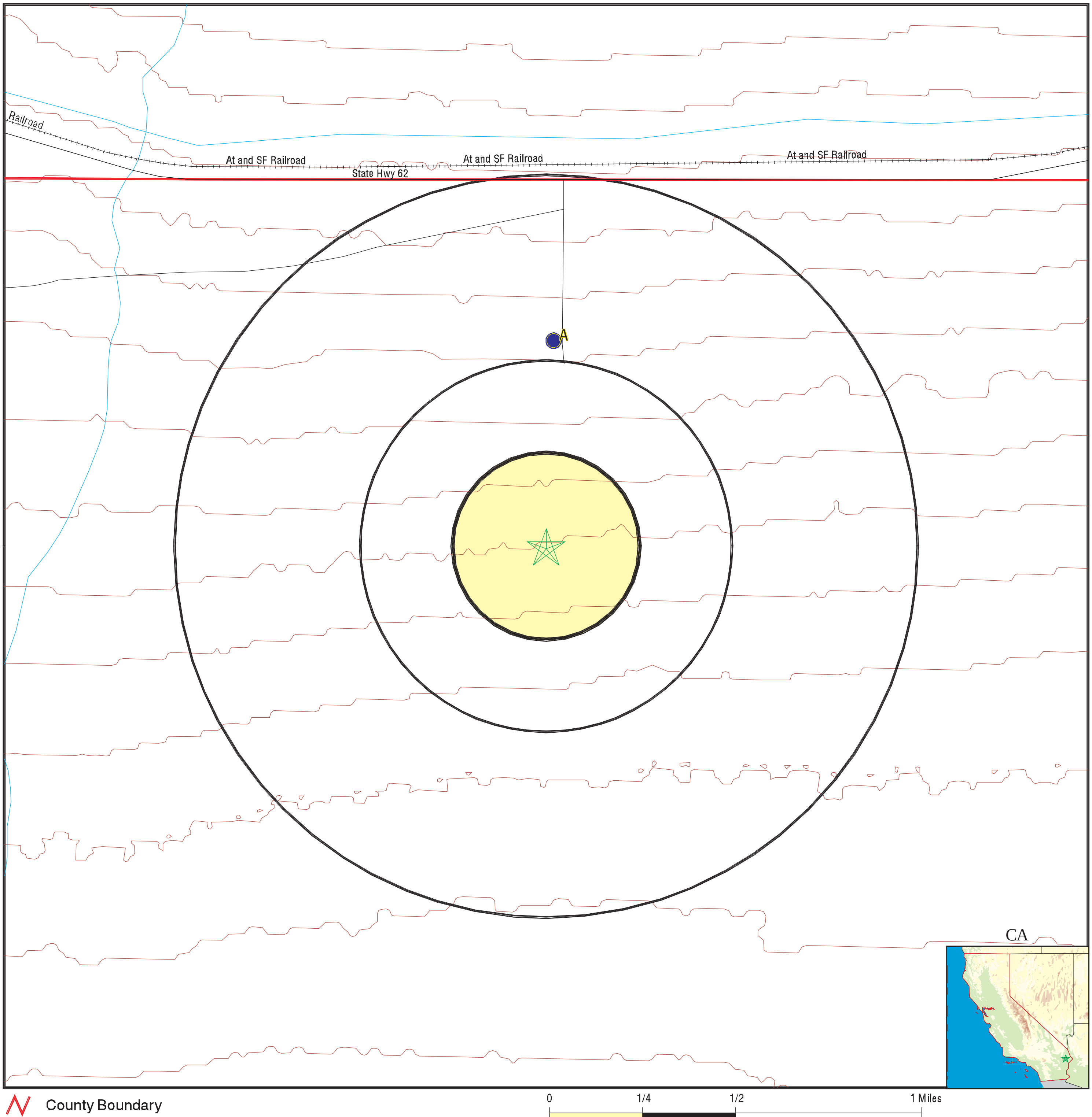
MAP ID	WELL ID	LOCATION FROM TP
No PWS System Found		

Note: PWS System location is not always the same as well location.

STATE DATABASE WELL INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
A2	CADW20000006586	1/2 - 1 Mile North

PHYSICAL SETTING SOURCE MAP - 2366316.2s



County Boundary
Major Roads
Contour Lines
Earthquake Fault Lines
Earthquake epicenter, Richter 5 or greater
Water Wells
Public Water Supply Wells
Cluster of Multiple Icons

Groundwater Flow Direction
Indeterminate Groundwater Flow at Location
Groundwater Flow Varies at Location
Closest Hydrogeological Data
Oil, gas or related wells

SITE NAME:	Former Rice Field	CLIENT:	URS Corporation
ADDRESS:	South Side Higway 62 at Mile Marker 109	CONTACT:	Lowell Woodbury
	Rice CA 92239	INQUIRY #:	2366316.2s
LAT/LONG:	34.0653 / 114.8149	DATE:	November 18, 2008 6:33 pm

000347

GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS

Map ID Direction Distance Elevation	Database	EDR ID Number
A1 **North** **1/2 - 1 Mile** **Higher**	**FED USGS**	**USGS3087434**

Agency cd:	USGS	Site no:	340424114484801
Site name:	001S021E19G001S		
Latitude:	340423.71		
Longitude:	1144847.90	Dec lat:	34.07326719
Dec lon:	-114.81410724	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	SESENWS19 T01S R21E S
Location map:	RICE	Map scale:	24000
Altitude:	878.3		
Altitude method:	Differential Global Positioning System (GPS)		
Altitude accuracy:	0.1		
Altitude datum:	National Geodetic Vertical Datum of 1929		
Hydrologic:	Southern Mojave. California. Area = 8700 sq.mi.		
Topographic:	Alluvial fan		
Site type:	Ground-water other than Spring	Date construction:	1947
Date inventoried:	19620327	Mean greenwich time offset:	PST
Local standard time flag:	Y		
Type of ground water site:	Single well, other than collector or Ranney type		
Aquifer Type:	Not Reported		
Aquifer:	Not Reported		
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported		
Project number:	CHI RCV		
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1954-09-17	Ground water data end date:	2001-03-29
Ground water data count:	3		

Ground-water levels, Number of Measurements: 3

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
2001-03-29					

Note: An obstruction was encountered in the well above the water surface (no water level recorded).

1992-03-18		

Note: An obstruction was encountered in the well above the water surface (no water level recorded).

1954-09-17	312.35	

A2 **North** **1/2 - 1 Mile** **Higher**	**CA WELLS**	**CADW20000006586**

Longitude:	114.8141
Latitude:	34.0733
Stwellno:	01S21E19G001S
Districtco:	3
Welluseco:	Z
Countycode:	33
Gwcode:	700400
Site id:	CADW20000006586

AREA RADON INFORMATION

State Database: CA Radon

Radon Test Results

Zip	Total Sites	> 4 Pci/L	Pct. > 4 Pci/L
92239	1	0	0.00

Federal EPA Radon Zone for RIVERSIDE County: 2

Note: Zone 1 indoor average level > 4 pCi/L.
: Zone 2 indoor average level >= 2 pCi/L and <= 4 pCi/L.
: Zone 3 indoor average level < 2 pCi/L.

Federal Area Radon Information for RIVERSIDE COUNTY, CA

Number of sites tested: 12

Area	Average Activity	% <4 pCi/L	% 4-20 pCi/L	% >20 pCi/L
Living Area - 1st Floor	0.117 pCi/L	100%	0%	0%
Living Area - 2nd Floor	0.450 pCi/L	100%	0%	0%
Basement	1.700 pCi/L	100%	0%	0%

PHYSICAL SETTING SOURCE RECORDS SEARCHED

TOPOGRAPHIC INFORMATION

USGS 7.5' Digital Elevation Model (DEM)
Source: United States Geologic Survey
EDR acquired the USGS 7.5' Digital Elevation Model in 2002 and updated it in 2006. The 7.5 minute DEM corresponds to the USGS 1:24,000- and 1:25,000-scale topographic quadrangle maps. The DEM provides elevation data with consistent elevation units and projection.

Scanned Digital USGS 7.5' Topographic Map (DRG)
Source: United States Geologic Survey
A digital raster graphic (DRG) is a scanned image of a U.S. Geological Survey topographic map. The map images are made by scanning published paper maps on high-resolution scanners. The raster image is georeferenced and fit to the Universal Transverse Mercator (UTM) projection.

HYDROLOGIC INFORMATION

Flood Zone Data: This data, available in select counties across the country, was obtained by EDR in 1999 from the Federal Emergency Management Agency (FEMA). Data depicts 100-year and 500-year flood zones as defined by FEMA.

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 2002 and 2005 from the U.S. Fish and Wildlife Service.

HYDROGEOLOGIC INFORMATION

AQUIFLOW[R] Information System
Source: EDR proprietary database of groundwater flow information
EDR has developed the AQUIFLOW Information System (AIS) to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted to regulatory authorities at select sites and has extracted the date of the report, hydrogeologically determined groundwater flow direction and depth to water table information.

GEOLOGIC INFORMATION

Geologic Age and Rock Stratigraphic Unit
Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - A digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

STATSGO: State Soil Geographic Database
Source: Department of Agriculture, Natural Resources Conservation Services
The U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) leads the national Conservation Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. Soil maps for STATSGO are compiled by generalizing more detailed (SSURGO) soil survey maps.

SSURGO: Soil Survey Geographic Database
Source: Department of Agriculture, Natural Resources Conservation Services (NRCS)
Telephone: 800-672-5559
SSURGO is the most detailed level of mapping done by the Natural Resources Conservation Services, mapping scales generally range from 1:12,000 to 1:63,360. Field mapping methods using national standards are used to construct the soil maps in the Soil Survey Geographic (SSURGO) database. SSURGO digitizing duplicates the original soil survey maps. This level of mapping is designed for use by landowners, townships and county natural resource planning and management.

PHYSICAL SETTING SOURCE RECORDS SEARCHED

LOCAL / REGIONAL WATER AGENCY RECORDS

FEDERAL WATER WELLS

PWS: Public Water Systems
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Public Water System data from the Federal Reporting Data System. A PWS is any water system which provides water to at least 25 people for at least 60 days annually. PWSs provide water from wells, rivers and other sources.

PWS ENF: Public Water Systems Violation and Enforcement Data
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Violation and Enforcement data for Public Water Systems from the Safe Drinking Water Information System (SDWIS) after August 1995. Prior to August 1995, the data came from the Federal Reporting Data System (FRDS).

USGS Water Wells: USGS National Water Inventory System (NWIS)
This database contains descriptive information on sites where the USGS collects or has collected data on surface water and/or groundwater. The groundwater data includes information on wells, springs, and other sources of groundwater.

STATE RECORDS

Water Well Database
Source: Department of Water Resources
Telephone: 916-651-9648

California Drinking Water Quality Database
Source: Department of Health Services
Telephone: 916-324-2319
The database includes all drinking water compliance and special studies monitoring for the state of California since 1984. It consists of over 3,200,000 individual analyses along with well and water system information.

OTHER STATE DATABASE INFORMATION

California Oil and Gas Well Locations
Source: Department of Conservation
Telephone: 916-323-1779

RADON

State Database: CA Radon
Source: Department of Health Services
Telephone: 916-324-2208
Radon Database for California

Area Radon Information
Source: USGS
Telephone: 703-356-4020
The National Radon Database has been developed by the U.S. Environmental Protection Agency (USEPA) and is a compilation of the EPA/State Residential Radon Survey and the National Residential Radon Survey. The study covers the years 1986 - 1992. Where necessary data has been supplemented by information collected at private sources such as universities and research institutions.

EPA Radon Zones
Source: EPA
Telephone: 703-356-4020
Sections 307 & 309 of IRAA directed EPA to list and identify areas of U.S. with the potential for elevated indoor radon levels.

PHYSICAL SETTING SOURCE RECORDS SEARCHED

OTHER

Airport Landing Facilities: Private and public use landing facilities
Source: Federal Aviation Administration, 800-457-6656

Epicenters: World earthquake epicenters, Richter 5 or greater
Source: Department of Commerce, National Oceanic and Atmospheric Administration

California Earthquake Fault Lines: The fault lines displayed on EDR's Topographic map are digitized quaternary fault lines, prepared in 1975 by the United State Geological Survey. Additional information (also from 1975) regarding activity at specific fault lines comes from California's Preliminary Fault Activity Map prepared by the California Division of Mines and Geology.

STREET AND ADDRESS INFORMATION

Former Rice Field
South Side Higway 62 at Mile Marker 109
Rice, CA 92239

Inquiry Number: 2366316.5
November 20, 2008

The EDR Aerial Photo Decade Package

EDR® Environmental Data Resources Inc

440 Wheelers Farms Road
Milford, CT 06461
800.352.0050
www.edrnet.com

EDR Aerial Photo Decade Package

Environmental Data Resources, Inc. (EDR) Aerial Photo Decade Package is a screening tool designed to assist environmental professionals in evaluating potential liability on a target property resulting from past activities. EDRs professional researchers provide digitally reproduced historical aerial photographs, and when available, provide one photo per decade.

When delivered electronically by EDR, the aerial photo images included with this report are for ONE TIME USE ONLY. Further reproduction of these aerial photo images is prohibited without permission from EDR. For more information contact your EDR Account Executive.

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

Date EDR Searched Historical Sources:

Aerial Photography November 20, 2008

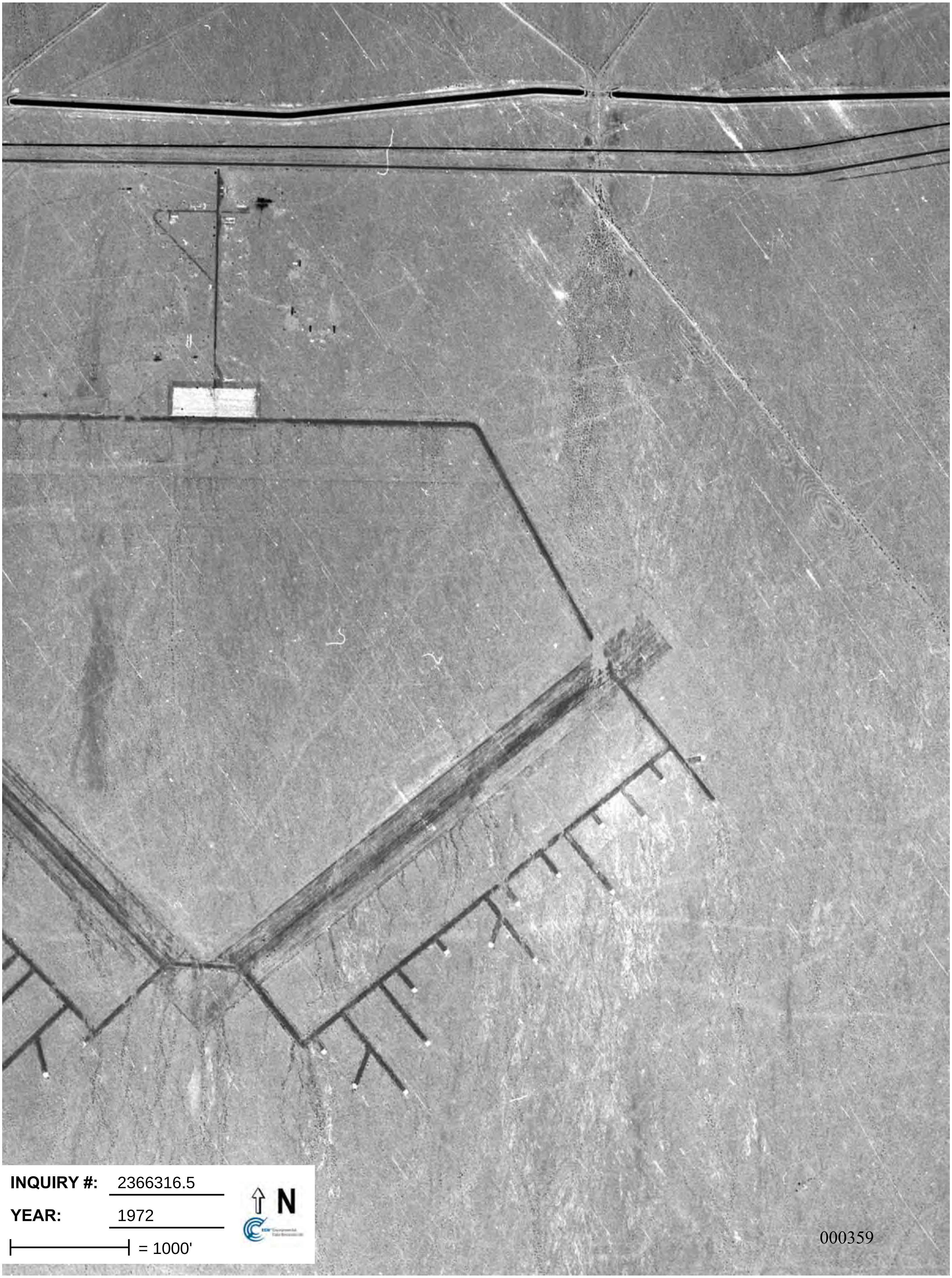
Target Property:

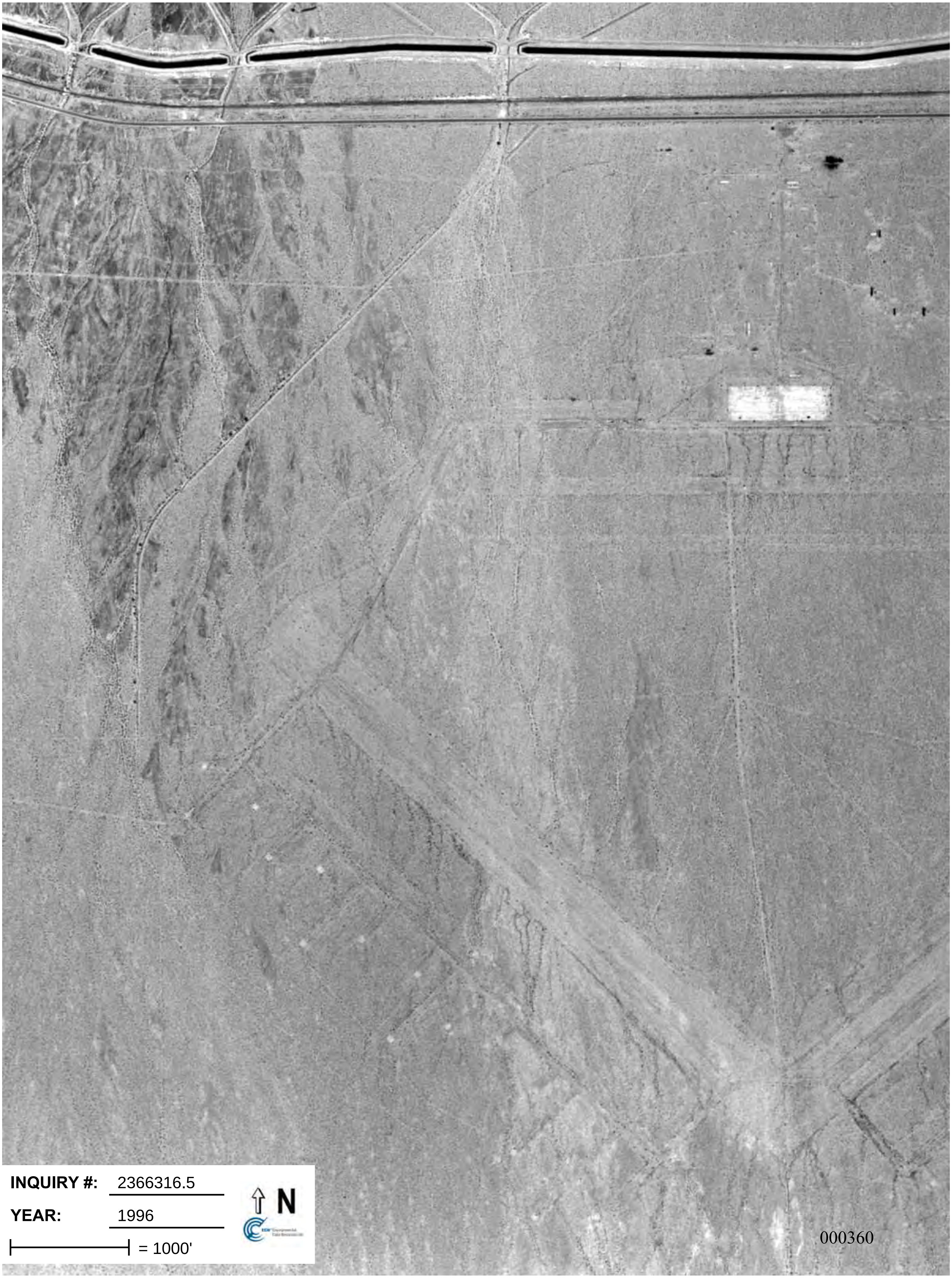
South Side Higway 62 at Mile Marker 109

Rice, CA 92239

Year	***Scale***	***Details***	***Source***
1972	Aerial Photograph. Scale: 1"=1000'	Flight Year: 1972	Teledyne
1972	Aerial Photograph. Scale: 1"=1000'	Flight Year: 1972	Teledyne
1996	Aerial Photograph. Scale: 1"=1000'	Flight Year: 1996	USGS
1996	Aerial Photograph. Scale: 1"=1000'	Flight Year: 1996 Best Copy Available from original source	USGS
2002	Aerial Photograph. Scale: 1"=1000'	Flight Year: 2002	USGS
2002	Aerial Photograph. Scale: 1"=1000'	Flight Year: 2002 Best Copy Available from original source	USGS
2005	Aerial Photograph. Scale: 1"=484'	Flight Year: 2005	EDR


INQUIRY #: 2366316.5
YEAR: 1972
= 1000'
N
EDR Environmental Data Resources Inc


INQUIRY #: 2366316.5
YEAR: 1972
= 1000'
N




INQUIRY #: 2366316.5
YEAR: 1996
N
= 1000'


INQUIRY #: 2366316.5
YEAR: 2002
= 1000'
N


INQUIRY #: 2366316.5
YEAR: 2002
= 1000'
N


INQUIRY #: 2366316.5
YEAR: 2005
N
= 484'

This Page

Intentionally

Left Blank

BLM
FWS

Military Munitions and Explosives of Concern:

A Handbook for Federal Land Managers, with Emphasis on Unexploded Ordnance

February 2006

BLM Handbook [H-1703-2] • FWS Handbook 2006

The U.S. Department of the Interior's Bureau of Land Management and U.S. Fish and Wildlife Service present an overview of unexploded ordnance and its management on Federal lands under their jurisdiction.

000366

We extend our thanks to the Department of the Army and the U.S. Army Corps of Engineers for their assistance with the preparation of this handbook.

Suggested citation:

Bureau of Land Management Protection and Response Group. 2005.
Military Munitions and Explosives of Concern: A Handbook for Federal Land Managers, with Emphasis on Unexploded Ordnance, BLM Handbook H-1703-2. Washington, DC. *****. 96 pages.
*Release number 1-1697

Unless noted otherwise, BLM and FWS provided all the photographs.

Cover Photo – Nomans Land Island National Wildlife Refuge, Massachusetts, the results of many years of practice bombing.

Military Munitions and Explosives of Concern:

A Handbook for Federal Land Managers, with Emphasis on Unexploded Ordnance

BLM Handbook [H-1703-2]
FWS Handbook
2006

Bureau of Land Management
U.S. Fish and Wildlife Service

U.S. Department of the Interior
Washington, DC

Unexploded ordnance comes in all shapes and sizes.
This World War II-era sea mine washed ashore in the Aleutian Islands,
Alaska Maritime National Wildlife Refuge.

How to Get Help if You Encounter Unexploded Ordnance

First: Call local law enforcement or the nearest military installation.
Next: Call the appropriate personnel for your agency:

- **BLM employee—**Call the BLM ranger or call the hazardous materials coordinator at the BLM office, or BLM State office, that has jurisdiction for the site. If you cannot reach the hazardous materials coordinator, call the BLM State law enforcement office emergency number or the BLM national law enforcement office at (208) 387-5126.

- **FWS employee—**Call the regional environmental compliance engineer or regional safety officer.

TABLE OF CONTENTS

FIGURES AND CAPTIONS

TABLES

PRIMARY DEFINITIONS

Note: Additional definitions are given in the glossary.

Discarded military munitions (DMM). Military munitions that have been abandoned without proper disposal or have been removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include unexploded ordnance, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed of consistent with applicable environmental laws and regulations. (10 U.S.C. §2710(e)(2))

Fuzes. Devices that initiate the detonation sequence in munitions. Fuzes are typically associated with munitions (e.g., mortars and bombs), but they are occasionally found separately. They may contain a charge large enough to cause injury. Magnetic and proximity fuzes are the most sensitive and, depending on other factors (e.g., fuze location and arming), greatly influence the likelihood of detonation. When separated from the munitions, a fuze may not look like an explosive munitions item.

The terms *fuse* and *fuze* mean different things. For this handbook, a *fuze* is a mechanical or electrical device with explosive or non-explosive components designed to initiate a train of fire or detonation in ordnance (e.g., hand grenade). A *fuse* is a cord of readily combustible material that can be lit at one end to carry a flame along the length of the fuse to detonate an explosive at the other end (e.g., firecracker).

Military munitions. Ammunition products and components produced for or used by the armed forces for national defense and security. The term *military munitions* includes ammunition products or components under the control of the Department of Defense, the U.S. Coast Guard, the Department of Energy, and the National Guard. The term includes confined gaseous, liquid, and solid propellants; explosives; pyrotechnics; chemical and riot control agents; smokes and incendiaries; bulk explosives; chemical agents; chemical munitions; rockets; guided and ballistic missiles; bombs; warheads; mortar rounds; artillery ammunition; small arms ammunition; grenades; mines; torpedoes; depth charges; cluster munitions and dispensers; demolition charges; and devices and components thereof.

Military munitions do not include wholly inert items, improvised explosive devices, or nuclear weapons, nuclear devices, or nuclear components. However, military munitions do include non-nuclear components of nuclear devices that are managed under the nuclear weapons program of the Department of Energy after all required sanitization operations under the Atomic Energy Act of 1954 (42 U.S.C. §2011 *et seq.*) have been completed. (10 U.S.C. §101(e)(4))

Munitions constituents (MC). Any materials originating from unexploded ordnance, discarded military munitions, or other military munitions, including explosive and non-explosive materials. MC also includes emission, degradation, or breakdown elements of such ordnance or munitions. (10 U.S.C. §2710(e)(3)) Note: Munitions constituents are MEC when explosive compounds of the munitions, such as TNT, RDX, and HMX, are in sufficient concentration as to pose an explosive hazard. This situation arises when concentration levels are 10 percent or more. Non-explosive munitions constituents and explosive concentrations less than 10 percent are not considered MEC.

Munitions and explosives of concern (MEC). Specific categories of military munitions that may pose unique explosive risks, including:

(a) unexploded ordnance (UXO), as defined in 10 U.S.C. §101(e)(5);
(b) discarded military munitions (DMM), as defined in 10 U.S.C. §2710(e)(2); or
(c) munitions constituents (e.g., TNT, RDX), as defined in 10 U.S.C. §2710(e)(3), present in high enough concentrations to pose an explosive hazard. (See "Munitions constituents")

Munitions response. Response actions—including investigation, removal actions, and remedial actions—to address the explosives safety, human health, or environmental risks presented by unexploded ordnance (UXO), discarded military munitions (DMM), or munitions constituents (MC), or to support a determination that no removal or remedial action is required.

Unexploded ordnance (UXO). Military munitions that:

(a) have been primed, fuzed, armed, or otherwise prepared for action;
(b) have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material; and
(c) remain unexploded whether by malfunction, design, or any other cause.
(10 U.S.C. §101(e)(5)(A) through (C))

P.L. 106-65, section 3031 (c)(5)(A), provides a more detailed description.

ACRONYMS

ADNT	Aminodinitrotoluene
AEC	Army Environmental Center
BIP	Blow-in-place
BLM	Bureau of Land Management
BRAC	Base Realignment and Closure
CB	Citizens band
CCP	Comprehensive conservation plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CSM	Conceptual site model
CTT	Closed, transferring, and transferred [ranges]
DDESB	Department of Defense Explosives Safety Board
DERP	Defense Environmental Restoration Program
DMM	Discarded military munitions
DNA	Dinitroaniline
DNB	Dinitrobenzene
DoD	Department of Defense
DOI	Department of the Interior
EM	Engineering Manual
EMI	Electromagnetic induction
EOD	Explosive ordnance disposal
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FACA	Federal Advisory Committee Act
FFCA	Federal Facility Compliance Act
FLPMA	Federal Land Policy and Management Act of 1976
FORSCOM	Forces Command (U.S. Army)
FUDS	Formerly used defense sites
FWS	U.S. Fish and Wildlife Service
GPR	Ground penetrating radar
GPS	Global positioning system
HMX	Her Majesty's explosive [high explosive] and high melting explosive
IR	Infrared
IRP	Installation Restoration Program
ITRC	Interstate Technology and Regulatory Council
JUXOCO	Joint Unexploded Ordnance Coordination Office
MC	Munitions constituents
MEC	Munitions and explosives of concern
MRA	Munitions response area
MRS	Munitions response site
MTADS	Multisensor Towed Array Detection System
NAVFAC	Naval Facilities Engineering Command
NEPA	National Environmental Policy Act

OB/OD	Open burning/open detonation
OE	Ordnance and explosives
OEW	Ordnance and explosives waste
OMB	Office of Management and Budget
PDA	Personal digital assistant
P.L.	Public Law
RAB	Restoration Advisory Board
RAC	Resource Advisory Council
RCRA	Resource Conservation and Recovery Act
RDX	Royal demolition explosive [high explosive]
SAR	Synthetic aperture radar
SARA	Superfund Amendments and Reauthorization Act
TNB	Trinitrobenzene
TNT	Trinitrotoluene
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
UXO	Unexploded ordnance

PREFACE

Approximately 40 national wildlife refuges managed by the U.S. Fish and Wildlife Service (FWS), and between 200 and 300 formerly used defense sites (FUDS) managed by the Bureau of Land Management (BLM), still have munitions and explosives of concern (MEC) on-site. Therefore, land managers must be prepared for the possibility that personnel, authorized users (i.e., oil gas operator, farmer, rancher, etc.), or visitors will encounter unexploded ordnance (UXO) or discarded military munitions (DMM) on certain public lands and refuges. UXO and DMM encounters that cause injury or death have been rare. However, public use of BLM and FWS lands is increasing, along with the potential for exposure to UXO and DMM. The BLM and FWS developed this handbook to provide managers with important information on what to do when UXO and DMM are encountered and how to minimize the likelihood of an incident leading to injury or death.

The BLM is responsible for managing over 261 million acres of America's public lands and resources for multiple use and sustained yield. As part of this management effort, the BLM accepts into its inventory lands that were formerly used by the military services (Army, Navy, Air Force, and Marine Corps). Accepting lands that have been returned to the public domain and opening former military ranges for public use present unique challenges. More than 5 million acres of BLM-managed land that is open to public access may contain MEC. The BLM is collaborating with the Department of Defense (DoD) and the U.S. Army Corps of Engineers (USACE) to address MEC-contaminated lands currently in BLM's inventory and the possible transfer of additional military lands to BLM management.

The FWS works in partnership with other Federal agencies, State and local governments, tribal governments, international organizations, private organizations, and individuals to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people. Under a wide range of Federal laws and executive orders, the FWS has principal responsibility for the protection and conservation of migratory birds, threatened and endangered species, certain marine mammals, and interjurisdictional fisheries. The FWS accomplishes its mission through the management of the National Wildlife Refuge System, Ecological Services Field Stations, National Fish Hatcheries, Wetlands Management Districts with Waterfowl Production Areas, and Coordination Areas, encompassing about 96 million acres in all. The National Wildlife Refuge System includes public lands that were formerly, and in some cases are currently, held and used by the military services. Congress sometimes legislatively directs the BLM and FWS to take lands from the military services. Often these lands contain MEC.

In addition, the FWS manages lands in the Aleutian Islands and the Pacific islands that were battlegrounds during World War II. The islands have MEC remnants from the war.

The BLM and FWS follow several basic principles for managing lands containing MEC, including the following:

- The BLM and FWS have been delegated response authorities under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) on lands subject to its jurisdiction, custody, or control (Executive Order 12580).

- On MEC sites managed by the BLM and FWS, risk management is primarily the responsibility of the BLM and FWS, in coordination with DoD.
- The military service is responsible for developing an inventory of the MEC sites on BLM- and FWS-managed lands, with the cooperation of the BLM and FWS. The BLM and FWS will provide the inventory to field offices and field stations, which will be responsible for making the inventories available to local law enforcement and firefighting personnel.
- The responsible military service and the BLM or FWS will jointly implement access controls and other risk reduction actions, as necessary and appropriate.
- The BLM and FWS normally do not accept the transfer of lands until the lands have been properly cleared of MEC to a level that safely supports the intended land use.

