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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region IX

IN THE MATTER OF:	)	
	)	
Aerojet Rancho Cordova Superfund Site Operable Unit 5	)	U.S. EPA Docket No. 9-2011-16
	)	
Aerojet General Corporation and Cordova Chemical Company	)	UNILATERAL ADMINISTRATIVE ORDER FOR THE PERFORMANCE OF REMEDIAL DESIGN AND INTERIM REMEDIAL ACTION FOR GROUNDWATER
RESPONDENTS	)	
	)	
Proceeding under Section 106(a) of the Comprehensive Environmental Response, Compensation and Liability Act of 1980, 42 U.S.C. § 9606(a) and Section 7003 of the Solid Waste Disposal Act, 42 U.S.C. § 6973	)	
	)	

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Attachment 1 – Interim Record of Decision for Groundwater and Final Record of Decision for Soil for the Perimeter Groundwater Operable Unit OU-5

Attachment 2 -- Statement of Work

I. INTRODUCTION AND JURISDICTION

1. This Order directs Respondents, Aerojet General Corporation ("Aerojet") and Cordova Chemical Company ("Respondents") to perform a remedial design for the interim groundwater remedy described in the Interim Record of Decision for Groundwater and Final Record of Decision for Soil for the Perimeter Groundwater Operable Unit No.5 ("Site"), Aerojet General Corporation Superfund Site, Rancho Cordova, California, dated February 15, 2011, and to implement the design by performing an interim groundwater remedial action. See Attachment 1.

2. This Order is issued to Respondents by the United States Environmental Protection Agency ("EPA") under the authority vested in the President of the United States by Section 106(a) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended ("CERCLA"), 42 U.S.C. § 9606(a). This authority was delegated to the Administrator of EPA on January 23, 1987, by Executive Order 12580 (52 Fed. Reg. 2926, January 29, 1987), and was further delegated to EPA Regional Administrators on September 13, 1987 by EPA Delegation No. 14-14-B. This authority has been duly redelegated to the Branch Chief (now titled, Assistant Director), Superfund Division, EPA Region IX, by Order R9 1290.14A (Nov. 16, 2001).

3. This Order is also issued under the authority vested in the Administrator of EPA by Section 7003 of the Solid Waste Disposal Act, 42 U.S.C. § 6973, commonly referred to as the Resource Conservation and Recovery Act of 1976 (RCRA), as amended by the Hazardous and Solid Waste Amendments of 1984, 42 U.S.C. §§ 6901 *et seq.* which authority has been duly delegated to the Regional Administrator of EPA Region 9, and further delegated to the Director of the Superfund Division by Order R9 1280.20 (April 6, 1998).

II. FINDINGS OF FACT

4. The Aerojet facility is a 8,500 acre former rocket manufacturing operation located outside of Sacramento in Rancho Cordova, California. Aerojet has owned and operated the facility since 1953. Aerojet operations on the facility have included manufacturing liquid and solid propellants for rocket engines for military and commercial applications and formulating a number of chemicals, including rocket propellant agents, agricultural pesticides, pharmaceuticals, and other industrial chemicals.

5. Cordova Chemical, a subsidiary of Aerojet, operated chemical manufacturing facilities on the Aerojet facility from 1974 to 1979.

6. Chemicals used by Respondents in the manufacturing and testing areas on the Aerojet facility have included chlorinated solvents, propellants, metals, oxidizers, and a variety of chemicals produced in the chemical operations areas. Historical operations and waste practices by Respondents on the Aerojet facility, e.g., surface impoundments, landfills, deep

injection wells, leachate fields, open burn areas, have resulted in the discharge of these chemicals to the vadose zone and the underlying groundwater. Although numerous types of chemicals have been used historically by Respondents, trichloroethylene (TCE), perchlorate and N-Nitrosodimethylamine (NDMA) comprise the primary chemicals of concern. TCE was utilized for cleaning and degreasing purposes. Perchlorate was combined with a cation, generally ammonium or potassium, and utilized as an oxidizer in solid rocket propellants. NDMA is a semi-volatile organic compound (SVOC) that was either an impurity in hydrazine-based liquid rocket fuels or was formed as a combustion product of these fuels. Other chemicals of concern include breakdown products and contaminants of TCE and other solvents like carbon tetrachloride, tetrachloroethene (PCE), 1,1-dichloroethene (1,1DCE), 1,2-dichloroethene (1,2-DCE), vinyl chloride, 1,1,2trichloroethane (1,1,2-TCA), 1,2-dichloroethane (1,2-DCA) and 1,1-dichloroethane (1,1-DCA). 1,4-Dioxane, freon, chloroform, nitrate and nitrite are also chemicals of concern.

7. The aquifer beneath the Aerojet facility and the Rancho Cordova area is part of the San Joaquin groundwater basin. The San Joaquin groundwater basin provides drinking water to over a million residents in Sacramento County and nearby areas. Given the absence of dependable alternatives to the aquifer as the region's primary water supply, the groundwater is expected to remain as the residents' primary source of drinking water indefinitely. Numerous water supply wells draw water directly from the aquifer, including the portion of the aquifer that has been contaminated above drinking water standards by Respondents.

8. The Aerojet facility was placed on the National Priorities List on August 8, 1983.

9. Between 1983 and 1987, Aerojet installed five groundwater extraction and treatment (GET) systems, primarily to prevent further migration of the groundwater plume off the Aerojet facility.

10. On January 15, 1986, the United States of America, on behalf of the Administrator of EPA, filed a complaint against Respondents pursuant to Sections 106 and 107 of CERCLA, 42 U.S.C. §§ 9606, 9607, seeking, inter alia: (1) reimbursement of costs, together with interest, incurred by EPA and the United States Department of Justice for response actions at the Aerojet Superfund Site; and (2) an injunction requiring Respondents to abate and remedy the imminent and substantial endangerment to public health or welfare or the environment presented by the Aerojet Superfund Site and the effects of actual or threatened releases of hazardous substances, solid and hazardous wastes, contaminants and pollutants from the Aerojet Superfund Site.

11. The State of California ("State") also filed a complaint against Respondents in federal court under Section 107 of CERCLA, 42 U.S.C. § 9607, as well as an earlier action in the Superior Court of California, County of Sacramento, seeking injunctive relief, abatement and other equitable relief.

12. On June 23, 1989, the United States, the State, and Respondents entered into a partial settlement (hereinafter "Partial Consent Decree") to settle some of the claims relating to payment of certain costs and implementation of a Remedial Investigation/Feasibility Study ("RI/FS") for the Aerojet Superfund Site.

13. The Partial Consent Decree obligates Aerojet to perform a site-wide RI/FS at the Aerojet Superfund Site and to take interim measures for protection of water supply wells. The interim measures taken by Aerojet pursuant to the Partial Consent Decree included sampling of water supply wells and the preparation of an Alternative Water Supply Contingency Plan.

14. In addition to the interim measures, the operation, maintenance and evaluation of the effectiveness of the existing GET systems were also incorporated in the Partial Consent Decree. The evaluation of the existing GET systems under the Partial Consent Decree revealed that the existing GETS were not fully effective in containing the groundwater contamination, and the groundwater plume continued to migrate off the Aerojet facility.

15. In 1997, using an improved detection method, perchlorate was detected in monitoring wells and in nine water supply wells off the Aerojet facility. Perchlorate is a hazardous substance that can cause a number of adverse effects on animals and humans, including neurological effects on a developing human embryo. NDMA, a potential animal and human carcinogen, was also discovered in some water supply wells.

16. To address the extensive groundwater contamination on and off the Aerojet facility, the State issued several cleanup and abatement orders to Aerojet pursuant to its authority. In 1995, the California Department of Toxic Substances and Control (DTSC) issued an order to Aerojet, requiring soil and groundwater cleanup at the Inactive Rancho Cordova Test Site (IRCTS), a part of the Aerojet Superfund Site. To address the contamination on the north side of the Aerojet facility, in 1996, the Central Valley Regional Water Quality Control Board ("Water Board") issued an order to Aerojet, requiring groundwater control and remediation of groundwater contamination not remediated by GET D. In the same year, the Water Board issued an order to Aerojet requiring abatement and remediation of perchlorate that has migrated off the Aerojet facility. From 1997 through 2001, the Water Board issued two more cleanup and abatement orders to Aerojet.

17. On July 29, 1998, the Partial Consent Decree was modified to add perchlorate to the list of contaminants that Aerojet has to monitor pursuant to the interim measures for protection of water supply wells. The modification also lowered the detection level for NDMA.

18. To accelerate RI/FS work and to allow early implementation of response actions pursuant to CERCLA, EPA and the State determined that it was necessary to divide the Aerojet Superfund Site into Operable Units (OUs). Thus, on April 15, 2002, the Partial Consent Decree was modified again, dividing the Aerojet Superfund Site into operable units.

19. The April 2002 modification of the Partial Consent Decree also clarified that surface soils of approximately 2,600 acres of land had never been contaminated and were not part of the Aerojet Superfund Site. The contaminated groundwater underlying these lands, however, remains part of the Aerojet Superfund Site.

20. Due to the impact of contaminated groundwater on public drinking water supplies, EPA and the State have concluded that the best cleanup strategy for the Aerojet Superfund Site is to give priority to containing and remediating the contaminated groundwater which is migrating off the Aerojet facility. The containment and remediation of contaminated groundwater off the Aerojet facility was divided into two OUs. The first OU, that was the subject of a 2002 Unilateral Administrative Order, was the Western Groundwater OU (also referred to as OU-3). Western Groundwater OU addresses the contamination of drinking water supplies in the most populated areas. As the completion of the final OU-3 GET approaches, USEPA, the State, and Aerojet have begun initial activities to evaluate the effectiveness of the outer barrier and inner barrier containment systems in OU-3.

21. The second OU, which is the subject of this Order, is the Perimeter Groundwater OU (also referred to as OU-5) which will address containment of the remaining contaminated groundwater off the Aerojet facility as well as remediation of contaminated soils located within OU-5. The remedial action for OU-5 groundwater addresses contaminated groundwater on the north and south sides of the Site and addresses contamination in surface and subsurface soil in one section of the Aerojet property. Implementation of the remedial action for OU-5, in conjunction with the existing remedy for the Western Groundwater Operable Unit (OU-3) to the west and other state enforcement actions to the south will complete the containment of groundwater contamination around the boundary of the Site. The containment provided by Groundwater Extraction and Treatment Systems (GETs) will prevent the loss of additional drinking water supplies in a populated area dependent on groundwater supplies.

22. The decision by EPA on the remedial action to be implemented for OU-5 is embodied in a Record of Decision, executed on February 15, 2011, on which the State has given its concurrence. The Record of Decision is attached to this Order as Attachment 1 and is incorporated by reference. The Record of Decision is supported by an administrative record that contains the documents and information upon which EPA based the selection of the response action.

23. The remedy selected in the attached Record of Decision will contain the migration of groundwater contamination at the leading edge of the groundwater contaminant plumes and remove additional contaminant mass from highly contaminated groundwater near the Aerojet facility boundary. The selected remedy will therefore reduce exposure to contaminated groundwater by limiting the spread of the contamination and by reducing the contaminant concentrations in the aquifer. This action is an interim remedy for the containment of contaminated groundwater areas in OU-5, and does not set numeric cleanup goals for the groundwater in the aquifer at this time. Groundwater restoration in OU-5 is dependent on control of source areas in other OUs still in the Remedial Investigation/ Feasibility Study

(RI/FS) phase. Remediation of the source areas within the Site including contaminated soil on the Aerojet facility and the groundwater beneath these soils will be addressed in subsequent OUs. Due to the size of the Aerojet facility, EPA anticipates that there will be at least 9 operable units. The remedy also addresses contaminated soils within OU-5, but remediation of soil contamination on OU-5 will be addressed in a separate Order.

24. The RI/FS Report and Proposed Plan for OU-5 were made available to the public on July 31, 2009. These documents can be found in the Administrative Record file of the information repositories maintained at the USEPA Region 9 Superfund Records Center at 95 Hawthorne St. in San Francisco and at the California State University Sacramento Library Reference Desk, 2000 State University Drive East Sacramento, CA. Pursuant to Section 117 of CERCLA, 42 U.S.C. § 9617, the notice of availability of the RI/FS, proposed plan, date and location for the public meeting and public comment period (August 3, 2009 through September 1, 2009, which was later extended to October 1, 2009 on request from community members) was published the week prior to the start of the public comment period in the Sacramento Bee newspaper and sent to the Aerojet mailing list. The public meeting was held August 11, 2009.

25. The regional aquifer is extremely large and extends beyond the city of Sacramento, over 15 miles to the west. Much of the aquifer in OU-5 off Aerojet property is currently used for drinking water (Federal Groundwater Classification IIA) and demand on the aquifer is growing. The need for water around the Site is expected to increase over the next 20 years as it is developed. The contamination, if not contained, will continue to flow off the property degrading more of the drinking water aquifer. The three most prevalent contaminants detected in the groundwater are perchlorate, NDMA and TCE.

26. Groundwater in the area is designated for municipal use as a drinking water source in accordance with the Central Valley Regional Water Quality Control Board Basin Plan for the Sacramento and San Joaquin River Basins. Public water supply wells around the Aerojet Site are closely monitored, and public water supplies are obtained from uncontaminated sources. None of the monitoring and extraction wells on Aerojet's property are used for potable water. The general groundwater flow direction varies at the Aerojet Site and is grouped into four main zones based on flow direction: Zone 1 to the northwest; Zone 2 to the west and southwest; Zone 3 to the south; and Zone 4 to the north-northwest. The cancer risk for all four zones exceeds EPA's target risk range of 10^{-4} to 10^{-6}.

27. The selected interim groundwater remedy will reduce human health risk by limiting the spread of highly contaminated groundwater into clean and less contaminated portions of the aquifer, reducing the likelihood and magnitude of human exposure to contaminated groundwater. The mass removal aspect of the remedy targets highly contaminated groundwater in the portions of OU-5 nearer the contaminant sources on Aerojet property. Exposure to contaminated groundwater through drinking water supplies is the area of potential risk addressed by the interim groundwater remedy. The selected remedy will contain the off-property contamination in all four OU-5 groundwater Zones and treat the water to discharge standards meeting the substantive requirements of a National Pollution Discharge

Elimination System (NPDES) permit and all applicable standards for off-Site reuse or disposal. Exposure levels will be within the acceptable risk range of 10^{-4} to 10^{-6} for carcinogenic risk and below the Hazard Index of 1 for non-carcinogens.

28. The land to the north of Aerojet's property has multiple uses including residential, recreational, office, commercial and industrial. The land to the south of Aerojet's property is used for recreation, ranching, agriculture and mining and is also undergoing planning for a mixed use development. The Aerojet Superfund Site is designated as a Special Planning Zone (SPZ) with multiple uses from propulsion systems testing to office use. The SPZ has a provision for future development under the Sacramento County Land Use Master Plan which would allow for residential use.

III. CONCLUSIONS OF LAW AND DETERMINATIONS

29. The Perimeter Groundwater Operable Unit, OU-5, at the Aerojet Superfund Site is a "facility" as defined in Section 101(9) of CERCLA, 42 U.S.C. § 9601(9).

30. Respondent, Aerojet, is a "person" as defined in Section 101(21) of CERCLA, 42 U.S.C. § 9601(2), and as defined in Section 1004(15) of RCRA, 42 U.S.C. § 6903(15).

31. Aerojet, the current owner and operator of the facility and the owner and operator of the facility at the time of disposal of hazardous substances, is "liable" within the meaning of Section 107(a)(1) and (2) of CERCLA, 42 U.S.C. § 9607(a)(1) & (2), and is subject to this Order under Section 106(a) of CERCLA, 42 U.S.C. § 9606(a).

32. Respondent, Cordova Chemical Company, is a "person" as defined in Section 101(21) of CERCLA, 42 U.S.C. § 9601(2), and as defined in Section 1004(15) of RCRA, 42 U.S.C. § 6903(15).

33. Respondent Cordova Chemical Company, a subsidiary of Aerojet, operated chemical manufacturing facilities on the Aerojet facility from 1974 to 1979 at the time of disposal of hazardous substances, and is "liable" within the meaning of Section 107(a) (2) of CERCLA, 42 U.S.C. § 9607(a)(2), and is subject to this Order under Section 106(a) of CERCLA, 42 U.S.C. § 9606(a).

34. The substances listed in Paragraph 6 are found at the Site and are "hazardous substances" as defined in Section 101(14) of CERCLA, 42 U.S.C. § 9601(14) and are solid wastes or hazardous wastes as defined by Section1004 of RCRA, 42 U.S.C. §§ 6903(27) & 6903(5).

35. The hazardous substances have been and continue to be released from the Site into the groundwater and soil.

36. The past disposal and current migration of hazardous substances from the Site are a "release" as defined in Section 101(22) of CERCLA, 42 U.S.C. § 9601(22).

37. The potential for future migration of hazardous substances from the Site poses a threat of a "release" as defined in Section 101(22) of CERCLA, 42 U.S.C. § 9601(22).

38. The release and threat of release of one or more hazardous substances from the facility may present an imminent and substantial endangerment to the public health or welfare or the environment.

39. Respondents' past or present handling, storage, treatment, transportation or disposal of "solid wastes" as defined by Section 1004(27) of RCRA, 42 U.S.C. § 6903(27), and 40 C.F.R. §261.2, have contributed and are contributing to a condition which may present an imminent and substantial endangerment to health or the environment under Section 7003 of RCRA, 42 U.S.C. §6973.

40. The composition of the materials in the facility's soils and groundwater are "solid wastes" or "hazardous wastes" as defined by Sections 1004(5) and 1004(27) of RCRA, 42 U.S.C. §§ 6903(5) & 6903(27), which may present an imminent and substantial endangerment to health or the environment under Section 7003 of RCRA, 42 U.S.C. § 6973.

41. Respondents are "liable parties" as defined in Section 107(a) of CERCLA, 42 U.S.C. § 9607(a), and are subject to this Order under Section 106(a) of CERCLA, 42 U.S.C. § 9606(a).

42. Respondents are jointly and severally liable under Section 7003 of RCRA, 42 U.S.C. § 6973, because they contributed and are contributing to the handling, storage, treatment, transportation or disposal of solid waste at the Aerojet Rancho Cordova facility.

43. Respondents are liable under Section 7003 of RCRA, 42 U.S.C. § 6973, to take all necessary action with respect to the release of hazardous wastes and/or solid wastes from the facility to underlying and adjacent soil and groundwater, in order to abate such imminent and substantial endangerment.

44. The contamination and endangerment at this Site constitute an indivisible injury. The actions required by this Order are necessary to protect the public health, welfare, and the environment.

45. Based on the foregoing FINDINGS OF FACT AND CONCLUSIONS OF LAW, on the administrative record, and upon evidence and information that the past or present handling, storage, treatment, transportation or disposal of solid or hazardous waste and the release of hazardous substances by Respondents at the Aerojet Rancho Cordova facility may present an imminent and substantial endangerment to health or the environment, the Director of

the Superfund Division of EPA, Region IX, has determined that issuance of this Order is necessary to protect public health and the environment.

IV. NOTICE TO THE STATE

46. On September 1, 2011, prior to issuing this Order, EPA notified the State of California that EPA would be issuing this Order.

V. ORDER

47. Based on the foregoing, Respondents are hereby ordered, jointly and severally, to comply with the following provisions, including but not limited to all attachments to this Order, all documents incorporated by reference into this Order, and all schedules and deadlines in this Order, attached to this Order, or incorporated by reference into this Order:

VI. DEFINITIONS

48. Unless otherwise expressly provided herein, terms used in this Order which are defined in CERCLA or in regulations promulgated under CERCLA shall have the meaning assigned to them in the statute or its implementing regulations. Whenever terms listed below are used in this Order or in the documents attached to this Order or incorporated by reference into this Order, the following definitions shall apply:

a. "CERCLA" shall mean the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, 42 U.S.C. §§ 9601 *et seq.*

b. "Day" shall mean a calendar day unless expressly stated to be a working day. "Working day" shall mean a day other than a Saturday, Sunday, or Federal holiday. In computing any period of time under this Order, where the last day would fall on a Saturday, Sunday, or Federal holiday, the period shall run until the end of the next working day.

c. "Disposal" shall mean "the discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous waste into or on any land or water so that such solid waste or hazardous waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including ground waters." 42 U.S.C. § 6903(3).

d. "Effective Date" shall mean the date specified in Section XXVIII of this Order.

e. "EPA" shall mean the United States Environmental Protection Agency.

f. "Hazardous Waste" shall mean a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may-

(A) cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or
(B) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed. 42 U.S.C. § 6903(5).

g. "Institutional Controls" or "ICs" shall mean: (1) easements or covenants running with the land that (a) limit land, water, or resource use and/or provide access rights and (b) are created pursuant to common law or statutory law by an instrument that is recorded by the owner in the appropriate land records office; and (2) state or local laws, regulations, ordinances, zoning restrictions, or other governmental controls or notices that: (a) limit land, water, and/or resource use to minimize the potential for human exposure to hazardous substances at or in connection with the Site; (b) limit land, water, and/or resource use to implement, ensure non-interference with, or ensure the protectiveness of the Remedial Action; and/or (c) provide information intended to modify or guide human behavior at or in connection with the Site.

h. "National Contingency Plan" or "NCP" shall mean the National Contingency Plan promulgated pursuant to Section 105 of CERCLA, 42 U.S.C. § 9605, codified at 40 C.F.R. Part 300, including any amendments thereto.

i. "Operation and Maintenance" or "O&M" shall mean all activities required under the Operation and Maintenance Plan developed by Respondents pursuant to this Order and Section V(G)1 of the Statement of Work, Attachment 2, and approved by EPA.

j. "Paragraph" shall mean a portion of this Order identified by an Arabic numeral.

k. "Performance Standards" shall mean those cleanup standards, standards of control, and other substantive requirements, criteria or limitations, identified in the Record of Decision and Statement of Work, that the Remedial Action and Work required by this Order must attain and maintain.

l. "Record of Decision" or "ROD" shall mean the EPA Record of Decision relating to the Site, Operable Unit 5, signed on February 15, 2011 by the Assistant Director of the Superfund Division, EPA Region IX, and all attachments thereto.

m. "Remedial Action" or "RA" shall mean those activities, except for Operation and Maintenance, to be undertaken by Respondents to implement the final plans and specifications submitted by Respondents pursuant to the Remedial Design Work Plan approved by EPA, including any additional activities required under Sections X, XI, XII, XIII, and XIV of this Order.

n. "Remedial Design" or "RD" shall mean those activities to be undertaken by Respondents to develop the final plans and specifications for the Remedial Action pursuant to the Remedial Design Work Plan.

o. "Response Costs" shall mean all costs, including direct costs, indirect costs, and accrued interest incurred by the United States to perform or support response actions at the Site. Response costs include but are not limited to the costs of overseeing the Work, such as the costs of reviewing or developing plans, reports and other items pursuant to this Order and costs associated with verifying the Work.

p. "Section" shall mean a portion of this Order identified by a roman numeral and includes one or more paragraphs.

q. "Site" shall mean the Perimeter Groundwater Operable Unit of the Aerojet Superfund Site, encompassing approximately 4,800 acres, located at and near the city of Rancho Cordova, Sacramento County, California, as described in the Record of Decision.

r. "Solid Waste" shall mean "any garbage, refuse . . . and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations . . . ." 42 U.S.C. § 6903(27).

s. "State" shall mean the State of California, including the Central Valley Regional Water Quality Control Board and the Department of Toxic Substances Control.

t. "Statement of Work" or "SOW" shall mean the statement of work for implementation of the Remedial Design, Remedial Action, and Operation and Maintenance at the Site, as set forth in Attachment 2 to this Order. The Statement of Work is incorporated into this Order and is an enforceable part of this Order.

u. "Transfer" shall mean to sell, assign, convey, lease, mortgage, or grant a security interest in, or where used as a noun, a sale, assignment, conveyance, or other disposition of any interest by operation of law or otherwise.

v. "United States" shall mean the United States of America.

w. "Work" shall mean all activities Respondents are required to perform under this Order to implement the interim ROD for groundwater for the Perimeter Groundwater Operable Unit, also known as OU-5, including Remedial Design, Remedial Action and Operation and Maintenance for OU-5 and any activities required to be undertaken pursuant to this Order.