Where MEC removal and remedial actions may destroy important habitat, the BLM and FWS may decide to leave some MEC in place and restrict public access to reduce the risk to the public and protect the habitat.

The military service's primary responsibilities include the following:

- Maintain an inventory of sites containing MEC.
- Provide site characterization and risk assessment.
- Assist Federal land managers with risk management.
- Coordinate with the BLM or FWS to obtain the necessary approvals for response actions to ensure that proposed actions are compatible with the agencies' resource management goals.
- Take appropriate removal and remedial actions, with the concurrence of the BLM or FWS.

BLM and FWS managers and personnel do not touch, move, or remove MEC on the Federal lands under their control. The military services retain liability and responsibility for MEC removal and remedial actions on all lands transferred or transferring from the military to the BLM or FWS. Through a partnership with the military services, the BLM and FWS ensure that MEC removal and remedial actions are consistent with the intended land use, protect the environment, and reduce the risk to the public and employees. The BLM and FWS, as land managers, provide oversight for actions performed by the military services.

This handbook will provide Federal land managers and personnel with a fundamental understanding of MEC and of their risk management options for sites with MEC. The handbook presents answers to the following:

- What is MEC and what does MEC look like?
- What should we do if we find MEC?
- What should we tell personnel and the public about MEC?
- What types of sites may contain MEC?
- How do we use a historical records search to learn what types of UXO may be encountered?
- What are the BLM's and FWS's policies and options for managing lands transferred from the military services?
- What technologies are available for detecting and removing UXO and DMM?
- What are the statutes, policies, and references associated with MEC?

Actual injuries and deaths due to contact with UXO and DMM are rare, but the consequences of encountering UXO and DMM are too severe to ignore. Proper UXO and DMM management reduces the risk to the public and to BLM and FWS employees. It is the responsibility of BLM and FWS managers to educate themselves and their personnel regarding these risk reduction measures.

This handbook does not address commercial explosives.

Chapter 1

Introduction

Acronym List	
BLM	Bureau of Land Management
BRAC	Base Realignment and Closure
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DMM	Discarded military munitions
DoD	Department of Defense
FWS	U.S. Fish and Wildlife Service
MC	Munitions constituents
MEC	Munitions and explosives of concern
UXO	Unexploded ordnance

1.1 BACKGROUND

Since World War II, the military services have returned more than 5 million acres of land used as military ranges to the Bureau of Land Management (BLM). In addition, some U.S. Fish and Wildlife Service (FWS) national wildlife refuges are former military lands or lands that are currently held by the military and are managed by the FWS as overlay refuges. The military used these sites to conduct research and development, testing and evaluation, and training exercises that involved dropping, firing, and placing various ordnance items.

Under the 1988 Base Realignment and Closure (BRAC) Act, subsequent BRAC laws, and other authorities, the military services have transferred or are transferring additional DoD properties to the BLM and FWS. Those lands are both withdrawn public lands and real property that are no longer needed by the military services.

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires that, before transferring lands from the military, the military service must search for and remove munitions and explosives of concern (MEC) to accommodate reasonably anticipated future land use. These range cleanup operations, especially before 1986, were typically surface removals and frequently did not remove all MEC on and beneath the surface of the land and water. However, in recent years, technological advances in ordnance detection and increasing public interest in environmental issues have prompted more thorough cleanup efforts.

Today, a military service or installation that is transferring its land prepares detailed surveys to identify and quantify MEC that remains on the site. MEC includes unexploded ordnance (UXO), discarded military munitions (DMM), and munitions constituents (MC) when MC is present in high enough concentrations to pose an explosive hazard. The surveys include physical searches, record searches, and interviews with people who worked on the site. Federal, State, and local environmental regulators; citizens; and representatives of land management agencies typically have a role in planning the survey, witnessing the cleanup of identified hazards, and ensuring that risks are reduced to an acceptable level. However, no existing method or combination of methods can ensure 100 percent removal of MEC (see Section 5.1, "Safety Issues Related to MEC"). This handbook refers to the cleanup effort as a *response operation* and the overall remedial or removal action as a *munitions response*.

1.2 THE NEED FOR SAFE MANAGEMENT OF TRANSFERRED DOD LANDS

Projections for the next decade indicate that the population in the West will increase more than in other regions of the United States. According to the U.S. Census Bureau, Nevada, the State with the highest proportion of Federal lands, has one of the highest rates of population growth, followed closely by Utah and Arizona.

The growing cities of the West have helped create unprecedented demand for outdoor recreation. Although national parks and national forests continue to attract tourists, the BLM's public lands attract a growing number of Americans who seek a more rugged or remote outdoor experience. In 2001, nearly 52 million people visited the public lands for recreation. Specially designated areas, such as wild and scenic rivers, wilderness areas, national monuments, and backcountry byways, are attracting record numbers of visitors. People are also visiting BLM-managed lands to see archeological, paleontological, and historical sites. The increased use of the public lands for recreational purposes, and in particular the use of off-highway vehicles, increases the risk that the public will be exposed to UXO and DMM.

In 2003, nearly 40 million people visited national wildlife refuges across the nation. Many visitors come to the refuges to get closer to the natural world, such as to visit a favorite fishing hole, watch birds at sunrise, or enjoy an environmental education program. Many refuge visitors participate in structured educational programs, but a significant number of visitors are also interested in just "getting away from it all" and exploring areas removed from visitor centers and trails. In the future, as the nation's population grows and urban areas expand, increased demand for outdoor recreation will lead to the need to protect people who are likely to visit Federal lands that are known or likely to contain MEC.

1.3 HANDBOOK LAYOUT

This handbook introduces basic MEC guidance and risk management options for BLM and FWS lands that were formerly, or are currently, used by the military.

Chapter 2, "BLM and FWS Principles for Managing MEC," provides an overview of the agencies' policies and guidance related to MEC on lands managed by those agencies.

Chapter 3, "Risk from Munitions and Explosives of Concern," describes the risk posed by MEC and MEC encounters.

Chapter 4, "MEC Risk Management," considers the risk of exposure to MEC in the context of BLM and FWS land management.

Chapter 5, "Safety and Reporting Procedures," gives an overview of safety guidelines and reporting procedures.

Chapter 6, "MEC Site Characterization and Munitions Response Operations," describes the site characterization process and current technologies available for identification and removal of MEC.

Chapter 7, "MEC-Related Statutes, Policies, and References," gives an overview of the laws and guidelines relating to the management of MEC-contaminated lands.

The **glossary** provides additional definitions of munitions-related concepts and terms.

Appendix 1, "Military Munitions," describes and illustrates the various classes of munitions.

Appendix 2, "Additional Information," lists useful Internet sites with additional information concerning MEC, UXO, DMM, and MC.

Appendix 3, "Points of Contact," lists the departments and officials of the BLM and FWS.

Appendix 4, "Sample Liability Waiver," shows the form given to recreational users at an installation that allows hunting and fishing in an area that may contain MEC.

Appendix 5, "Site Safety and Health Plan," shows the information necessary to minimize potential exposure, accidents, or injuries that could occur.

Chapter 2

BLM and FWS Principles for Managing MEC

Acronym List	
BLM	Bureau of Land Management
CCP	Comprehensive Conservation Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DDESB	Department of Defense Explosives Safety Board
DMM	Discarded military munitions
DOI	Department of the Interior
EOD	Explosive ordnance disposal
EPA	Environmental Protection Agency
FLPMA	Federal Land Policy and Management Act
FUDS	Formerly used defense sites
FWS	U.S. Fish and Wildlife Service
MEC	Munitions and explosives of concern
NEPA	National Environmental Policy Act
OMB	Office of Management and Budget
USACE	U.S. Army Corps of Engineers
UXO	Unexploded ordnance

The Department of the Interior (DOI) addresses the management of munitions and explosives of concern on BLM and FWS sites in its Departmental Manual, Part 602, Chapter 2, "Real Property Pre-Acquisition Environmental Site Assessment" (see Section 2.2 of this handbook). Until specific policy is established, the BLM and FWS are operating under a set of principles for the management of lands containing MEC.

Lands transferred to the BLM or FWS by the military services may contain MEC and may require additional munitions response actions. The ultimate goal of the BLM and FWS is to have unrestricted use of the lands they manage by ensuring the removal of MEC or the remediation of MEC sites by the military services that used the lands. Until that goal is achieved, interim goals should be established that limit risk by considering potential exposure, impacts on the environment, proposed land use, technology limitations, and cost-effectiveness. Current technologies are unable to achieve 100 percent removal of UXO or DMM at a MEC site, refuge, or public lands. Therefore, managers should assume that all MEC sites contain a residual amount of UXO or DMM until proven otherwise.

2.1 GENERAL STATEMENTS OF BLM AND FWS PRINCIPLES

The BLM and FWS, as the Federal agencies responsible for administration of the Federal lands, and DOI, as the department of jurisdiction, work with the military services to limit exposure to MEC for the public and employees. The BLM and FWS have been delegated the CERCLA response authorities on lands subject to its jurisdiction, custody, or control under Executive Order 12580.

2.1.1 BLM

The BLM administers public lands within a framework of numerous laws. The most comprehensive of those laws is the Federal Land Policy and Management Act of 1976 (FLPMA). All BLM policies, procedures, and management actions must be consistent with the act and with other laws that govern the use of public lands.

2.1.2 FWS

The FWS manages the National Wildlife Refuge System under the authority of the National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997. The refuge system is managed according to the principles of sound management of fish and wildlife and the administration of fishing, hunting, wildlife observation, and environmental education programs.

2.1.3 Department of Defense

DoD is responsible for the control of military munitions under 10 U.S.C. §172 and responsible for MEC removal or remedial actions under 10 U.S.C. §2701. Therefore, the military retains responsibility and liability for MEC on transferring lands and for MEC that remains on lands already transferred to the BLM or FWS. At sites for which DoD maintains administrative control, it retains complete responsibility related to MEC.

2.2 ACQUISITION OF LANDS CONTAINING MEC

The DOI Departmental Manual, Part 602, Chapter 2, states: "It is the Departmental policy to minimize the potential liability of the Department and its bureaus by acquiring real property that is not contaminated unless directed by the Congress, court mandate, or as determined by the Secretary." The DOI policy requires a bureau that is acquiring real property to ascertain the nature and extent of any potential liability from hazardous substances or other environmental problems, including potential liabilities associated with MEC. The DOI allows bureaus to acquire property with liability only when Congress or the court mandates the acquisition, or when the bureau determines that the acquisition benefits the bureau's programs and when the appropriate authority in the bureau or the Secretary of the Interior approves the acquisition. This latter situation generally is limited to properties for which substantial natural or cultural resource values override the associated environmental liability.

The BLM or FWS will work with the military service responsible for the munitions response actions at a site to balance the need to reduce the risk from MEC with the natural resource values of the site that the agency intends to protect. In some circumstances in which a property has high resource value but is still an active range or otherwise contains MEC, the FWS and the military service can enter into an agreement by which the FWS manages the land as an overlay refuge. In some cases, the FWS might accept the transfer of such properties after military action has ceased and the military service or installation has completed munitions response actions for MEC and other environmental contamination to acceptable levels. The BLM does not have a property management option that is comparable to an overlay refuge.

2.3 EXPLOSIVES SAFETY

The military service is responsible for explosives safety at a MEC site. The regulations and policies of the Department of Defense Explosives Safety Board (DDESB) and military service apply. The BLM and FWS personnel must never ask the military service to disregard explosives safety regulations and policies.

It is the responsibility of the Military Service (not BLM or FWS) land manager to determine if it is likely that a site contains MEC that may pose a hazard to users. Prior to authorizing access to such a site, the land manager should coordinate with DoD and request an analysis of any safety issues that may be associated with access to the site. The preparation by DoD of a safety plan will ensure that such access is accomplished in a manner consistent with DDESB standards. At a minimum the safety plan must state whether visitors entering the site must have an escort who is a specially trained UXO technician.

BLM and FWS employees must report all observed or suspected MEC to appropriate authorities for elimination of the risk. Employees with the potential to encounter MEC must receive safety training so they can (a) recognize potential MEC, (b) identify the location so the UXO or bomb squad personnel can find the UXO or DMM item, (c) safely leave the area, and (d) report the encounter to the proper authorities.

2.4 INVENTORY OF SITES CONTAINING MEC

The U.S. Congress has mandated that the military service is responsible for MEC and for explosives safety and must maintain an inventory of sites containing UXO (P.L. 107-107, section 311). The BLM and FWS will assist the military service with reviewing inventory data for lands they manage.

BLM managers will establish priorities for munitions response actions on their sites that contain MEC. The BLM will provide the prioritized list to the U.S. Army Corps of Engineers (USACE) for its national priorities list of formerly used defense sites (FUDS) response actions.

2.5 RISK MANAGEMENT

2.5.1 Responsibility for Risk Assessment

The military service is responsible for assessing the risk associated with MEC at DoD sites and will provide that information to the BLM or FWS. The BLM or FWS will assist the military with this assessment as it relates to the future intended use of the lands, public visitor use, and employee visits to accomplish the agencies' management objectives. (See USACE Engineer Manual 1110-1-4009, June 23, 2000, Chapter 10, and *Management Guidance for Defense Environment Restoration Program*, September 2001, page 4, paragraph 5.)

2.5.2 Risk Management Planning

As soon as possible after identifying a MEC site, the military service, along with the BLM or FWS, will develop and implement a risk management plan. The plan should protect human health and the environment, including natural and cultural resources. The plan will include a detailed statement concerning the risk at the site, identify institutional and engineering land use controls to be implemented, where appropriate, and establish funding responsibilities for the initial implementation and maintenance of land use controls. The plan should also include a discussion of the long-term management of the land use controls, possible changes in land use, site inspections to ensure that the remedy is working, and the use of new technologies when they become available to reduce or eliminate the need for land use controls.

2.5.3 Risk Management When Archeological Sites, Traditional Cultural Properties, or Historic Properties Are Present

The values associated with archeological sites, traditional cultural properties, and historic properties should be preserved during munitions response actions. The military service should have cultural inventories for sites transferred after 1990 and should be able to provide these reports upon request.

People may be drawn to these sites for ceremonies, curiosity, or other reasons. If the site contains UXO and access cannot be controlled, the munitions response must be adequate to safely accommodate these visits and activities.

During munitions response actions at or near archeological, cultural, or historic properties, measures will be used to minimize the impact on those resources. If there will be unavoidable impacts on the resource, the site will be documented and mitigated by the appropriate specialist prior to the munitions response action, if the documentation and mitigation actions can be conducted safely.

2.6 LAND USE PLANS

Land use plans for lands that include sites containing MEC must address the risk posed by the MEC. The plan will include access closures or restrictions on subsurface activities, if appropriate, and disposal of the lands out of Federal ownership. BLM managers should refer to the *Land Use Planning Handbook* (H-1601-1).

2.7 MUNITIONS RESPONSE ACTIONS AT SITES CONTAINING MEC

2.7.1 Responsible Party

Congress provides the military with funds for munitions response actions at MEC sites. The military retains the liability and responsibility for MEC. If the U.S. Environmental Protection Agency (EPA) or a State regulatory agency directs the BLM or FWS to clean up a site containing MEC, the BLM or FWS will forward that notice to the appropriate military service and advise EPA of the military service's responsibility for the site. The military services have the knowledge, technical expertise, funding, and responsibility to clean up MEC sites.

2.7.2 Remedy Selection

The BLM or FWS is an equal partner with DoD on the munitions response team that selects the cleanup level and methodology. The BLM or FWS manager should be concerned with balancing risk reduction with the safety of visitors, employees, and natural resources. The munitions response plan must protect human health and the environment, including natural and cultural resources.

2.7.3 Site Access

The BLM or FWS will provide DoD, including its contractors, with adequate access to the property containing MEC, as may be reasonably required for DoD to meet its obligations. Before entering the property, DoD will notify the BLM or FWS to allow coordination between response actions and the agency's land management activities. In emergencies, DoD must notify the BLM or FWS as soon as practicable, but no later than 24 hours after entry.

2.7.4 Responses Involving Land Use Controls

The BLM or FWS will coordinate decisions with DoD regarding response actions and land management. Both parties must agree on the remedy selection for any response actions. DoD may act as a cooperating agency for the development of the National Environmental Policy Act (NEPA) documentation for land use planning. Consistent with applicable law, DoD must notify the Office of Management and Budget (OMB) as early as possible about any land use proposal that will affect DoD's budget. This notice may be contained in a refuge comprehensive conservation plan (CCP), any other land use planning process, legislative proposal, or court judgment. To the extent permitted by law, the OMB will review and determine any unresolved budgetary issues between DoD and the BLM or FWS that might result from the land use planning processes or response actions.

2.7.5 Additional Removal and Remedial Actions at a MEC Site

2.7.5.1 Circumstances Under Which BLM or FWS May Request Additional Munitions Response Actions

The BLM or FWS and the military service will jointly decide when the military service will return to a site to conduct additional removal or remedial response actions. BLM and FWS land managers might request the military to return to a site under the following circumstances:

- The initial cleanup level does not adequately protect human health and the environment for the land use.

- EPA or State environmental cleanup standards have become more stringent than those imposed in earlier cleanup actions.
- New technology has become available that would reduce risk and therefore reduce the need for land use controls.
- The land use has changed as a result of events beyond the control of the BLM or FWS and the military service.
- A major natural event, such as a landslide, flood, or wildfire, has exposed MEC that had been buried.

2.7.5.2 Third-Party Use of Federal Lands

Sometimes a third party (e.g., lessee, permit holder, right-of-way grantee) chooses to use lands containing MEC when other options are available. In such cases, the BLM or FWS document authorizing use must include a MEC hazard warning notice and a requirement that the third party complete the MEC removal or remedial action to a level appropriate for the intended use. The third party will bear all costs associated with the additional MEC removal or remedial action and will assume all liability for its actions, including injuries to authorized users of the MEC hazard area.

2.8 MUNITIONS RESPONSE SITE PRIORITIZATION PROTOCOL

The DoD published the Munitions Response Site Prioritization Protocol in the Federal Register on October 5, 2005 (70 FR 58016). The purpose of the protocol is to assign each defense site a relative priority for response activities related to MEC based on the overall conditions at the defense site.

The relative priority is based on an analysis of site conditions by a project team, which includes stakeholders, such as the land owner/manager. The BLM or FWS are participating stakeholders for munitions response sites on public lands or refuge lands, respectively.

The site conditions analysis is primarily a hazard/risk analysis which leads to the site being placed in one of eight priority categories or three “Alternative Priorities”. “Sequencing” within each of the eight priority categories is influenced by other factors, including proposed land management and land use changes, and other factors which may be known to the land manger, but not specifically addressed in the hazard analysis. It is in the sequencing part of the process where the BLM, FWS, and DOI will have the opportunity to influence timeliness of cleanup of munitions response sites on lands managed by the BLM or FWS.

Chapter 3

Risk from Munitions and Explosives of Concern

Acronym List

DMM	Discarded military munitions
EOD	Explosive ordnance disposal
HMX	Her Majesty's explosive (high explosive) and high melting explosive
ITRC	Interstate Technology and Regulatory Council
MEC	Munitions and explosives of concern
OB/OD	Open burn/open detonation
RDX	Royal demolition explosive
TNT	Trinitrotoluene
USACE	U.S. Army Corps of Engineers
UXO	Unexploded ordnance

3.1 POTENTIAL MUNITIONS ON BLM AND FWS SITES

A simple definition of risk is "the probability of loss or injury." Risks can be differentiated from hazards by thinking of a hazard as a source of danger, or something that exists, such as MEC on a site, that may bring about risk if encountered. A more complex definition states that risk can be characterized as the probability of a negative event occurring and the severity of the event's effect should it occur. This chapter describes the four factors associated with risk incurred from an encounter with MEC and discusses how to manage those factors.

Munitions and explosives of concern consist of the following categories of military munitions that may pose unique explosive risks:

- Unexploded ordnance (UXO) is the most dangerous category of munitions because it has been readied for use, used, and malfunctioned (i.e., it has not yet functioned as planned). However, the fuze has been activated. Therefore, the explosive condition of munitions that have been readied is unknown. Munitions that have survived an attempt to destroy them by open burning/open detonation (OB/OD) are also considered to be UXO, as the condition of the fuze is unknown.
- Discarded military munitions (DMM) are complete munitions that have not been readied for use and have not been used. They are munitions that were abandoned by troops at a firing range (e.g., buried near the firing line) or tossed aside by maneuvering troops to lighten their load. Given that untrained persons cannot consistently distinguish between DMM and UXO, all BLM and FWS personnel must treat DMM as if it is UXO.
- Munitions constituents are MEC when explosive compounds of the munitions, such as TNT, RDX, and HMX, are in sufficient concentration as to pose an explosive hazard. This situation arises when concentration levels are 10 percent or more. Non-explosive munitions constituents and explosive concentrations less than 10 percent are not considered MEC.

As public use of BLM- and FWS-managed lands increases, more agency personnel will be on those lands. As a result, BLM and FWS managers need to take an active risk management position to ensure the safety of the public and employees. The information in this chapter is provided to increase the managers' understanding of the factors that influence risk associated with MEC on their sites.

3.2 MEC RISK FACTORS

Land managers need to understand risk factors to effectively mitigate MEC hazards on their lands. These factors form a progression of conditions—a chain of events—that lead to a detonation. Eliminating any one step in the chain of events can eliminate the acute consequence of a detonation. Land managers can reduce the risk of exposure posed by MEC by managing all of the following elements of a MEC chain of events:

- Presence of MEC—The determination is made that MEC is present or likely to be found.
- Likelihood of a MEC encounter—The likelihood that a person will have a MEC encounter is based on site accessibility, activity of that individual, and location of the MEC.
- Likelihood of detonation—The likelihood that MEC will detonate as a result of the encounter will depend on the type and condition of the MEC and the type of disturbance.
- Consequences of detonation—The range of possible outcomes or results includes injury or death.

3.2.1 PRESENCE OF MEC

Numerous factors affect whether MEC will be present on public lands and refuges. The primary factor is whether the military used the land for testing, training, or munitions storage or manufacture. Managers should assume that all lands used by the military and its munitions contractors and suppliers contain MEC until proven otherwise. If the lands were never used for testing, training, munitions storage, or munitions manufacturing, the presence of MEC is unlikely. MEC that is found in "clean" portions of an installation generally consists of small items that were perhaps inappropriately removed from training ranges and later hidden or buried to avoid detection.

Transferred lands that were testing and training ranges will probably always have residual surface, and probably subsurface, MEC, even after the military response team conducts response efforts. Also, areas that were used for the manufacture, transport, or storage of munitions may contain authorized munitions burial sites and MEC. Until the mid-1960s, the burial of obsolete, damaged, or otherwise unserviceable munitions was an accepted practice. Most former military lands that were transferred before 1987 were given only a surface clearance. Such "surface sweeps" are generally limited to a visual inspection by military personnel walking the site. Even thorough surface sweeps will not find all the munitions on the surface and will usually not find any subsurface UXO or DMM. If the military response team has conducted a subsurface response, residual UXO and possibly DMM will remain, because the best current technology can find only about 90 percent of subsurface UXO and DMM. Older technologies detected as little as 30 percent. Also, the freeze and thaw cycles of soil moisture, and other soil mechanics, can cause residual UXO and DMM to rise to the soil surface.

To learn about past activity on a transferred site, BLM and FWS personnel can read the military installation's historical records review, also known as the archive search report, which is prepared by the U.S. Army Corps of Engineers (USACE) or the responsible military service. The report gives historical background on MEC and chemical warfare materiel used on a site and is essential for identifying where potential and residual UXO munitions may be located. The Interstate Technology and Regulatory Council's (ITRC) *Munitions Response Historical Records Review* is an excellent source that describes how historical records reviews are prepared by the military and factors that affect their adequacy. The document can be ordered through the ITRC web site at http://www.itrcweb.org.

3.2.2 Likelihood of a MEC Encounter

The likelihood of encountering MEC depends on various factors related to the types and locations of residual MEC at a known or suspected MEC site. An analysis of the potential risk of encountering MEC at a given location should consider the following factors:

- Effectiveness of prior response actions
- Amount of UXO or DMM
- Depth of UXO or DMM
- Size of UXO or DMM
- Shapes of UXO and DMM
- Current and potential land use
- Accessibility of the land
- Topography
- Vegetation and ground cover
- Water cover
- Soil type
- Climate
- Other site features

3.2.2.1 Effectiveness of Prior Response Actions

All MEC sites managed by the BLM and FWS received some level of MEC removal before they were transferred from the military service. The likelihood of encountering MEC is directly related to the effectiveness of prior response actions. It is important for BLM and FWS managers to learn the nature and extent of the response action and, if possible, obtain the associated records from the military, because the residual MEC presents a risk to the public and employees (see ***Figure 1***). Those records include the archive search report or historical records review, which contains the history of the use of the lands, including dates of use of the range, types of activity and munitions used on the range, and types of munitions contained in the storage facility or manufactured on the site.

Figure 1 – Range residue, including fins from a 60 mm mortar, fins from a 3.5-inch rocket-propelled antitank round, and shrapnel.

Reports of the removal actions will indicate the level of removal, the technical tools used, and the location and nature of materials found. That documentation also will indicate the effectiveness of the surface removal and the occurrence and depth of any subsurface clearance. It is unlikely that the military did any subsurface clearance before 1986. Documentation of the types and locations of previously detected MEC will be very helpful in determining the types and locations of residual MEC.

3.2.2.2 Amount of UXO or DMM

The likelihood of an encounter increases as the amount of UXO or DMM increases. Although this sounds very basic, it is important to note that the amount of UXO or DMM varies across a military installation and across military ranges. At a military installation, most MEC occurs on former ranges and maneuver areas. However, other sites, including former storage, disposal, or housing areas, may also contain UXO or DMM.

On a typical range, the amount of UXO will be greatest in the target area, in a pattern similar to that shown in ***Figure 2***. The primary impact area of all rounds, and therefore of UXO, is in an elliptical pattern with the target in the center. The long axis is in the direction of fire and results from rounds landing short or long of the target (firing axis), and the short axis lies to the left and right of the firing axis (deflection axis). Beyond this target area, rounds also could have landed anywhere within the safety fan, with the likelihood of encountering UXO decreasing as the distance from the target area increases. Any area in front of the firing point (down range) could have UXO.

Figure 2 depicts a single firing point, target, and safety fan. Most ranges consist of multiple firing points and multiple ranges. Multiple ranges may be in a line with all weapons firing in the same general direction. If the range area is large enough, the multiple ranges may be located inside a perimeter road with all weapons firing into the center. ***Figure 3*** is a drawing of the overlapping ranges at Siskiyou Rocket and Bombing Range, California. Note that the three safety fans overlap and use the same target. This will affect the density and distribution of UXO.

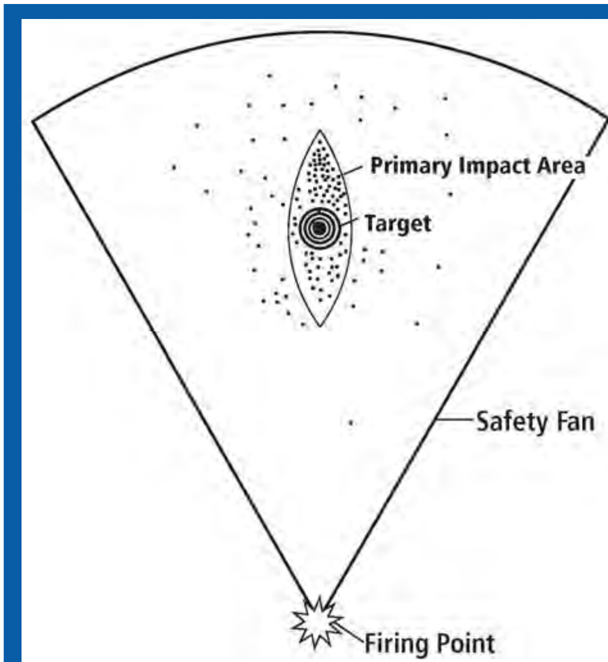


Figure 2 *– Illustration of UXO density in a target area on a typical range.*

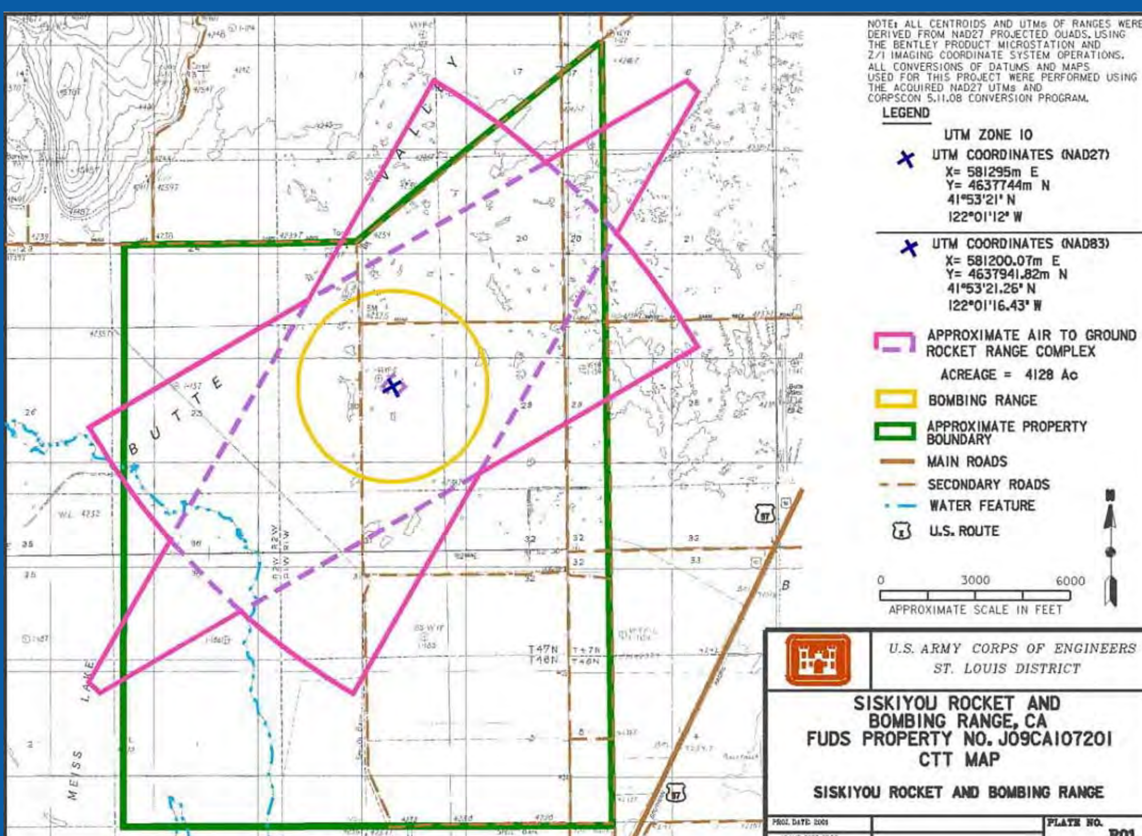


Figure 3 *– Maps of a multi-range area showing overlapping range fans with a single impact area. In this case, the density pattern is more complicated than Figure 2 as it reflects the flight paths of the rockets and the circle within which all bombs impacted.*

In addition, full rounds of DMM may be buried near a firing point. Until recently, military personnel could not return rounds from an opened case to the ammunition supply point. Although burial was never an approved practice, personnel sometimes buried unused rounds instead of firing the rounds down range. DMM also may be found along “routes of march,” at dug-in positions (foxholes), and in bivouac (camping) areas within maneuver areas. Soldiers would lighten their load by tossing rounds aside or leaving rounds behind when they were given the order to move out. A high amount of UXO also is likely to remain in the vicinity of an OB/OD crater. The amount of UXO decreases as the distance from the crater increases.

BLM or FWS managers and personnel should avoid areas that indicate high amounts of UXO; otherwise, they must have a qualified UXO escort when entering areas of suspected or known high amounts of UXO.

3.2.2.3 Depth of UXO or DMM

An encounter is more likely if the MEC is exposed on the surface than if it is buried in the subsurface. On typical Army and Marine Corps ranges, more than 90 percent of UXO and DMM are found within the top 2 feet of soil. Larger, more powerful munitions, such as bombs and artillery projectiles, are heavier than grenades and small arms munitions and therefore are more likely to penetrate the ground to greater depths (see ***Figure 4***). In addition, munitions and projectiles will generally penetrate hard clay soils more deeply than soft soils or sandy soils (see ***Table 1***).

Activities such as walking, driving, digging, trenching, plowing, doing construction, and building campfires may disturb MEC in the subsurface, moving it closer to the surface and thereby increasing the risk of an encounter. Many activities that frequently occur on BLM and FWS lands have the potential to create such a risk, including digging for fence installation, trenching in utility corridors, road building, and maintenance activities.

Figure 4 *– Large ordnance can easily penetrate soils.*

Weather and climate can also affect the depth of MEC. Over time, buried UXO or DMM may become exposed through weather or wind erosion or may migrate to the surface as a result of the freeze and thaw cycles of soil. Conversely, surface UXO and DMM may become buried by vegetative matter or deposition of wind- or water-borne soil material (see Section 3.2.2.12).

3.2.2.4 Size of UXO or DMM

Large UXO or DMM items on the surface of the ground are more likely to be seen and are therefore easier to avoid than small UXO or DMM (see ***Figure 5***). Easily seen surface UXO or DMM includes large bombs, rockets, and guided

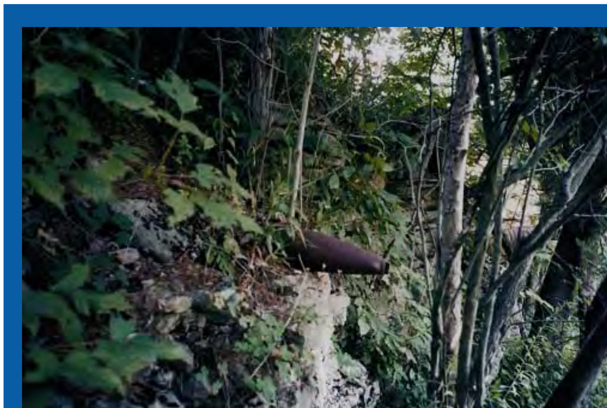


Figure 5 *– This 155 mm round is quite noticeable even partially concealed by vegetation.*

Table 1. Penetration of Bombs and Projectiles into the Earth

Weight of Bomb or Projectile (in pounds)	Depth of Penetration (in feet)*									
	Sandstone		Sand and Gravel		Chalk		Clay		Offset**	
	Avg.	Prob. Max.	Avg.	Prob. Max.	Avg.	Prob. Max.	Avg.	Prob. Max.	Avg.	Prob. Max.
0.25 (20 mm)	0.2	0.5	0.3	0.6	0.3	0.6	0.5	1	–	–
2 (37 mm)	0.3	0.6	0.4	0.8	0.5	0.9	0.8	1.5	–	–
16 (75 mm)	1	2	1	3	2	4	4	6	–	–
30 (105 mm)	2	3	4	6	6	9	10	13	–	–
90 (155 mm)	4	9	8	11	10	13	12	17	–	–
100	8	17	9	19	11	19	14	25	3	18
500	11	23	13	28	16	29	20	35	4	20
1,000	14	29	17	33	20	34	24	43	5	20
2,000	17	34	20	40	24	41	29	52	7	26

*Depth below surface is based on tests designed to maximize the depth of penetration. The depth below surface is provided to show the difference in depths when the same weight bomb or projectile is sent into different soil types. Specific maximum depths of MEC items will be determined site-specifically based on a variety of factors.
**Offset is the distance laterally from the point of entry that a bomb may travel after penetrating the surface of the ground.
Avg. = average
Prob. Max. = probable maximum
– = Not applicable
Source: Range Clearance Technology Assessment (Revision 1), March 1990, Final Report, prepared by Naval Explosive Ordnance Technology Center, Indian Head, MD, pp. 2-14.

missiles. Small arms munitions, grenades, and projected grenades, which are much smaller, are more difficult to avoid. Unfortunately, because of their size, small UXO or DMM items are often picked up and kept as souvenirs.

3.2.2.5 Shapes of UXO and DMM

Many people can readily identify and thus avoid UXO or DMM items that they have seen in movies or on television (e.g., hand grenades and bombs). Nevertheless, some people will pick up such items without thinking. Submunitions, fuzes, and many other small items do not look like military munitions to the untrained eye; therefore, people may be more likely to pick up and examine such items (see Appendix 1). In addition, children may be attracted to smaller munitions because these munitions have enticing shapes and colors.

Another shape-related factor is that munitions may corrode over time and look more like scrap metal (shrapnel) than like a munitions item. Many people assume that old, rusted munitions can no longer be explosive. That assumption can be a fatal mistake.

3.2.2.6 Current and Potential Land Use

Land uses allowed on a MEC site directly affect the exposure of individuals to the MEC hazard. The likelihood that an individual will encounter a MEC item on a munitions response site is directly related to the number of persons who are on the munitions site, the duration of their presence, and their activities during that time. For example, MEC encounters are more likely on lands used for general recreational purposes (e.g., hiking, hunting, off-highway vehicle use, and camping) than on lands used for grazing or in areas without public access simply because more individuals for a longer period of time have an opportunity to encounter a MEC item.

Any management change in land use that may increase the likelihood that users or personnel will encounter MEC (e.g., from grazing to recreation) requires an understanding of the MEC hazard present. This understanding is developed through review of the work already accomplished by the military at the site, for example a preliminary assessment, site inspection, or other documentation; a hazard assessment or application of other risk methodology; and an understanding of the exposure risk of surface and subsurface intrusive activity. Public use of public lands and refuges where MEC is present should be appropriate to the hazard associated with the MEC and the risk of an encounter. Access controls and education are tools that may be used to reduce the likelihood of a MEC encounter.

When considering land use at or near MEC sites, the adjacent land uses which might bring people within the maximum horizontal fragmentation distance of an explosive event at the site should also be considered. The military service responsible for the site can provide that information.

Before approving intrusive activity into the subsurface where MEC may be located (e.g., installing fences, building roads, or excavating a foundation), the land manager should request the appropriate military service to provide MEC avoidance or construction support so MEC in the subsurface may be avoided or remediated prior to the intrusive activity (see Sections 6.1 and 6.2).

3.2.2.7 Accessibility of the Land

An area's accessibility contributes to the number of people likely to go on the land and encounter MEC (see ***Figure 6***). An unfenced area near a road is more accessible than a remote fenced area. In addition, the use of off-highway vehicles, such as all-terrain vehicles, has made some rugged, remote areas more accessible.

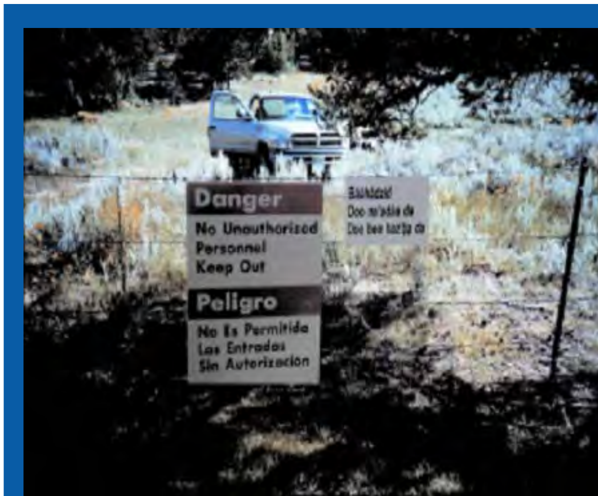


Figure 6 *– A way to limit access is to fence areas and post sign.*

Land managers may need to increase the number of warning signs, install fences, or use other access restrictions, and enforce those restrictions, in areas of concern.

3.2.2.8 Topography

Topography can influence the number of people likely to enter a site, the amount and type of MEC found, and potential land use (see ***Figure 7***). In general, the public is more likely to enter flat land near populated areas than remote land with rugged terrain. Topography also influences where MEC may be concentrated. MEC is more likely to migrate to valleys and depressions

Figure 7 *– Land with a flat or rolling topography is much more accessible and more likely to attract visitors than land with mountainous or rugged terrain.*

through surface water movement, soil erosion, landslides, and avalanches.

3.2.2.9 Vegetation and Ground Cover

Surface MEC may be seen more easily on barren desert lands (see ***Figure 8***). Conversely, heavy vegetation and ground cover may conceal even large MEC items. However, heavy vegetation and ground cover can limit access to an area, thus reducing potential encounters with MEC.

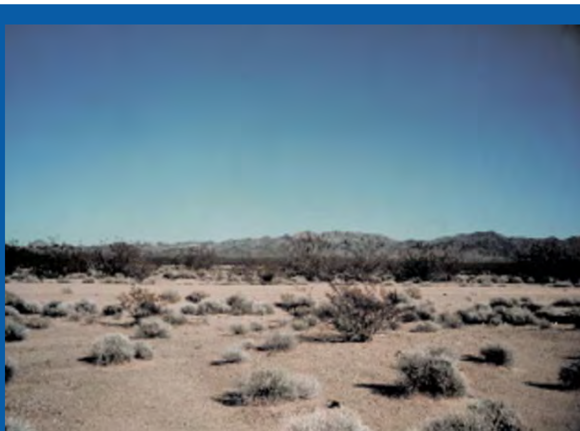


Figure 8 *– Surface UXO or DMM may be more easily seen on barren desert lands; however, UXO or DMM may also be concealed by the scrub growth and shifting soils.*

3.2.2.10 Water Cover

MEC can also be found in groundwater, surface water, and marine environments. Water may increase or limit visibility, depending on the water's depth and turbidity. Water may restrict access to UXO and DMM. Some activities, such as dropping an anchor, could lead to MEC encounters.

3.2.2.11 Soil Type

Soil type influences the depth to which munitions penetrate the ground and can affect whether the fuze activates. Some fuze types require a substantial impact before they will activate. If the munitions item lands in mud or fine soil, the fuze may not activate as designed. With such site conditions, the likelihood and amount of UXO increases. In addition, munitions penetrate hard clay soils deeper than soft soils.

3.2.2.12 Climate

Climate affects the surface and subsurface movement of UXO and DMM in several ways. Heavy rainfall and high winds cause surface water movement and soil erosion, thus causing UXO and DMM to migrate. The depth of the frost line and the frequency of the freeze/thaw cycle in different climates also affect the movement of UXO and DMM to the surface. Generally, colder climates have deeper frost lines, thus contributing to a greater number of UXO and DMM items migrating to the surface. Colder climates with more snow cover also may conceal surface UXO and DMM.

3.2.2.13 Other Site Features

Impact craters indicate a high potential for UXO. Jagged pieces of metal, mortar fins, and other debris from munitions that functioned properly are good indicators that numerous large UXO may also be present. BLM and FWS managers should ensure that personnel and visitors are not permitted to enter these areas without an EOD escort. All persons entering these areas must use extreme caution.

3.2.3 Likelihood of Detonation

The likelihood of a MEC encounter that leads to an accidental detonation depends on three primary factors: (a) the actions of the individual encountering the UXO or DMM, (b) the location of the MEC, and (c) the condition of the UXO or DMM.

Following the safety guidelines presented in Chapter 5 will greatly reduce the likelihood of detonation:

- Do not move any closer to the UXO or DMM after observing it.

- Do not touch, move, disturb, or attempt to pick up the UXO or DMM.
- Do not attempt to mark or remove an object on, attached to, or near the UXO or DMM.
- When reporting the UXO or DMM, do not use any electronic communication devices, such as cell phones, near the UXO or DMM.

The location of the UXO or DMM (i.e., surface, subsurface, or partially buried) also affects the likelihood of detonation (see ***Figure 9***). Subsurface UXO or DMM is less likely to be disturbed by someone walking or driving over it than UXO or DMM that is lying on the surface. The risk of encountering UXO or DMM decreases as the depth of the UXO or DMM increases. Partially buried UXO or DMM is most susceptible to being disturbed by someone tripping over it or kicking it or by a vehicle driving over it and radically changing its position. An item on the surface is most easily seen and avoided.

The condition of the UXO, especially the fuze, is a critical variable in the likelihood of an unintentional detonation. When the fuze of a UXO has been armed, but has not functioned as intended, the damaged fuze may be further sensitized. Even professional EOD personnel cannot determine with certainty the condition of the fuze. For those reasons, anyone encountering munitions on a site should never approach, touch, or otherwise disturb it, because it could be UXO.

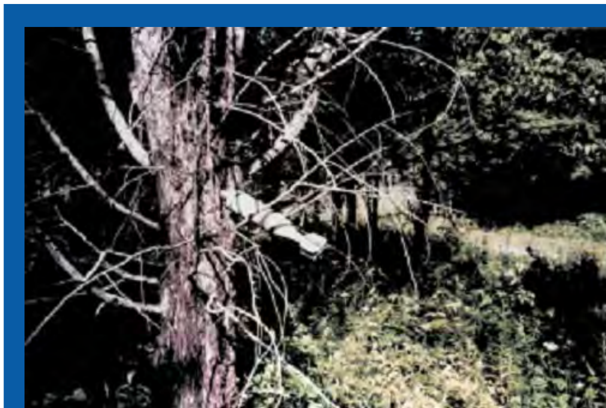


Figure 9 *– Not all UXO is on or under the ground. This tank-fired antitank round may be overlooked, although it is a danger and an attractive risk.*

3.2.4 Consequences of Detonation

The BLM's and FWS's goal is to avoid the accidental detonation of MEC. The consequences of detonation can range from limited injuries (e.g., loss of fingers or a hand caused by a spotting charge in practice munitions) to massive injury or loss of life. In any case, detonations are instantaneous. Although in most cases the risk from MEC cannot be completely eliminated, reducing the risk is essential to the safe reuse of former ranges as public lands and refuges.

Chapter 4

MEC Risk Management

Acronym List

AEC	Army Environmental Center
CSM	Conceptual site model
CTT	Closed, transferring, and transferred
DMM	Discarded military munitions
DoD	Department of Defense
EM	Engineering Manual
EOD	Explosive ordnance disposal
EPA	Environmental Protection Agency
FACA	Federal Advisory Committee Act
ITRC	Interstate Technology and Regulatory Council
MEC	Munitions and explosives of concern
NAVFAC	Naval Facilities Engineering Command
OB/OD	Open burning/open detonation
RAB	Restoration Advisory Board
RAC	Resource Advisory Council
USACE	U.S. Army Corps of Engineers
UXO	Unexploded ordnance

4.1 ELEMENTS OF RISK MANAGEMENT

This section provides information to help BLM and FWS land managers apply risk management practices to MEC-contaminated lands. Managers should use professional risk managers to develop a risk management plan for the MEC site.

Risk management on Federal lands will involve the following three phases (see ***Figure 10***):

- **Risk perception** — Perception of risk, that is, awareness of a hazard that has an associated risk, may come from land use inventories performed by the military services, BLM, or FWS; from MEC site inventories; or from reports by the public or employees who encounter MEC. Once it is known that MEC may be present and pose a risk to the public and employees, the next step is to determine the magnitude and extent of the problem.
- **Risk assessment** — The second phase involves the analysis of the risk factors discussed in Section 3.2. This analysis provides information on the MEC hazard, its location, the amount or degree of risk, and the consequences of an encounter with the hazard.
- **Risk management** — The third phase involves developing a risk management plan and managing the site to reduce or eliminate an encounter with the hazard.

4.2 OBJECTIVE OF RISK MANAGEMENT

The objective of risk management is to reduce or eliminate the opportunity for an encounter with

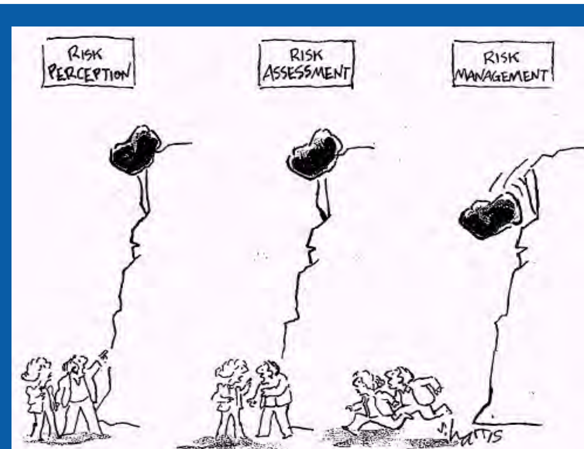


Figure 10 – Risk Cartoon

the hazard. That is done by analyzing the risk at each step of the potential chain of events, as shown in Section 3.2, and by either breaking the chain of events or reducing the likelihood of an event occurring. The following steps are involved in managing risk:

- Manage the source of the risk (the presence of MEC)
- Manage the likelihood of an encounter
- Educate people to recognize and avoid MEC

Although the likelihood of detonation and consequences of detonation are beyond a land manager's control, eliminating or reducing the likelihood of an encounter through management actions reduces the risk of detonation.

4.3 USE OF A CONCEPTUAL SITE MODEL TO IDENTIFY AND ASSESS RISK

The conceptual site model (CSM) is a description of a site and its environment that is based on existing knowledge and is updated regularly. It describes sources of MEC at a site; actual, potentially complete, or incomplete exposure pathways; current or reasonably anticipated future land use; and potential receptors. The source-receptor interaction is one descriptive output of a CSM. The CSM serves as a planning instrument, a modeling and data interpretation aid, and a communication device among the response team members.

4.4 METHODS FOR ELIMINATING OR MINIMIZING SOURCES OF RISK

Section 3.2.1 outlines the factors affecting the presence of MEC on lands used for military training and testing or for manufacturing and storing munitions. The BLM and FWS manage the source of the risk by working with the military services to have MEC eliminated from the site. If all MEC is eliminated from the site, the potential chain of events is broken, and the risk management action can stop.

Currently, eliminating 100 percent of MEC from a site is generally not technically feasible, unless the soils are excavated and sifted. Therefore, MEC sites will almost always have a residual risk that must be managed. The land manager's objective is to work with the responsible military service to determine a balance among residual risk, the proposed land uses, environmental damage caused by the munitions response action, and cost. The management goal is to reduce the amount of residual MEC to a level appropriate for the proposed land uses, without destroying important habitats. This is not an easy balancing act, given limited funding, and should involve input from the BLM's public Resource Advisory Council (RAC) or the military installation's Restoration Advisory Board (RAB), or some other public input. Although the FWS does not have a RAC, the FWS manager should assign an interdisciplinary team composed of refuge personnel, biologists, real estate specialists, outdoor recreation specialists, environmental engineers, and environmental contaminants specialists to work with the military service. (Note: The BLM RAC is a Federal Advisory Committee Act [FACA] group. It is a public body and is not the same as the FWS interdisciplinary internal team.)

Personnel could encounter MEC on almost any former military installation. For example, controlled burns or wildland fires can expose previously hidden UXO or DMM, soil erosion from heavy precipitation or high winds can uncover subsurface UXO or DMM, and normal freeze/thaw cycles can cause munitions to migrate to the surface. When significant land-altering events occur on previous munitions response areas, BLM or FWS managers should request the military service to return to the site to do a surface survey for newly exposed MEC.

4.4.1 Emergency Munitions Response Action

Whenever a discrete UXO or DMM item is discovered on a site, BLM and FWS managers must contact explosive ordnance disposal (EOD) or bomb squad personnel to have them immediately remove the item from the site. This type of removal action is referred to as an *emergency munitions response* action because it expeditiously addresses a known, specific, exposed UXO or DMM hazard.

The likelihood of additional persons encountering the UXO or DMM decreases as the thoroughness of the munitions response action increases. The EOD team or bomb squad conducting the emergency removal should also check the immediate vicinity for other UXO or DMM. The local BLM or FWS office should retain a copy of the EOD or bomb squad report and periodically review reports to determine if the reports reflect any pattern indicating that a specific area warrants further investigation.

4.4.2 Non-emergency Munitions Response Action

A non-emergency munitions response action is generally long term. The BLM or FWS land manager should request a non-emergency munitions response action when (a) MEC are known or suspected in an area, but the nature and extent of the contamination have not yet been defined, or (b) multiple emergency munitions response actions have been required at the same location, indicating a concentration of UXO or DMM items near the surface that are becoming exposed. In such cases, an appropriate risk reduction measure would be a subsurface non-emergency munitions response action to remove the UXO or DMM before it becomes exposed. This non-emergency munitions response action would reduce the frequency of emergency munitions response actions by EOD teams and would eliminate the possibility that the UXO or DMM would later be exposed and result in a public encounter.

4.5 METHODS FOR PREVENTING OR MINIMIZING MEC ENCOUNTERS

In addition to using emergency and non-emergency response actions to minimize the MEC at a site, the BLM and FWS land managers must evaluate ways to minimize encounters by the public or agency personnel with any remaining MEC. If there is no encounter, there will be no risk from a detonation.

4.5.1 Land Use Controls

BLM and FWS managers can minimize unintended encounters with MEC by implementing land use controls (where appropriate), which consist of institutional controls and engineering controls. In certain situations the military may maintain administrative control of parcels of land within properties controlled by the BLM or FWS. In these situations the military will be responsible for implementing and maintaining the appropriate land use controls.

4.5.1.1 Institutional Controls

Institutional controls are the legal and administrative tools that ensure that the continuing and future use of the site is compatible with any residual MEC contamination. For the BLM and FWS such tools normally include: governmental controls (e.g., permits), access restrictions established through resource and refuge management plans, and informational tools (e.g., signs). The following are examples of ways that managers can establish institutional controls:

- BLM and FWS land managers can transcribe information indicating locations of hazardous areas to master title plats (BLM) and land records (FWS).
- BLM resource management plans and FWS refuge management plans should consider MEC hazards when analyzing access, land use, and information (educational) requirements.
- The BLM may close the area to incompatible activities by withdrawing from operation of some or all of the public land laws (e.g., withdrawal and reservation for public safety).
- The FWS may limit public access to part of a refuge.

All refuge and public lands personnel must have access to hazard information in order to support management decisions that minimize encounters with MEC. The BLM plats and FWS records should provide a source of information that agency personnel can check before doing field-work to ensure that the proposed work area contains no hazards. Also, agency personnel can check the records for hazards so that future authorized land use activities remain compatible with land use restrictions that have been imposed because of the residual risk from MEC.

4.5.1.2 Engineering Controls

Engineering controls are used to limit access to MEC sites by posting a warning, such as signage, or by erecting a physical barrier, such as fencing. If signage is used, signs must be posted in the languages used most commonly in the area, such as English and Spanish, but may also include local Native American languages (see ***Figure 11***). Fencing must convey the message, along with signage, that an area is off limits to the public. In some cases barbed wire will be sufficient; in other areas chain-link fencing may be required. Other less frequently used measures include closing roads to make reaching an area more difficult, or capping burial sites or open burning/open detonation (OB/OD) areas.

Engineering controls require maintenance; therefore, either the military service or the BLM or FWS must provide funding to maintain the engineering controls. This responsibility is often shared. Details of the relationship are described in a memorandum of agreement.

4.5.2 Training and Education to Minimize Inappropriate Actions by Persons Encountering MEC

BLM and FWS personnel and the public have encountered and will continue to encounter MEC on lands transferred from the military services. How they react to an encounter is determined in part by the safety training they have received. The land manager is responsible for ensuring that safety training is provided to all personnel who may be working in or transiting potential MEC hazard areas. The amount and types of training needed depend on the duties of the individual.

Training is available through the following entities:

- **DoD** — Web site at http://www.denix.osd.mil/denix/Public/Library/Explosives/UXOSafety/uxosafety.html
- **Interstate Technology and Regulatory Council (ITRC)** — UXO Basic Training at http://www.itrcweb.org
- **EPA** — Planning and Management of Munitions Response Actions
- **BLM and FWS** — This handbook and other printed sources

Figure 11 – Examples of warning signs. The first two signs are in two languages: English and Spanish.

The USACE and Naval Facilities Engineering Command (NAVFAC) also have more advanced courses available for employees working on munitions response project teams. Those agencies also can help with the design of signage and may be able to provide it.

Managers of sites with MEC-contaminated lands that are open to public access and use should show a short safety video and provide safety cards similar to the one shown in ***Figure 12***. Safety videos are available from USACE and the Army Environmental Center (AEC). The BLM is developing a short safety video for its public lands. Appendix 2 provides a list of sources for safety information and videos.

The basic training for the public and employees should be simple, such as repetition of slogans and some basic recognition factors. Slogans such as the following are very effective in MEC areas: “Remember the three R’s of UXO – Recognize, Retreat, and Report,” and “If You Did not Drop It, Do not Pick It Up.”

Safety training must include a discussion of the likelihood and consequences of a detonation. If a person is behaving in an unsafe manner, such as carrying a MEC item they have picked up, it is too late to do anything other than clear the area and request the person to stop the inappropriate behavior. After securing the area, call the EOD unit or bomb squad to assess the situation.

4.6 THE SPECIAL CASE OF WILDLAND FIREFIGHTING AND REHABILITATION OF BURN AREAS

Wildfires may be hot enough to cause munitions to detonate. Wildfires will also expose munitions on the surface. Wildland firefighting and fire rehabilitation activities penetrate the ground surface and expose firefighters and equipment operators to significant risk.

Land use plans and fire management plans should note areas of potential MEC so that managers do not send BLM and FWS personnel into such areas to fight fires. Heat from the fire and impact from equipment could detonate explosives, thereby making the fighting of fires in such areas too risky.

Land managers should also avoid fire rehabilitation in areas with potential MEC, or they should file a request with DoD for assistance from properly trained EOD personnel. Trained personnel will investigate areas where ground-disturbing activity may take place. They also will locate and mark potential MEC and the hazard area ingress and egress routes. BLM and FWS rehabilitation personnel must avoid marked locations, unless properly trained EOD or UXO personnel have removed the MEC.

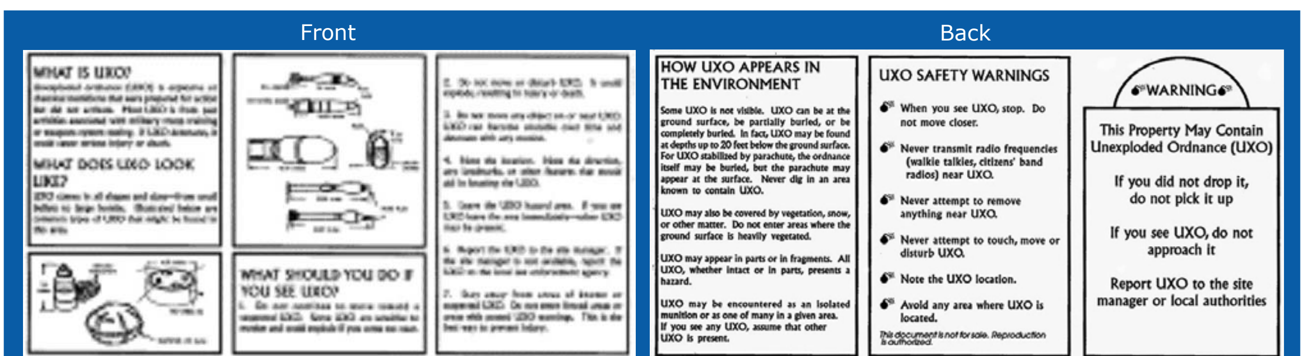


Figure 12 – Example of a double-sided, trifold UXO safety card.

Chapter 5

Safety and Reporting Procedures

Acronym List

AEC	Army Environmental Center
BRAC	Base Realignment and Closure
CB	Citizens band
DMM	Discarded military munitions
DoD	Department of Defense
EOD	Explosive ordnance disposal
FORSCOM	U.S. Army Forces Command
FUDS	Formerly used defense site
GPS	Global positioning system
IRP	Installation Restoration Program
MEC	Munitions and explosives of concern
NAVFAC	Naval Facilities Engineering Command
PDA	Personal digital assistant
USACE	U.S. Army Corps of Engineers
UXO	Unexploded ordnance

This chapter provides a summary of safety guidelines and reporting procedures that are essential to the proper management of MEC and lands that contain MEC.

5.1 SAFETY ISSUES RELATED TO MEC

Although the military services retain liability for MEC cleanup, DoD munitions response operations typically cannot remove every item of MEC given the current technological limitations. BLM and FWS personnel should assume that residual munitions remain on-site after a response operation is completed. All lands known to contain or suspected of containing MEC, including lands where a removal action has been completed, must be managed as if the risk of encountering MEC will continue. Residual UXO and DMM may migrate to the surface long after response operations are completed; thus, land managers must plan for long-term risk management at all MEC sites.

All site personnel must treat any UXO and DMM they encounter, including practice ordnance, with great caution. Practice ordnance can contain a spotting charge that could cause injury or death.

5.2 SAFETY GUIDELINES TO FOLLOW WHEN ENCOUNTERING UXO AND DMM

The first and most important rule of UXO and DMM safety is to remember:

If you did not drop it, DO NOT pick it up!

Second, memorize the three R's of UXO and DMM:

Recognize, Retreat, and Report.

Other important considerations include the following:

- Treat all MEC found on a site as UXO, the most hazardous of the MEC categories. Only qualified EOD personnel can tell the difference between UXO and DMM.
- Do not move any closer to a MEC item after recognizing it as potential UXO or DMM. Some types of ordnance have magnetic, or motion-sensitive, proximity fuzes that may detonate when a target is sensed. Others have built-in self-destruct timers. Even casting a shadow on a certain type of fuze (piezoelectric) may cause an abrupt change in temperature that is sufficient to cause a detonation. In

most cases, if you can see a UXO or DMM item, you are already within its kill radius.

- Do not move or disturb UXO or DMM, because the motion could activate the fuze, causing the munition to explode. If the fuze has malfunctioned, there is no way to know its condition, and any movement could cause it to function. Also, some munitions have antidisturbance fuzing.
- Do not attempt to remove any object on, attached to, or near UXO or DMM. Some fuzes are motion-sensitive or might have trip wires that could cause the UXO or DMM to explode.
- Do not mark the location of a UXO or DMM in a way that would attract the attention of someone just passing by.
- Document and unobtrusively mark the location of a UXO or DMM item to help ordnance experts locate the item.
- Leave the UXO or DMM hazard area.
- Restrict visitor access.
- Report the UXO or DMM to the appropriate authority (see Section 5.3).
- Do not transmit from walkie-talkies, shortwave radios, citizens band (CB) radios, cellular telephones, wireless PDAs (personal digital assistants) that transmit to the Internet, or other communication and navigation devices. The transmission signal may detonate the munition. You *can* use a global positioning system (GPS) receiver because it is a receive-only device.

The best way to prevent an encounter with UXO or DMM is to stay away from areas known to contain or suspected of containing MEC. However, if you must enter an area with known or suspected UXO or DMM, request a military EOD specialist escort. And remember:

All UXO or suspected UXO is fuzed, armed, and extremely dangerous!

5.3 PROCESS FOR REPORTING MEC AND REQUESTING DOD SUPPORT

The two types of requests for military service support are the emergency response request and the non-emergency response request. A munitions emergency occurs when a known, observed munition is discovered on a site and presents a hazard that must be dealt with immediately to prevent a MEC encounter. A non-emergency situation occurs when munitions are known to be or are suspected in an area, but there are no visible munitions that pose an immediate threat. In non-emergency situations, the military service has time to characterize the site and, if necessary, investigate and remove any suspect items.

5.3.1 Emergency Response Procedures for Reporting UXO or DMM Encounters

MEC encounters should be reported as soon as it is possible to do so safely. Private citizens who discover MEC should, after leaving the area, call 911 or immediately notify a BLM or FWS authority. Instructions for notifying authorities should be posted, along with instructions about safe reporting and other safety procedures. BLM and FWS personnel and law enforcement officers should contact the following offices.

BLM personnel: Call the local law enforcement office (bomb squad), 911, or the nearest military installation's EOD unit. Also notify the BLM ranger or call the hazardous materials coordinator at the BLM office, or BLM State office, that has jurisdiction for the site. If you cannot reach the hazardous materials coordinator, call the BLM State law enforcement office emergency number or the BLM national law enforcement office at (208) 387-5126.

FWS personnel: Call the local law enforcement office (bomb squad), 911, or the nearest military installation's EOD unit. Also, call the regional environmental compliance engineer or regional safety officer.

Both BLM and FWS hazardous materials staff should have a point of contact at the local military EOD unit for emergency response actions.

5.3.2 Details to Include in Reports on UXO or DMM Encounters

Remember, all observations should be made as far away as possible from the MEC.

The report should include as much of the following information as possible:

- Location of the MEC using a map, GPS coordinates, or landmarks (use of a GPS receiver is acceptable because it is a receive-only device)
- Who discovered the MEC and how they can be contacted
- Condition of the MEC (e.g., buried, partially exposed, fully exposed, corroded, punctured)
- Type of MEC (e.g., bomb, rocket, grenade, mortar)
- Number of MEC items visible
- Estimated size of MEC (e.g., length and diameter)
- Distinctive features of MEC (e.g., shape, color, markings)
- Nearby structures, if any (so inhabitants can be contacted and evacuated if necessary)
- Public access to the vicinity (i.e., open, closed)

5.3.3 Procedures for Requesting an Emergency Response

An emergency response may be undertaken at sites where the explosives or munitions pose an immediate danger. An emergency response is usually a short-term action that involves a local bomb squad or a military EOD unit responding to a specific observed item of ordnance.

When UXO or DMM has been observed and reported to the local law enforcement authority, BLM ranger, or FWS refuge officer, those authorities should evacuate and restrict access to the area. The law enforcement authority should contact the nearest EOD unit or military installation through existing local procedures for military support.