VII. NOTICE OF INTENT TO COMPLY

49. Respondents shall provide by September 26, 2011 written notice to EPA's Remedial Project Manager (RPM) stating whether they will comply with the terms of this Order. If Respondents do not unequivocally commit to perform the RD and RA as provided by this Order, they shall be deemed to have violated this Order and to have failed or refused to comply with this Order. Respondents' written notice shall describe, using facts that exist on or prior to the Effective Date of this Order, any "sufficient cause" defenses asserted by Respondents under Sections 106(b) and 107(c)(3) of CERCLA. The absence of a response by EPA to the notice required by this Paragraph shall not be deemed to be acceptance of Respondents' assertions.

VIII. PARTIES BOUND

50. This Order shall apply to and be binding upon each Respondent identified in Paragraph 1 of this Order, its directors, officers, employees, agents, successors, and assigns. Respondents are jointly and severally responsible for carrying out all activities required by this Order. No change in the ownership, corporate status, or other control of any Respondents shall alter any of the Respondents' responsibilities under this Order.

51. Respondents shall, at least 60 days prior to any Transfer of any real property located at the Site, give written notice: (a) to the transferee regarding the Order and any Institutional Controls regarding the real property; and (b) to EPA and the State regarding the proposed Transfer, including providing a true and correct copy of the transfer document(s), the name, principal business address of the transferee, the effective date of the transfer, and the date on which the transferee was notified of the Order and any Institutional Controls.

52. Respondents may Transfer any real property located at the Site only if: (1) any Institutional Controls required by Paragraph 101 have been recorded with respect to the real property; or (2) Respondents have obtained an agreement from the transferee, enforceable by Respondents and the United States, to (i) allow access and restrict land/water use, pursuant to Paragraphs 102.a and 102.b, (ii) record any Institutional Controls on the real property, pursuant to Paragraph 102.c, and (iii) subordinate their rights to any such Institutional Controls, pursuant to Paragraph 102.c, and EPA has approved the agreement in writing. If, after a Transfer of the real property, the transferee fails to comply with the agreement provided for in this Paragraph 52, Respondents shall take all reasonable steps to obtain the transferee's compliance with such agreement. The United States may seek the transferee's compliance with the agreement and/or assist Respondents in obtaining compliance with the agreement. Respondents shall reimburse the United States under Section XXIV (Reimbursement of Response Costs), for all costs incurred, direct or indirect, by the United States regarding obtaining compliance with such agreement, including, but not limited to, the cost of attorney time.

53. Respondents shall provide a copy of this Order to any prospective owners or successors before a controlling interest in Respondents' assets, property rights, or stock are

transferred to the prospective owner or successor. Respondents shall provide a copy of this Order to each contractor, sub-contractor, laboratory, or consultant retained to perform any Work under this Order, within five days after the Effective Date of this Order or on the date such services are retained, whichever date occurs later. Respondents shall also provide a copy of this Order to each person representing any Respondents with respect to the Site or the Work and shall condition all contracts and subcontracts entered into hereunder upon performance of the Work in conformity with the terms of this Order. With regard to the activities undertaken pursuant to this Order, each contractor and subcontractor shall be deemed to be related by contract to the Respondents within the meaning of Section 107(b)(3) of CERCLA, 42 U.S.C. § 9607(b)(3). Notwithstanding the terms of any contract, Respondents are responsible for compliance with this Order and for ensuring that their contractors, subcontractors and agents comply with this Order, and perform any Work in accordance with this Order.

54. In the event of any Transfer of real property located at the Site, unless the United States otherwise consents in writing, Respondents shall continue to comply with their obligations under the Order, including, but not limited to, their obligation to provide and/or secure access, to implement, maintain, monitor, and report on Institutional Controls, and to abide by such Institutional Controls.

IX. WORK TO BE PERFORMED

55. Respondents shall cooperate with EPA in providing information regarding the Work to the public. As requested by EPA, Respondents shall participate in the preparation of such information for distribution to the public and in public meetings which may be held or sponsored by EPA to explain activities at or relating to the Site.

56. All aspects of the Work to be performed by Respondents pursuant to this Order shall be under the direction and supervision of a qualified project manager, the selection of which shall be subject to approval by EPA. Within ten (10) days after the Effective Date of this Order, Respondents shall notify EPA in writing of the name and qualifications of the project manager, including primary support entities and staff, proposed to be used in carrying out work under this Order. With respect to any proposed project manager, Respondents shall demonstrate that the proposed project manager has a quality system that complies with ANSI/ASQC E4-1994, "Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs," (American National Standard, January 5, 1995), by submitting a copy of the proposed project manager's Quality Management Plan (QMP). The QMP should be prepared in accordance with the specifications set forth in "EPA Requirements for Quality Management Plans (QA/R-5)," (EPA/240/B-01/003 March 2001), Guidance for Quality Assurance Project Plans (G-5), December 2002, EPA/240/R-02/009 or equivalent documentation as determined by EPA. If at any time Respondents propose to use a different project manager, Respondents shall notify EPA and shall obtain approval from EPA before the new project manager performs any work under this Order.

57. EPA will review Respondents' selection of a project manager according to the terms of this Paragraph and Section XIV of this Order. If EPA disapproves of the selection of the project manager, Respondents shall submit to EPA within thirty (30) days after receipt of EPA's disapproval of the project manager previously selected, a list of project managers, including primary support entities and staff, who would be acceptable to Respondents. EPA will thereafter provide written notice to Respondents of the names of the project managers that are acceptable to EPA. Respondents may then select any approved project manager from that list and shall notify EPA of the name of the project manager selected within twenty-one (21) days of EPA's designation of approved project managers.

A. Remedial Design

58. Within thirty (30) days after Respondents select an approved project manager, Respondents shall submit a work plan for the Remedial Design at the Site ("Project Work Plan") to EPA for review and approval. The Project Work Plan shall be developed in accordance with the ROD and Section V(C) and Attachment E of the attached SOW. Respondents shall also, within thirty (30) days after Respondents select an approved project manager, prepare and submit to EPA for review, a Site Health and Safety Plan for field design activities. The Site Health and Safety Plan shall conform to the applicable Occupational Safety and Health Administration and EPA requirements, including but not limited to 54 Fed. Reg. 9294 (Mar. 6, 1989).

59. The Project Work Plan shall be consistent with, and shall provide for implementing the SOW, and shall comport with EPA's "Superfund Remedial Design and Remedial Action Guidance, OSWER Directive 9355.0-4A" Upon approval by EPA, the Project Work Plan is incorporated into this Order as a requirement of this Order and shall be an enforceable part of this Order.

60. Upon approval of the Project Work Plan by EPA, Respondents shall implement the Project Work Plan according to the schedule in the approved Project Work Plan. Any violation of the approved Project Work Plan shall be a violation of this Order. Unless otherwise directed by EPA, Respondents shall not perform further Work at the OU-5 groundwater remedial action prior to EPA's written approval of the Project Work Plan.

61. Within ninety (90) days after EPA approves the Project Work Plan, Respondents shall submit a Preliminary Design prepared in accordance with ROD and Section V(D) of the attached SOW to EPA for review and approval.

62. Within ninety (90) days after EPA approves the Preliminary Design, Respondents shall submit an Intermediate Design to EPA. The Intermediate Design submittal shall continue and expand on the contents of the Preliminary Design.

63. Within thirty (30) days after EPA approves the Intermediate Design, Respondents shall submit a Final Design prepared in accordance with the ROD and Section V(D) of the attached SOW to EPA for review and approval. The Intermediate RD shall serve as the Final RD if the Agencies have no further comments and EPA provides its approval.

64. Upon EPA approval, the Final Design is incorporated into this Order as a requirement of this Order and shall be an enforceable part of this Order.

B. Remedial Action

65. Not later than thirty (30) days after EPA approves all deliverables required as part of the Final Design, Respondents shall submit a Remedial Action Work Plan (RA Work Plan) to EPA for review and approval. The RA Work Plan shall be developed in accordance with the ROD, and Section V(E) of the attached SOW, and shall be consistent with the Final Design as approved by EPA. Respondents shall also submit to EPA for review, not later than thirty (30) days after EPA approves all deliverables required as part of the Final Design, a Health and Safety Plan for field activities required by the RA Work Plan. The Health and Safety Plan for field activities shall conform to applicable Occupational Safety and Health Administration and EPA requirements, including but not limited to the regulations at 54 Fed. Reg. 9294 (Mar. 6, 1989).

66. Upon approval by EPA, the RA Work Plan is incorporated into this Order as a requirement of this Order and shall be an enforceable part of this Order.

67. Upon approval of the RA Work Plan by EPA, Respondents shall implement the RA Work Plan according to the schedules in the RA Work Plan. Unless otherwise directed by EPA, Respondents shall not commence remedial action on any OU-5 groundwater zone prior to approval of the RA Work Plan for that zone.

68. If Respondents seek to retain a construction contractor to assist in the performance of the Remedial Action, then Respondents shall submit a copy of the contractor solicitation documents to EPA not later than five (5) days after publishing the solicitation documents.

69. Within ten (10) days after EPA approves the RA Work Plan Respondents shall notify EPA in writing of the name, title, and qualifications of any construction contractor proposed to be used in carrying out work under this Order. With respect to any proposed construction contractor, Respondents shall demonstrate that the proposed construction contractor has a quality system that complies with ANSI/ASQC E4-1994, "Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs," (American National Standard, January 5, 1995), by submitting a copy of the proposed project manager's QMP. The QMP should be prepared in accordance with the specifications set forth in "EPA Requirements for Quality Management Plans (QA/R-2),"

(EPA/240/B-01/002, March 2001) or equivalent documentation as determined by EPA. EPA shall thereafter provide written notice of the name(s) of the contractor(s) it approves, if any. Respondents may select any approved contractor from that list and shall notify EPA of the name of the contractor selected within twenty one (21) days of EPA's designation of approved contractors. If at any time Respondents propose to change the construction contractor, Respondents shall notify EPA and shall obtain approval from EPA as provided in this Paragraph, before the new construction contractor performs any work under this Order. If EPA disapproves of the selection of any contractor as the construction contractor, Respondents shall submit a list of contractors that would be acceptable to them to EPA within thirty (30) days after receipt of EPA's disapproval of the contractor previously selected.