If the local law enforcement authority does not know which military unit to contact, then the local law enforcement authority should contact the U.S. Army Forces Command (FORSCOM), 52nd Ordnance Group (EOD), at its 24-hour emergency response number, (404) 469-3333. In the event the operations center cannot be contacted, the 52nd Ordnance Group S-3 (Operations) can be notified during normal duty hours (Eastern time zone) at (404) 469-3325. For Alaska and Hawaii, the contact is (808) 287-1524 (24-hour pager). This applies to the United States and its territories.

For BLM employees, if the local law enforcement authority does not respond, contact the BLM national law enforcement office at (208) 387-5127. The national office will ask the national interagency fire center's emergency response center to request military support.

A local bomb squad may respond at the request of the local law enforcement authority. The use of the civilian bomb squad depends on its level of training for military munitions and on existing protocols between the military service and the local government.

If responding military EOD personnel determine that the response action is not an emergency or is not within their capability, they will contact the appropriate authority to respond to the incident. If a MEC risk remains after the EOD unit's emergency response is completed, the Federal land manager should follow the procedures for a non-emergency MEC munitions response action.

5.3.4 Reporting Procedure for Requesting a Non-emergency Response

The military services will conduct a non-emergency munitions response at sites where an emergency response has been completed and follow-up work is necessary, or at sites where MEC generally is known or suspected because of prior military use. In either case, a non-emergency response generally is a long-term action involving a site survey, site characterization, MEC removal, land use controls, risk management measures, and periodic evaluation to determine if additional munitions response actions are necessary.

Most sites with MEC will fall under one of three DoD-funded programs, depending on the date lands were or will be transferred to BLM or FWS management and on the method of transfer.

5.3.4.1 Formerly Used Defense Sites (FUDS) Program

The FUDS program is managed by USACE. Every USACE District Office has a FUDS coordinator. FUDS lands generally include any lands that were used by the military services or their contractors and that were transferred to BLM or FWS management on or before October 16, 1986. However, the FUDS program does not include former battlefields (e.g., Aleutian Islands), cemeteries, and certain sites.

5.3.4.2 Installation Restoration Program (IRP)

The individual military services are responsible for their bases' IRPs. All lands transferred to BLM or FWS management on or after October 17, 1986, fall within this program, unless they are listed as a Base Realignment and Closure (BRAC) Act site. The USACE FUDS coordinator should know which service and installation to contact. Also, a check of the historical index of BLM's master title plats or FWS's land records should indicate which military service and military organization used the lands. Generally, although the military service is responsible for munitions response actions, Air Force and Army installations will contract with USACE to accomplish MEC removal. Navy installations contract with Naval Facilities Engineering Command (NAVFAC) to accomplish MEC removal.

5.3.4.3 Base Realignment and Closure (BRAC) Program

The BRAC program started in 1988 with the passage of the first Base Realignment and Closure Act. As of 2005, five BRAC rounds are in progress. The military uses only BRAC funds to remove MEC from installations closed by those laws. Again, the military services are responsible for their own installations, but they normally contract with USACE or NAVFAC to perform MEC removal.

5.4 ROLE OF THE BLM AND FWS LAND MANAGER

BLM and FWS land managers are responsible for actions taken by all parties on the lands they manage. The military service personnel have expertise relating to explosives and munitions response operations. The BLM or FWS manager's responsibility is to ensure that the military's proposed actions are compatible with the agency's goals for land and resources management while they meet risk reduction goals.

For an emergency munitions response, the land manager's role is to ensure that no one enters the site without authorization until the EOD unit or bomb squad removes the hazard. Without delaying the emergency munitions response action, the Federal land manager should evaluate available information on important natural and cultural resources that might be affected by the action. All reasonable efforts should be made to protect those resources.

For a non-emergency munitions response, the BLM or FWS must authorize the proposed action before the bomb squad or EOD unit begins the munitions response action.

The BLM or FWS manager has oversight of land use controls used in the long-term risk management for the MEC site (see Chapter 4). The BLM or FWS may have responsibility for implementation and enforcement of land use controls, or those responsibilities may be retained by DoD.

5.5 INFORMATION FOR VISITORS AND AUTHORIZED USERS ABOUT UXO AND DMM

Public lands provide visitors with a vast array of recreational opportunities. These include hunting, fishing, camping, hiking, boating, hang gliding, off-highway vehicle driving, mountain biking, birding, and visiting natural and cultural heritage sites. A significant number of visitors are interested in "getting away from it all" and exploring areas removed from visitor facilities and trails. In the future, as the nation's population grows and urban areas expand, increasing demands for outdoor recreation will lead to the need to protect visitors in areas on public lands that are known or likely to contain MEC.

Land managers should provide UXO and DMM information to visitors and authorized users of public lands and refuges to ensure their safe access and use of the lands. The BLM or FWS can convey this information through written materials (e.g., brochures), briefings, videos, or a combination of these methods. Information should include site-specific access information, types of UXO or DMM that might be encountered at the site (with pictures), and the likelihood of an encounter.

Briefings are ideal opportunities for land managers to provide information to authorized visitors at controlled access locations. The briefing can be an entrance requirement at Federal lands that were former military ranges and would allow visitors to ask questions and plan or modify their activities based on the likelihood of potential MEC encounters. Short safety videos and written materials can be ordered from DoD, the Army Environmental Center (AEC), and USACE Huntsville (see Appendix 2).

5.5.1 Hold-Harmless Waiver

In most locations, Federal land managers require visitors and other authorized users to sign a statement acknowledging that they have read the safety material and hold the U.S. Government harmless for any MEC incidents. The required waiver (see Appendix 4) helps to emphasize the need to behave safely. The waiver demonstrates that the land manager has provided information about known and unknown risks to visitors.

5.5.2 Web Site

The following MEC safety web site provides samples of signage, informational material, video clips, and more: http://www.denix.osd.mil/denix/Public/Library/Explosives/UXOSafety/uxosafety.html.

Chapter 6

MEC Site Characterization and Munitions Response Operations

Acronym List

ADNT	Aminodinitrotoluene
AEC	Army Environmental Center
BIP	Blow-in-place
BRAC	Base Realignment and Closure
DNA	Dinitroaniline
DNB	Dinitrobenzene
EMI	Electromagnetic induction
EOD	Explosive ordnance disposal
EPA	Environmental Protection Agency
FUDS	Formerly used defense site
GPR	Ground penetrating radar
GPS	Global positioning system
HMX	Her Majesty's explosive or high melting explosive
IR	Infrared
JUXOCO	Joint Unexploded Ordnance Coordination Office
MTADS	Multisensor Towed Array Detection System
RDX	Royal demolition explosive
SAR	Synthetic aperture radar
TNB	Trinitrobenzene
TNT	Trinitrotoluene

MEC site characterization and munitions response operations are the responsibility of the military services. However, the BLM and FWS are responsible for identifying their agencies' priorities for the munitions response, for describing expected land use, and for concurring with and overseeing the military service's operations on BLM- and FWS-managed lands. Representatives of the BLM or FWS become part of a project team, which also consists of the military service project office, the EPA, and the State's environmental department.

6.1 PROCEDURE FOR REQUESTING TECHNICAL SUPPORT FROM DOD

Requests for technical support from DoD for munitions response, including site characterization and munitions response operations, will be submitted to different military organizations, depending on the type of munitions response site involved:

- For formerly used defense sites (FUDS) — Send requests to the supporting U.S. Army Corps of Engineers district office.
- For base realignment and closure (BRAC) lands — Send requests to the military installation or command that was responsible for remediation and transfer of the lands. If that office no longer exists, the BLM or FWS headquarters' point of contact will forward the request to the appropriate military office.
- For sites that are neither FUDS nor BRAC — Send requests to the appropriate BLM headquarters' military liaison or to the point of contact at the FWS headquarters' Division of Engineering, Environmental and Facility Compliance, who will forward the request to the appropriate military office.

The BLM or FWS headquarters staff will contact, as appropriate, Headquarters USACE, Headquarters Naval Facilities Engineering Command, Air Force Real Estate Agency, or the DoD office responsible for munitions response policy to determine the appropriate munitions response organization.

The request for support should include the following information, if known:

- Site name
- Site location
- Type of support, such as the following:
  – Site characterization
  – Surface munitions response
  – Subsurface munitions response
- Narrative about site use (who, what, when, where, and how), such as the following:
  – Period of use by the military
  – Type of training (how site was used)
  – Types of munitions used
- BLM or FWS point of contact

6.2 SITE CHARACTERIZATION

Site characterization is the investigation of known or suspected MEC areas to determine the presence or absence of MEC and to gather other information such as type, density, depth, or lateral extent of the MEC. Former military properties are characterized to provide a baseline for determining whether the selected risk reduction measures will be adequate for the proposed land uses. Characterization of these former military properties requires searching for discrete metallic objectives on the surface or buried beneath the surface. The objects may be located in concentrated areas in association with a specific target, or distributed randomly in a wide variety of areas. Knowing where to look depends on historical knowledge of the munitions activities that took place at the site and a documented conceptual site model. DoD has conducted tests and demonstration projects and still finds that many UXO detection and discrimination systems or procedures are less reliable than desired. UXO discrimination systems are designed to differentiate a UXO explosive item from scrap metal. The military services sponsor research and development programs to improve UXO detection and discrimination. Current information is available from the DoD Joint Unexploded Ordnance Coordination Office (JUXOCO) at the web site http://www.denix.osd.mil.

The site characterization process should also include an environmental investigation to determine if the site is contaminated with chemical constituents from munitions. Some of the specific chemicals used in munitions are 2,4,6-trinitrotoluene (TNT); 1,3,5-trinitrobenzene (TNB); 1,3-dinitrobenzene (DNB); 3,5-dinitroaniline (DNA); 2-amino-4,6-dinitrotoluene (ADNT); 1,3,5-trinitro-1,3,5-triazine (RDX, or royal demolition explosive); HMX (Her Majesty's explosive or high melting explosive); perchlorate; and tetryl. If concentrations of these chemicals are sufficiently high (more than 10 percent), the soils are potentially explosive. In addition, ambient concentrations of these chemicals may be toxic to biota and contaminate surface and groundwater.

If MEC is found anywhere on the site, additional site characterization and remediation are required. BLM personnel should consult State or regional BLM environmental specialists for more specific environmental investigation information. FWS personnel should contact the environmental contaminants specialist in the Ecological Services Field Office and the Environmental and Facility Compliance Office in the Division of Engineering.

6.3 SITE CHARACTERIZATION TECHNOLOGIES

Two primary technologies are deployed on a number of different platforms to characterize sites and detect UXO and DMM: magnetometers and electromagnetic induction (EMI) sensors. They each have strengths and weaknesses depending on the specific munitions items for which they are searching, the manner in which the weapon system was deployed (and the resulting maximum depth of the munition), and the physical environment at the site being investigated.

This section describes these primary technologies, a variety of secondary technologies that may be helpful in specific circumstances, plus technology advancements.

6.3.1 Primary Technologies

This section describes the two primary technologies used to detect subsurface UXO and DMM: magnetometry and electromagnetic induction.

6.3.1.1 Magnetometry

Magnetometers measure variations in the magnetic field of the Earth. Iron (ferrous) objects or minerals on the surface or in the subsurface cause local distortions or anomalies in that field. Magnetometers locate buried iron objects, including UXO or DMM, by detecting those distortions.

A typical magnetometer consists of a detection sensor, power supply, computer data system, and means to record the locations of detected anomalies. More advanced magnetometers incorporate a navigational system, such as a differential global positioning system (GPS), to determine location.

The effectiveness of magnetometers depends on their sensitivity, distance between the sensor and UXO or DMM, amount of iron material in the UXO or DMM, background magnetic noise, and site-specific soil properties. Recent demonstrations show that newer systems detect 70 to 90 percent of the UXO or DMM. These systems generally are used with the sensor head only a few inches above the ground.

There are numerous types of magnetometers (see ***Figures 13-15***). Gradiometers, which are systems of two magnetometers configured to measure the spatial rate of change in the magnetic field, are widely used to detect UXO and DMM. Helicopter-borne systems fly 6 to 10 feet above the ground. However, at that height the system loses the ability to detect small- and medium-caliber projectiles. Other magnetometers are available that have improved detection sensitivity for specific soil conditions.

6.3.1.2 Electromagnetic Induction

Electromagnetic induction (EMI) sensors detect both ferrous and nonferrous metallic objects. EMI systems transmit electric current into the soil to detect metallic objects. The systems measure either the secondary magnetic field induced in metal objects or the difference between the electrical conductivity of the soil and the electrical conductivity of buried objects, such as UXO (see ***Figures 16-18***).

Figure 13 – *Multisensor Towed Array Detection System (MTADS) configured with cesium vapor magnetometers. Photo courtesy of Blackhawk Geometrics.*

Figure 14 – *Cart system configured with cesium vapor magnetometers. Photo courtesy of Blackhawk Geometrics.*

Figure 15 – *Helicopter configured with magnetometers for UXO and DMM detection. Photo courtesy of Oak Ridge National Laboratory.*

000422

Figure 16 – *MTADS configured with EMI sensors. Photo courtesy of Blackhawk Geometrics.*

6.3.2 Secondary Technologies

The secondary technologies described below have a number of limitations, but they may be useful in selected site-specific circumstances.

6.3.2.1 Infrared Sensors

Infrared (IR) sensor technologies detect UXO and DMM by distinguishing between the temperature of the UXO or DMM and the surrounding soil. Metal objects heat and cool at a different rate than the surrounding soils. IR detectors locate UXO and DMM at or near ground surface by detecting those temperature differences. This technology is typically most effective on unvegetated or sparsely vegetated surfaces and when weather conditions and time of day provide the greatest temperature differential (see ***Figures 19-21***). IR technology has minimal capability to identify types or categories of UXO or DMM (e.g., mortar fins versus smooth artillery munitions).

Figure 18 – *EMI skirt configuration. Photo courtesy of Blackhawk Geometrics.*

Figure 17 – *EMI cart and backpack configuration. Photos courtesy of Blackhawk Geometrics.*

6.3.2.2 Ground Penetrating Radar

Ground penetrating radar (GPR) is a radar system designed to penetrate the earth and return signals that indicate the nature of subsurface items.

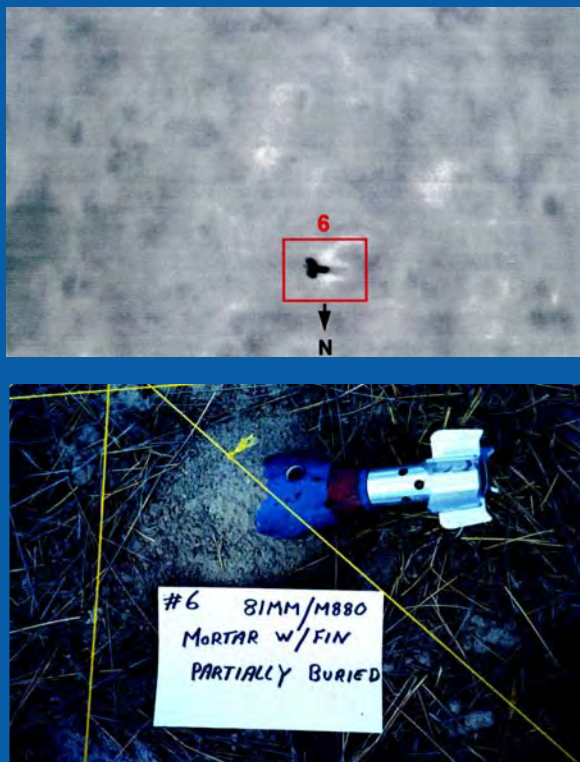


Figure 19 – *Airborne infrared and ground images of an 81 mm mortar. Photos courtesy of ORD-TECH.*

Figure 20 – *Airborne infrared and ground images of a 25 mm round. Photos courtesy of ORD-TECH.*

The main elements of any GPR system are the transmitter, receiver or antenna, controls, and display and recorder units. The transmitter directs short pulses of electromagnetic energy toward the ground. As the energy pulses travel into the ground, buried objects reflect signals back to the receiving unit. The processing and recording of these signals form an image.

Figure 21 – *ORD-TECH's helicopter with an advanced infrared detection system. Photo courtesy of ORD-TECH.*

Many environmental factors significantly affect the ability of GPR systems to produce accurate images. Important factors include the density and type of vegetative cover, water content of the vegetation and soil, and topography. In general, GPR is not effective in saturated soils and wet areas because water absorbs GPR energy.

Most GPR systems are on sleds that are pulled across the ground (see ***Figure 22***). Sensor heads, which are essentially in contact with the ground, provide deeper penetration of the ground and less surface-signal-return clutter. Signal penetration into the soil decreases with increasing distance between the sensor head and the ground, thus lowering the equipment's ability to discriminate small objects.

Figure 22 – Ground penetrating radar sled in towed configuration. Photo courtesy of Blackhawk Geometrics.

6.3.2.3 Synthetic Aperture Radar

Synthetic aperture radar (SAR) is an airborne system that provides a radar image of the land surface and objects on the surface. Metallic objects have a stronger radar signal return than nonmetallic objects. This allows for identification of metallic objects, both munitions-related and non-munitions-related. The synthetic aperture provides a high degree of surface image resolution even though the aircraft is flying at thousands of feet above the ground. This system can cover large areas at relatively low cost. SAR is effective at finding surface indicators of UXO and DMM as well as the actual munitions, thereby allowing more efficient and focused use of ground systems. SAR is not good at differentiating between sizes of metallic objects.

6.3.3 Technological Advancements

Industry continues to make significant technological advancements in UXO detection and in the ability to differentiate between UXO or DMM and non-UXO/DMM items. Use of these technologies increases UXO and DMM detection rates and reduces the number of false alarms (signal responses that indicate a possible UXO or DMM item when none is present, such as non-UXO/DMM ferrous metal or naturally occurring ferrous elements). False alarms are a major cost for munitions response operations. Reductions in false alarm rates increase efficiency and significantly decrease the cost of the munitions response operation. Technology advancements in UXO and DMM discrimination sciences are evolving rapidly. The U.S. Army Environmental Center (AEC) has information regarding the latest detection and discrimination technologies.

The combination of EMI and magnetometer sensors on a single platform appears to hold the highest promise for improving detection systems. Ongoing research and development efforts focus on the analysis of magnetometer and EMI signals to discriminate between ordnance and non-ordnance items. Although GPR is not as good as magnetometers or EMI at detecting UXO and DMM, GPR systems show promise for discrimination of detected objects.

Finally, recent demonstrations by the DoD Environmental Security and Technology Certification Program (ESTCP) suggest that data from high airborne light detection and ranging (LiDAR) systems and orthophotography offer promise in identifying potential munitions-related features in large, open range areas such as those frequently found in the West.

6.4 MUNITIONS RESPONSE OPERATIONS

Response operations at former military sites typically include the remediation of many different types of hazards, such as MEC, range debris, and possibly radioactive contaminants associated with range debris. Munitions response actions often entail actual destruction of the MEC on-site (sometimes referred to as "blow-in-place," or BIP). Destroying the MEC on-site is the preferred method of disposal, as it involves less risk to the EOD team; however, it may leave some explosives residue. When MEC removal is deemed necessary, such as the discovery of MEC in a residential area, specially trained and certified EOD professionals must perform the removal action or the *render safe* procedure. Render safe usually means removing the fuze or disrupting the fuze train of the UXO or DMM so that it will not explode.

The emergency contacts listed at the beginning of this handbook will call the military ordnance experts to evaluate and remove or neutralize (destroy or render safe) any MEC found on BLM or FWS sites. In some areas, a local police unit or the hazardous materials response squad from the fire department may respond to a MEC discovery. For large-scale, non-emergency MEC removal operations, DoD will hire UXO contractors to conduct the munitions response operations. These types of operations typically will involve the formation of a project team.

6.5 SELECTION OF A RESPONSE ACTION

Munitions response actions reduce risk from exposure to MEC by removing some or all MEC from an area in response operations. The BLM or FWS and the military jointly determine the extent of a response action by considering the following:

- Reasonably anticipated future land use
- Boundaries of the areas to be investigated and remediated
- Effectiveness of risk reduction
- Environmental impact from response operations
- Cost

Evaluation of these factors is embodied in the analysis conducted under the remedy selection process associated with the Comprehensive Environmental Response, Compensation, and Liability Act (see Chapter 7).

Using the military installation's historical records and current information provided by the BLM or FWS, the military services will do the following:

- Research all archival material to determine when, where, and how the military used the lands
- Determine the types of known or suspected MEC
- Define the locations and depths of MEC
- Develop a conceptual site model of the munitions response area
- Remove or neutralize the MEC
- Document the process
- Provide continued surveillance of areas where MEC is to remain above the frost line but below the removal depth

It is the position of the BLM and FWS that the military services are obligated to perform a new MEC site characterization or additional munitions response operations when changes in land use are proposed. The military services sometimes do not agree with this position and maintain that they will return to do additional munitions response only if Congress or a court order mandates the land use change. The BLM and FWS manager should consider the cost and risk to EOD personnel and alternatives available before proposing a land use change on lands containing MEC. This is an unresolved principle that the DoD and DOI are still discussing.

The BLM and FWS have no established standards for describing the depth of munitions removal at a munitions response site. The depth of removal will be developed at each munitions response site by the site's project team. The project team should consider current and future management actions that are likely to occur onsite and the depth to which the response actions will penetrate the subsurface. Examples of typical actions in which depth will be a consideration include fence construction to the depth of the post holes; road or pipeline construction because of excavation; intrusive wildland firefighting actions such as construction of firebreaks and associated restoration activities; activities associated with prescribed burning; and vegetation management actions such as seeding, invasive species removal and eradication, and habitat modification.

6.6 MEC EXCAVATION TECHNOLOGIES

MEC removal may cause the detonation of explosives or the release of hazardous or toxic materials. EOD specialists or UXO technicians must perform all removal operations. The project munitions response team will determine the site-specific procedures for MEC removal. Although a detailed discussion of the excavation procedures associated with removal of MEC is beyond the scope of this handbook, the following sections provide a general overview of available excavation technologies.

Historically, MEC excavation primarily involved labor-intensive manual methods. Since the 1980s, research and development efforts have focused on increased mechanization to improve efficiency and enhance operator safety. The major categories of excavation technologies are manual methods, mechanized systems, and remote-controlled systems.

6.6.1 Manual Methods

Standard manual excavation involves the use of shovels and other digging tools to excavate soil and expose potential MEC. Manual methods work best for MEC in the near-surface and shallow subsurface (not more than 24 inches deep). Manual methods present significant safety risks to workers.

6.6.2 Mechanized Systems

Mechanized MEC excavation systems include excavators, bulldozers, front-end loaders, and other heavy construction equipment. Historically, backhoe-type excavators were the most commonly used mechanized system. Vacuum excavators, another kind of mechanized system, use a high-pressure jet of air to penetrate and dislodge soil, then use a vacuum to extract the dislodged soil (to expose the MEC), and finally transport the soil away using a conveyor belt.

6.6.3 Remote-Controlled Systems

Remote-controlled MEC excavation systems include telerobotic and autonomous systems. In general, the capabilities, effectiveness, and use of remote-controlled systems are the same as for mechanized systems. The primary difference is that the operator of a remote-controlled system remains outside the immediate hazard area. Of the three categories of MEC excavation methods, remote-controlled systems offer the highest degree of safety, but they may also be the slowest and most expensive.

Chapter 7

MEC-Related Statutes, Policies, and References

Acronym List

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
DMM	Discarded military munitions
DOI	Department of the Interior
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FUDS	Formerly used defense site
MC	Munitions constituents
MEC	Munitions and explosives of concern
NEPA	National Environmental Policy Act
RCRA	Resource Conservation and Recovery Act
SARA	Superfund Amendments and Reauthorization Act
UXO	Unexploded ordnance

This chapter contains an overview of MEC-related statutes, policies, and references. For additional information, consult the applicable reference.

7.1 NATIONAL ENVIRONMENTAL POLICY ACT OF 1969

NEPA (42 U.S.C. §4231 *et seq.*) requires the BLM and FWS to ensure that environmental considerations are given appropriate weight during the decision-making process. It also requires Federal departments and agencies to perform an environmental evaluation of proposed actions that considers all alternatives in order to minimize potential environmental damage. The act requires the preparation of environmental documentation (environmental assessments and environmental impact statements) to evaluate the potential environmental effects of a proposed action and any unavoidable adverse environmental effects.

The selection of cleanup alternatives under CERCLA does not require a NEPA assessment, as CERCLA is considered to be the functional equivalent of NEPA, and the CERCLA remedy selection process (either removal or remedial) stands in place of a NEPA assessment.

7.2 RESOURCE CONSERVATION AND RECOVERY ACT OF 1976

RCRA (42 U.S.C. §6901 *et seq.*) provides the comprehensive Federal regulation for the collection, treatment, storage, and disposal of solid waste, including hazardous waste.

Munitions, used for their intended purpose, at some point become solid waste potentially subject to RCRA and also may include hazardous substances, pollutants or contaminants subject to CERCLA. It is EPA's position that munitions become a statutory solid waste when EPA or a state determines they have been left in the environment long enough to be considered "discarded" within the statutory definition of "solid waste." UXO and DMM are not listed as hazardous waste under RCRA; however, when managed, they will become hazardous waste if they fail the RCRA hazardous waste characteristics tests (e.g., toxicity, ignitability, reactivity, and corrosivity). MC may in some instances be listed as hazardous waste, or it may become a regulated waste if it fails one of the RCRA hazardous waste characteristics tests.

RCRA also contains corrective action requirements that apply to the cleanup of old hazardous waste units. Depending upon State preferences, a munitions response action may be conducted under RCRA or CERCLA but must be consistent with both.

7.3 COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT

CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA; 42 U.S.C. §9601 *et seq*.), prescribes reporting and investigation requirements for hazardous substance releases and for cleanup of sites. CERCLA imposes potential liability for owners or operators (including Federal agencies) of land containing hazardous substances. The National Contingency Plan contains the implementing regulations for CERCLA (40 CFR §300). CERCLA is the primary authority directing the military's munitions response activities. The DoD has asserted a preference for conducting response actions under CERCLA rather than RCRA.

7.4 ENDANGERED SPECIES ACT OF 1973

The Endangered Species Act (ESA) of 1973 (16 U.S.C. §1531 *et seq*.) protects plant and animal species formally listed as threatened or endangered by the Secretary of the Interior (terrestrial and freshwater species and some marine species) or the Secretary of Commerce (other marine species). The act calls for the listing of species to be based solely on scientific data. As of September 2003, 1,263 U.S. species and 558 foreign species were listed as threatened or endangered. Once a species is listed, section 7 of the ESA directs Federal agencies to consult with the FWS or the National Maritime Fisheries Service to ensure that any actions the Federal agencies authorize, fund, or carry out do not jeopardize the continued existence of any listed species or destroy critical habitat.

7.5 DEPARTMENT OF THE INTERIOR MANUAL

The DOI Departmental Manual, Part 602, Chapter 2 ("Real Property Pre-Acquisition Environmental Site Assessment" in the Public Lands Series on Land Acquisition, Exchange, and Disposal) describes departmental policy, responsibilities, and functions regarding liability and risk. Before real property is acquired (including withdrawn public lands that are returning to the jurisdiction of the Secretary of the Interior), the DOI agency acquiring the property is required to determine if hazardous material, including MEC, are present. If hazardous materials are present, the extent of DOI's exposure to cleanup liability and other associated risks must be evaluated.

7.6 DEPARTMENT OF THE ARMY TECHNICAL MANUAL, AMMUNITION, GENERAL

The Technical Manual, Ammunition, General, was published by the Department of the Army in 1969 (TM 9-1300-200) and reprinted in 1993. The manual provides a comprehensive report of U.S. military munitions, munitions data, illustrations, munitions packaging information, and labeling and marking of munitions.

7.7 UNEXPLODED ORDNANCE (UXO) PROCEDURES FIELD MANUAL

The *Unexploded Ordnance (UXO) Procedures* field manual was published by the Department of the Army in 1981 (FM 21-16) and reprinted in 1994. This document is designed for military identification and removal operations for UXO resulting from battlefield operations. This manual provides very good background on UXO identification, munitions photographs, and removal techniques.

Glossary

Active range: A military range that is currently in service and is being regularly used for range activities.

Anomaly avoidance: Techniques employed on property known or suspected to contain UXO, other munitions that may have experienced abnormal environments (e.g., DMM), munitions constituents in high enough concentrations to pose an explosive hazard, or chemical agent (CA), regardless of configuration, to avoid contact with potential surface or subsurface explosive or CA hazards, to allow entry to the area for the performance of required operations.

Arming device: A device designed to perform the electrical and/or mechanical alignment necessary to initiate an explosive train.

Base Realignment and Closure (BRAC): BRAC is a process DoD has used to reorganize its installation infrastructure to more efficiently and effectively support its forces, increase operational readiness, and facilitate new ways of doing business.

Blow-in-place: The method used to destroy UXO or DMM, by use of explosives, in the location the item is encountered.

Caliber: The diameter of a projectile or the bore of a gun or launching tube expressed in millimeters or inches. When caliber is given only as a number, such as .50, it is in inches. A caliber given in millimeters will always have "mm" after the number.

Chemical agent (CA): A chemical compound (including experimental compounds) that is intended for use in military operations to kill, seriously injure, or incapacitate persons through its chemical properties that produce lethal or other damaging effects on human beings. Excluded are research, development, testing, and evaluation (RDTE) solutions; riot control agents; chemical defoliants and herbicides; smoke and other obscuration materials; flame and incendiary materials; and industrial chemicals.

Clearance: The removal of UXO or DMM from the surface and subsurface at operational ranges.

Closed range: A military range that has been taken out of service and either has been put to new uses that are incompatible with range activities or a range that is not considered by the military to be a potential range area. A closed range is still under the control of a military service.

Construction support: Assistance provided by EOD- or UXO-qualified DoD personnel or personnel trained and qualified for operations involving chemical agent (CA), regardless of configuration, to ensure the safety of personnel or resources from any potential explosive or CA hazards during intrusive construction activities on property known or suspected to contain UXO, other munitions that may have experienced abnormal environments (e.g., DMM), munitions constituents in high enough concentrations to pose an explosive hazard, or CA, regardless of configuration.

Defense sites: Locations that are or were owned by, leased to, or otherwise possessed or used by the Department of Defense. The term does not include any operational range, operating storage or manufacturing facility, or facility that is used for or was permitted for the treatment or disposal of military munitions. (10 U.S.C. §2710(e)(1))

Detonation: A violent chemical reaction within a chemical compound or mechanical mixture evolving heat and pressure. The result of the chemical reaction is exertion of extremely high pressure on the surrounding medium.

Discarded military munitions (DMM): Military munitions that have been abandoned without proper disposal or have been removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include unexploded ordnance, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed of, consistent with applicable environmental laws and regulations. (10 U.S.C. §2710(e)(2))

Electromagnetic induction (EMI): The transfer of an electrical field from one item to another, causing a magnetic field resonance in the object that can be detected by sensors.

Engineering controls (land use): Any physical barriers or actions that are designed to limit access to locations where MEC is believed to exist, such as fencing, signage, and cap and cover systems.

Explosion: A chemical reaction of any chemical compound or mechanical mixture that, when initiated, undergoes a very rapid combustion or decomposition, releasing large volumes of highly heated gases that exert pressure on the surrounding medium. Also, a mechanical reaction in which failure of the container causes sudden release of pressure from within a pressure vessel.

Explosive: A substance or mixture of substances that can undergo a rapid chemical change, generating large quantities of energy generally accompanied by hot gases.

Explosive hazard: A condition where danger exists because explosives are present that may react (e.g., detonate, deflagrate) and result in death or injury of people or damage to property, operational capability, or the environment.

Explosive ordnance disposal (EOD): The detection, identification, on-site evaluation, rendering safe, recovery, and final disposal of unexploded ordnance and of other munitions that have become an imposing danger, for example, by damage or deterioration.

Explosive ordnance disposal incident: The suspected or detected presence of UXO or damaged military munitions that constitute a hazard to operations, installations, personnel, or material. Each EOD response to reported UXO or DMM is an EOD incident.

Explosive ordnance disposal personnel: Military personnel who have graduated from the Naval School, Explosive Ordnance Disposal; are assigned to a military unit with a service-defined EOD mission; and meet service and assigned unit requirements to perform EOD duties. EOD personnel have received specialized training to address explosive and certain chemical hazards during both peacetime and wartime. EOD personnel are trained and equipped to perform render-safe procedures on nuclear, biological, chemical, and conventional munitions, and on improvised explosive devices.

Explosive ordnance disposal response: The safe recovery and final disposal of UXO or munitions. An EOD response may also include actions to render-safe or dispose of explosive ordnance that has become hazardous by damage or deterioration, when the disposal of such items is beyond the capabilities of the personnel normally assigned the responsibilities for routine disposal.

Explosive ordnance disposal unit: A military organization constituted by proper authority, manned with EOD personnel, outfitted with equipment required to perform EOD functions, and assigned an EOD mission.

Explosive soil: Any mixture of explosives with soil, sand, clay, or other solid media at concentrations that cause the mixture itself to be reactive or ignitable. Defined by the USACE as soil that is composed of more than 10 percent reactive or ignitable material.

Explosive train: The arrangement of different explosives in a sequence in which (1) a small quantity of an initiating compound or mixture, such as lead azide, is used to detonate a larger quantity of (2) a booster compound, such as tetryl, which results in (3) RDX, TNT, or other compounds detonating.

Explosives or munitions emergency response: All immediate response activities by an explosives and munitions emergency response specialist to control, mitigate, or eliminate the actual or potential threat encountered during an explosives or munitions emergency. An explosives or munitions emergency response may include in-place render-safe procedures, treatment or destruction of the explosives or munitions, and/or transporting of those items to another location to be rendered safe, treated, or destroyed. Any reasonable delay in the completion of an explosives or munitions emergency response caused by a necessary, unforeseen, or uncontrolled circumstance will not terminate the explosives or munitions emergency. Explosives and munitions emergency responses can occur on either public or private lands and are not limited to responses at RCRA facilities. (Military Munitions Rule, 40 CFR §260.10)

Flares: Devices that are dropped or fired as a projectile. They normally consist of a magnesium compound that burns at very high temperatures, a fuze that initiates the burning process, and possibly a parachute, all contained in a canister. Flares as UXO will normally be found on or near the ground surface. The danger from a flare is both from the fuze used to ignite the flare and the intense heat from the burning flare.

Fragmentation: Characteristic of ordnance that is primarily intended to produce many small fragments (shrapnel) for the purpose of killing personnel or damaging soft targets.

Fuse: A cord of readily combustible material that is lit at one end to carry a flame along its length to detonate an explosive at the other end (e.g., firecracker).

Fuze: A mechanical or electrical device with explosive or non-explosive components designed to initiate a train of fire or detonation in ordnance.

Fuze, delay: Any impact fuze incorporating a means of delaying its action after contact with the target. The delay duration classifies the fuze. A chemical or timing device can cause the delay.

Fuze, impact: A fuze in which the force of impact initiates detonation. This fuze may activate instantaneously or after a short delay.

Fuze, proximity: A fuze that is activated when it remotely senses the presence, distance, or direction of the target through the characteristics of the target itself or its environment. Noise, vibration, movement, magnetic signature, or radio signal may cause activation.

Gradiometer: Magnetometer for measuring the rate of change of a magnetic field.

Ground penetrating radar (GPR): A system that uses pulsed radar waves to penetrate the ground and measure the distance and direction of subsurface targets through radar waves that are reflected back to the system.

Hazardous substance: (A) any substance designated pursuant to section 311(b)(2)(A) of the Federal Water Pollution Control Act [33 U.S.C. §1321 (b)(2)(A)]; (B) any element, compound, mixture, solution, or substance designated pursuant to section 9602 of this title; (C) any hazardous waste having the characteristics identified under or listed pursuant to section 3001 of the Solid Waste Disposal Act [42 U.S.C. §6921] (but not including any waste the regulation of which under the Solid Waste Disposal Act [42 U.S.C. §6901 *et seq*.] has been suspended by Act of Congress); (D) any toxic pollutant listed under section 307(a) of the Federal Water Pollution Control Act [33 U.S.C. §1317 (a)]; (E) any hazardous air pollutant listed under section 112 of the Clean Air Act [42 U.S.C. §7412]; and (F) any imminently hazardous chemical substance or mixture with respect to which the Administrator has taken action pursuant to section 7 of the Toxic Substances Control Act [15 U.S.C. §2606]. The term does not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a hazardous substance under subparagraphs (A) through (F) of this paragraph, and the term does not include natural gas, natural gas liquids, liquefied natural gas, or synthetic gas usable for fuel (or mixtures of natural gas and such synthetic gas). (42 U.S.C. §9601(14))

Illumination: A term applied to ordnance indicating its ability to produce high-intensity light. The ordnance usually contains a magnesium flare and may contain a parachute for suspension in the air.

Inactive range: A military range that is not currently being used but is still under military control, is considered by the military to be a potential range area, and has not been put to a new use that is not compatible with range activities.

Incendiary: Any flammable material used as filler in ordnance intended to destroy a target by fire, such as napalm and white phosphorus.

Inert: The state of some types of ordnance that (1) when used as designed leave only a harmless carrier, or (2) are manufactured without explosive, propellant, or pyrotechnic content. Inert ordnance poses no explosive hazard to personnel or material.

Installation: A grouping of facilities, located in the same vicinity, that support particular functions. Installations may be elements of a base.

Institutional controls (land use): Non-engineering measures designed to prevent or limit human exposure to hazardous substances left in place at a site or to ensure the effectiveness of the chosen remedy. Institutional controls are usually, but not always, legal controls, such as public access closures, withdrawal and reservation of lands for public safety purposes, and notations on official land records.

Land use controls: Any type of physical, legal, or administrative mechanism that restricts the use of, or limits access to, property to prevent or reduce risks to human health and the environment.

Magnetometer: An instrument for measuring the intensity and direction of magnetic fields.

Material potentially presenting an explosive hazard: Material potentially containing explosives or munitions (e.g., munitions containers and packaging material; munitions debris remaining after munitions use, demilitarization, or disposal; and range-related debris); or material potentially containing a high enough concentration of explosives such that the material presents an explosive hazard (e.g., equipment, drainage systems, holding tanks, piping, or ventilation ducts that were associated with munitions production, demilitarization, or disposal operation). Excluded from this definition are munitions within DoD's established munitions management system and other hazardous items that may present explosion hazards (e.g., gasoline cans or compressed gas cylinders that are not munitions and are not intended for use as munitions).

Military munitions: Ammunition products and components produced for or used by the armed forces for national defense and security. The term *military munitions* includes ammunition products or components under the control of the Department of Defense, the U.S. Coast Guard, the Department of Energy, and the National Guard. The term includes confined gaseous, liquid, and solid propellants; explosives; pyrotechnics; chemical and riot control agents; smokes and incendiaries; bulk explosives; chemical agents; chemical munitions; rockets; guided and ballistic missiles; bombs; warheads; mortar rounds; artillery ammunition; small arms ammunition; grenades; mines; torpedoes; depth charges; cluster munitions and dispensers; demolition charges; and devices and components thereof.

Military munitions do not include wholly inert items, improvised explosive devices, or nuclear weapons, nuclear devices, or nuclear components. However, military munitions do include non-nuclear components of nuclear devices that are managed under the nuclear weapons program of the Department of Energy after all required sanitization operations under the Atomic Energy Act of 1954 (42 U.S.C. §2011 *et seq*.) have been completed. (10 U.S.C. §101(e)(4)(A) through (C))

Military munitions burial site: A site, regardless of location, where military munitions or CA, regardless of configuration, was intentionally buried, with the intent to abandon or discard in a manner consistent with applicable environmental laws and regulations or the national practice at the time of burial. It does not include sites where munitions were intentionally covered with earth during authorized destruction by detonation, or where in-situ capping is implemented as an engineered remedy under an authorized response action.

Military range: See "Operational Range" and "Range."

Munitions constituents (MC): Any materials originating from unexploded ordnance, discarded military munitions, or other military munitions, including explosive and non-explosive materials. MC also includes emission, degradation, or breakdown elements of such ordnance or munitions. (10 U.S.C. §2710(e)(4)) [NOTE: Explosive munitions constituents in sufficient concentration to be explosive are included in the definition of "Munitions and Explosives of Concern".]

Munitions and explosives of concern (MEC): Specific categories of military munitions that may pose unique explosive risks, including:

(a) Unexploded ordnance (UXO), as defined in 10 U.S.C. §101(e)(5);

(b) Discarded military munitions (DMM), as defined in 10 U.S.C. §2710(e)(2); or

(c) Munitions constituents (e.g., TNT, RDX), as defined in 10 U.S.C. §2710(e)(3), present in high enough concentrations to pose an explosive hazard. (Note: See "Munitions Constituents"). (Munitions constituents are MEC when explosive compounds of the munitions, such as TNT, RDX, and HMX, are in sufficient concentration as to pose an explosive hazard. This situation arises when concentration levels are 10 percent or more. Non-explosive munitions constituents and explosive concentrations less than 10 percent are not considered MEC.)

Munitions debris: Remnants of munitions (e.g., fragments, penetrators, projectiles, shell casings, links, and fins) remaining after munitions use, demilitarization, or disposal.

Munitions response: Response actions, including investigation, removal actions, and remedial actions, to address the explosives safety, human health, or environmental risks presented by UXO, DMM, or MC, or to support a determination that no removal or remedial action is required.

Munitions response area: Any area on a defense site that is known or suspected to contain UXO, DMM, or MC. Examples include former ranges and munitions burial areas. A munitions response area consists of one or more munitions response sites.

Munitions response site: A discrete location within a munitions response area that is known to require a munitions response.

Obscurant: Man-made or naturally occurring particles suspended in the air that block or weaken the transmission of a particular part or parts of the electromagnetic spectrum.

Open burning (OB): An open-air combustion process by which excess, unserviceable, or obsolete munitions are destroyed to eliminate their inherent explosive hazards. The combustion of any material without (1) control of combustion air, (2) containment of the combustion reaction in an enclosed device, (3) mixing for complete combustion, and (4) control of emission of the gaseous combustion products.

Open detonation (OD): An open-air process used for the treatment of excess, unserviceable, or obsolete munitions whereby an explosive donor charge initiates the munitions being treated.

Operational range: A range that is under the jurisdiction, custody, or control of the Secretary of Defense and that is used for range activities, or, although not currently being used for range activities, that is still considered by the Secretary to be a range and has not been put to a new use that is incompatible with range activities (10 U.S.C. §101(e)(3)(A) and (B)). Also includes "military range," "active range," and "inactive range" as those terms are defined in 40 CFR §266.201.

Ordnance: Military weapons collectively, including ammunition and the equipment to keep them in good repair; also includes explosives, chemicals, pyrotechnics, and similar materials (e.g., bombs, guns, ammunition, flares, smoke, and napalm).

Ordnance and explosives (OE) and ordnance and explosives waste: Formerly used terms that have been replaced by the term munitions and explosives of concern (MEC).

Pollutant or contaminant: The term *pollutant or contaminant* shall include, but not be limited to, any element, substance, compound, or mixture, including disease-causing agents, which, after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer, genetic mutation, physiological malfunctions (including malfunctions in reproduction), or physical deformations in such organisms or their offspring. The term *pollutant or contaminant* shall not include petroleum, including crude oil or any fraction thereof, which is not otherwise specifically listed or designated as a hazardous substance (42 U.S.C. §9601 (14)) and shall not include natural gas, liquefied natural gas, or synthetic gas of pipeline quality (or mixtures of natural gas and such synthetic gas).

Practice ordnance: Ordnance manufactured to serve a training purpose. Practice ordnance generally does not carry a full payload, but it may still contain explosive components such as spotting charges, bursters, and propulsion charges.

Projectile: An object launched by an applied force and continuing in motion by its own inertia, such as a bullet, bomb, shell, mortar, or grenade.

Propellant: An agent such as an explosive powder or fuel made to provide the necessary energy for propelling ordnance.

Range: When used in a geographic sense, a designated land or water area that is set aside, managed, and used by the Department of Defense for range activities. Ranges include the following areas:

(a) Firing lines and positions, maneuver areas, firing lanes, test pads, detonation pads, impact areas, electronic scoring sites, buffer zones with restricted access, and exclusionary areas.

(b) Airspace areas designated for military use in accordance with regulations and procedures prescribed by the administrator of the Federal Aviation Administration.

(10 U.S.C. §101(e)(1)(A) and (B))

Real property: Any land or an interest therein, and all buildings, structures, and improvements affixed to the land acquired by any Federal agency (such as the BLM or FWS), that is managed pursuant to the Federal Property and Administrative Services Act of 1949. Real property does not include lands withdrawn or reserved, from the public domain but does include lands or portions of lands withdrawn or reserved by the Secretary of the Interior, with the concurrence of the Administrator of General Services, if those lands are determined to be not suitable for return to the public domain for disposition under the general public land laws.

Real property acquisition: Real property obtained either through discretionary acts or by law—whether by way of condemnation, donation, escheat, right-of-entry, escrow, exchange, lapses, purchase, or transfer—that will be under the jurisdiction or control of any Federal agency (such as the BLM or FWS) and will be managed pursuant to the Federal Property and Administrative Services Act of 1949.

Remedial action: A type of response action under CERCLA. Remedial actions are those actions consistent with a permanent remedy, instead of or in addition to removal actions, to prevent or minimize the release of hazardous substances into the environment.

Removal action: Short-term response actions under CERCLA that address immediate threats to public health and the environment.

Render-safe procedures: The portion of EOD procedures involving the application of special EOD methods and tools to provide for the interruption of functions or separation of essential components of UXO to prevent an unacceptable detonation.

Response action: As defined in section 101 of CERCLA, "remove, removal, remedy, or remedial action, including enforcement activities related thereto." As used in this handbook, the term *response action* incorporates cleanup activities undertaken under any statutory authority.

Returning lands: Lands relinquished by the military service and returned to DOI when public lands that were withdrawn for military use are no longer needed for military purposes. When returning lands, DoD files a notice of intent to relinquish the lands with BLM (43 CFR §2372).

Small arms ammunition: Ammunition, without projectiles that contain explosives (other than tracers), that is .50 caliber or smaller, or for shotguns.

Smoke: A chemical filler for ordnance such as bombs, projectiles, and grenades that produces a cloud of smoke to mark a position or obscure a battlefield. The term is applied to ordnance to indicate that it is primarily intended to produce smoke to mark a position or obscure a battlefield.

Technical escort unit: A DoD organization of specially trained personnel that provide verification, sampling, detection, mitigation, rendering safe, decontamination, packaging, escort, and remediation of chemical, biological, and industrial devices or hazardous material.

Technology-aided surface removal: A removal of UXO, DMM, or chemical weapons material on the surface (i.e., the top of the soil layer) only, in which the detection process is primarily performed visually, but is augmented by technology aids (e.g., hand-held magnetometers or metal detectors) because vegetation, the weathering of UXO, DMM, or CWM; or other factors make visual detection difficult.

Time-critical removal action: Removal action where, based on the site evaluation, a determination is made that a removal is appropriate, and that less than 6 months exists before on-site removal activity must begin. (40 CFR §300.5)

Transferred range: A military range that has been released from military control. Transferred ranges have been transferred from DoD control to other Federal agencies, State or local agencies, tribes, or private entities.

Transferring range: Ranges in the process of being transferred from DoD control (e.g., sites that are at facilities closing under the Base Realignment and Closure Act or other authorities). The term also refers to a military range that is proposed to be leased, transferred, or returned from the Department of Defense to another entity, including Federal entities.

Unexploded ordnance (UXO): Military munitions that:

- (a) have been primed, fuzed, armed, or otherwise prepared for action;
- (b) have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material; and
- (c) remain unexploded whether by malfunction, design, or any other cause.

(10 U.S.C. §101(e)(5)(A) through (C))
P.L. 106-65, section 3031 (c)(5)(A) provides a more detailed description.

UXO technicians: Personnel who are qualified for and filling contractor positions of UXO Technician I, UXO Technician II, and UXO Technician III, as defined by the Department of Labor, Service Contract Act, Directory of Occupations.

Warhead: The part of a missile, projectile, rocket, or other munition that contains the explosive system, chemical or biological agents, or inert materials intended to inflict damage.

White phosphorus: A chemical that, when exposed to air, burns spontaneously, producing dense clouds of white smoke.

Wildland fire: Any nonstructure fire that occurs in the wildland, other than prescribed fire.

Withdrawn public lands: Public lands that are removed from the operation of the public land laws and reserved for a specific Federal Government purpose.

Appendix 1

Military Munitions

This appendix describes military munitions commonly found as UXO on FUDS, BRAC, and other transferred properties. Being able to identify UXO is an important step in the UXO risk management process.

TYPES OF ORDNANCE

The following categories of ordnance are the most common types found in the field and are discussed in more detail in the following sections:

1. Small Arms Munitions
2. Hand Grenades
3. Rifle Grenades
4. Projected Grenades
5. Projectiles
6. Mortars
7. Rockets
8. Guided Missiles
9. Bombs
10. Submunitions
11. Land Mines
12. Flares
13. Fuzes

1. Small Arms Munitions

A small arms munition, normally called a *round*, is a single unit consisting of a cartridge for holding the propellant (explosive) charge, with the projectile (bullet) inserted in one end and the primer (initiating) charge in the other end. Small arms munitions can be fired from pistols, rifles, shotguns, and machine guns. Small arms munitions include projectiles of .50 caliber and smaller without an explosive warhead (see glossary). Photos of the 20 mm round and 20 mm projectile, which are considered medium-caliber munitions and may contain explosive projectiles, are included for size comparison (see ***Figure 23***). Although the hazards associated with small arms UXO are relatively minor, small arms munitions may explode if thrown into a fire or if the primer is struck with a sharp object such as a nail.

2. Hand Grenades

Hand grenades are small hand-thrown devices that contain explosive or chemical filler. A grenade has three main parts: a body, a fuze with

Figure 23 –*Left to right: a 20 mm round (medium caliber) compared with a 20 mm projectile; a .50-caliber round compared with a .50-caliber projectile; and a .50-caliber round compared with a .223-caliber round (used in an M-16 rifle).*

Figure 24 –*Left to right, hand-thrown grenades: a World War II "pineapple" grenade, a fragmentation (practice) grenade, and a canister-style grenade used for smoke and riot-control agents, e.g., tear gas. (Red top indicates a red smoke grenade.)*

a pull ring and safety clip, and a filler. Classes of grenades that can be encountered as UXO include fragmentation, smoke, chemical, and illumination grenades. The traditional "pineapple" fragmentation variety was used in World War II and the Korean War. The Vietnam-era and current fragmentation varieties look like a baseball. The smoke, chemical, and illumination grenades look like and are about the size of a soft drink can (see ***Figure 24***).

3. Rifle Grenades

Rifle grenades are grenades attached to a tube that fits over a rifle barrel. They range in length from about 9 to 17 inches. Special ammunition is used in the rifle to provide the force necessary to propel the grenade to the target. Rifle grenades typically contain high explosives, white phosphorus, riot-control agents, illumination flares, or chemicals that produce colored or screening smoke. Rifle grenades typically have impact fuzes either on the nose or behind the warhead.

4. Projected Grenades

Projected grenades replaced the rifle grenade in the early 1960s. The 40 mm grenade is about the size and shape of a goose egg and contains a high-explosive charge and a sensitive internal impact fuzing system. When the grenade is fired, the fuze is armed. If the fuze does not activate upon impact, the resulting UXO item is extremely dangerous and likely to explode if moved or handled. The small size, quantity of explosive, and fragmentation make this the most likely munition to cause death or injury to the public and employees on the public lands and refuges (see ***Figure 25***).

5. Projectiles

Projectiles range from approximately .223 to 16 inches in diameter and from 1 inch to 4 feet in length. Munitions that are .50 caliber and smaller do not contain an explosive charge. Munitions from 20 mm through 30 mm may contain a fuze and an explosive charge. All munitions larger than 30 mm should be assumed to have a fuze and an explosive charge, white phosphorus, or chemical agent. In general, the larger the munition, the larger the explosive charge or amount of chemical agent it will contain. Also, the larger the projectile, the greater the force of impact and, therefore, the deeper the projectile may penetrate into the soil (see ***Figure 26***).

Figure 25 – *The projected grenade's small size and appealing shape and color make it most likely to cause death or injury on public lands and refuges.*

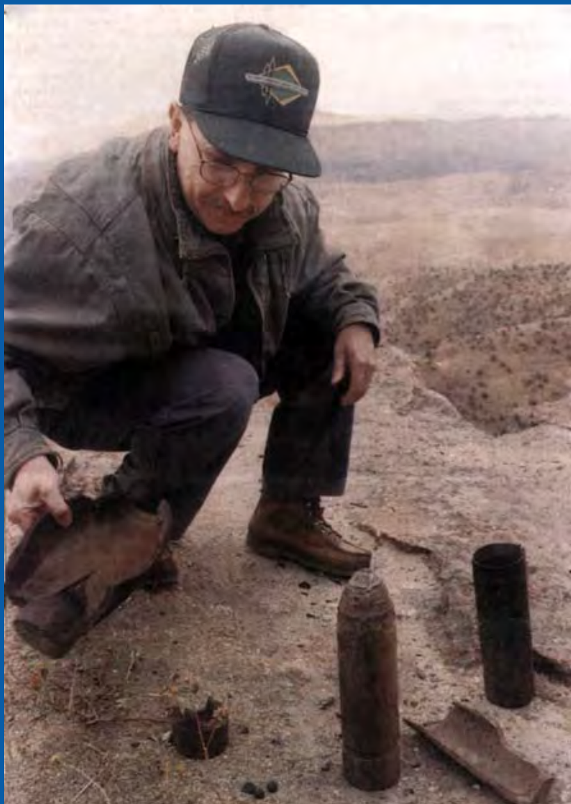


Figure 26 – *Milt Williams, public information officer for the Idaho State Department of Lands, looks over some of the artillery shells on an old gunnery range in the Boise Foothills. Wildfire made the surface more visible and led to the discovery of these rounds. Reprinted with permission of the Idaho Statesman, photograph ©Tom Shanahan, September 20, 1996.*

6. Mortars

A mortar is a type of projectile that has a very steep angle of impact. Mortars range from approximately 1 inch to 11 inches in diameter and are filled with explosives, toxic chemicals, white phosphorus, or illumination flares. The mortar fuze is normally in the nose (front) of the round, which is activated only after the round leaves the firing tube. The round normally has a tube with stabilizing fins behind the explosive warhead (see ***Figure 27***). Mortars, being fairly lightweight when compared with other larger projectiles, are generally found at or near the ground surface.

7. Rockets

Rockets generally look like a metal tube with the warhead at one end and stabilizing fins and rocket motor at the other end (see ***Figure 28***). Rockets can range from 1.5 inches to more than 15 inches in diameter and can vary from 1 foot to more than 9 feet in length. Rocket warheads contain explosives, toxic chemicals, white phosphorus, submunitions, riot-control agents, or illumination flares. Fuzes can be located in the nose of the rocket warhead or at the base of the warhead in front of the rocket motor. Both the warhead and residual propellant in the motor can cause injury or death.

Figure 27 – *81 mm high-explosive mortar.*

8. Guided Missiles

Guided missiles differ from rockets in that guided missiles have internal electronics that direct the missile to its target while in flight. Spent (fired) guided missiles can still contain residual propellant that could ignite and burn violently. Many forces, such as pressure, radio and sound waves, and electrostatic and photoelectric energy, can activate guided missile fuzes. Guided missiles are extremely dangerous because they can contain fuzes that detonate even without human contact.

Figure 28 – *Rocket, 2.75-inch practice.*

9. Bombs

Bombs are considered to be dropped munitions. Bombs range from 1 pound to 3,000

000442

Figure 29 –*Left and center: Practice bomb (BDU-33) and a cutaway of the bomb. This practice bomb is approximately 2 feet long. The central channel in the bomb contains an explosive spotting charge large enough to cause serious injury. (Note: Practice munitions are painted blue, but not all blue munitions are necessarily inert.) Right: Bomb found on public lands north of Chocolate Mountains Gunnery Range, California.*

(or more) pounds and from 2 to 10 feet in length. Newer bombs (e.g., smart bombs) can have a guidance device to guide the bomb to its intended target. Generally, all bombs have the same components: a metal container, a fuze, and a stabilizing device (see ***Figure 29***). The metal container, or bomb body, holds the explosive or chemical filler and may consist of one or more pieces. Bombs use either internal or external mechanical or electrical fuzes, which are typically located in the nose or tail section. Some type of arming vane generally arms mechanical fuzes. The arming vane operates like a propeller to line up all the fuze parts and arm the fuze. Fins or parachute assemblies attached to the rear section of the bomb stabilize it during flight. These assemblies often detach from the bomb after impact. As UXO, bombs may be broken into components (e.g., body components and a fuze) and may not appear to be bombs, but they remain hazardous.

10. Submunitions

Submunitions are multiple bomblets, grenades, or mines housed in a canister-like or artillery projectile delivery system. When activated, the delivery system (e.g., dispenser, missile or rocket warhead, or artillery projectile) releases the submunitions (see ***Figure 30***). The delivery system disperses the submunitions while still airborne, scattering the submunitions over a wide area. After dispersal, submunition fuzing systems activate in a variety of ways, including impact, pressure, time-delay, magnetic, or movement. Overall, submunitions are among the most dangerous UXO because they are small (as small as a 35 mm film canister), contain an explosive charge, do not look like military munitions, and are easily picked up.

11. Land Mines

Land mines are explosive munitions placed in or on the ground. Land mines detonate when the fuze is activated by pressure, when a trip wire is pulled, or in the presence of a magnetic field. Land mines are generally of two types: small antipersonnel mines and larger antitank mines (see ***Figure 31***). The only confirmed incidence of land mines on BLM-managed public lands

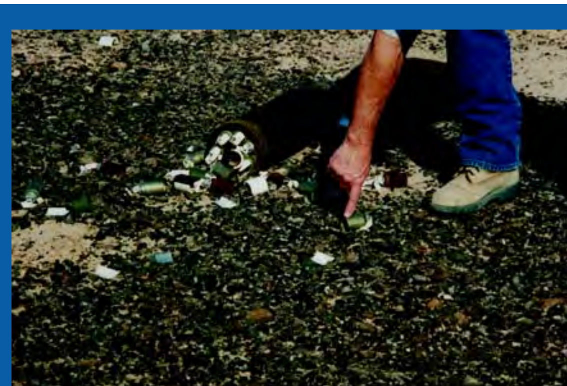


Figure 30 – *A 155 mm artillery dispenser carries grenade-like submunitions to the target. This dispenser did not open properly to scatter the submunitions; the inert submunitions fell out when the round hit the ground. Submunitions are small and often do not look like military munitions.*

were practice antitank mines in the California desert that were left over from training during World War II. The same type of practice antitank mines may also be located in southern Arizona and southern Nevada, where similar training took place. These practice antitank mines contain a spotting charge equivalent to the explosive force of a shotgun shell.

Figure 31 – *Left: Antitank practice mine found on public lands, Chemehuevi Mountains, BLM Needles Field Office, California. Right: Antipersonnel mine.*

The FWS had an active World War II-era antipersonnel and antitank minefield on Adak Island, but the Navy removed the tank and minefield as part of the BRAC cleanup. The FWS may have additional minefields on national wildlife refuges in the Pacific islands.

Figure 32 – The numbers in the "window" of this fuze for a 155 mm projectile indicate an internal timing mechanism to allow for an airburst of the projectile.

12. Flares

Flares may be either dropped or fired as a projectile. They normally consist of a magnesium compound that burns at very high temperatures; a fuze that initiates the burning process; and a canister that contains the magnesium compound, a fuze, and possibly a parachute. Flares as UXO will normally be found on or near the surface. The danger from a flare is both the fuze used to ignite the flare and the intense heat from the burning flare.

13. Fuzes

A fuze may be an integral part of a complete munition or a separate component that is attached to the remainder of the munition prior to firing (see ***Figure 32***). If a fuze fails to function properly, it will have undergone significant stress and may or may not still be attached to the munition. Fuzes come in a large variety of shapes and sizes and, therefore, are some of the most difficult MEC items to identify.

Appendix 2

Additional Information

Web Address	Sponsor	Synopsis
http://www.acq.osd.mil	Under Secretary of Defense for Acquisition and Technology	Provides updates for DoD technology-related activities
http://www.defenselink.mil	Department of Defense	Provides entrance into DoD web site; includes a search engine
http://www.denix.osd.mil	Defense Environmental Network and Information Exchange (DENIX)	Environmental legislation, compliance, restoration, cleanup, and DoD guidance
http://www.denix.osd.mil/denix/Public/Library/Explosives/UXOSafety/uxosafety.html	DENIX UXO Safety URL	UXO safety messages, posters, video clips, etc.
http://www.eglin.af.mil/navscleod	Naval School Explosive Ordnance Disposal	Navy EOD web site
http://www.frtr.gov/resources.htm	Federal Remediation Technologies Roundtable	Agency explosives, ranges, and EOD-UXO links to other web sites with UXO information
http://www.fws.gov	U.S. Fish and Wildlife Service	FWS web site
http://www.dtic.mil	Defense Technical Information Center	Provides access to a forum for the exchange of scientific and technical information
http://www.epa.gov	Environmental Protection Agency	EPA's web site information regarding EPA activities, policies, and regulations
http://www.estcp.org	Environmental Security Technology Certification Program	Promotes environmental technologies through demonstration and validation
http://www.doi.gov	Department of the Interior	DOI web site
http://www.blm.gov	Bureau of Land Management	BLM web site
http://www.serdp.org	Strategic Environmental Research and Development Program	Latest news and events, and information regarding new cleanup technologies, including UXO
http://www.atsdr.cdc.gov/toxfaq.html	Agency for Toxic Substances and Disease Registry	Fact sheets on various contaminants, including some explosive materials that may be found at hazardous waste sites

Appendix 3

Points of Contact (July 2005)

Bureau of Land Management	
Chief Ranger (BLM National Law Enforcement Office, Boise, ID)	(208) 387-5126
Protection and Response Group	(202) 557-3585
Lands and Realty	(202) 452-7773
BLM Safety Officer	(202) 501-2664
Military Liaison	(202) 452-7778
U.S. Fish and Wildlife Service	(303) 984-6867
Division of Engineering, Branch or Environmental and Facility Compliance	
Department of the Interior	
Office of Environmental Policy and Compliance	(202) 208-3891
DoD's Liaison to DOI	(202) 208-7211
Department of Defense	
DoD Explosives Safety Board, Chairman	(703) 325-0891

Appendix 4

Sample Liability Waiver

The following is an example of a waiver used at an installation that authorizes hunting and fishing in areas that may contain MEC. The recreational user must read or attend a safety briefing and sign this waiver before entering the property.

This is only a sample. Waivers must be approved by the regional solicitor or field solicitor that supports the local office.

CONDITION OF ENTRY AND LIABILITY WAIVER

I, the undersigned, hereby agree to observe all applicable regulations and circulars and all (State) Wildlife and Fish laws. I am fully aware that all activities are at my own risk, and in consideration for the permission to participate, I relieve the Government of all responsibility and liability for any damages or injuries that might occur.

I am fully aware that I may encounter hazards, including unexploded ordnance. I further agree not to enter any area except those that I have been authorized to enter. I will also follow the instructions provided for entry onto these lands. I certify that I have received a map and applicable regulations and/or instructions.

____________________________ ____________________________

SIGNATURE DATE

____

FULL ADDRESS INCLUDING ZIP CODE

Appendix 5

Site Safety and Health Plan

Instructions: Complete all blanks. If a response is not applicable, insert NA. Return to the Health and Safety Coordinator for review and approval.

Site Name:			
Prepared by:		Date	
Reviewed by:		Date	

A. INTRODUCTION

This health and safety plan establishes procedures and practices to protect employees and subcontractors from potential hazards posed by non-invasive field activities at the ___________________ site. In this health and safety plan, measures are provided to minimize potential exposure, accidents, and physical injuries that may occur during daily on-site activities and during normal working conditions. Contingencies are also provided for emergency situations. This plan should only be modified or amended by qualified BLM personnel or a contractor, assigned by BLM, qualified to make such modifications or amendments.

B. SITE DESCRIPTION

Site location or address:

Current site use:

Past site use:

Topography:

Name of and distance to nearest surface waters:

Surrounding land use and nearest population:

Site access [Provide directions to site]:

Nearest drinking water/sanitary facilities:

Nearest telephone:

Utilities located?

Site map attached?

C. PROJECT PERSONNEL

Role	Name	Training/Medical Monitoring Current? (Y/N)	Safety Briefing. Initials	Date
Team Leader				
Site Safety Officer				
Decontamination				
Sampler				

D. WORK PROPOSED

This plan was prepared for [describe specific tasks]:

Proposed work dates:

If visual inspection, will personnel be entering or contacting potentially hazardous areas? If yes, describe:

E. HAZARD EVALUATION AND ANALYSIS

Potentially hazardous agents known or suspected to be on-site (include preservatives and decontamination chemicals):

Substance	Concentration	Media	OSHA PEL	FP/LEL/VP	Odor Thresh	IP (ev)	Symptoms	First Aid
Heat	NA	NA	NA	NA	NA	NA	Flushed, hot or clammy skin, dizzy, nausea, disoriented	Provide water, electrolytes, rest, cool off in shade, sponge baths, seek medical attention

List any agents suspected to be at the site that cannot be detected by routine air monitoring equipment and plans made to detect them:

Potential chemical exposure routes [provide an "X"]:

Route	Known	Possible	Unlikely
Inhalation			
Ingestion			
Dermal			
Eye contact			

Chemical characteristics [provide an "X"]:

Hazard	Known	Possible	Unlikely
Toxic			
Ignitable			
Reactive			
Carcinogenic			
Volatile			
Radioactive			
Corrosive			
Particulate/fibers			

Possible physical hazards present during site investigation activities:

Hazard	Yes	No	Prevention
Terrain/tripping			
Heat/cold			
Electrical			
Drowning			
Falling objects			
Noise			
Venomous			
Other			

F. SITE CONTROL

Site control consists of measures taken to prevent human exposure to hazardous materials at the site. Such controls are defined as exclusion zones, contaminant reduction zones (CRZ), and support zone/ command post. If site control zones are needed for this site, they are shown on the attached map.