70. The Work performed by Respondents pursuant to this Order shall, at a minimum, achieve the Performance Standards specified in the ROD and in Attachments B and C of the SOW. Respondents shall conduct an Effectiveness Evaluation in accordance with Section V(I) of the attached SOW using multiple lines of evidence to demonstrate containment of the plumes to meet the Performance Standards—including a statistical analysis of chemical concentrations in wells, hydrogeological modeling from well elevation measurements, contaminant transport modeling and other appropriate methods.

71. Notwithstanding any action by EPA, Respondents remain fully responsible for achievement of the Performance Standards in the ROD and SOW. Nothing in this Order, or in EPA's approval of the SOW, or in the Remedial Design or Remedial Action Work Plans, or approval of any other submission, shall be deemed to constitute a warranty or representation of any kind by EPA that full performance of the Remedial Design or Remedial Action will achieve the Performance Standards set forth in the ROD and in Attachments B and C of the SOW. Respondents' compliance with such approved documents does not foreclose EPA from seeking additional work to achieve the applicable performance standards.

72. Respondents shall, prior to any off-site shipment of hazardous substances from the Site to an out-of-state waste management facility, provide written notification to the appropriate state environmental official in the receiving state and to EPA's RPM of such shipment of hazardous substances. However, the notification of shipments shall not apply to any off-Site shipments when the total volume of all shipments from the Site to the State will not exceed ten (10) cubic yards.

a. The notification shall be in writing, and shall include the following information, where available: (1) the name and location of the facility to which the hazardous substances are to be shipped; (2) the type and quantity of the hazardous substances to be shipped; (3) the expected schedule for the shipment of the hazardous substances; and (4) the method of transportation. Respondents shall notify the receiving state of major changes in the shipment plan, such as a decision to ship the hazardous substances to another facility within the same state, or to a facility in another state.

b. The identity of the receiving facility and state will be determined by Respondents following the award of the contract for Remedial Action construction. Respondents shall provide all relevant information, including information under the categories noted in Paragraph 72.a above, on the off-Site shipments as soon as practicable after the award of the contract and before the hazardous substances are actually shipped.

73. Within thirty (30) days after Respondents conclude that the Remedial Action has been fully performed, Respondents shall so notify EPA and shall schedule and conduct a pre-certification inspection to be attended by Respondents and EPA. The pre-certification inspection shall be followed by a written report submitted within thirty (30) days of the inspection by a registered professional engineer and Respondents' Project Coordinator certifying that the Remedial Action has been completed in full satisfaction of the requirements of this Order. If, after completion of the pre-certification inspection and receipt and review of the written report, EPA determines that the Remedial Action or any portion thereof has not been completed in accordance with this Order, EPA shall notify Respondents in writing of the activities that must be undertaken to complete the Remedial Action and shall set forth in the notice a schedule for performance of such activities. Respondents shall perform all activities described in the notice in accordance with the specifications and schedules established therein. If EPA concludes, following the initial or any subsequent certification of completion by Respondents that the Remedial Action has been fully performed in accordance with this Order, EPA may notify Respondents that the Remedial Action has been fully performed. EPA's notification shall be based on present knowledge and Respondents' certification to EPA, and shall not limit EPA's right to perform periodic reviews pursuant to Section 121(c) of CERCLA, 42 U.S.C. § 9621(c), or to take or require any action that in the judgment of EPA is appropriate at the Site, in accordance with 42 U.S.C. §§ 9604, 9606, or 9607.

74. Within thirty (30) days after Respondents conclude that all phases of the Work have been fully performed, that the Performance Standards have been attained, and that all Operation and Maintenance activities have been completed, Respondents shall submit to EPA a written report by a registered professional engineer certifying that the Work has been completed in full satisfaction of the requirements of this Order. EPA shall require such additional activities as may be necessary to complete the Work or EPA may, based upon present knowledge and Respondents' certification to EPA, issue written notification to Respondents that the Work has been completed, as appropriate, in accordance with the procedures set forth in Paragraph 73 for Respondents' certification of completion of the Remedial Action. EPA's notification shall not limit EPA's right to perform periodic reviews pursuant to Section 121(c) of CERCLA, 42 U.S.C. § 9621(c), or to take or require any action that in the judgment of EPA is appropriate at the Site, in accordance with 42 U.S.C. §§ 9604, 9606, or 9607.

X. FAILURE TO ATTAIN PERFORMANCE STANDARDS

75. In the event that EPA determines that additional response activities are necessary to meet applicable Performance Standards, EPA may notify Respondents that additional response actions are necessary.

76. Unless otherwise stated by EPA, within thirty (30) days of receipt of notice from EPA that additional response activities are necessary to meet any applicable Performance Standards, Respondents shall submit for approval by EPA a work plan for the additional response activities. The plan shall conform to the applicable requirements of Sections IX, XVI, and XVII of this Order. Upon EPA's approval of the plan pursuant to Section XIV, Respondents shall implement the plan for additional response activities in accordance with the provisions and schedule contained therein.

XI. EPA PERIODIC REVIEW

77. Under Section 121(c) of CERCLA, 42 U.S.C. § 9621(c), and any applicable regulations, EPA may review the Site to assure that the Work performed pursuant to this Order adequately protects human health and the environment. Until such time as EPA certifies completion of the Work, Respondents shall conduct the requisite studies, investigations, or other response actions as determined necessary by EPA in order to permit EPA to conduct the review under Section 121(c) of CERCLA. As a result of any review performed under this Paragraph, Respondents may be required to perform additional work or to modify work previously performed.

XII. ADDITIONAL RESPONSE ACTIONS

78. EPA may determine that in addition to the work identified in this Order and attachments to this Order, additional response activities may be necessary to protect human health and the environment. If EPA determines that additional response activities are necessary, EPA may require Respondents to submit a work plan for additional response activities, including but not limited to preparing separate plans for each groundwater zone located within OU-5. EPA may also require Respondents to modify any plan, design, or other deliverable required by this Order, including any approved modifications.

79. Not later than thirty (30) days after receiving EPA's notice that additional response activities are required pursuant to this Section, Respondents shall submit a work plan for the response activities to EPA for review and approval. Upon approval by EPA, the work plan is incorporated into this Order as a requirement of this Order and shall be an enforceable part of this Order. Upon approval of the work plan by EPA, Respondents shall implement the work plan according to the standards, specifications, and schedule in the approved work plan. Respondents shall notify EPA of their intent to perform such additional response activities within seven (7) days after receipt of EPA's request for additional response activities.

XIII. ENDANGERMENT AND EMERGENCY RESPONSE

80. In the event of any action or occurrence during the performance of the work which causes or threatens to cause a release of a hazardous substance or which may present an

immediate threat to public health or welfare or the environment, Respondents shall immediately take all appropriate action to prevent, abate, or minimize the threat, and shall immediately notify EPA's Remedial Project Manager (RPM) or, if the RPM is unavailable, EPA's Alternate RPM. If neither of these persons is available Respondents shall notify the EPA Emergency Response Unit, Region IX. Respondents shall take such action in consultation with EPA's RPM and in accordance with all applicable provisions of this Order, including but not limited to the Health and Safety Plan and the Contingency Plan. In the event that Respondents fail to take appropriate response action as required by this Section, and EPA takes that action instead, Respondents shall reimburse EPA for all costs of the response action not inconsistent with the NCP. Respondents shall pay the response costs in the manner described in Section XXIV of this Order, within thirty (30) days of Respondents' receipt of demand for payment that includes an "Aerojet General Cost Summary" which includes all direct and indirect costs incurred by EPA and its contractors.

81. Nothing in the preceding paragraph shall be deemed to limit any authority of the United States to take, direct, or order all appropriate action to protect human health and the environment or to prevent, abate, or minimize an actual or threatened release of hazardous substances on, at, or from the Site.

XIV. EPA AND STATE REVIEW OF SUBMISSIONS

82. All deliverables, plans, reports and other items that are required to be submitted for review and approval pursuant to this Order, shall be submitted to the following EPA and State contacts for review:

EPA's Remedial Project Manager:

Kevin Mayer
U.S. Environmental Protection Agency
Region IX; SFD-7-2
75 Hawthorne Street
San Francisco, CA 94105
(415) 972-3176

California Regional Water Quality Control Board:

Alex MacDonald
Regional Water Quality Control Board- Central Valley Region
11020 Sun Center Drive, Suite 200
Rancho Cordova, CA 95670-6114
(916) 464-4625

California Department of Toxic Substances Control:

Ed Cargile
Department of Toxic Substances Control
Sacramento Field Office
8800 Cal Center Drive
Sacramento, 95826-3200
(916) 255-3703

83. After EPA and State review of any deliverable, plan, report or other item which is required to be submitted for review and approval pursuant to this Order, EPA may: (a) approve the submission; (b) approve the submission with modifications; (c) disapprove the submission and direct Respondents to re-submit the document after incorporating consolidated EPA and State comments; or (d) disapprove the submission and assume responsibility for performing all of any part of the response action. As used in this Order, the terms "approval by EPA," "EPA approval," or a similar term means the action described in paragraph (a) or (b) of this Paragraph.

84. In the event of approval or approval with modifications by EPA, Respondents shall proceed to take any action required by the plan, report, or other item, as approved or modified by EPA.

85. Upon receipt of a notice of disapproval or a request for a modification, Respondents shall, within twenty-one (21) days or such longer time as specified by EPA in its notice of disapproval or request for modification, correct the deficiencies and resubmit the plan, report, or other item for approval. Notwithstanding the notice of disapproval, or approval with modifications, Respondents shall proceed, at the direction of EPA, to take any action required by any non-deficient portion of the submission.

86. If any submission is not approved by EPA, Respondents shall be deemed to be in violation of this Order.

XV. PROGRESS REPORTS

87. In addition to the other deliverables set forth in this Order, Respondents shall provide monthly progress reports to EPA with respect to actions and activities undertaken pursuant to this Order. The progress reports shall be submitted on or before the 15th day of each month following the Effective Date of this Order. Respondents' obligation to submit progress reports continues until EPA gives Respondents written notice under Paragraph 74. At a minimum these progress reports shall: (1) describe the actions which have been taken to comply with this Order during the prior month; (2) include all results of sampling and tests and all other data received by Respondents and not previously submitted to EPA; (3) describe all work planned for the next three months with schedules relating such work to the overall project

schedule for RD/RA completion; and (4) describe all problems encountered and any anticipated problems, and actual or anticipated delays, and solutions developed and implemented to address any actual or anticipated problems or delays.

XVI. QUALITY ASSURANCE, SAMPLING AND DATA ANALYSIS

88. Respondentsshall use the quality assurance, quality control, and chain of custody procedures described in the "EPA NEIC Policies and Procedures Manual," May 1978, revised May 1986, "EPA Guidance on Systematic Planning Using the Data Quality Objectives Process" (EPA QA/G-4),February 2006, "EPA Requirements for Quality Assurance Project Plans," (EPA QA/R-5), March 2001, "*Guidance for Quality Assurance Project Plans (G-5)*" December 2002, EPA/240/R-02/009, EPA Region 9 "Sampling and Analysis Plan Guidance and Template, Version 2," March 2000 (R9QA/002), and any amendments to these documents, while conducting all sample collection and analysis activities required herein by any plan. To provide quality assurance and maintain quality control, Respondents shall:

a. Use only California-certified laboratories that have a documented quality system that complies with ANSI/ASQC E4-1994, "Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs," (American National Standard, January 5, 1995) and "EPA Requirements for Quality Management Plans (QA/R-5)" (EPA/240/B-01/002, March 2001) or equivalent documentation as determined by EPA. EPA may consider laboratories accredited under the National Environmental Laboratory Accreditation Program (NELAP) to meet the quality system requirements.

b. Ensure that the laboratory used by the Respondents for analyses, performs according to a method or methods deemed satisfactory to EPA and submits all protocols to be used for analyses to EPA at least thirty (30) days before beginning analysis.

c. Ensure that EPA personnel and EPA's authorized representatives are allowed access to the laboratory and personnel utilized by the Respondents for analyses.

89. Respondents shall notify EPA not less than fourteen (14) days in advance of any sample collection activity. At the request of EPA, Respondents shall allow split or duplicate samples to be taken by EPA or its authorized representatives, of any samples collected by Respondents with regard to the Site or pursuant to the implementation of this Order. In addition, EPA shall have the right to take any additional samples that EPA deems necessary.

XVII. COMPLIANCE WITH APPLICABLE LAWS

90. All activities by Respondents pursuant to this Order shall be performed in accordance with the requirements of all Federal and state laws and regulations. EPA has determined that the activities contemplated by this Order are consistent with the National Contingency Plan (NCP), 40 C.F.R. Part 300.

91. Except as provided in Section 121(e) of CERCLA and the NCP, no permit shall be required for any portion of the Work conducted entirely on-Site. Where any portion of the Work requires a Federal or state permit or approval, Respondents shall submit timely applications and take all other actions necessary to obtain and to comply with all such permits or approvals.

92. This Order is not, and shall not be construed to be, a permit issued pursuant to any Federal or state statute or regulation.

93. All materials removed from the Site shall be disposed of or treated at a facility approved by EPA's RPM and in accordance with Section 121(d)(3) of CERCLA, 42 U.S.C. § 9621(d)(3); with the U.S. EPA "Off-Site Rule: "Procedures for Planning and Implementing Off-Site Response Actions" (September 1993); the NCP, 40 C.F.R. § 300.440, and with all other applicable Federal, state, and local requirements.

XVIII. REMEDIAL PROJECT MANAGER

94. All communications, whether written or oral, from Respondents to EPA shall be directed to EPA's Remedial Project Manager or Alternate Remedial Project Manager. Unless otherwise directed by EPA, Respondents shall submit to EPA three copies of all documents, including plans, reports, and other correspondence, which are developed pursuant to this Order, and shall send these documents by overnight mail.

EPA's Remedial Project Manager is:

Kevin Mayer
U.S. Environmental Protection Agency
Region IX; SFD-7-2
75 Hawthorne Street
San Francisco, CA 94105
(415) 972-3176

EPA's Alternate Remedial Project Manager is:

Gary Riley
U.S. Environmental Protection Agency
Region IX, SFD-7-2
75 Hawthorne Street
San Francisco, CA 94105
(415) 972-3003

95. EPA has the unreviewable right to change its Remedial Project Manager or Alternate Remedial Project Manager. If EPA changes its Remedial Project Manager or

Alternate Remedial Project Manager, EPA will inform Respondents in writing of the name, address, and telephone number of the new Remedial Project Manager or Alternate Remedial Project Manager.

96. EPA's RPM and Alternate RPM shall have the authority lawfully vested in a Remedial Project Manager (RPM) and On-Scene Coordinator (OSC) by the National Contingency Plan, 40 C.F.R. Part 300. EPA's RPM or Alternate RPM shall have authority, consistent with the National Contingency Plan, to halt any work required by this Order, and to take any necessary response action.

97. Within ten (10) days after the Effective Date of this Order, Respondents shall designate a Project Coordinator and shall submit the name, address, and telephone number of the Project Coordinator to EPA for review and approval. Respondents' Project Coordinator shall be responsible for overseeing Respondents' implementation of this Order. If Respondents wish to change their Project Coordinator, Respondents shall provide written notice to EPA, five (5) days prior to changing the Project Coordinator, of the name and qualifications of the new Project Coordinator. Respondents' selection of a Project Coordinator shall be subject to EPA approval.

XIX. ACCESS TO SITE NOT OWNED BY RESPONDENTS

98. If the Site, the off-Site area that is to be used for access, property where documents required to be prepared or maintained by this Order are located, or other property subject to or affected by the clean up, is owned in whole or in part by parties other than those bound by this Order, Respondents will obtain, or use their best efforts to obtain, site access agreements from the present owner(s) within ninety (90) days of the Effective Date of this Order. Such agreements shall provide access for EPA, its contractors and oversight officials, the state and its contractors, and Respondents or Respondents authorized representatives and contractors, and such agreements shall specify that Respondents are not EPA's representative with respect to liability associated with Site activities. Respondents shall save and hold harmless the United States and its officials, agents, employees, contractors, subcontractors, or representatives for or from any and all claims or causes of action or other costs incurred by the United States including but not limited to attorneys fees and other expenses of litigation and settlement arising from or on account of acts or omissions of Respondents, their officers, directors, employees, agents, contractors, subcontractors, and any persons acting on their behalf or under their control, in carrying out activities pursuant to this Order, including any claims arising from any designation of Respondents as EPA's authorized representative(s) under Section 104(e) of CERCLA. Copies of such agreements shall be provided to EPA prior to Respondents' initiation of field activities. Respondents' best efforts shall include providing reasonable compensation to any off-Site property owner. If access agreements are not obtained within the time referenced above, Respondents shall immediately notify EPA of its failure to obtain access. Subject to the United States' non-reviewable discretion, EPA may use its legal authorities to obtain access for the Respondents, may perform those response actions with EPA contractors at the property in question, or may terminate the Order if Respondents cannot obtain

access agreements. If EPA performs those tasks or activities with contractors and does not terminate the Order, Respondents shall perform all other activities not requiring access to that property, and shall reimburse EPA, pursuant to Section XXIV of this Order, for all costs incurred in performing such activities. Respondents shall integrate the results of any such tasks undertaken by EPA into its reports and deliverables. Respondents shall reimburse EPA, pursuant to Section XXIV of this Order, for all response costs (including attorney fees) incurred by the United States to obtain access for Respondents.

XX. INSTITUTIONAL CONTROLS AND ACCESS

99. If the Site, or any other real property where access or land/water use restrictions are needed, is owned or controlled by Respondents, Respondents shall, commencing on the Effective Date of this Order, provide the United States, the State of California and their representatives, contractors, and subcontractors, with access at all reasonable times to the Site, or such other real property, to conduct any activity regarding the Order including, but not limited to, the following activities:

a. Monitoring the Work;
b. Verifying any data or information submitted to the United States or the State;
c. Conducting investigations regarding contamination at or near the Site;
d. Obtaining samples;
e. Assessing the need for, planning, or implementing additional response actions at or near the Site;
f. Assessing implementation of quality assurance and quality control practices as defined in the approved Quality Assurance Project Plans;
g. Implementing the Work pursuant to the conditions set forth in Paragraphs 80 and 81;
h. Inspecting and copying records, operating logs, contracts, or other documents maintained or generated by Respondents or their agents, consistent with Paragraph 109 and Section XXI (Data/Document Availability and Record Preservation);
i. Assessing Respondents' compliance with the Order;
j. Determining whether the Site or other real property is being used in a manner that is prohibited or restricted, or that may need to be prohibited or restricted under the Order; and
k. Implementing, monitoring, maintaining, reporting on, and enforcing any Institutional Controls and the requirements of the SOW.

100. Commencing on the Effective Date of the Order, Respondents shall not use the Site, or such other real property, in any manner that EPA determines will pose an unacceptable risk to human health or to the environment due to exposure to Solid or Hazardous Waste or hazardous substances or interfere with or adversely affect the implementation, integrity, or protectiveness of the Remedial Action.

101. Prior to any Transfer of property within OU-5 that is not currently to subject to EPA approved Institutional Controls, Respondents shall execute and record in the appropriate land records office Institutional Controls that: (a) grant a right of access to conduct any activity regarding the Order including, but not limited to, those activities listed in Paragraph 99, as determined to by necessary by EPA, and (b) grant the right to enforce any necessary land/water use restrictions , including, but not limited to any necessary land/water use restrictions listed herein, any land/water use restrictions listed in the SOW, and any additional land/water use restrictions determined by EPA to be necessary to protect human health and environment.

102. If the Site, or any other real property where access and/or land/water use restrictions are needed, is owned or controlled by persons other than any Respondents, Respondents shall use best efforts to secure from such persons:

a. an agreement to provide access thereto for the United States, the State, and Respondents, and their representatives, contractors and subcontractors, to conduct any activity regarding the Order including, but not limited to, the activities listed in Paragraph 99 and in a manner consistent with Paragraph 98;

b. an agreement, enforceable by Respondents and the United States, to refrain from using the Site, or such other real property, in any manner that EPA determines will pose an unacceptable risk to human health or to the environment due to exposure to Solid or Hazardous Waste or hazardous substances, or interfere with or adversely affect the implementation, integrity, or protectiveness of the Remedial Action. The agreement shall include, but not be limited to, any necessary land/water use restrictions listed herein, any land/water use restrictions listed in the SOW, and any additional land/water use restrictions determined by EPA to be necessary to protect human health and environment; and

c. if, determined by EPA to be necessary, the execution and recordation in the appropriate land records office, within the time frame determined by EPA, of Institutional Controls, that (1) grant a right of access to conduct any activity regarding the Order including, but not limited to, those activities listed in Paragraph 99, and (2) grant the right to enforce any necessary land/water use restrictions listed herein, any land/water use restrictions listed in the SOW, and any additional land/water use restrictions determined by EPA to be necessary to protect human health and environment.

103. The Institutional Controls required in Paragraphs 98-102 shall be granted to EPA, the State and their representatives. The Institutional Controls shall include a designation that the State of California is a "covenantee" and, that EPA is a "covenantee" or, alternatively, subject to EPA's discretion, a "third party beneficiary," allowing EPA, without acquiring an

interest in real property, to maintain the right to enforce the Institutional Controls or obtain access pursuant to the Institutional Control.

104. Within thirty (30) days of a written request from EPA or thirty (30) days prior to the Transfer of property within OU-5 that is not subject to existing EPA approved Institutional Controls, whichever is the earlier date, Respondents shall submit to EPA for review and approval regarding such property: (a) a draft Institutional Control as required by Paragraphs 98-102 in substantially the form attached as Attachment F to the SOW (Attachment 2), or as otherwise directed by EPA, that is enforceable under state law; and (b) a current title insurance commitment, or other evidence of title acceptable to EPA, which shows title to the land affected by the Institutional Control to be free and clear of all prior liens and encumbrances (except when EPA waives the release or subordination of such prior liens or encumbrances or when, despite best efforts, Respondents are unable to obtain release or subordination of such prior liens or encumbrances).

105. Within 15 days of EPA's approval and acceptance of the Institutional Control required in Paragraphs 98-102 and the title evidence, Respondents shall update the title search and, if it is determined that nothing has occurred since the effective date of the commitment, or other title evidence, to affect the title adversely, the Institutional Control shall be recorded with the appropriate land records office. Within 30 days of the recording of the Institutional Control, Respondents shall provide EPA with a final title insurance policy, or other final evidence of title acceptable to EPA, and a certified copy of the original recorded Institutional Control showing the clerk's recording stamps. If the Institutional Control is to be conveyed to the United States, the Institutional Control and title evidence (including final title evidence) shall be prepared in accordance with the U.S. Department of Justice Title Standards 2001, and approval of the sufficiency of title must be obtained as required by 40 U.S.C. § 3111.