Site conditions and the work proposed under this plan (________________________________) do or do not require the establishment of exclusion zones that limit trained employee access. However, employees should minimize potential exposures and the raising of dust.

Regardless of the activities to be conducted, all site workers must use the buddy system, whereby each worker is paired with another worker or in communication (e.g., by radio under certain circumstances) with another worker. Under this system, each worker has the following responsibilities:

- Provide co-worker with assistance.
- Observe co-worker for evidence of chemical or heat exposure.
- Monitor the integrity of co-workers protective equipment.
- Notify the site safety officer or project manager if emergency help is needed.

G. CONFINED SPACES

A confined space is any space having limited means of egress that may be subject to the accumulation of toxic or flammable contaminants or an oxygen-deficient atmosphere. Confined spaces include tanks; process vessels; catch basins; boilers; bins; ducts; sewers; tunnels; pipelines; mine adits; and open-top spaces more than 4 ft deep, such as pits, vaults, and other vessels. **No confined spaces should be entered at the site for the work proposed under this plan.**

H. SPILL CONTAINMENT

No provisions are made within this plan for spill containment, as the information provided during the preparation of this plan did not identify any liquid wastes as being present at the site.

I. TASK DESCRIPTION AND PERSONAL PROTECTIVE EQUIPMENT

Based on the type of hazards identified in Section E, list the site tasks, level of protection, and protective clothing required for the each task:

Task	Level of Protection	Type of Coverall	Type of Bootie	Type of Glove

Only Level D tasks are approved for this site at this time. Workers performing these activities should minimize activities that raise dust. Level D: Safety boots, cotton clothing (no shorts). Upgrade may be to Tyvek or Saranex coveralls, safety glasses, surgical gloves, and overglove. **NOTE: Project personnel are not permitted to deviate from the specified level of protection without the prior approval of the site safety officer or BLM's health and safety officer.**

J. MEDICAL SURVEILLANCE

Employers are required by 29 CFR 1910.120 to provide a medical monitoring program for certain employees working with hazardous materials. The purpose of this program is to evaluate occupational exposures and to confirm that the employee is in satisfactory physical condition to wear the appropriate personal protective equipment. The employer must provide a medical surveillance program meeting the requirements of 29 CFR 1910.120 for the following personnel:

- All personnel who are or may be exposed to hazardous materials at or above the permissible exposure level at this and any other potential hazardous material site for more than 30 days a year regardless of the use of respiratory protection.
- Personnel who wear respirators more than 30 days a year.
- Personnel who develop injuries or symptoms of overexposure to hazardous substances.

The medical monitoring program must include the following elements:

- Physical examination prior to employment or assignment to a position necessitating contact with potentially hazardous materials.
- Yearly physical examination (the examination may be made at less frequent intervals at the direction of the physician).
- Physical examination at termination of employment or reassignment to a position that does not involve potential exposure to hazardous materials.
- Physical examination as soon as possible following an injury or the development of symptoms of overexposure to hazardous materials.

The medical examination must include the following elements:

- Determination and evaluation of the worker's employment and medical history.
- Description of the employee's duties.
- Estimate of the employee's potential exposure levels.
- Information from previous medical examinations, as needed.
- Diagnostic or analytical procedures as recommended by the physician.

The results of the medical surveillance program must be made available to the employee (including a written opinion from the physician regarding the fitness of the employee for the required task), and medical surveillance program records must be kept for the period of employment plus 30 years.

K. TRAINING

All employees working on-site that are exposed or potentially exposed to hazardous substances or general health and safety hazards shall receive training meeting the requirements of 29 CFR 1910.120 (e)(1) through (9), as appropriate. This includes the minimum 40-hour training for general site workers and additional 8-hour training for supervisors.

L. SAFETY EQUIPMENT

The following safety equipment will be on-site during the field investigation: first aid kit, eyewash, fire extinguisher, and wind tape.

M. AIR MONITORING

The following equipment will be used to monitor air quality in the breathing zone during work activities:

Instruments	Calibration	Parameter	Frequency
Dataram	None	Particulates	Continuous
Multirae	Daily per manual	Vapors/gases	Continuous
Multirae	Factory	O_2, combustible gas, H_2S	Varies
Monitor 4	Factory	Radiation	Varies
Detector tubes	None	Numerous; chemical-specific	Varies

If air contaminants are detected, continuous monitoring shall be employed. The following action levels have been established to determine the appropriate level of personal protection to be used during site investigation activities:

Hazard	Action Level	Action	Instrument
Particulates	> 5.0 mg/m^3	Vacate site	Dataram
Organic vapor	> 1 ppm[a]	Vacate site	Multirae
Detector tubes	> PEL	Vacate site	Draeger
Gamma radiation	> 2mrem/hr[b]	Vacate site	Survey instrument
Combustible gas/ O_2 level	> 20% LEL < 19.5%	Vacate hazard area	Multirae

[a] Above background in breathing zone
[b] Milliroentgen equivalent in man per hour
Comments: Assumes lead constitutes 1% of airborne dust. Background radiation is normally 0.01-0.02 mrem/hr.

Note: Source for radiation hazard information: *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, prepared by NIOSH/OSHA/USCG/EPA. 1985.

N. DECONTAMINATION

To prevent the distribution of contaminants outside the exclusion zone and to prevent cross-contamination, the following procedures will be used to decontaminate equipment: Dismantle to expose hidden contamination, wash with soap and water in a wash tub, rinse with water, rinse with clean water, and place equipment in a clean plastic bag. More delicate equipment or surfaces should be decontaminated by wiping with a clean, moist cloth. To prevent the distribution of contaminants outside the exclusion zone and to prevent personal exposure to chemicals, VEHICLES WILL NOT BE ALLOWED INSIDE THE EXCLUSION ZONE.

To minimize or prevent personal exposure to hazardous materials, all personnel working in the exclusion zone and contamination reduction zones will comply with the following decontamination procedures: Wash boots, rinse boots, remove duct tape (if used), remove coveralls, remove gloves. Decontamination may not be necessary if site control zones have not been identified and soils are not wet.

Decontamination equipment required on-site will include: Wash and rinse tubs, brushes, water storage, alconox. Decontamination wastewater and contaminated materials will be disposed of in the following manner: decontaminated PPE is expected to be of low hazard and should be placed in plastic bags for disposal at a landfill. Soapy water may be discharged on the ground.

O. SHIPMENT OF RESTRICTED ARTICLES

Federal laws and international guidelines place restrictions on certain materials shipped by passenger and cargo aircraft. No shipping of restricted materials is expected for the work proposed under this safety plan. This section may require revision in the future if the scope of work is modified (for example, to include shipment of environmental samples).

P. EMERGENCY RESPONSE PLAN

The site safety officer (SSO) is responsible for implementing this aspect of the plan. He will decide when to evacuate the site and notify local resources listed below. He will be alert for symptoms of chemical or heat exposure as listed in Section E. The SSO will maintain the first aid kit. He or other members of the team will provide decontamination and first aid in accordance with Section E (if needed) and immediately transport injured persons to the hospital.

Local Resources	Name	Telephone
Fire		
Police		
Ambulance		
Hospital		
Site phone		

Directions to the hospital: See attached map. [Provide directions]

[Hint: Try Mapquest.com]

BLM and other resources:

	Name/Location	Work Phone	Home Phone
Site Health and Safety Officer			
Health and Safety Coordinator			
Medical Consultant			

Q. DOCUMENTATION

Document	Attached (Y/N)	In File (Y/N)
Hospital Route Map		
Site Map		
Work Plan		
Material Safety Data Sheets		
Training Records		
Medical Clearance		
Equipment SOPs		
General Work Practices		
Accident Report Form		
Health and Safety Plan		

R. EQUIPMENT LIST

A. Health and Safety ___ Organic vapor detector ___ Dataram ___ Explosimeter ___ Oxygen level indicator ___ Radiation meter ___ Detector tubes ___ Other ___ Tyvek suits number ( ) ___ Saranex suits ( ) ___ Nitrile gloves ( ) ___ Surgical gloves ___ Booties ( ) ___ Hardhats ___ Safety boots ___ Respirators ___ Duct tape ___ Cell phone/radio ___ First aid kit ___ Eyewash ___ Vehicle fire extinguisher ___ ___ ___	C. Basic Sampling Equipment ___ Hand auger; number of auger heads: ___ Stainless steel bailer ___ Teflon bailer ___ Plastic scoop ___ Rope for bailer; feet ( ) ___ Shovel ___ Stainless steel spoons ( ) ___ Disposable plastic spoons ___ Ziploc bags ___ Sample bottles (number and type) ___ Preservatives ___ Water filtering apparatus ___ Disposable bags ___ Ice ___ Coolers ( ) ___ Strapping tape ___ Air bills ___ 100 ft. measuring tape ___ pH, temperature, conductance kit ___ Soil pH tester ___ Water level indicator ___ X-ray fluorescence (XRF)/field screening kits ___ Pin flags ___ Global Positioning System (GPS) unit
B. Decontamination ___ Alconox (detergent) ___ Decontamination tubs (2 minimum) ___ Brushes (bailer type) ___ Brushes (dairy type) ___ Brushes (auger type) ___ 10 gal tap water ___ Methanol (optional) ___ Squirt bottles (optional) ___ Foil ___ Garbage bags ___ Distilled water	D. Documentation ___ Field logbook ___ Chain-of-custody forms ___ Sample tags ___ Custody seals ___ Camera ___ Film ___ Wristwatch ___ ___ ___ ___

This Page

Intentionally

Left Blank

Use of California Human Health Screening Levels (CHHSLs) in Evaluation of Contaminated Properties

January 2005

California Environmental Protection Agency

DISCLAIMER

Use of California Human Health Screening Levels in Evaluation of Contaminated Properties has been prepared by the California Environmental Protection Agency (Cal/EPA). This document is not intended to establish policy or regulation. The Human Health Screening Levels presented here are not to serve as: 1) a stand-alone decision making tool, 2) a substitute for guidance for the preparation of baseline human health risk assessments, 3) a rule to determine if a waste is hazardous under the state or federal regulations, 4) a rule to determine when the release of hazardous chemicals must be reported to the overseeing regulatory agency, 5) set of final cleanup or action levels to be applied at contaminated sites or 6) a guarantee that an oversight regulatory agency will determine that a project is adequately studied or agree with the conclusions of the site investigation and risk assessment report.

The information presented in this document is not final Cal/EPA action. Cal/EPA may update this information as needed without public notice. This document is not intended, nor can it be relied upon, to create any rights enforceable by any party in litigation in the State of California. Staff in overseeing regulatory agencies may decide to follow the information provided herein or act at a variance with the information, based on an analysis of site-specific circumstances.

The CHHSLs should NOT be used to determine when impacts at a site should be reported to a regulatory agency. The list of CHHSLs is also not a comprehensive list of all potential chemicals of concern that may be found at a property. All releases of hazardous substances to the environment should be reported to the appropriate regulatory agency in accordance with governing regulations. Staff overseeing work at a specific site should be contacted prior to use of the information in this document to ensure that the document is applicable to the site and that the user has the most up-to-date version available.

This document is not copyrighted. Copies may be freely made and distributed. However, reference to or use of the screening levels presented in this document without adequate review of the accompanying narrative could result in misinterpretation and misuse of the information.

Table of Contents

TABLES

APPENDICES

Overview

What are the CHHSLs?

The California Human Health Screening Levels (CHHSLs or "Chisels") are concentrations of 54 hazardous chemicals in soil or soil gas that the California Environmental Protection Agency (Cal/EPA) considers to be below thresholds of concern for risks to human health. The CHHSLs were developed by the Office of Environmental Health Hazard Assessment (OEHHA) on behalf of Cal/EPA, and are contained in their report entitled "Human-Exposure-Based Screening Numbers Developed to Aid Estimation of Cleanup Costs for Contaminated Soil" (Appendix 1). The thresholds of concern used to develop the CHHSLs are an excess lifetime cancer risk of one-in-a-million (10^{-6}) and a hazard quotient of 1.0 for noncancer health effects. The CHHSLs were developed using standard exposure assumptions and chemical toxicity values published by the U.S. Environmental Protection Agency (USEPA) and Cal/EPA.

How can the CHHSLs help facilitate restoration of contaminated properties?

The CHHSLs can be used to screen sites for potential human health concerns where releases of hazardous chemicals to soils have occurred. Under most circumstances, and within the limitations described in this document, the presence of a chemical in soil, soil gas or indoor air at concentrations below the corresponding CHHSLs can be assumed to not pose a significant health risk to people who may live (residential CHHSLs) or work (commercial/industrial CHHSLs) at the site. As discussed below, however, evaluation of other potential environmental concerns must also be addressed.

The presence of a chemical at concentrations in excess of a CHHSL does not indicate that adverse impacts to human health are occurring or will occur but suggests that further evaluation of potential human health concerns is warranted. Residential CHHSLs may be used in conjunction with the human health screening evaluation described in the Department of Toxic Substances Control (DTSC) Preliminary Endangerment Assessment (PEA) Guidance Manual to assist the risk manager in deciding whether further site characterization, risk assessment, or remediation is necessary (Cal/EPA 1994b). Further evaluation may include additional sampling at the site, consideration of ambient levels in the environment, or a reassessment of the assumptions used to calculate the CHHSLs or PEA estimates. This stepwise approach expedites judgments about the degree of effort that may be necessary to remediate contaminated properties and restore the properties to productive use.

How do the CHHSLs differ from cleanup standards?

The CHHSLs presented in the lookup tables are NOT regulatory "cleanup standards". Use of the CHHSLs and this document is voluntary on the part of those who choose to use them. At sites where cleanup of contaminated soils to levels at or below the CHHSLs would be costly, the time and effort to develop more site-specific cleanup may be desired. At sites where the extent of contaminated soil is limited or the timeframe available to carry out cleanup actions is very short, use of the CHHSLs as final soil cleanup standards may be cost-beneficial. However, this would require the concurrence of both the responsible party and the overseeing regulatory agency and can only be done after a full evaluation of site conditions and other potential environmental concerns. Regulatory agencies cannot be compelled to use the CHHSLs as final cleanup standards for a contaminated property.

If contaminant concentrations are below the CHHSLs am I finished?

As discussed above, the CHHSLs cannot be used as a stand-alone tool for final cleanup and closure decisions. In addition, using only the CHHSLs may not be protective of groundwater resources or address other potential environmental concerns. Therefore, a thorough investigation of site conditions must also be performed to ensure that: 1) all potential human exposure pathways and exposure scenarios at the site are fully accounted for; 2) groundwater resources are protected; 3) terrestrial and aquatic habitats are protected, including the erosion of contaminated soils and subsequent runoff into a nearby wetland, stream or other aquatic habitat; and 4) that nuisance (e.g., odors and staining) and gross contamination concerns are addressed. These and other issues related to environmental contamination that are identified at the site must be evaluated separately. If a formal regulatory decision or determination is desired, additional assessment or cleanup of contaminated soils to address these concerns may ultimately be required.

How should the CHHSLs be integrated into the DTSC PEA process?

The human health screening evaluation presented in the DTSC Preliminary Endangerment Assessment (PEA) document is intended to provide a preliminary evaluation of potential risk and hazard to human health. The PEA process uses models and exposure assumptions similar to those used to develop the residential CHHSLs but does not provide actual risk-based screening levels based on these models. The PEA screening evaluation assumes that the land use of the site will be residential, regardless of the current use and zoning for the site. Therefore, residential CHHSLs for specific chemicals may be utilized in a PEA. Chemicals that do not have CHHSLs should be evaluated using the DTSC PEA methodology for their potential to pose human health risks. Chemicals found at a site should be evaluated separately for other potential environmental concerns, using the PEA guidance and other references as appropriate. The user should consult DTSC for additional information about use of the CHHSLs in the PEA process.

How are the CHHSLs related to the USEPA Preliminary Remediation Goals (PRGs) and to the San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels (ESLs)?

The soil and soil gas CHHSLs are modeled after the USEPA Region IX "Preliminary Remediation Goals (PRGs)" for these media (http://www.epa.gov/region09/waste/sfund/prg/index.htm). The primary difference between the CHHSLs and the PRGs is the use of Cal/EPA-specific "toxicity factors" (estimates of a chemical's toxicity to humans) in development of the CHHSLs, when available, rather than toxicity factors published by the USEPA. For volatile chemicals, soil gas CHHSLs were developed to evaluate the potential intrusion of subsurface vapors (soil gas) into buildings and subsequent impacts to indoor air quality.

The San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) Environmental Screening Levels (ESLs) are a compilation of screening levels for not only risk to human health but also a number of other environmental concerns. The ESLs are intended for use only at sites overseen by that agency. These ESLs may be found at the SFRWQCB web site at http://www.waterboards.ca.gov/sanfranciscobay/esl.htm. The SFBRWQCB refers to the comprehensive evaluation of all potential environmental concerns as an "Environmental Risk Assessment," as opposed to a more focused "Human Health Risk Assessment" reflected in development of the CHHSLs and this document in general. The soil, soil gas and indoor air ESLs and CHHSLs for human health concerns were developed using similar methodology and are essentially identical. In addition, the SFBRWQCB document provides soil screening levels for leaching of contaminants into groundwater, toxicity to flora and fauna and nuisance or gross contamination concerns. These concerns are not addressed by the CHHSLs and must be evaluated separately.

Because many different sets of screening levels are now available, the overseeing regulatory agency should be consulted before using any screening levels in a human health screening evaluation. The regulatory agency may have specific recommendations with respect to which screening levels it prefers to use at sites under their jurisdiction.

If I am in the jurisdiction of the San Francisco Bay Regional Water Quality Control Board, can I continue to use that office's Environmental Screening Levels (ESLs) document?

At sites in the jurisdiction of and overseen by the SFBRWQCB, the reader should consult the SFBRWQCB regarding continued use of the ESLs versus use of the CHHSLs.

How often are the CHHSLs updated?

The CHHSLs will be updated as needed to incorporate new toxicity information of referenced chemicals as well as new information regarding the exposure or potential exposure of humans to potentially hazardous chemicals in soils. CHHSLs for additional chemicals will also be included as they become available.

Who can I contact for more information?

Refer to the CHHSL link posted on the Cal/EPA website (www.calepa.ca.gov) for further information and local contacts. The document will also be posted on the OEHHA web site (www.oehha.ca.gov), the DTSC web site (www.dtsc.ca.gov), the SWRCB web site (www.waterboards.ca.gov) and at the SFBRWQCB web site (www.waterboards.ca.gov/sanfranciscobay/), as well as other Regional Boards' web sites.

1 Introduction

1.1 Purpose and Development

The California Human Health Screening Levels (CHHSLs) were developed as a tool to assist in the evaluation of contaminated sites for potential adverse threats to human health. Residential and commercial/industrial land use screening levels for soil, soil gas and indoor air are provided in Tables 1 and 2. The screening levels in Table 1 pertain to direct exposure of humans to contaminants in soil via incidental soil ingestion, dermal contact and inhalation of vapors or dust in outdoor air. The soil gas and indoor air screening levels in Table 2 pertain to the emission of volatile chemicals from contaminated soil or groundwater and their potential intrusion into overlying buildings.

Preparation of the CHHSLs by the California Environmental Protection Agency (Cal/EPA) was required under the California Land Environmental Restoration and Reuse Act of 2001 (CLERRA 2001). CLERRA also required that a guidance document be prepared to explain how the CHHSLS may be used in California to aid in making judgments about the degree of effort (or costs) that might be necessary to remediate contaminated properties, facilitate the restoration and revitalization of contaminated properties, and assist local-level remediation programs in making more efficient and effective decisions.

Appendix 1 is the Office of Environmental Health Hazard Assessment's (OEHHA) report entitled "Human-Exposure-Based Screening Numbers Developed to Aid Estimation of Cleanup Costs for Contaminated Soil" which contains the CHHSLs, and describes the approach used to develop the human-health-risk-based screening levels, the comments received regarding the draft document and OEHHA's response to those comments. The approach reflected in OEHHA's report is based on the USEPA *Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A)* (USEPA 1989) and is essentially equivalent to the approach used by USEPA Region IX in developing their *Preliminary Remediation Goals* (USEPA 2004), the San Francisco Bay Area Regional Water Quality Control Board (SFRWQCB) in developing their Environmental Screening Levels for human health (SFRWQCB 2003), and the Department of Toxic Substances Control (DTSC) in their Preliminary Endangerment Assessment (PEA) guidance (Cal/EPA 1994b).

Soil and soil gas data collected at a site can be directly compared to CHHSLs for each chemical of concern. Under most circumstances, and within the limitations described, the presence of a chemical in soil or soil gas at concentrations below the corresponding CHHSLs can be assumed to not pose a significant health risk to people who may live or work at the site. The presence of a chemical at concentrations in excess of a CHHSL does not necessarily indicate that adverse impacts to human health are occurring but indicates that a potential for adverse risk may exist and that additional evaluation is warranted.

Residential CHHSLs are appropriate for other types of sensitive property use, including hospitals, day care centers and schools. In order to assess the maximum, future beneficial use of a property, data collected at commercial or industrial sites should be compared to both residential and commercial sets of screening levels. A formal restriction to the deed may be required for sites that meet requirements for commercial/industrial use but not residential use. Regulatory agency oversight would be needed in this circumstance.

The scope of the CHHSLs is limited to human health concerns. For this reason, the CHHSLs cannot be used as a stand-alone tool to determine the extent of remedial actions needed at sites with contaminated soils. Depending on site conditions and the chemicals present, additional cleanup of contaminated soils may be required to protect groundwater resources, prevent toxicity to flora and fauna, address uptake in edible plants, and address nuisance and aesthetic concerns posed by odors and staining. A brief summary of these concerns and a list of references for evaluating these issues are provided at the end of the text.

1.2 Tiered Approach to Environmental Risk Assessments

Human health risk assessments for regulatory purposes are usually carried out using a step-wise or "tiered" approach. Comparison of site data to residential soil or soil gas CHHSLs (e.g., in a screening health risk evaluation performed using the DTSC PEA guidance) usually represents "Tier 1". If multiple chemicals with similar health effects are present at a site then "forward mode," cumulative health risks may also need to be calculated and compared to target Tier 1 goals before an evaluation of potential human health concerns can be completed (refer to Section 2.8).

If the results of the Tier 1 assessment indicate that further evaluation of human health risks is warranted, site-specific exposure assumptions, target risks, etc., can be substituted for default parameter values used to develop the Tier 1 CHHSLs and alternative screening levels developed under a Tier 2 assessment. This assessment can be incorporated into the guidelines presented in the DTSC PEA document. Prior to modifying the Tier 1 default assumptions, concurrence from the appropriate regulatory agency should be obtained. Site data can then be compared to the revised screening levels. This provides an intermediate but still relatively rapid and cost-effective option for preparing more site-specific screening or cleanup levels. Cumulative health risks or hazards should also be presented under a Tier 2 assessment, as described in Section 2.8.

If exposure pathways of concern and conditions at the site do not match those taken into account by the CHHSL framework or PEA methodology, a Tier 3, baseline human health and ecological risk assessment should be performed. In a baseline human health and ecological risk assessment, alternative models and site-specific assumptions are used to quantify the risk/hazard posed to human and/or ecological receptors by the impacted media in the “forward” mode. After a baseline health risk assessment is accepted by the regulatory agency, the assessment may be used in the “backward’ model to develop site-specific screening or cleanup levels. An understanding of the methodologies used to develop the CHHSLs is important to ensure consistency between all tiers of assessments and to expedite their preparation and review.

1.3 Chemicals Not Listed In CHHSL Lookup Tables

The lookup tables list 54 chemicals, including many that are commonly found at sites where releases of hazardous chemicals have occurred. Cal/EPA will incorporate CHHSLs for additional chemicals in future updates of this document as needed and practical. Prior to that time, the PEA methodology should be used to evaluate those chemicals for which CHHSLs do not exist. Toxicity factors published by Cal/EPA should be utilized in the PEA when available, unless otherwise instructed by the overseeing regulatory agency.

1.4 Limitations

The CHHSLs presented in this document are NOT regulatory "cleanup standards." Use of the CHHSLs as final cleanup levels to address human health concerns should be discussed with the overseeing regulatory agency and evaluated in terms of the cost/benefit of developing more site-specific cleanup levels through a risk assessment.

The CHHSLs presented in this document are NOT adequate to evaluate ALL environmental conditions at ALL contaminated sites. Other environmental concerns posed by the presence of contamination at a site may include:

- Leaching of contaminants from soil to groundwater and subsequent impacts to groundwater quality;
- Intrusion of subsurface vapors into basements or buildings with substandard ventilation systems and subsequent impacts to indoor air;
- Uptake of contaminants in edible fruit and vegetables and subsequent intake by humans;
- Exposure of children and teachers at school sites;
- Toxicity to terrestrial flora and fauna;
- Gross contamination, including nuisance (odors, etc.) and aesthetic concerns.

A summary of potential environmental concerns that may also be relevant at a site for a particular chemical is also provided in Table 1.

The CHHSLs specifically do not address contamination in groundwater, surface water or sediment or the erosion of contaminated soils and subsequent runoff into a nearby wetland, stream or other aquatic habitat. Contamination identified in these media or that may threaten these media must be considered separately. References for evaluation of contaminants in these media are provided in Chapter 4.

The soil gas CHHSLs for the intrusion of vapors into buildings may not be adequately conservative for estimating impacts to indoor air in poorly ventilated basements or buildings with substandard ventilation systems in general. Additional guidance on this subject is provided in Section 2.5.2.

The CHHSLs for direct-exposure to soils concerns are calculated assuming that specific exposure pathways are complete for the human receptor: incidental soil ingestion, dermal absorption of chemicals in soil, and inhalation of vapors or particulate matter in ambient (outdoor) air. For volatile chemicals, the soil gas CHHSLs are calculated assuming that the exposure pathway of inhalation of indoor air contaminated with vapors intruding from the subsurface is complete. If these pathways are not congruent with site conditions, the CHHSLs should not be used. The PEA guidance should then be followed.

The CHHSLS for inorganic chemicals (metals) are based on human health risks. However, metals are naturally occurring in the soil. Therefore, metals concentrations should be compared to local background levels as discussed in Section 2.7.

(Page intentionally left blank)

2 CHHSL Lookup Tables

2.1 Organization of Lookup Tables

CHHSLS for soil, soil gas and indoor air are presented in Tables 1 and 2. Soil CHHSLs address the potential direct exposure of residents and workers to contaminants in soil. Indoor air and soil gas screening levels address the potential intrusion of subsurface vapors into buildings and subsequent impacts to indoor air quality (and resulting potential exposure of residents and workers in those buildings).

Separate CHHSLs are presented for residential and commercial/industrial land uses. A summary of models and exposure assumptions used for each land use is in Appendix 1. The category "Residential Land Use" applies to sites where unrestricted land use is desired. This includes use for residences, hospitals, day-care centers and other sensitive purposes (Cal/EPA 2002). Residential CHHSLs incorporate conservative assumptions regarding the long-term, frequent exposure of children and adults to contaminated soils in a residential setting. In contrast, "Commercial/Industrial Use Only" assumes that only working age adults will be present at the site on a regular basis. Exposure assumptions incorporated into these CHHSLs are less conservative than assumptions used in the residential land-use scenario.

In a DTSC PEA, the land use of the site under a Tier 1 assessment is assumed to be residential, regardless of the current use and zoning for the site. Other regulatory agencies may evaluate land use with respect to the current and foreseeable future use of the site in question. Reference to adopted General Plan zoning maps and local redevelopment plans is an integral part of this evaluation.

If chemicals at a site exceed residential CHHSLs but are below CHHSLs for commercial/industrial land-use, restrictions on the use of affected property will likely be necessary (refer to Section 2.10). The need for such restrictions should be weighed against the cost-benefit of remediating the property to meet the CHHSLs for unrestricted land use.

Although schools may also be a sensitive land use, proposed school sites must be evaluated using the OEHHA Guidance for Assessing Exposures and Health Risks at Existing and Proposed School Sites (Cal/EPA 2004a) rather than the CHHSLs. Refer to Section 2.9 for a discussion of school-specific risk evaluations. Use of the lookup tables for sites with other land uses (e.g., agriculture, parkland, etc.) should be discussed with and approved by the overseeing regulatory agency.

2.2 Developing a Conceptual Site Model

The primary condition for use of CHHSLs is that exposure pathways of concern and conditions at the site match those taken into account in the development of the CHHSLs. Thus, it is always necessary to develop a conceptual site model (CSM) to identify likely contaminant source areas, exposure pathways, and potential receptors to determine the applicability of CHHSLs at the site and the need for additional information. The conceptual site model summarizes information about site conditions in a schematic presentation in terms of: 1) primary sources (e.g., leaking tanks); 2) secondary sources (e.g., contaminated soil); 3) contaminant transport mechanisms (e.g., volatilization and intrusion into buildings); 4) contaminated exposure media (e.g., indoor air); and 5) potentially complete exposure pathways.

The CSM can be used to provide a rationale for additional site investigation, as a basis for a more detailed CSM, and/or to select screening levels or cleanup levels for specific environmental concerns. An example model is shown in Figure 2-1. The example model represents a hypothetical release of petroleum-based fuels and pesticides to soil and groundwater at a large housing redevelopment project with open spaces accessible to residents (direct exposure), enclosed buildings (vapor intrusion), wetlands (ecotoxicity) and communal garden areas where fruits and vegetables are grown (uptake in edible plants). Potential environmental concerns at the hypothetical site are identified by a check mark in the appropriate column. In addition, xylene and other compounds in petroleum often cause odor and aesthetic concerns (nuisances). Cleanup to address these and other gross contamination concerns may be required even after all other potential concerns have been adequately addressed.

If completed exposure pathways at a site match those pathways considered in the development of the CHHSLs, the appropriate soil and soil gas data can be directly compared to the CHHSLs to determine if the magnitude of exposure may pose a potential threat to human health. If the exposure pathways at a site do not match those pathways used in the development of the CHHSLs, these screening levels may not be used, and a site-specific human health risk evaluation should be performed.

Other potential environmental concerns must be evaluated separately, either through use of a comparable set of screening levels or through a more detailed, site-specific environmental risk assessment. Additional information regarding the preparation of conceptual site models is provided in the DTSC *Preliminary Endangerment Assessment Manual* (Cal/EPA 1994b), the USEPA Region IX *Preliminary Remediation Goals* document (USEPA 2004), the USEPA *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*, Interim Final Document (USEPA 1988) and the Region 2 Environmental Screening Levels document (SFBRWQCB 2003).

2.3 Using the Lookup Tables

A step-by-step approach for using the CHHSLs is summarized below.

Step 1 – Check for CHHSL Updates and Applicability

Check with the overseeing regulatory agency to determine if the CHHSLs can be applied to the subject site. Ensure that the most up-to-date CHHSLs are being used.

Step 2 - Prepare a Conceptual Site Model

The purpose of the conceptual site model is to present information about site conditions and potential impacts to receptors. All potential environmental concerns at the site (e.g., contaminant sources, pathways, exposure routes and receptors) should be clearly identified in a conceptual site model (Section 2.2 and Chapter 4). Identification of these concerns helps to provide the rationale for the type and location for site sampling. The level of detail required in a conceptual site model will vary from site to site. The presentation and scope of the model should be discussed with the overseeing regulatory agency. The conceptual site model should be continually updated as additional data for the site is obtained.

Step 3 – Collect Data

An environmental risk assessment is based on the results of a thorough site investigation, where all chemicals of potential concern have been identified. The scope and type of site investigation will vary depending on the site specific history and the nature of the actual or suspected chemical release. Sampling objectives should be defined in advance of field activities. For example, the objective may be to document whether a release has occurred; to identify hot spots that may require an expedited removal action; to provide sufficient data to determine whether site remediation is necessary; or to evaluate whether site conditions would be consistent with proposed or potential land uses.

Steps 4 - Determine the Desired Land Use

Screening levels for residential land use are generally appropriate for other sensitive uses of the property (e.g., day-care centers, hospitals, etc.). If preparing a DTSC PEA, residential land use CHHSLs should be used. **For evaluation of commercial/industrial properties, it is highly recommended that site data be compared to CHHSLs for both unrestricted/residential and commercial/industrial land use.** Commercial/industrial CHHSLs should be used only under the oversight of a regulatory agency, as that agency will likely require a land use covenant that restricts use of the property to these purposes.

Steps 5 - Select CHHSLs

Based on the actual or proposed land use, select the appropriate soil and/or soil gas CHHSLs. Replace CHHSLs with naturally occurring, background concentrations of chemicals of concern (e.g., arsenic) or laboratory method reporting levels if appropriate (see Sections 2.6 and 2.7).