106. For purposes of this Section XX (Institutional Controls and Access), "best efforts" includes the payment of reasonable sums of money to obtain access, an agreement to restrict land/water use, a Institutional Control, and/or an agreement to release or subordinate a prior lien or encumbrance. If, within the schedule set forth in the approved Remedial Action Work Plan, Respondents have not: (a) obtained agreements to provide access, restrict land/water use or record Institutional Controls, as required by Paragraph 101; or (b) obtained, pursuant to Paragraph 101 or 104, agreements from the holders of prior liens or encumbrances to release or subordinate such liens or encumbrances to the Institutional Controls, Respondents shall promptly notify the United States in writing, and shall include in that notification a summary of the steps that Respondents have taken to attempt to comply with Paragraphs 99-101 or 102. The United States may, as it deems appropriate, assist Respondents in obtaining access, agreements to restrict land/water use, Institutional Controls, or the release or subordination of a prior lien or encumbrance. Respondents shall reimburse the United States under Section XXIV (Reimbursement of Response Costs), for all costs incurred, direct or indirect, by the United States in obtaining such access, agreements to restrict land/water use, Institutional Controls, and/or the release/subordination of prior liens or encumbrances including, but not limited to, the cost of attorney time and the amount of monetary consideration paid or just compensation.

107. If EPA determines that Institutional Controls in the form of state or local laws, regulations, ordinances, zoning restrictions, or other governmental controls are needed, Respondents shall cooperate with EPA's and the State's efforts to secure and ensure compliance with such governmental controls.

108. Notwithstanding any provision of the Order, the United States and the State retain all of their access authorities and rights, as well as all of their rights to require Institutional Controls, including enforcement authorities related thereto, under CERCLA, RCRA, and any other applicable statute or regulations.

109. Respondents shall allow EPA and its authorized representatives and contractors to enter and freely move about all property at the Site and off-Site areas subject to or affected by the work under this Order or where documents required to be prepared or maintained by this Order are located, for the purposes of inspecting conditions, activities, the results of activities, records, operating logs, and contracts related to the Site or Respondents and its representatives or contractors pursuant to this Order; reviewing the progress of the Respondents in carrying out the terms of this Order; conducting tests as EPA or its authorized representatives or contractors deem necessary; using a camera, sound recording device or other documentary type equipment; and verifying the data submitted to EPA by Respondents. Respondents shall allow EPA and its authorized representatives to enter the Site, to inspect and copy all records, files, photographs, documents, sampling and monitoring data, and other writings related to work undertaken in carrying out this Order. Nothing herein shall be interpreted as limiting or affecting EPA's right of entry or inspection authority under Federal law.

XXI. DATA/DOCUMENT AVAILABILITY AND RECORD PRESERVATION

110. Respondents may assert a claim of business confidentiality covering part or all of the information submitted to EPA pursuant to the terms of this Order under 40 C.F.R. § 2.203, provided such claim is not inconsistent with Section 104(e)(7) of CERCLA, 42 U.S.C. § 9604(e)(7) or other provisions of law. This claim shall be asserted in the manner described by 40 C.F.R. § 2.203(b) and substantiated by Respondents at the time the claim is made. Information determined to be confidential by EPA will be given to protection specified in 40 C.F.R. Part 2. If no such claim accompanies the information when it is submitted to EPA, it may be made available to the public by EPA or the state without further notice to the Respondents. Respondents shall not assert confidentiality claims with respect to any data related to Site conditions, sampling, or monitoring.

111. Respondents shall maintain for the period during which this Order is in effect, an index of documents that Respondents claims contain confidential business information. The index shall contain, for each document, the date, author, addressee, and subject of the document. Upon written request from EPA, Respondents shall submit a copy of the index to EPA.

112. Respondents shall provide to EPA upon request, copies of all documents and information within their possession and/or control or that of their contractors or agents relating to activities at the Site or to the implementation of this Order, including but not limited to sampling, analysis, chain of custody records, manifests, trucking logs, receipts, reports, sample traffic routing, correspondence, or other documents or information related to the Work. Respondents shall also make available to EPA for purposes of investigation, information gathering, or testimony, their employees, agents, or representatives with knowledge of relevant facts concerning the performance of the Work.

113. Until ten (10) years after EPA provides notice pursuant to Paragraph 74, each Respondentsshall preserve and retain all records and documents in its possession or control, including the documents in the possession or control of their contractors and agents on and after the Effective Date of this Order that relate in any manner to the Site. At the conclusion of this document retention period, Respondents shall notify the United States at least ninety (90) calendar days prior to the destruction of any such records or documents, and upon request by the United States, Respondents shall deliver any such records or documents to EPA.

114. Until ten (10) years after EPA provides notice pursuant to Paragraph 74 of this Order, Respondents shall preserve, and shall instruct their contractors and agents to preserve, all documents, records, and information of whatever kind, nature or description relating to the performance of the Work. Upon the conclusion of this document retention period, Respondents shall notify the United States at least ninety (90) days prior to the destruction of any such records, documents or information, and, upon request of the United States, Respondents shall deliver all such documents, records, and information to EPA.

115. Within thirty (30) days after the Effective Date of this Order, Respondents shall submit a written certification to EPA's RPM that they have not altered, mutilated, discarded, destroyed or otherwise disposed of any records, documents or other information relating to their potential liability with regard to the Site since notification of potential liability by the United States or the State or the filing of suit against it regarding the Site. Respondents shall not dispose of any such documents without prior approval by EPA. Respondents shall, upon EPA's request and at no cost to EPA, deliver the documents or copies of the documents to EPA.

XXII. DELAY IN PERFORMANCE

116. Any delay in performance of this Order that, in EPA's judgment, is not properly justified by Respondents under the terms of this Paragraph shall be considered a violation of this Order. Any delay in performance of this Order shall not affect Respondents obligations to fully perform all obligations under the terms and conditions of this Order.

117. Respondents shall notify EPA of any delay or anticipated delay in performing any requirement of this Order. Such notification shall be made by telephone to EPA's RPM or Alternate RPM within forty eight (48) hours after Respondents first knew or should have known that a delay might occur. Respondents shall adopt all reasonable measures to avoid or minimize

any such delay. Within five (5) business days after notifying EPA by telephone, Respondents shall provide written notification fully describing the nature of the delay any justification for delay, any reason why Respondents should not be held strictly accountable for failing to comply with any relevant requirements of this Order, the measures planned and taken to minimize the delay, and a schedule for implementing the measures that will be taken to mitigate the effect of the delay. Increased costs or expenses associated with implementation of the activities called for in this Order is not a justification for any delay in performance.

XXIII. ASSURANCE OF ABILITY TO COMPLETE WORK

118. In order to ensure the full and final completion of the Work, Respondents within sixty (60) days after the Effective Date of this Order shall establish and maintain a performance guarantee, initially in the amount of $20 million, for the benefit of EPA (hereinafter "Estimated Cost of the Work"). The performance guarantee, which must be satisfactory in form and substance to EPA, shall be in the form of one or more of the following mechanisms (provided that, if Respondents intend to use multiple mechanisms, such multiple mechanisms shall be limited to surety bonds guaranteeing payment, letters of credit, trust funds, and insurance policies):

a. A surety bond unconditionally guaranteeing payment and/or performance of the Work that is issued by a surety company among those listed as acceptable sureties on federal bonds as set forth in Circular 570 of the U.S. Department of the Treasury;

b. One or more irrevocable letters of credit, payable to or at the direction of EPA, that is issued by one or more financial institution(s) (1) that has the authority to issue letters of credit and (2) whose letter-of-credit operations are regulated and examined by a federal or state agency;

c, A trust fund established for the benefit of EPA that is administered by a trustee (1) that has the authority to act as a trustee and (2) whose trust operations are regulated and examined by a federal or state agency;

d. A policy of insurance that (1) provides EPA with acceptable rights as a beneficiary thereof; and (2) is issued by an insurance carrier (i) that has the authority to issue insurance policies in the applicable jurisdiction(s) and (ii) whose insurance operations are regulated and examined by a federal or state agency;

e. A demonstration by Respondents that Respondents meet the financial test criteria of 40 C.F.R. § 264.143(f) with respect to the Estimated Cost of the Work (plus the amount(s) of any other federal or any state environmental obligations financially assured through the use of a financial test or guarantee), provided that all other requirements of 40 C.F.R. § 264.143(f) are met to EPA's satisfaction; or

f. A written guarantee to fund or perform the Work executed in favor of EPA by one or more of the following: (1) a direct or indirect parent company of Respondents, or (2) a

company that has a "substantial business relationship" (as defined in 40 C.F.R. § 264.141(h)) with Respondents; provided, however, that any company providing such a guarantee must demonstrate to the satisfaction of EPA that it satisfies the financial test and reporting requirements for owners and operators set forth in subparagraphs (1) through (8) of 40 C.F.R. § 264.143(f) with respect to the Estimated Cost of the Work (plus the amount(s) of any other federal or any state environmental obligations financially assured through the use of a financial test or guarantee) that it proposes to guarantee hereunder.

119. If, at any time after the Effective Date and before issuance of the Certification of Completion of the Work pursuant to Paragraph 74, Respondents provide a performance guarantee for completion of the Work by means of a demonstration or guarantee pursuant to Paragraphs 118(e) or 118(f), Respondents shall also comply with the other relevant requirements of 40 C.F.R. § 264.143(f) relating to these mechanisms unless otherwise provided in this Order, including but not limited to: (a) the initial submission of required financial reports and statements from the pertinent Respondent's chief financial officer ("CFO") and independent certified public accountant ("CPA"), in the form prescribed by EPA in its financial test sample CFO letters and CPA reports available at: http://www.epa.gov/compliance/resources/policies/cleanup/superfund/fa-test-samples.pdf; (b) the annual resubmission of such reports and statements within 90 days after the close of the pertinent Respondent's fiscal year; and (c) the prompt notification of EPA after each such entity determines that it no longer satisfies the financial test requirements set forth at 40 C.F.R. § 264.143(f)(1) and in any event within 90 days after the close of any fiscal year in which Respondents no longer satisfy such financial test requirements. For purposes of the performance guarantee mechanisms specified in this Section XXIII, references in 40 C.F.R. Part 264, Subpart H, to "closure," "post-closure," and "plugging and abandonment" shall be deemed to include the Work; the terms "current closure cost estimate," "current post-closure cost estimate," and "current plugging and abandonment cost estimate" shall be deemed to include the Estimated Cost of the Work; the terms "owner" and "operator" shall be deemed to refer to Respondents making a demonstration under Paragraph 118; and the terms "facility" and "hazardous waste facility" shall be deemed to include the Site.

120. In the event that EPA determines at any time that a performance guarantee provided by Respondents pursuant to this Section is inadequate or otherwise no longer satisfies the requirements set forth in this Section, whether due to an increase in the estimated cost of completing the Work or for any other reason, or in the event that Respondents become aware of information indicating that a performance guarantee provided pursuant to this Section is inadequate or otherwise no longer satisfies the requirements set forth in this Section, whether due to an increase in the estimated cost of completing the Work or for any other reason, Respondents, within 30 days after receipt of notice of EPA's determination or, as the case may be, within 30 days after Respondents become aware of such information, shall obtain and present to EPA for approval a proposal for a revised or alternative form of performance guarantee listed in Paragraph 118 that satisfies all requirements set forth in this Section XXIII; provided, however, that if Respondents cannot obtain such revised or

alternative form of performance guarantee within such 30-day period, and provided further that Respondents shall have commenced to obtain such revised or alternative form of performance guarantee within such 30-day period, and thereafter diligently proceeds to obtain the same, EPA shall extend such period for such time as is reasonably necessary for Respondents in the exercise of due diligence to obtain such revised or alternative form of performance guarantee, such additional period not to exceed 30 days. Respondents' inability to post a performance guarantee for completion of the Work shall in no way excuse performance of any other requirements of this Order, including, without limitation, the obligation of Respondents to complete the Work in strict accordance with the provisions of this Order.

121. Respondents shall not release, cancel, or discontinue any performance guarantee provided pursuant to this Section except as provided in this Paragraph. If Respondents receive written notice from EPA in accordance with Paragraph 74 that the Work has been fully and finally completed in accordance with the provisions of this Order, or if EPA otherwise so notifies Respondents in writing, Respondents may thereafter release, cancel, or discontinue the performance guarantee(s) provided pursuant to this Section.

122. At least seven (7) days prior to commencing any work at the Site pursuant to this Order, Respondents shall submit to EPA a certification that Respondents or their contractors and subcontractors have adequate insurance coverage or have indemnification for liabilities for injuries or damages to persons or property which may result from the activities to be conducted by or on behalf of Respondents pursuant to this Order. Respondents shall ensure that such insurance or indemnification is maintained for the duration of the Work required by this Order.

XXIV. REIMBURSEMENT OF RESPONSE COSTS

123. Respondents shall reimburse EPA, upon written demand, for all Response Costs incurred by the United States in overseeing Respondents' implementation of the requirements of this Order or in performing any response action which Respondents fail to perform in compliance with this Order. EPA may submit to Respondents on a periodic basis an accounting of all Response Costs incurred by the United States with respect to this Order. EPA's certified Agency Financial Management System summary data (SPUR Reports), or such other summary as certified by EPA, shall serve as basis for payment demands.

124. Respondents shall, within thirty (30) days of receipt of each EPA accounting, remit payment by certified check, cashier's check, or wire transfer for the amount of those costs. Interest shall accrue from the later of the date that payment of a specified amount is demanded in writing or the date of the expenditure. The interest rate is the rate established by the Department of the Treasury pursuant to 31 U.S.C. § 3717.

125. Payments should be directed to the Hazardous Substances Superfund and must include: 1) name of the Site; 2) Site identification number; 3) account number; and 4) title of

this Order. Checks should be made payable to Hazardous Substances Superfund and be forwarded to:

U.S. Environmental Protection Agency
Superfund Payments
Cincinnati Finance Center
P.O. Box 979076
St. Louis, MO 63197-9000

Wire Transfers should be directed to:

Federal Reserve Bank of New York
ABA=021030004
Account=68010727
SWIFT address=FRNYUS33
33 Liberty Street
New York, NY 10045

Field Tag 4200 of the Fedwire message should read "D 68010727 Environmental Protection Agency"

Overnight Mail:

U.S. Bank
1005 Convention Plaza
Mail Station SL-MO-C2GL
St. Louis, MO 63101

Contact: Natalie Pearson
Phone: 314-418-4087

ACH (also known as REX or remittance express)

Automated Clearinghouse (ACH) for receiving U.S. currency
PNC Bank
808 17th Street, NW
Washington, D.C. 20074
Contact – Jesse White 301-887-6548
ABA=051036706
Transaction Code 22 - checking
Environmental Protection Agency
Account 310006
CTX Format

126. Respondents shall send copies of each transmittal letter and payment to the EPA's RPM.

XXV. UNITED STATES NOT LIABLE

127. The United States, by issuance of this Order, assumes no liability for any injuries or damages to persons or property resulting from acts or omissions by Respondents, or their directors, officers, employees, agents, representatives, successors, assigns, contractors, or consultants in carrying out any action or activity pursuant to this Order. Neither EPA nor the United States may be deemed to be a party to any contract entered into by Respondents or their directors, officers, employees, agents, successors, assigns, contractors, or consultants in carrying out any action or activity pursuant to this Order.

XXVI. ENFORCEMENT AND RESERVATIONS

128. EPA reserves the right to bring an action against Respondents under Section 107 of CERCLA, 42 U.S.C. § 9607, for recovery of any response costs incurred by the United States related to this Order and not reimbursed by Respondents. This reservation shall include but not be limited to past costs, direct costs, indirect costs, the costs of oversight, the costs of compiling the cost documentation to support oversight cost demand, as well as accrued interest as provided in Section 107(a) of CERCLA.

129. Notwithstanding any other provision of this Order, at any time during the response action, EPA may perform its own studies, complete the response action (or any portion of the response action) as provided in CERCLA and the NCP, and seek reimbursement from Respondents for its costs, or seek any other appropriate relief.

130. Nothing in this Order shall preclude EPA from taking any additional enforcement actions, including modification of this Order or issuance of additional Orders, and/or additional remedial or removal actions as EPA may deem necessary, or from requiring Respondents in the future to perform additional activities pursuant to CERCLA, 42 U.S.C. §§ 9606(a), *et seq.*, 42 U.S.C. § 6973, or any other applicable law. Respondents shall be liable under CERCLA Section 107(a), 42 U.S.C. § 9607(a), for the costs of any such additional actions.

131. Notwithstanding any provision of this Order, the United States hereby retains all of its information gathering, inspection and enforcement authorities and rights under CERCLA, RCRA and any other applicable statutes or regulations.

132. Respondents shall be subject to civil penalties under Section 106(b) of CERCLA, 42 U.S.C. § 9606(b), of not more than $37,500 for each day in which Respondents willfully violate, or fail or refuse to comply with this Order without sufficient cause. In addition, failure to properly provide response action under this Order, or any portion hereof,

without sufficient cause, may result in liability under Section 107(c)(3) of CERCLA, 42 U.S.C. § 9607(c)(3), for punitive damages in an amount at least equal to, and not more than three times the amount of any costs incurred by the Fund as a result of such failure to take proper action.

133. Nothing in this Order shall constitute or be construed as a release from any claim, cause of action or demand in law or equity against any person for any liability it may have arising out of or relating in any way to the Site.

134. If a court issues an order that invalidates any provision of this Order or finds that Respondents has sufficient cause not to comply with one or more provisions of this Order, Respondents shall remain bound to comply with all provisions of this Order not invalidated by the court's order.

XXVII. ADMINISTRATIVE RECORD

135. Upon request by EPA, Respondents must submit to EPA all documents related to the selection of the response action for possible inclusion in the administrative record file.

XXVIII. EFFECTIVE DATE AND COMPUTATION OF TIME

136. This Order shall be effective on September 20, 2011. All times for performance of ordered activities shall be calculated from this Effective Date.

XXIX. OPPORTUNITY TO CONFER

137. Respondents may request a conference, by no later than September 23, 2011 with EPA's Assistant Director of the Superfund Division, or her delegatee, to discuss this Order. If requested, the conference shall occur at U.S. EPA, 75 Hawthorne Street, San Francisco, California, or by telephone at a date to be determined by EPA.

138. The purpose and scope of the conference shall be limited to issues involving the implementation of the response actions required by this Order and the extent to which Respondents intend to comply with this Order. This conference is not an evidentiary hearing, and does not constitute a proceeding to challenge this Order. It does not give Respondents a right to seek review of this Order, or to seek resolution of potential liability, and no official stenographic record of the conference will be made. At any conference held pursuant to Respondents' request, Respondents may appear in person or by an attorney or other representative.

139. Requests for a conference must be by telephone followed by written confirmation mailed that day to Kevin Mayer, Remedial Project Manager, U.S. Environmental Protection Agency, Region IX, 75 Hawthorne Street, San Francisco, CA 94105, Telephone number (415) 972-3176.

So Ordered, this 20th day of Sept, 2011.

By: _____
Jane Diamond, Director
Superfund Division
U.S. Environmental Protection Agency, Region IX

INTERIM RECORD OF DECISION for GROUNDWATER

and

FINAL RECORD OF DECISION for SOIL

for the

Perimeter Groundwater Operable Unit

OU-5

AEROJET GENERAL CORPORATION SUPERFUND SITE,
RANCHO CORDOVA, CALIFORNIA

U.S. Environmental Protection Agency
Region 9
San Francisco, California

February 15, 2011

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PART 1: THE DECLARATION

1.1 Site Name and Location

Aerojet General Corporation Superfund Site ("Site"), Sacramento County California, Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) Identification Number CAD980358832.

1.2 Statement of Basis and Purpose

This decision document presents the United States Environmental Protection Agency's (USEPA) Selected Remedy for the Perimeter Groundwater Operable Unit (OU-5) at the Aerojet General Corporation (Aerojet) Site in Sacramento County, California, which was chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended, and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the USEPA's Administrative Record file.

This action is an interim remedy for the groundwater areas in OU-5 since the groundwater remedy is dependent on control of source areas in other OUs still in the Remedial Investigation/ Feasibility Study (RI/FS) phase. This action is the final remedy for cleanup of contaminated soil areas which were included in OU-5 as established by the 2001 Stipulation and Order Modifying Partial Consent Decree, (entered in 2002 and hereafter described as the 2002 Modifications of the 1989 Partial Consent Decree (PCD)).

The State of California concurs with the Selected Remedy for the groundwater, although the Regional Water Quality Control Board expressed a preference for lower containment levels and final aquifer cleanup goals for some contaminants based on California Public Health Goals and State water policies. The State of California concurs with the Selected Remedy for cleanup of the soil areas.

1.3 Assessment of Site

The response actions selected in this Interim Record of Decision (ROD) for Groundwater and Final ROD for Soil are necessary to protect the public health or welfare or the environment from actual or threatened releases into the environment of hazardous substances and pollutants or contaminants from this Site which may present an imminent and substantial endangerment to public health or welfare.

1.4 Description of Selected Remedy

The Site is divided into operable units (OUs) because of the overall size of the remediation effort and to expedite the remediation. The scope and definition of the current Aerojet OUs were developed in the 2002 Modification of the PCD. Due to the impact of contaminated groundwater on public drinking water supplies, the site cleanup strategy gives priority to containing and remediating the contaminated groundwater extending from the Aerojet Site, followed by remediation of on-property contaminated soil and groundwater. The containment and remediation of contaminated groundwater surrounding the Aerojet Site is divided into two OUs. The ROD for Western Groundwater Operable Unit (OU-3) was signed on July 20, 2001 to address the loss of drinking water supplies in some of the most populated areas. The remaining contaminated groundwater beyond and near the boundary of the Aerojet Site is addressed in this ROD. The scope of the on-property soil and groundwater remediation effort will require at least four additional OUs.

The remedial action for OU-5 groundwater addresses contaminated groundwater on the north and south sides of the Site and addresses contamination in surface and subsurface soil in one section of the Aerojet property. Implementation of the remedial action for OU-5, in conjunction with the existing remedy for the Western Groundwater Operable Unit (OU-3) to the west and other state enforcement actions to the south will complete the containment of groundwater contamination around the boundary of the Site. The containment provided by Groundwater Extraction and Treatment Systems (GETs) will prevent the loss of additional drinking water supplies in a populated area dependent on groundwater supplies. This action is an interim remedy for the containment of contaminated groundwater areas in OU-5, and does not set numeric cleanup goals for the groundwater in the aquifer at this time. Groundwater restoration in OU-5 is dependent on control of source areas in other OUs still in the Remedial Investigation/ Feasibility Study (RI/FS) phase.

The OU-5 Contaminated Soil Areas were selected from potential source and contaminated soil sites that transect, border, or are surrounded by lands removed from the boundary of the Aerojet Superfund Site by the PCD modification ("carve-out lands"). Several potential source areas on the Aerojet property formerly used for administration and liquid fuel rocket manufacturing have been identified within the contaminated soil areas of OU-5 and are addressed in this ROD. Primary source areas for the groundwater contamination and potential Non-Aqueous Phase Liquids (NAPLs) are located upgradient of OU-5 and principal threat waste from those sources will be addressed in subsequent OUs. Several areas with VOCs and perchlorate include relatively minor amounts of contaminants that do not constitute principal threats due to the lack of mobility of these contaminants and the provisions for containment of more mobile contaminants. Contaminated surface and subsurface soil areas will be treated or removed to protective levels. This action is the final remedy for cleanup of contaminated soil areas in OU-5.