Step 6 - Compare Site Data To CHHSLs; calculate cumulative risks as necessary

Compare site data to CHHSLs to identify areas where concentrations of contaminants pose potential human health concerns. For sites where sample data are limited and/or if preparing a DTSC PEA, compare the maximum-detected concentrations of chemicals of concern to the CHHSLs.

For sites where an adequate number of data points are available, statistical methods can be used to estimate site-specific exposure point concentrations. The exposure point concentration is the lesser of the maximum-detected concentration and the 95% upper confidence limit (UCL) of the arithmetic mean of sample data (Cal/EPA 1996a). The USEPA guidance document *Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites* recommends evaluating the distribution of the data and choosing the best UCL estimate for the data set (USEPA 2002). Guidance for the estimation of exposure point concentrations, use of "non-detect" data, and other issues is also provided in the Cal/EPA documents *Preliminary Endangerment Assessment Guidance Manual* (Cal/EPA 1994b), *Supplemental Guidance For Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities* (Cal/EPA 1996a), among other sources. As discussed in these documents, sample data collected outside of impacted areas should generally not be included in estimation of exposure point concentrations.

For residential land use scenarios, soil sample data should be averaged over no more than a 1,000 ft^2 area (assumed area of a typical, urban area back yard and footprint area of typical residence). For commercial/industrial properties, soil sample data can be averaged within affected areas of open spaces.

Use the maximum soil gas concentration over an area of the footprint of existing or assumed future buildings to compensate for potentially isolated rooms within a building and the uncertainties in soil gas collection.

If multiple chemicals with similar heath effects are present at a site, the cumulative excess cancer risk and/or noncancer hazard index should be calculated before final consideration of the site for closure. This will be of particular concern at sites where residual concentrations of chemicals with similar noncancer health effects may approach CHHSLs following the proposed, final cleanup of contaminated soil. Calculation of cumulative risks and hazard indices is discussed in Section 2.8. The need to include calculation of cumulative health risks in final closure reports should be discussed with the overseeing regulatory agency.

Steps 7 - Evaluate the Need for Additional Investigation or Actions to Address Human Health Concerns

Based on a comparison of available site data to the CHHSLs, the objectives identified in Step 3 should be evaluated. For example, comparison to CHHSLs may show that a site does not pose an unacceptable health risk to residential users, or it may show that additional investigation is warranted. Summarize the results of this evaluation in the Tier 1 Human Health Risk Assessment report (or preliminary endangerment assessment), and include recommendations for additional investigations or remediation as needed. Decisions for or against additional actions should always be made in coordination with the overseeing regulatory agency.

Step 8 - Evaluate Other Potential Environmental Concerns

The soil CHHSLs presented in Table 1 are limited to human health concerns associated with direct exposure to contaminated soil. In many instances, the presence of a potential hazardous chemical in soil may pose other environmental concerns that outweigh the risk to human health through direct exposure (see Sections 1.4 and 2.2, Chapter 4 and Table 1). The purpose of the Conceptual Site Model (Step 2) is to assist the user in identifying these concerns early in the process. For example, many metals and pesticides are significantly more toxic to flora and fauna than they are to humans (e.g., copper and nickel). Chemicals that easily leach from soils (e.g., MTBE) may pose a threat to shallow groundwater resources even though direct exposure to the soils does not pose a significant health risk. Since the CHHSLs do not address impacts to groundwater, surface water or sediment, these and other potential environmental concerns should be addressed as part of a comprehensive environmental risk assessment.

2.4 Screening For Soil Direct-Exposure Concerns

The soil screening levels presented in Table 1 address potential exposure of humans to contaminants in soil through incidental soil ingestion, dermal absorption and inhalation of dust or vapors in outdoor air. These soil screening levels are given in milligrams (mg) of chemical per kilogram (kg) of dry soil. Therefore, the analytical laboratory must be instructed to report their results accordingly. Models and assumptions used to develop the soil CHHSLs are summarized in Appendix 1. The CHHSLs represent a combination of standard assumptions regarding exposure of residents and workers to contaminants in soil and outdoor air and toxicity factors for each of the specific chemicals listed. CHHSLs for chemicals that are known or suspected carcinogens were calculated using a target excess lifetime cancer risk of one-in-one-million (10^{-6}). A target hazard quotient of 1.0 was used to calculate CHHSLS for noncancer health effects.

The presence of a chemical in soil at concentrations below its corresponding CHHSL can be assumed to not pose a significant health risk to people who may live or work at the site. Since sites usually have multiple contaminants, the cumulative, or total risk and hazards posed by all the hazardous chemicals a site should also be estimated using the approach described in Section 2.8.

Residential and commercial/industrial soil CHHSLs are applicable to soils that are at the ground surface or could be brought to the ground surface at some time in the future, with subsequent potential exposure by human receptors. A depth of more than three meters (approximately 10 feet) is generally used to delineate "deep" soils that are likely to remain isolated in the subsurface versus "shallow" soils that may be exposed during future redevelopment activities (Cal/EPA 1996a). Exposure of workers to deeper soils could still occur during periodic construction and utility maintenance work. Even if deep soil contamination does not present a human health risk, the overseeing regulatory agency may require preparation of a formal land-use covenant in order to allow such contamination to remain on site.

2.4.1 Evaluating Lead

In Table 1, the Commercial/Industrial Soil CHHSL for lead is listed as 3,500 mg/kg. This number was calculated using the methods described in Appendix 1. It should be noted, however, that this screening number is above the Total Threshold Limit Concentration for lead (1,000 mg/kg) as defined in Title 22 of the California Code of Regulations. It is also above the USEPA Region IX Preliminary Remediation Goal (PRG) of 800 mg/kg for commercial land use.

OEHHA is evaluating the method it used to derive its health-based screening number for a commercial/industrial scenario. Until this evaluation is complete, the commercial/industrial Soil CHHSL for lead in Table 1 should be considered an interim value, and the overseeing regulatory agency should be consulted on the appropriate screening number to be used at a site under investigation.

2.5 Screening of Volatile Organic Chemicals

2.5.1 Soil Screening Levels for Direct Exposure Concerns

Screening levels for direct exposure to volatile organic compounds (VOCs) in soil were not developed by OEHHA and are not included in this edition of the CHHSLs document. Direct-exposure models such as those used by USEPA Region IX do not take into account the total amount (mass) of a volatile chemical that might be present at a site (refer to Appendix 2). This is important, since the direct-exposure models assume a continuous off-gassing of vapors throughout a 30-year exposure period. In addition, the models assume exposure both via inhalation of vapors emitted to outdoor air and via incidental ingestion of volatile chemicals in soil. These assumptions may be overly conservative for highly volatile chemicals that are not expected to remain at significant concentrations in the soil over time following off-gassing to the outdoor air.

Bulk soil screening levels (i.e. concentrations measured in soil) for volatile chemicals are not presented in this document. The restricted size of soil samples limits the ability to use soil data to evaluate vapor intrusion concerns except at sites with very minor releases. At sites where significant releases of volatile chemicals have occurred, the collection of soil gas data in conjunction with bulk soil data is strongly recommended. For sites characterized by only minor releases of volatile chemicals and limited impacts to soil (e.g., minor spills around the fill ports of underground storage tanks), cleanup of soils to meet direct-exposure concerns should generally be adequate to address vapor intrusion concerns (see also Table 1).

2.5.2 Soil Gas Screening Levels for Vapor Intrusion Concerns

The indoor air and soil gas screening levels presented in Table 2 address the potential emission of volatile chemicals from contaminated soil or groundwater and subsequent intrusion into the indoor air of overlying buildings. A full discussion of the development of the soil gas screening levels, and the models and assumptions used, is discussed in Appendix 1.

The soil gas CHHSLs for the intrusion of vapors into buildings were developed assuming that buildings have a "slab on grade" construction. The screening levels are also considered to be adequately conservative for buildings with crawl space or underground parking construction. These reflect the most common type of building designs in California. The soil gas screening levels may not be adequately conservative for estimating impacts to indoor air in structures with basements, however, or buildings with substandard ventilation systems in general. Field data suggest that attenuation of vapors in such scenarios may be an order of magnitude below that expected in rooms or buildings with normal ventilation systems. Therefore, at sites where significant vapor intrusion concerns may exist, the collection and evaluation of samples from both basement areas and overlying living spaces may be warranted.

Additional information on subsurface vapor intrusion into buildings is provided the USEPA document *User's Guide for the Johnson and Ettinger (1991) Model for Subsurface Vapor Intrusion into Buildings* (USEPA 2003) and in the following section.

2.5.3 Evaluating Vapor Intrusion Concerns

If the concentration of a volatile chemical in soil gas at a site exceeds its CHHSL, the exposure pathway of soil vapor intrusion into indoor air should be further evaluated using the Cal/EPA *Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air* (Cal/EPA 2004b). The investigation of this pathway can be complex. The identification of sources of indoor air contaminants is often complicated by the presence of the same or similar chemicals products found and used in many households and industrial buildings (e.g., aerosol sprays, dry-cleaned clothing, cleaners, and tobacco smoke). Elevated levels of the same chemicals in ambient, outdoor air also pose a problem. Plumes of groundwater contaminated with volatile chemicals can also serve as the source of volatile chemicals found in soil gas and extend over significant areas. If there is strong evidence that the intrusion of vapors into buildings may exceed levels of potential concern, the collection and analysis of indoor air samples may be necessary. The inevitable effect of indoor air studies on the personal lives of residents and building workers will further require that risk issues be carefully communicated.

Guidance on the collection of soil gas and indoor air samples is provided in the following documents, among other sources:

- *Soil Gas Advisory* (January 2003): Department of Toxic Substances Control and Los Angeles Regional Water Quality Control Board; http://www.dtsc.ca.gov/policyAndProcedures/SiteCleanup/SMBR_ADV_activesoilgasinvst.pdf.

- *Indoor Air Sampling And Evaluation Guide* (2002): Massachusetts Department of Environmental Protection, Office of Research and Standards, WSC Policy #02-430; http://www.state.ma.us/dep/bwsc/finalpol.htm.

Properly collected indoor air sample data may be compared to the indoor air screening levels. Averaging of indoor air data within a single building may not be appropriate beyond the specific room being tested. Screening levels for indoor air (Table 2) are based on standard exposure models for long-term inhalation of contaminants in air at a target excess cancer risk of 10^{-6} and a target hazard quotient of 1.0. The indoor air CHHSLs do not account for potential cumulative effects posed by the presence of multiple contaminants in air (see Section 2.8).

2.6 Substitution of Laboratory Reporting Limits for CHHSLs

The overseeing regulatory agency should review and agree to the analytical methods used to quantify chemicals in soil samples to make sure that the methods are sensitive enough to detect low concentrations of chemicals of potential concern. The attainment of detection limits that are at or below the screening levels should be part of the Data Quality Objectives. If all agreed-upon methods have been used, the overseeing regulatory agency may allow the use of the method reporting limit in place of the screening level in cases where a CHHSL for a specific chemical is less than its laboratory method reporting limit. Potential examples include the soil direct-exposure CHHSL for dioxin (e.g., 0.0000046 mg/kg for residential exposure).

2.7 Substitution of Naturally Occurring Concentrations for CHHSLs

Naturally occurring background concentrations of arsenic, beryllium, cadmium, chromium and other metals in soils may exceed their respective soil CHHSLs. Cal/EPA generally does not require cleanup of soil to below background levels. This issue is frequently encountered with arsenic. Natural background concentrations of arsenic in California are often well above the health-based, direct-exposure goals in soil of 0.07 mg/kg for residential land use and 0.24 mg/kg for commercial/industrial land use (e.g., Bradford et. al, 1996; LBNL 2002). Background concentration of arsenic or other metals of potential concern at a site should be determined from analysis of site-specific samples in uncontaminated areas using guidance published by Cal/EPA and/or reference to published data for nearby sites (Cal/EPA 1997). However, background data for nearby sites may only be used as a surrogate for uncontaminated site data if those data are obtained from soil of the same lithology as that found on-site.

2.8 Cumulative Risks at Sites with Multiple Contaminants

Risks posed by exposure to multiple chemicals with similar health affects are considered to be additive or "cumulative." For example, the total excess lifetime risk of cancer posed by the presence of several carcinogenic chemicals in all exposure media is the sum of the risk posed by each individual chemical. The same is true for chemicals that cause noncarcingenic health effects.

A stepwise approach for screening of sites with multiple contaminants is suggested (after USEPA 2004):

Step 1: Identify potential chemicals of concern.

Step 2: Record CHHSLs for each chemical separated by media type (soil, soil gas and/or indoor air). Include CHHSLs for both cancer and noncancer effects, if available (refer to Appendix 1). If CHHSLs are not available for specific chemicals, evaluate those chemicals using the approaches discussed in Appendix 1 and in the PEA manual.

Step 3: Calculate cumulative cancer risk estimates by taking the assumed exposure point concentration for each chemical (maximum or approved 95% UCL) and divide by the respective CHHSL concentration designated for cancer evaluation. Multiply the ratio by 10^{-6} (the target risk used to develop the CHHSLs) to calculate the estimated cancer risk for that specific chemical for a reasonable maximum exposure (RME).

$$Risk = [\left(\frac{conc_x}{CHHSL_x}\right) + \left(\frac{conc_y}{CHHSL_y}\right) + \left(\frac{conc_z}{CHHSL_z}\right)] \times 10E - 06$$

For multiple chemicals, simply add the risks for individual chemicals or sum individual ratios and multiply the total by a factor of 10^{-6}:

Step 4: Calculate cumulative noncancer hazard estimates by taking the assumed exposure point concentration for each chemical (maximum or approved 95% UCL) and divide by the respective CHHSL concentration designated for noncancer effects. This generates an individual Hazard Quotient for that chemical. Calculate a cumulative Hazard Index by adding the individual Hazard Quotients. A Hazard Index of one or less is generally considered "safe". A ratio that is greater than one suggests that further evaluation is necessary. (Note that carcinogens may have CHHSLs for both cancer effects as well as noncancer effects. Refer to Appendix 1).

For more information, refer to the USEPA Preliminary Remediation Goals

$$Hazard\,Index = [\left(\frac{conc_x}{CHHSL_x}\right) + \left(\frac{conc_y}{CHHSL_y}\right) + \left(\frac{conc_z}{CHHSL_z}\right)]$$

document (USEPA 2002). OEHHA has also developed a spread sheet tool for calculating cumulative risk. This spread sheet is available on Cal/EPA's, DTSC's, the State Board's and OEHHA's web pages.

2.9 Evaluation of School Sites

DTSC's Schools Property Evaluation and Cleanup Division is the lead agency for the environmental assessment of potential contamination at new, expanding, or existing schools. Since January 2000, school districts have been required to conduct an environmental assessment under the oversight and approval of DTSC prior to the construction of new schools. By law, DTSC uses specific guidance and protocols for school projects. Because of this, the CHHSLs may not be applicable for these sites. Contact DTSC for further information and direction for the evaluation of potential contamination on school properties and the application of the CHHSLs.

2.10 Use of CHHSLs as Cleanup Levels and Land Use Restrictions

As stated earlier in this guidance, these CHHSLs are not stand-alone decision making tools, a set of final cleanup or action levels to be applied at contaminated sites or a guarantee that an oversight regulatory agency will determine that a project is adequately studied or agree with the conclusions of the site investigation and risk assessment report. Cleanup decisions are at the discretion of the overseeing regulatory agency and can only be made after a full evaluation of site conditions and potential human health and environmental concerns.

While regulatory agencies cannot be compelled to use the CHHSLs as final cleanup standards for a contaminated property, there may be circumstances where the residential CHHSLS would be sufficiently protective and considered as appropriate cleanup levels with the following caveats.

- The overseeing regulatory agency has determined that the site has been adequately characterized and agrees that the use of CHHSLs is appropriate.

- The potentially complete exposure pathways at the site match the exposure pathways used to develop the CHHSLs and no additional completed exposure pathways or receptors were identified.

- All other environmental concerns have been addressed to the satisfaction of the overseeing regulatory agency (refer to Section 1.4 and Table 1).

In a similar manner, there may be circumstances where the Commercial/Industrial CHHSLS would be sufficiently protective and considered as appropriate cleanup goals under regulatory agency oversight. Their use at a site in this context must also be coupled with the understanding that such a use of these CHHSLs may be subject to existing regulations and land-use covenants. In addition, the following should also be considered:

- **Concentrations of chemicals in soils left in place at a commercial/industrial site should always be compared to both commercial/industrial AND residential CHHSLs.** If the soils meet

CHHSLs for residential land use after cleanup then this should be clearly stated in the site closure report. This point may prove important should the site unexpectedly become desirable for other uses in the future (e.g., residential, day care, health care, etc.).

- Sites cleaned up to commercial CHHSLs only are not suitable for unrestricted land use without further evaluation. The appropriate regulatory agency should be consulted to determine actions necessary to remove land-use restrictions.

(Page intentionally left blank)

3 Conditions Warranting Site Specific Human Health Risk Assessments

3.1 Site Considerations

Use of the CHHSLs is optional and a standard human health risk assessment may be undertaken for any site. Site conditions may prevent the full use of the CHHSLs and require preparation of a more site-specific, health risk evaluation or baseline risk assessment (refer to Section 1.2). Examples of site conditions that may warrant site-specific or detailed human health risk assessment include:

- Sites that have a high public profile and need a detailed, fully documented human health risk assessment for public review;
- Sites where multiple contaminants with similar health effects are present and cumulative health risks (or hazards) must be calculated;
- Sites with contaminants for which CHHSLs have not been developed.
- Sites where alternative target risk levels or chemical-specific toxicity factors may be acceptable to the regulatory agency (Appendix 1);
- Sites where direct-exposure concerns for residents and workers may not need to be considered (Section 2.4);
- Sites where site conditions may be engineered to eliminate or reduce specific exposure pathways;
- Sites where field observations or site conditions indicate that the CHHSLs may not be adequately protective or may be excessively conservative.

Additional considerations should be evaluated on a site-by-site basis and discussed with the overseeing regulatory agency.

3.2 Tier 2 Human Health Risk Assessments

3.2.1 Purpose

The Tier 1 CHHSLs were developed with default or generic assumptions that are not specific to any particular site condition. If site soil concentrations exceed CHHSLs, site-specific exposure assumptions may be used in the standard risk models described in Appendix 1 or the PEA guidance to estimate risk and/or develop site-specific CHHSLs. Using alternative exposure assumptions in these standard risk models could reduce the time and cost incurred by both the regulated business and the overseeing responsible party in finalizing the risk assessment. Modifications to the default assumptions must be described and justified in the text of the report, presented with the revised set of screening or cleanup levels, and agreed to beforehand with the regulatory agency.

3.2.2 Examples of Site-Specific Adjustments

Potential site-specific modifications include:

- Use of alternative target risk levels, and/or alternative exposure assumptions;
- Elimination of direct-exposure concerns through imposition of institutional controls;
- Inclusion of potential exposure of construction and trench workers to contaminated soil not likely to be exposed at the ground surface in the future (e.g., capped soils or soils isolated at depth);
- Consideration of method reporting limits or natural background or ambient concentrations of a chemical in place of the CHHSL.

After incorporating site-specific parameter values into the Tier 1 direct-exposure models, alternative human-health-based screening levels can be calculated and re-compared to site data.

3.3 Tier 3 (Baseline) Human Health Risk Assessments

3.3.1 Purpose

In a site-specific baseline human health risk assessment, alternative models and assumptions are used and fully justified to develop a detailed, comprehensive human health risk assessment. Portions of the models and assumptions used to develop the CHHSLs may still be retained for some components of the risk assessment. Any baseline human health risk assessment should be carried out under the oversight of the regulatory agency.

Detailed guidance on the preparation of and information for use in site-specific baseline environmental risk assessments is provided in the following references:

Human Health Risk Assessment:

- *Risk Assessment Guidance for Superfund. Volume I, Human Health Evaluation Manual* (Part A) (USEPA 1989a);
- *Soil Screening Guidance: Technical Background Document* (USEPA 1996);
- *CalTOX, A Multimedia Total Exposure Model For Hazardous-Waste Sites* (Cal/EPA 1994a);
- *Preliminary Endangerment Assessment Guidance Manual* (Cal/EPA 1994b);
- *Supplemental Guidance For Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities* (Cal/EPA 1996a);
- *Exposure Factors Handbook* (USEPA 1997a); and
- *Assessing the Significance of Subsurface Contaminant Vapor Migration to Enclosed Spaces* (Johnson et. al, 1998).

(Page intentionally left blank)

4 Evaluation of Other Potential Environmental Concerns

The importance of identifying all environmental concerns at sites where releases of hazardous chemicals have occurred is discussed in Sections 1.4 and 2.2. The CHHSLs provided in Tables 1 and 2 specifically address risks to human health posed by exposure to contaminated soil and indoor air. At sites affected by highly toxic but relatively immobile chemicals (e.g., PCBs, DDT, arsenic, etc.), cleanup of contaminated soils to address human health concerns will generally be sufficient to address other potential environmental concerns provided that sensitive ecological habitats are not threatened. In other cases or for other chemicals, additional environmental concerns may still be present even after impacted soils have been remediated to levels sufficient to address risks to human health. This could include leaching of contaminants from soil and subsequent impacts on groundwater resources, toxicity to terrestrial biota, uptake of contaminants in edible fruits or vegetables and nuisance or gross contamination concerns.

A summary of other environmental concerns potentially posed by contaminants in soil is incorporated into Table 1. This summary compares the CHHSLs to the SFBRWQCB's ESLs for leaching, ecotoxicity and nuisance concerns. The ESLs can be found at http://www.waterboards.ca.gov/sanfranciscobay/esl.htm.

For example, the residential CHHSL for endrin in soil (21 mg/kg) is much higher than the corresponding ESL for ecotoxicity concerns (0.06 mg/kg). This means that ecotoxicity concerns may outweigh human health concerns at sites where potentially sensitive habitats are present (designated by an "X" in the Table 1). This is not surprising, since endrin, a pesticide, was specifically formulated to be highly toxic to terrestrial biota.

Additional evaluation should be carried out at sites where the basic conceptual site model indicates that the presence of contaminated soils may pose other environmental concerns or where potential impacts to groundwater, surface water or sediment are identified. It is beyond the scope of this document to present guidance on the proper evaluation of these additional concerns. However, useful references are provided in Figure 4-1. Additional risk assessment guidance should be consulted as needed.

5 References

Bradford, G. R., et. al, 1996, *Background Concentrations of Trace and Major Elements in California Soils*: University of California (Riverside), Division of Agriculture and Natural Resources, March 1996.

Cal/EPA, 1994a, *CalTOX, A Multimedia Total Exposure Model For Hazardous-Waste Sites*: California Environmental Protection Agency, Department of Toxics Substances Control, Version 1.5 (and updates), www.dtsc.ca.gov/ScienceTechnology/index.html.

Cal/EPA, 1994b, *Preliminary Endangerment Assessment Guidance Manual*: California Environmental Protection Agency, Department of Toxics Substances Control, January 1994.

Cal/EPA, 1996a, *Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities*: California Environmental Protection Agency, Department of Toxics Substances Control, August, 1996, www.dtsc.ca.gov/ScienceTechnology/ index.html.

Cal/EPA, 1996b, *Guidance for Ecological Risk Assessments at Hazardous Waste Sites and Permitted Facilities (Parts A and B)*: California Environmental Protection Agency, Department of Toxics Substances Control, July 4, 1996, www.dtsc.ca.gov/ScienceTechnology/index.html.

Cal/EPA, 1997, *Selecting Inorganic Constituents as Chemicals of Potential Concern at Risk Assessments at Hazardous Waste Sites and Permitted Facilities, Final Policy*: California Environmental Protection Agency, Department of Toxics Substances Control, February 1997, http://www.dtsc.ca.gov/ScienceTechnology/ftp/backgrnd.pdf.

Cal/EPA, 2002, Response Actions For Sites Where Future Uses May Include Sensitive Uses: California Environmental Protection Agency, Department of Toxic Substances Control, Site Mitigation and Brownfields Reuse Program, Management Memo EO-02-002-MM (July 0, 2002).

Cal/EPA, 2004a, *Guidance for Assessing Exposures and Health Risks at Existing and Proposed School Sites* (Draft): California Environmental Protection Agency, Office of Environmental Health Hazard Assessment.

Cal/EPA, 2004b, *Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air*: California Environmental Protection Agency, Department of Toxics Substances Control.

CLRA, 2002, *California Land Restoration and Reuse Act*, California Health and Safety Code, Section 25401 *et seq*. and section 57008 *et seq*., http://www.leginfo.ca.gov/calaw.html.

Johnson, P.C., Kemblowski, M. W., and Johnson, R.L., 1998, *Assessing the Significance of Subsurface Contaminant Vapor Migration to Enclosed Spaces*: American Petroleum Institute, Health and Environmental Sciences Department, December, 1998, API Publication No. 4674.

LBNL, 2002, *Analysis of Background Distributions of Metals in the Soil at Lawrence Berkeley National Laboratory*: University of California (Berkeley), Lawrence Berkeley Laboratory, June 2002.

MADEP, 1994, *Background Documentation for the Development of the MCP Numerical Standards*: Massachusetts Department of Environmental Protection, Bureau of Waste Site Cleanup and Office of Research and Standards, April 1994, www.state.ma.us/dep/ors/orspubs.htm.

MADEP, 1995, *Guidance For Disposal Site Risk Characterization*: Massachusetts Department of Environmental Protection, Bureau of Waste Site Cleanup and Office of Research and Standards, July 1995.

MOEE, 1996, *Rational for the Development and Application of Generic Soil, Groundwater and Sediment Criteria for Use at Contaminated Sites in Ontario*: Ontario Ministry of Environment and Energy, Standards Development Branch, December, 1996, www.ene.gov.on.ca/.

NOAA, 1999, *Sediment Screening Reference Tables* (SQuiRTs): National Oceanic and Atmospheric Organization, Coastal Protection and Restoration Division (September 1999), http://response.restoration.noaa.gov/cpr/sediment/squirt/squirt.html.

SFBRWQCB, 2003, *Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater* (July 2003): California Regional Water Quality Control Board, San Francisco Bay Region, http://www.swrcb.ca.gov/rwqcb2/esl.htm.

USEPA, 1988, *Superfund Exposure Assessment Manual*: U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Publication EPA/540/1-88/001.

USEPA, 1989a, *Risk Assessment Guidance for Superfund. Volume I, Human Health Evaluation Manual (Part A)*: U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Publication EPA/540/1-89/092.

USEPA, 1989b, *Risk Assessment Guidance for Superfund. Volume II, Environmental Evaluation Manual*: U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Publication EPA/540/1-89/001.

USEPA, 1994, *Synthetic Precipitation Leaching Procedure*: U.S. Environmental Protection Agency, Office of Solid Waste, SW-846 Method 1312, September 1994, www.epa.gov/epaoswer/hazwaste/test/main.htm.

USEPA, 1996, *Soil Screening Guidance: Technical Background Document*: U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Publication 9355.4-17A, May 1996.

USEPA, 1997a, *Exposure Factors Handbook*: U.S. Environmental Protection Agency, Office of Research and Development, Publication EPA/600/P-95/002Fa, August 1997.

USEPA, 1997b, *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments*. U.S. Environmental Protection Agency, Environmental Response Team, Interim Final, June 5, 1997, EPA 540-R-97-006.

USEPA, 1999, *Estimating Risk From Contaminants Contained in Agricultural Fertilizers (Draft)*: U.S. Environmental Protection Agency, Office of Solid Waste, August 1999, http://www.epa.gov/epaoswer/hazwaste/recycle/fertiliz/risk/.

USEPA, 2002, *Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites.* U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, December 2002, OSWER 9285.6-10.

USEPA, 2003, *User's Guide For The Johnson and Ettinger (1991) Model For Subsurface Vapor Intrusion Into Buildings*: U.S. Environmental Protection Agency Office of Emergency and Remedial Response, September 1997 (and updates), www.epa.gov/oerrpage/superfund/programs/risk/airmodel/johnson_ettinger.htm.

USEPA, 2004, *Preliminary Remediation Goals*: U.S. Environmental Protection Agency, Region IX, October 2002, www.epa.gov/region09/waste/sfund/prg/index.htm.

(Page intentionally left blank)

FIGURES

(Page intentionally left blank)

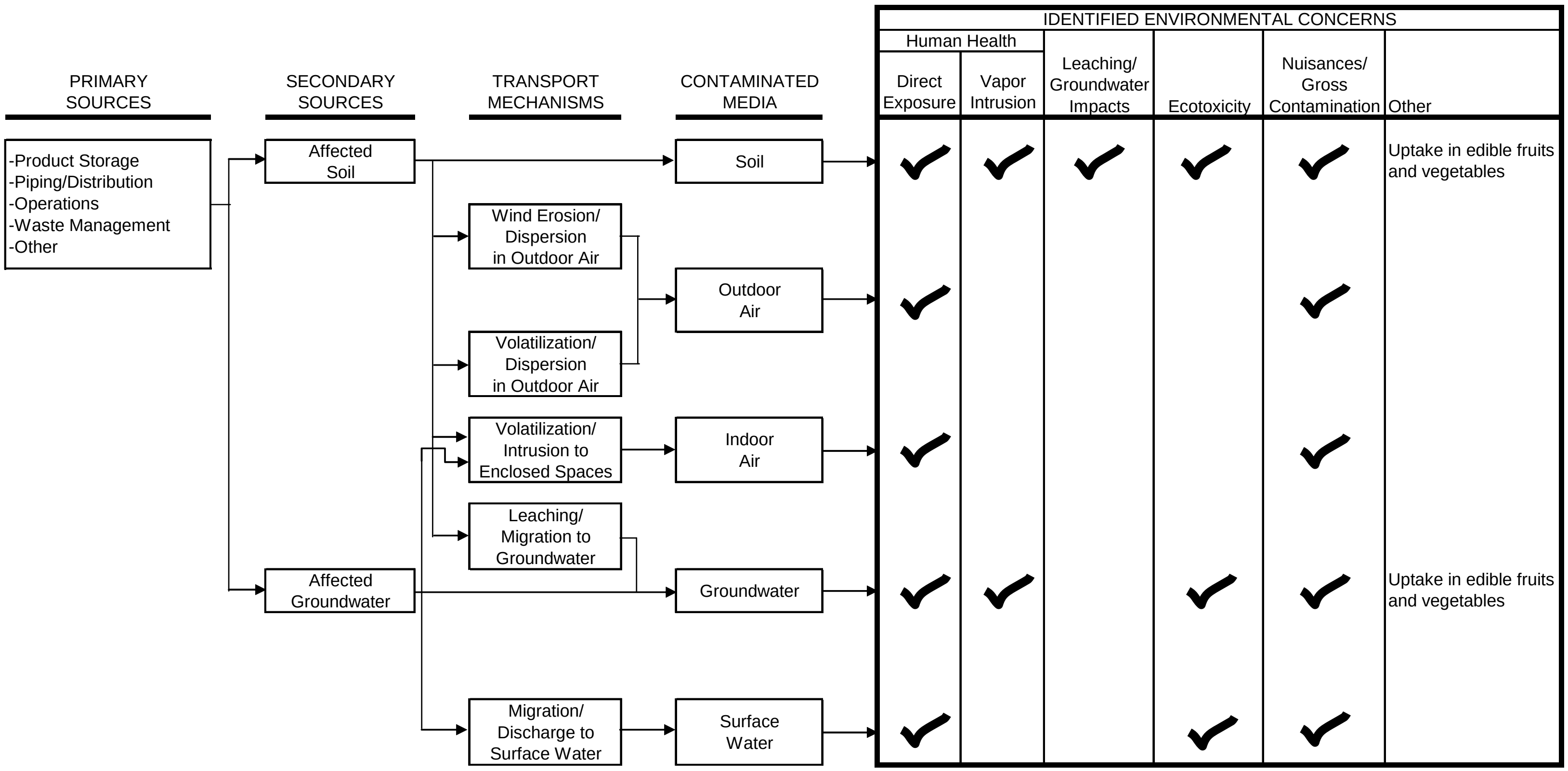


Figure 2-1. Example conceptual site model depicting environmental concerns identified at a site where hazardous chemicals were released to soil and groundwater. See Section 2.2.

(Page intentionally left blank)

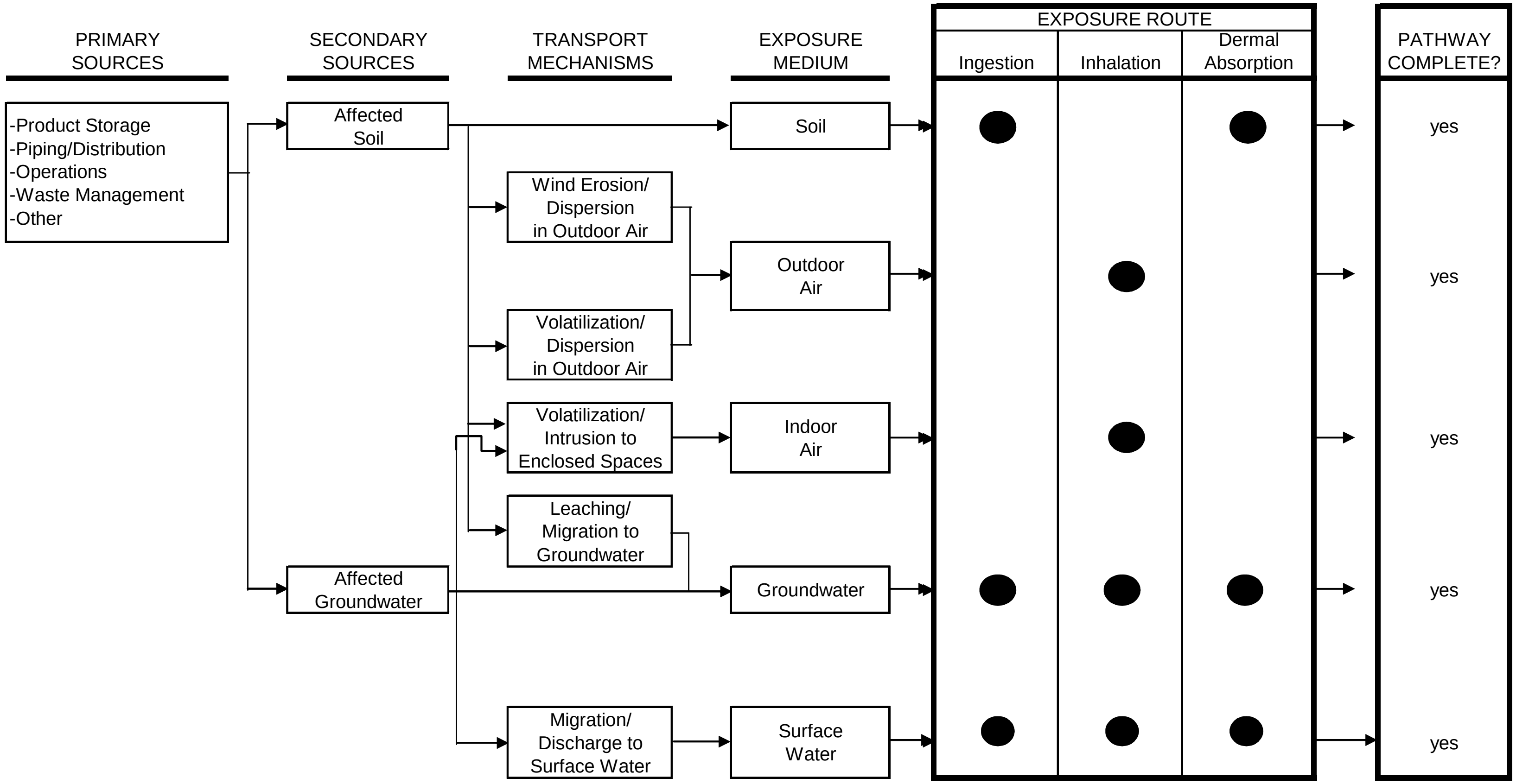


Figure 2-2. Example focused conceptual site model of human health concerns identified at a site where hazardous chemicals were released to soil and groundwater. See Section 2.2.

(Page intentionally left blank)

Environmental Concern	Reference/Website
Leaching and migration of contaminants to groundwater	USEPA Soil Screening Guidance (USEPA 1996): http://www.epa.gov/superfund/resources/soil/index.htm SFBRWQCB ESL Document (SFBRWQCB 2003): http://www.waterboards.ca.gov/sanfranciscobay/esl.htm. USEPA Synthetic Precipitation Leaching Procedure (USEPA 1994): http://www.epa.gov/epaoswer/hazwaste/test/main.htm. Commonly Used Models: SESOIL, VLEACH
Ecotoxicity	USEPA Ecological Soil Screening Guidance (USEPA 1996): http://www.epa.gov/superfund/programs/risk/ecorisk/ecossl.htm Risk Assessment Guidance for Superfund: Volume II Environmental Evaluation Manual (USEPA 1989b); Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (USEPA 1997b) Guidance for Ecological Risk Assessments at Hazardous Waste Sites and Permitted Facilities (CalEPA 1996a,b) Ontario MOEE Rational for the Development and Application of Generic Soil, Groundwater and Sediment Criteria for Use at Contaminated Sites in Ontario (MOEE 1996): http://www.ene.gov.on.ca/ SFBRWQCB ESL Document (SFBRWQCB 2003): http://www.waterboards.ca.gov/sanfranciscobay/esl.htm NOAA Sediment Screening Table (NOAA 1999): http://response.restoration.noaa.gov/cpr/sediment/squirt/squirt.html
Ingestion via plant uptake	USEPA Soil Screening Guidance (USEPA 1996): http://www.epa.gov/superfund/resources/soil/index.htm USEPA Fertilizer Risk Assessment (USEPA 1999): http://www.epa.gov/epaoswer/hazwaste/recycle/fertiliz/risk/ CalEPA CALTOX model (CalEPA 1994a): http://www.dtsc.ca.gov/ Massachusetts DEP Guidance for Disposal Site Risk Characterization (MADEP 1995): http://www.state.ma.us/dep/ors/orspubs.htm
Nuisance/Gross Contamination	Massachuestts DEP Background Documentation for the Development of the MCP Numerical Standards (MADEP 1994): http://www.state.ma.us/dep/ors/orspubs.htm SFBRWQCB ESL Document (SFBRWQCB 2003): http://www.waterboards.ca.gov/sanfranciscobay/esl.htm

Figure 4-1. Suggested references for evaluation of environmental concerns not currently addressed by the CalEPA CHHSLs.

(Page intentionally left blank)

TABLE 1: California Human Health Screening Levels for Soil and Comparison to Other Potential Environmental Concerns

Notes:
Always compare soil data for commercial/industrial sites to residential CHHSLs and evaluate need for formal land-use restrictions (see Section 2.10).

(Page intentionally left blank)

Table 1. California Human Health Screening Levels for Soil And Comparison To Other Potential Environmental Concerns

Chemical	[1]Soil Human Health Screening Levels (mg/kg of dry soil)		[2]Other Potential Environmental Concerns Posed By Contaminated Soil			
	Residential Land Use	**Commercial/ Industrial Land Use Only**	**[3]Leaching**	**[4]Ecotoxicity**	**[5]Nuisance/ Aesthetic Concerns**	**[6]Other**
Organic Acidic Chemicals						
2,4-D	6.9E+02	7.7E+03	X	X	o	
2,4,5-T	5.5E+02	6.1E+03	X	X	o	
Pentachlorophenol	4.4E+00	1.3E+01	X	X	o	
Organic Neutral Chemicals						
Aldrin	3.3E-02	1.3E-01	o	X	o	
Benzo(a)pyrene	3.8E-02	1.3E-01	o	X	o	TPH
Chlordane	4.3E-01	1.7E+00	o	X	o	
DDD	2.3E+00	9.0E+00	o	X	o	
DDE	1.6E+00	6.3E+00	o	X	o	
DDT	1.6E+00	6.3E+00	o	X	o	
Dieldrin	3.5E-02	1.3E-01	X	X	o	
1,4 Dioxane	1.8E+01	6.4E+01	X	o	o	
Dioxin (2,3,7,8-TCDD)	4.6E-06	1.9E-05	o	o	o	
Endrin	2.1E+01	2.3E+02	X	X	o	
Heptachlor	1.3E-01	5.2E-01	X	X	o	
Lindane	5.0E-01	2.0E+00	X	X	o	
Kepone	3.5E-02	1.3E-01	X	o	o	
Methoxychlor	3.4E+02	3.8E+03	o	X	o	
Mirex	3.1E-02	1.2E-01	X	X	o	
PCBs	8.9E-02	3.0E-01	o	X	o	
Toxaphene	4.6E-01	1.8E+00	X	X	o	

Table 1. California Human Health Screening Levels for Soil And Comparison To Other Potential Environmental Concerns

Chemical	[1]Soil Human Health Screening Levels (mg/kg of dry soil)		[2]Other Potential Environmental Concerns Posed By Contaminated Soil			
	Residential Land Use	**Commercial/ Industrial Land Use Only**	**[3]Leaching**	**[4]Ecotoxicity**	**[5]Nuisance/ Aesthetic Concerns**	**[6]Other**
Inorganic Chemicals						
Antimony and compounds	3.0E+01	3.8E+02	site specific	o	o	
Arsenic	7.0E-02	2.4E-01	site specific	X	o	Ambient background
Barium and compounds	5.2E+03	6.3E+04	site specific	X	o	Construction workers
Beryllium and compounds	1.5E+02	1.7E+03	site specific	X	o	
Beryllium oxide[7]	9.1E-02	4.1E-01	o	o	o	Construction workers
Beryllium sulfate[7]	2.1E-04	9.5E-04	o	o	o	
Cadmium and compounds	1.7E+00	7.5E+00	site specific	X	o	Ambient background
Chromium III	1.0E+05	1.0E+05	site specific	X	X	
Chromium VI	1.7E+01	3.7E+01	site specific	X	o	Construction workers
Cobalt	6.6E+02	3.2E+03	site specific	X	o	Construction workers
Copper and compounds	3.0E+03	3.8E+04	site specific	X	X	
Fluoride	4.6E+03	5.7E+04	site specific	o	o	
Lead and lead compounds	1.5E+02	3.5E+03[9]	site specific	X	o	Uptake in fruits and vegetables
Lead acetate[7]	2.3E+00	1.0E+01	X	o	o	
Mercury and compounds	1.8E+01	1.8E+02	site specific	X	o	
Molybdenum	3.8E+02	4.8E+03	site specific	X	X	
Nickel and compounds	1.6E+03	1.6E+04	site specific	X	X	Construction workers
Nickel subsulfide[7]	3.8E-01	1.1E+04	site specific	o	o	
Perchlorate[8]	pp[8]	pp[8]	X	o	o	
Selenium	3.8E+02	4.8E+03	site specific	X	X	
Silver and compounds	3.8E+02	4.8E+03	site specific	X	X	
Thallium and compounds	5.0E+00	6.3E+01	site specific	o	o	Ambient background
Vanadium and compounds	5.3E+02	6.7E+03	site specific	X	X	

Table 1. California Human Health Screening Levels for Soil And Comparison To Other Potential Environmental Concerns

Chemical	[1]Soil Human Health Screening Levels (mg/kg of dry soil)		[2]Other Potential Environmental Concerns Posed By Contaminated Soil			
	Residential Land Use	Commercial/ Industrial Land Use Only	[3]Leaching	[4]Ecotoxicity	[5]Nuisance/ Aesthetic Concerns	[6]Other
Zinc	2.3E+04	1.0E+05	site specific	X	X	

Notes:

1. Direct-exposure screening levels address human exposure to chemicals in soil via incidental ingestion, dermal absorption and inhalation of vapors and particulates emitted to outdoor air (refer to Appendix 1). Assumes impacted soil is situated at or near the ground surface or could be at some time in the future. Volatile chemicals not included at this time (refer to Section 2.5).
   "Residential Land Use" screening levels generally considered appropriate for other sensitive uses (e.g., day-care centers, hospitals, etc.).
   Commercial/industrial properties should be evaluated using both residential and commercial/industrial CHHSLs. A deed restriction that prohibits use of the property for sensitive purposes may be required at sites that are evaluated and/or remediated under a commercial/industrial land use scenario only.
   Carcinogens: CHHSLs based on target cancer risk of 10^{-6}. Cal/EPA cancer slope factors used when available.
   Noncarcinogens: CHHSLs based on target hazard quotient of 1.0.
   Calculation of cumulative risk may be required at sites where multiple contaminants with similar health effects are present (see Section 2.8).
   Residential and C/I soil CHHSLs for arsenic below background for most sites in California (0.07 mg/kg and 0.24 mg/kg, respectively - see Appendix 1). Use identified or anticipated background as screening level (see Section 2.7).
2. Environmental concerns in addition to direct exposure that may need to be considered in evaluation of contaminated soil. Based on a comparison of soil CHHSLs to soil screening levels for noted concerns compiled by the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB 2003). The need to address other environmental concerns must be evaluated separately in coordination with the lead regulatory agency (See Sections 1.4, 2.2 and Chapter 4).
   "X": Noted concern may outweigh direct-exposure risks at many sites and drive decisions for cleanup actions.
   "o": Potential concern but generally will be addressed if cleanup of contaminated soils to meet direct-exposure CHHSLs is carried out.
   "site specific": Potential concern, but evaluation as to whether this factor is a potential concern must be done on a site specific basis.
3. Leaching of chemicals from soil and subsequent impacts to groundwater. Soil ESLs consider of impacts to drinking water resources, re-emission of volatile chemicals from groundwater into overlying buildings and discharges of contaminated groundwater to surface water. Leaching of metals from soil should be evaluated on a site-specific basis, depending on the potential mobility of the metal species present. Laboratory-based leaching studies are generally preferred over model-derived screening levels.
4. Toxicity to terrestrial flora and fauna. Need to consider ecotoxicity concerns generally determined on a site-by-site basis.
5. Nuisance and gross contamination concerns address odors and aesthetic concerns as well as general resource degradation and presence of potentially mobile free product.
6. Other pertinent environmental concerns and considerations as determined on a site-specific basis.
   Health risk to construction workers may outweigh risk to residents or commercial/industrial workers for chemicals that are carcinogenic due to increased exposure to airborne dust particles and incidental ingestion of soil. Uptake of chemicals in edible fruits and vegetables from soil may need to be considered in some cases for noted chemicals.
7. These metal salts are significantly (greater than 10-fold) more toxic than the values for the metals in general. If it is known that this chemical was used at the site, the screening number for this chemical should be used instead of the screening number for the metal and its compounds.
8. Calculation of a screening number for the chemical has been postponed (pp) until the toxicity criterion currently being developed by OEHHA is published as a final document.
9. This screening number is above the Total Threshold Limit Concentration for lead of 1000 mg/kg, as defined in Title 22, California Code of Regulations. It is also above the US EPA Region IX PRG of 800 mg/kg.

(Page intentionally left blank)

TABLE 2: California Human Health Screening Levels for Indoor Air and Soil Gas

Notes:
Always compare soil data for commercial/industrial sites to residential CHHSLs and evaluate need for formal land-use restrictions (see Section 2.10).

(Page intentionally left blank)

Table 2. California Human Health Screening Levels for Indoor Air and Soil Gas

Chemical	[1]Indoor Air Human Health Screening Levels ($\mu g/m^3$)		[2]Shallow Soil Gas Human Health Screening Levels (Vapor Intrusion) ($\mu g/m^3$)	
	Residential Land Use	**Commercial/ Industrial Land Use Only**	**Residential Land Use**	**Commercial/ Industrial Land Use Only**
Benzene	8.40 E-02	1.41 E-01	3.62 E+01	1.22 E+02
Carbon Tetrachloride	5.79 E-02	9.73 E-02	2.51 E+01	8.46 E+01
1,2-Dichloroethane	1.16 E-01	1.95 E-01	4.96 E+01	1.67 E+02
cis-1,2-Dichloroethylene	3.65 E+01	5.11 E+01	1.59 E+04	4.44 E+04
trans-1,2-Dichloroethylene	7.30 E+01	1.02 E+02	3.19 E+04	8.87 E+04
Ethylbenzene	Postponed[3]	Postponed[3]	Postponed[3]	Postponed[3]
Mercury, elemental	9.40 E-02	1.31 E-01	4.45 E+01	1.25 E+02
Methyl tert-Butyl Ether	9.35 E+00	1.57 E+01	4.00 E+03	1.34 E+04
Naphthalene	7.20 E-02	1.20 E-01	3.19 E+01	1.06 E+02
Tetrachloroethylene	4.12 E-01	6.93 E-01	1.80 E+02	6.03 E+02
Tetraethyl Lead	3.65 E-04	5.11 E-04	2.06 E-01	5.78 E-01
Toluene	3.13 E+02	4.38 E+02	1.35 E+05	3.78 E+05
1,1,1-Trichloroethane	2.29 E+03	3.21 E+03	9.91 E+05	2.79 E+06
Trichloroethylene	1.22 E+00	2.04 E+00	5.28 E+02	1.77 E+03
Vinyl Chloride	3.11 E-02	5.24 E-02	1.33 E+01	4.48 E+01
m-Xylene	7.30 E+02	1.02 E+03	3.19 E+05	8.87 E+05
o-Xylene	7.30 E+02	1.02 E+03	3.15 E+05[4]	8.79 E+05[4]
p-Xylene	7.30 E+02	1.02 E+03	3.17 E+05	8.87 E+05

Reference: Appendix 1, OEHHA Target Indoor Air Concentrations and Soil-Gas Screening Numbers for Existing Buildings under Residential and Industrial/Commercial land uses.

Notes:

1. "Residential Land Use" screening levels generally considered adequate for other sensitive uses (e.g., day-care centers, hospitals, etc.). Commercial/industrial properties should be evaluated using both residential and commercial/industrial CHHSLs. A deed restriction that prohibits use of the property for sensitive purposes may be required at sites that are evaluated and/or remediated under a commercial/industrial land use scenario only.
Calculation of cumulative risk may be required at sites where multiple contaminants with similar health effects are present.
Carcinogens: CHHSLS based on target cancer risk of 10-6. Cal/EPA cancer slope factors used when available.
Noncarcinogens: CHHSLS based on target hazard quotient of 1.0.
2. Soil Gas: Screening levels based on soil gas data collected <1.5 meters (five feet) below a building foundation or the ground surface. Intended for evaluation of potential vapor intrusion into buildings and subsequent impacts to indoor-air. Soil gas data should be collected and evaluated at all sites with significant areas of VOC-impacted soil. Screening levels also apply to sites that overlie plumes of VOC-impacted groundwater.
3. Calculation of a screening number for the chemical has been postponed (pp) until the toxicity criterion currently being developed by OEHHA is published as a final document.
4. Representative Screening Numbers for mixed xylenes. The representative value for mixed xylenes is based on the calculated lowest one amongst the three isomers.

(Page intentionally left blank)

Appendix 1: Human-Exposure-Based Screening Numbers Developed To Aid Estimation of Cleanup Costs for Contaminated Soil

OEHHA (November 2004)

(Revised January 2005)

(Page intentionally left blank)

APPENDIX 2: Comparison of CHHSLs to Existing Screening Levels and Standards

(Page intentionally left blank)

Comparison of CHHSLs to Existing Screening Levels and Standards

The U.S. Environmental Protection Agency Region IX office in San Francisco publishes "Preliminary Remediation Goals (PRGs)" for soil, drinking water and ambient air with a focus on risks to human health (USEPA 2004). The San Francisco Bay Area Regional Water Quality Control Board (SFBRWQCB) publishes Environmental Screening Levels (ESLs) for soil, groundwater, surface water and air that provide screening levels for other common environmental concerns as well (SFBRWQCB 2003).

Methods used by the USEPA and the SFBRWQCB to assess potential human exposure to contaminants in soil and air are very similar. The resulting screening levels are therefore almost identical. Similarities and differences between the CHHSLs and these suites of screening levels are summarized below. In addition, federal and state agencies publish screening levels or regulatory standards for hazardous waste that are sometimes confused with environmental screening levels. The applicability of these criteria to contaminated sites is also briefly described.

USEPA Region IX PRGs

The USEPA Region IX "Preliminary Remediation Goals" or "PRGs" address the direct exposure of residents and commercial workers to contaminants found in soil, drinking water and air (USEPA 2004). These PRGs may be found at http://www.epa.gov/region09/waste/sfund/prg/index.htm. Equations and assumptions used to develop the PRGs are consistent with the human health risk assessment guidance prepared by Cal/EPA, including the CalTOX model (Cal/EPA 1994a) and the *Preliminary Endangerment Assessment Guidance Manual* (Cal/EPA 1994b) and *Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities* (Cal/EPA 1996a).

The USEPA approach for developing the PRGs was adopted to develop the CHHSLs with minor modifications. The CHHSLs are an adjustment of soil and ambient air PRGs by using Cal/EPA-specific toxicity factors. For the majority of the chemicals listed, Cal/EPA toxicity factors are slightly more stringent or equal to those used by the USEPA to develop the PRGs. Some CHHSLs are significantly more restrictive.

A detailed discussion of the USEPA Region IX PRGs models is provided in Appendix 1. As discussed in the USEPA Region IX document, the PRGs are intended to address human direct-exposure with impacted soil and "...do not consider impact to groundwater or address ecological concerns" and cannot be used as a stand-alone tool for the evaluation of contaminated sites (USEPA 2004). The same is true for the CHHSLs.

USEPA Soil Screening Levels

The USEPA Office of Emergency and Remedial Response document *Soil Screening Guidance: Technical Background Document* presents methodologies and related soil screening levels for evaluation of direct-exposure concerns, leaching of contaminants from soil and subsequent impacts to groundwater, uptake of contaminants into plants and the intrusion of volatile chemicals into buildings (USEPA 1996). Although subsequent guidance documents on specific topics have since been prepared by USEPA and other agencies (USEPA PRGs, USEPA vapor intrusion guidance document, etc.), the Soil Screening Guidance nonetheless provides a valuable resource for evaluation of these environmental concerns.

Soil screening levels for direct exposure concerns are based on USEPA toxicity factors and similar exposure models used to develop the USEPA Region IX PRGs and the Cal/EPA CHHSLs. Screening levels are presented for specific pathways (e.g., ingestion, inhalation of outdoor air, etc.), rather than for combined exposure routes as now presented in the PRGs and the CHHSLs. Dermal absorption was not considered in calculation of the direct-exposure screening levels. This pathway was included in calculation of the PRGs and CHHSLs, however. The ultimate difference in screening levels is in most cases minimal.

Soil screening levels for leaching concerns are based on a simplistic contaminant equilibrium partitioning model. The model uses USEPA maximum contaminant levels (MCLs) for drinking water as target groundwater impact goals. Generic dilution factors of “1” and “20” are presented for mixing of leachate in groundwater and subsequent dilution of contaminant concentrations. The leaching based soil screening levels are presented in the USEPA Region IX PRG document.

The Soil Screening Guidance model does not take into account fate and transport of leachate in the vadose zone and can be excessively conservative for highly volatile or highly sorptive chemicals or for use at sites where groundwater is greater than ten meters or more below the base of contaminated soil. The document also presents leaching based screening levels for inorganic (contaminants, primarily metals). Leaching of metals from soil is highly dependent on the actual specifies of the metal present and site-specific soil factors. Laboratory-based studies are generally preferable over model-based approaches for evaluation of leaching of metals and other inorganic chemicals from soil.

The uptake of contaminants in edible plants is briefly discussed in the Soil Screening Guidance document. Screening levels are presented for a limited number of inorganic contaminants. The report concludes that uptake of contaminants into plants may be of particular concern for arsenic and cadmium. With the exception of these compounds, the report notes that inorganic contaminants in soil are likely to be toxic to the plants themselves at levels far lower than would be of concern for uptake and consumption of the plants by humans. (DTSC also considers the uptake of lead in edible plants. Refer to Table 1 of the main document).

A brief discussion of the Johnson and Ettinger model for vapor intrusion from contaminated soils into buildings is provided in the Soil Screening Guidance document. Soil screening levels for this concern are not presented, however, due to concerns that the soil model significantly overestimates potential impacts to indoor air. The document instead recommends that soil gas data be used to evaluate this concern, although screening levels are likewise not provided. Soil gas CHHSLs presented in Table 2 of this document reflect more up-to-date USEPA methods for evaluation of vapor intrusion concerns (see Appendix 1). The USEPA is currently developing additional guidance on this subject.

SFBRWQCB Environmental Screening Levels (ESLs)

The SFBRWQCB ESLs are a compilation of screening levels specific for use at sites overseen by that agency in the San Francisco bay area for a number of different environmental concerns, including risk to human health. The July 2003 edition (updated February 2004) of the SFBRWQCB ESLs includes screening levels for the following exposure pathways and/or environmental concerns:

Soil:

- Protection of human health
- Direct/indirect exposure to impacted soil (ingestion, dermal absorption, inhalation of vapors and dust in outdoor air);
- Emission of subsurface vapors to building interiors;
- Protection of groundwater quality (leaching of chemicals from soil);
- Protection of terrestrial (nonhuman) biota;
- Protection against nuisance concerns (odors, etc.) and general resource degradation;

Indoor Air:

- Protection of human health;

Shallow Soil Gas:

- Emission of subsurface vapors to building indoor air.

Similar ESLs are also provided for the environmental media of groundwater and surface water. In the ESL document, soil screening levels for individual environmental concerns are compared and the lowest of these levels (i.e., the concentration of the chemical at which all other environmental concerns would likewise be addressed) is presented in the ESL summary lookup tables.

By comparison, the CHHSLs reflect a subset of the screening levels considered in the ESL document specific to human health concerns. CHHSLs were developed for the follow concerns only:

Soil:

- Direct/indirect exposure to impacted soil (nonvolatile chemicals only - ingestion, dermal absorption, inhalation of vapors and dust in outdoor air);

Indoor Air:

- Protection of human health;

Shallow Soil Gas:

- Emission of subsurface vapors to building indoor air.

For comparative purposes, the most current ESLs may be found at http://www.waterboards.ca.gov/sanfranciscobay/esl.htm. The soil direct exposure CHHSLs and ESLs for nonvolatile chemicals and soil gas CHHSLs and ESLs for volatile chemicals are essentially identical. Soil and indoor air ESLs for human health concerns were developed by incorporating Cal/EPA toxicity factors into the USEPA PRG models for direct exposure to contaminated soil and USEPA models for the intrusion of soil gas into buildings. Since this mimics the approach used to develop the CHHSLs, the resulting screening levels are very similar.

The primary difference is the assumption in the ESL soil and indoor air screening levels for human health that up to five chemicals with similar noncancer health effects may be present at a given site. This allows potential cumulative health risks to be conservatively taken into account at most sites without requiring that the screening levels be adjusted on a site-by-site basis (see Section 2.8). This was done by simply dividing the initial screening level based on a hazard quotient of 1.0 by a factor of five (adjusting the target Hazard Quotient to 0.2). Future editions of the ESL document will directly incorporate the Cal/EPA CHHSLs for soil and indoor air as part of that document, again adjusted to address cumulative risk concerns at a Tier 1 level.

Hazardous Waste Regulations

California Total Threshold Limit Concentrations (TTLC) criteria for solids and Soluble Threshold Limit Concentration (STLC) are used to determine whether a waste is a hazardous waste (Title 22, California Code of Regulations, section 66261.24(a)(2)(A) and (B)). If a waste is determined to be a hazardous waste, specific regulations and statues regarding the management, storage, transportation and disposal must be met.

In most cases, TTLC values exceed the most conservative environmental screening levels presented in this document. In the case of Endrin and DDT/DDE/DDD, however, the TTLC is somewhat lower than the screening levels for human health concerns. The TTLC for combined DDT/DDE/DDD is 1.0 mg/kg while the residential, direct-exposure soil screening for each compound ranges from 1.6 mg/kg to 2.3 mg/kg, for a sum of 5.5 mg/kg (see Table 1).

In practice, the extent of soil contaminated above 1.0 mg/kg versus 5.5 mg/kg total DDT/DDE/DDD may not be significant in the field following cleanup to the risk-based CHHSLs. However, it may be prudent to use TTLCs as final cleanup values for residential sites where the TTLC is less than cleanup values that were based on actual risk to human health and the environment. This may help to avoid potential future problems with soil management and disposal.

TSCA Cleanup Levels for PCBs

The treatment, storage and disposal of polychlorinated biphenyls (PCBs) are regulated under the federal Toxics Substance Control Act (TSCA), as described in 40 CFR Part 761 (revised 7/1/99), which is administered by the USEPA Toxics Section. If PCBs are found at a site, the regulation should be consulted to determine its applicability and to ensure that the appropriate notifications are provided to and approvals are obtained from USEPA (refer also to *Guidance on remedial Actions for Superfund Sites with PCB Contamination,* USEPA 1990). To obtain more information regarding regulations and guidance, the USEPA's PCB web page can be accessed at: http://www.epa.gov/opptintr/pcb/

Within each USEPA Region, the Regional Administrator has designated Regional PCB Coordinators to oversee the development of PCB efforts. The staff of the Region IX PCB Program is available to members of the regulated community and others who have questions concerning the manufacture, processing, distribution in commerce, use, cleanup, storage and disposal of PCBs and PCB articles. The Region IX PCB web page can be accessed at:
http://www.epa.gov/region09/toxic/pcb/index.html

USEPA Region IX staff can be contacted at:

U.S. EPA Region 9
Mail Code CMD-4-2
75 Hawthorne Street
San Francisco, CA 94105

Max Weintraub	415-947-4163	weintraub.max@epa.gov
Christopher Rollins	415-947-4166	rollins.christopher@epa.gov

References

ASTM, 1995, *Standard Provisional Guide for Risk-Based Corrective Action*: American Society for Testing and Materials, Designation E2081-00.

Cal/EPA, 1994a, *CalTOX, A Multimedia Total Exposure Model For Hazardous-Waste Sites*: California Department of Environmental Protection, Department of Toxics Substances Control, Version 1.5 (and updates), www.dtsc.ca.gov/ScienceTechnology/index.html.

Cal/EPA, 1994b, *Preliminary Endangerment Assessment Guidance Manual*: California Department of Environmental Protection, Department of Toxics Substances Control, January 1994.

Cal/EPA, 1996a, *Supplemental Guidance For Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities*: California Department of Environmental Protection, Department of Toxics Substances Control, August, 1996, www.dtsc.ca.gov/ScienceTechnology/ index.html.

NIOSH, 2004, NIOSH Pocket Guide To Chemical Hazards: National Institute for Occupational Safety and Health (NIOSH), www.cdc.gov/niosh/npg/ npg.html.

SFBRWQCB, 2003, Screening For Environmental Concerns At Sites With Contaminated Soil and Groundwater (July 2003): California Regional Water Quality Control Board, San Francisco Bay Region, http://www.swrcb.ca.gov/rwqcb2/esl.htm.

USEPA, 1990, *Guidance on remedial Actions for Superfund Sites with PCB Contamination*: U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Publication EPA/540/G-90/007.

USEPA, 2004, *Preliminary Remediation Goals*: U.S. Environmental Protection Agency, Region IX, October 2004, www.epa.gov/region09/waste/sfund/prg/index.htm.

This Page

Intentionally

Left Blank

Regional Screening Levels (Formerly PRGs)

Screening Levels for Chemical Contaminants

The Region 9 PRGs have been harmonized with similar risk-based screening levels used by Regions 3 and 6 into a single table: "Regional Screening Levels (RSL) for Chemical Contaminants at Superfund Sites." These updated screening levels, along with a detailed user's guide and supplementary tables, can be accessed directly on-line or downloaded to your own computer. In addition, the web site contains a Screening Level Calculator to assist in calculating site-specific screening levels.

Region 9-specific information regarding the Regional Screening Level Table »

Regional Screening Level Resources

- What's New
- Frequently Asked Questions
- Screening Level Calculator
- User's Guide
- Online Screen Level Calculator
- PRG (RSL) Contact Information
- Region 9-Specific Information

RSL Tables (Last updated May 2012)

The screening level (RSL) tables are available for download in Excel and PDF formats. These tables are considered ready for use. The tables contain both RSL calculations and the toxicity values that were used. For additional information please see the resources box at the the upper-right of this page.

	PDF (Color)	PDF (B+W)	Excel (Color)	Excel (B+W)
Summary Table	(PDF) (12 pp, 177K)	(PDF) (12 pp, 173K)	XLS	XLS
Residental Soil Supporting	(PDF) (12 pp, 175)	(PDF) (12 pp, 171K)	XLS	XLS
Industrial Soil Supporting	(PDF) (12 pp, 174K)	(PDF) (12 pp, 170K)	XLS	XLS
Residental Air Supporting	(PDF) (10 pp, 142K)	(PDF) (10 pp, 138K)	XLS	XLS
Industrial Air Supporting	(PDF) (10 pp, 143K)	(PDF) (10 pp, 137K)	XLS	XLS
Residental Tapwaters Supporting	(PDF) (12 pp, 169K)	(PDF) (12 pp, 164K)	XLS	XLS
Residental Soil to Groundwater Supporting	(PDF) (12 pp, 174K)	(PDF) (12 pp, 168K)	XLS	XLS
Chemical Specific Parameters	(PDF) (12 pp, 157K)	(PDF) (12 pp, 154K)	XLS	XLS
Composite Table	(PDF) (92 pp, 776K)	(PDF) (92 pp, 755K)	XLS	XLS

You will need the free Adobe Reader to view some of the files on this page.
See EPA's PDF page to learn more.

NOTE: The 2004 version of the Region 9 PRG Table will remain at this web site in case users need to reference this historical document. However, the 2004 Table should no longer be used for contaminant screening of environmental media because it has been replaced with the more current Table above.

Region 9 PRGs 2004 Table (PDF) (16pp, 962 K)

User's Guide/Technical Background Document (PDF) (29pp, 284 K)