1.4.1 The groundwater portion of the OU-5 remedy includes the following actions:

- Contain contaminated groundwater off-property within OU-5 with groundwater extraction and treatment in all contaminated layers of the aquifer to prevent further contamination of the aquifer;

- Remove additional contaminant mass from the contaminated groundwater on-property which is migrating off-property into OU-5 groundwater Zones, through groundwater extraction and treatment at or near the Aerojet property boundary in all contaminated layers of the aquifer;

- Treat extracted groundwater using reliable, proven treatment methods including biological treatment or resin adsorption for perchlorate, ultraviolet oxidation for NDMA, and carbon filtration or air stripping for residual Volatile Organic Compounds (VOCs), and oxidative destruction for VOCs and 1,4-Dioxane;

  The treated groundwater will be used for non-potable purposes such as industrial cooling or discharged to surface water or land. Aerojet may also provide the extracted water to drinking water providers for treatment for potable or non-potable uses. Water providers are subject to federal drinking water standards as well as California Department of Public Health, Division of Drinking Water and Environmental Management requirements[1];

- Coordinate water replacement contingency planning and implementation with the contingency plans for OU-3;

- Implement Institutional Controls (ICs). These controls will include Sacramento County review of new well drilling permits and prohibitions on access to groundwater on the land overlaying the contaminated groundwater to restrict use of untreated groundwater within the contaminated portions of the aquifer until the final water quality objectives have been attained;

- Monitor groundwater at monitoring wells, drinking water wells, irrigation wells, and up-gradient sentinel wells to verify and evaluate plume control and effectiveness of the remedy; and

- Manage groundwater within the hydraulic influence of the OU-5 groundwater remedy to maintain optimum water levels, to prevent adverse impact on the remedy and to mitigate impacts on downgradient beneficial uses.

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[1] Under CERCLA, performance standards for treatment of water to be discharged to on-site surface water shall comply with the substantive requirements of a National Pollution Discharge Elimination System (NPDES) permit as listed in Table 2.16. Discharge of treated water to off-site surface water or use as non-potable water shall comply with applicable federal and State water standards in effect at the time of discharge. On-site discharge of treated groundwater to land shall comply with the substantive requirements of Waste Discharge Requirements developed by the Central Valley Regional Water Quality Control Board.

1.4.2 The contaminated soil areas of the OU-5 remedy incorporate active measures to eliminate or reduce contaminants and control contaminated soil in the eleven areas exceeding risk-based limits and include the following actions:

- Excavate contaminated surface soils and related drainage ditch sediments in areas 10D and 11D to allow for unrestricted use of the land based on residential risk;

- Excavate surface soil contaminated above the cleanup levels that allow for unrestricted use based on residential use in areas C4 and C41 laterally and to a minimum ten foot depth unless the cleanup levels are reached at a shallower depth. The contaminated soil shall be excavated and treated to remove the contaminants or, if justified and approved during remedial design, the soil may be excavated and transported to an approved landfill. The excavated area shall be refilled with soil that meets the residential soil criteria. If waste is left in place deeper than ten feet, land use controls will be necessary to protect against exposure resulting from excavation to depths greater than ten feet;

- Install and operate a soil vapor extraction system in soil areas 32D, 34D, 35D and 38D, covering a total of approximately 11 acres in close proximity to each other to remove VOCs from unsaturated subsurface soil. A temporary asphalt cap or equivalent shall be constructed over the surface to improve capture of the VOCs. Contaminants in the vapors shall be captured and treated by granulated carbon, or destroyed using a catalytic oxidation system with air monitoring. Until the cleanup attains unrestricted use levels for exposure from vapor intrusion, the land shall be restricted to commercial or industrial use with a land use covenant;

- Control the risks from elevated VOCs measured in the vadose zone in soil areas 7D, 33D and the Former Company Store location (FCS) by vapor mitigation systems to prevent movement of contaminant vapors into buildings constructed at these locations. The RI concluded that neither soil excavation nor soil vapor extraction would be protective for these areas until levels of VOCs in the groundwater are reduced by controlling sources of migration onto OU-5. Vapor mitigation systems typically include vapor barriers and venting of vapors from beneath the structure. Appropriate monitoring and land use covenants are required for either residential or commercial use of these locations until the potential threat of vapor intrusion is removed;

Review the monitoring results of the solid waste landfill closure in Zone 4 to ensure both soil and groundwater protectiveness from this potential source of contamination. The landfill in Zone 4 is not included in the actions for OU-5 selected in this ROD. EPA expects that all potential risks from this landfill will be satisfactorily addressed by State and County approval and oversight of the landfill closure process. If potential risks from the landfill are not adequately addressed, EPA will evaluate alternatives in an Explanation of Significant Differences or an amendment to the ROD.

1.5 Statutory Determinations

The Selected Remedy attains the mandates of CERCLA Section 121 and, to the extent practicable, the NCP. Specifically, the remedy is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and utilizes permanent solutions to the maximum extent practicable.

This remedy also satisfies the statutory preference for treatment as a principal element of the remedy (i.e., reduces the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants as a principal element through treatment) for the final contaminated soil area actions. Although the groundwater interim action is not intended to fully address the statutory mandate for permanence and treatment "to the maximum extent practicable," the remedy does utilize treatment and thus supports the statutory mandate. Because the groundwater action does not constitute the final remedy for the Site, the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element, although partially addressed in this remedy, will be addressed by the final response action. Subsequent actions are planned to fully address the threats posed by conditions at this Site.

Because this interim groundwater remedy will result in hazardous substances, pollutants, or contaminants remaining within OU-5 above levels that allow for unlimited use and unrestricted exposure, a statutory review for the entire OU-5 will be conducted within five years after initiation of the remedial action, and every five years thereafter, to ensure that the remedy is, or will be, protective of human health and the environment.

1.6 ROD Data Certification Checklist

The following information is included in the Decision Summary Section of this ROD (Additional information can be found in the Administrative Record file for this Site):

- Chemicals of Concern (COC) and their respective health-based concentrations – Section 2.7.1, Page 26 and following;
- Baseline risk represented by the COC – Sections 2.7.5, Page 28 and following;
- Cleanup or containment levels established for the COCs and the basis for these levels – Tables 2.7, page 34, Table 2.11, page 38, and Table 2.12, Page 39;
- How source materials constituting principal threats are addressed – Section 2.11, Page 53;
- Current and reasonable anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD – Section 2.6, Page 20;

- Potential groundwater use that will be available at the Site as a result of the Selected Remedy – Section 2.12.5, Page 57;

- Estimated capital, operation and maintenance (O&M), and total present value costs, discount rate, and the number of years over which the remedy cost estimates are projected – Tables 2.13 and 2.14 a.-c., Pages 44-47 and Appendices C and D; and

- Key factors that led to selecting the remedy – Section 2.12, Pages 53 and 54.

1.7 Authorizing Signature

Kathleen Salyer
Assistant Director, Superfund Division
California Site Cleanup Branch
U.S. Environmental Protection Agency Region IX

2/15/11
Date

PART 2: THE DECISION SUMMARY

2.1 Site Name, Location, and Description

The Aerojet General Corporation Superfund Site is located near Rancho Cordova, California, approximately 15 miles east of Sacramento, CA. (See Figure 2-1). It is bounded on the west and north by the cities of Rancho Cordova, Carmichael, Fair Oaks, Folsom and unincorporated Gold River.

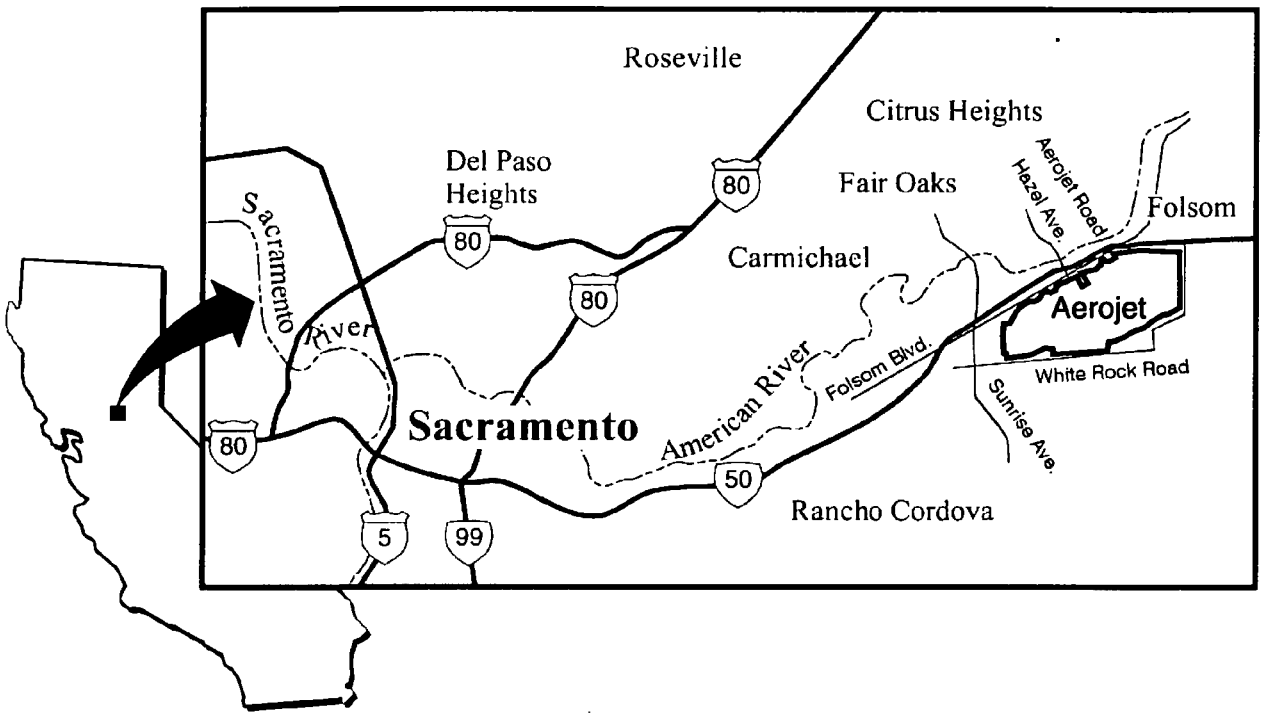


Figure 2-1 Aerojet Superfund Site Map - Location

The CERCLIS Identification Number is CAD980358832.

The lead agency is the USEPA, supported by California EPA Regional Water Quality Control Board -Central Valley Region (RWQCB) and Department of Toxic Substances Control (DTSC).

The major sources of the groundwater contamination are from Aerojet's facilities up-gradient of OU-5. There are areas of contaminated soil within OU-5 that will be remediated by the OU-5 response actions.

OU-5 consists of four Zones of contaminated groundwater (Zones 1 through 4, see Figure 2-2) comprising less than five square miles of the twenty-seven square mile Site. A small portion of the Aerojet industrial facility (Figure 2-3) with known or suspected areas of surface or

subsurface soil contamination is included in OU-5. This area of soil contamination is on the Aerojet property south of the groundwater Zones 1 and 4. The potentially contaminated areas of soil investigated in OU-5 are surrounded by land that had no indication of contamination and which had been "carved out" of the CERCLA cleanup in a negotiated 2002 modification of the 1989 Partial Consent Decree. OU-5 is not known to include major soil or vadose zone sources or areas of NAPL. The Western Groundwater Operable Unit (OU-3) is the groundwater area to the west of the Aerojet property. To the south of Zone 2 is the cleanup project at Inactive Rancho Cordova Test Site (IRCTS) which is overseen by the State of California. Further to the south and west is the closed United States Air Force Mather Field, a Federal National Priority List (NPL) site. (See Figure 2-4)

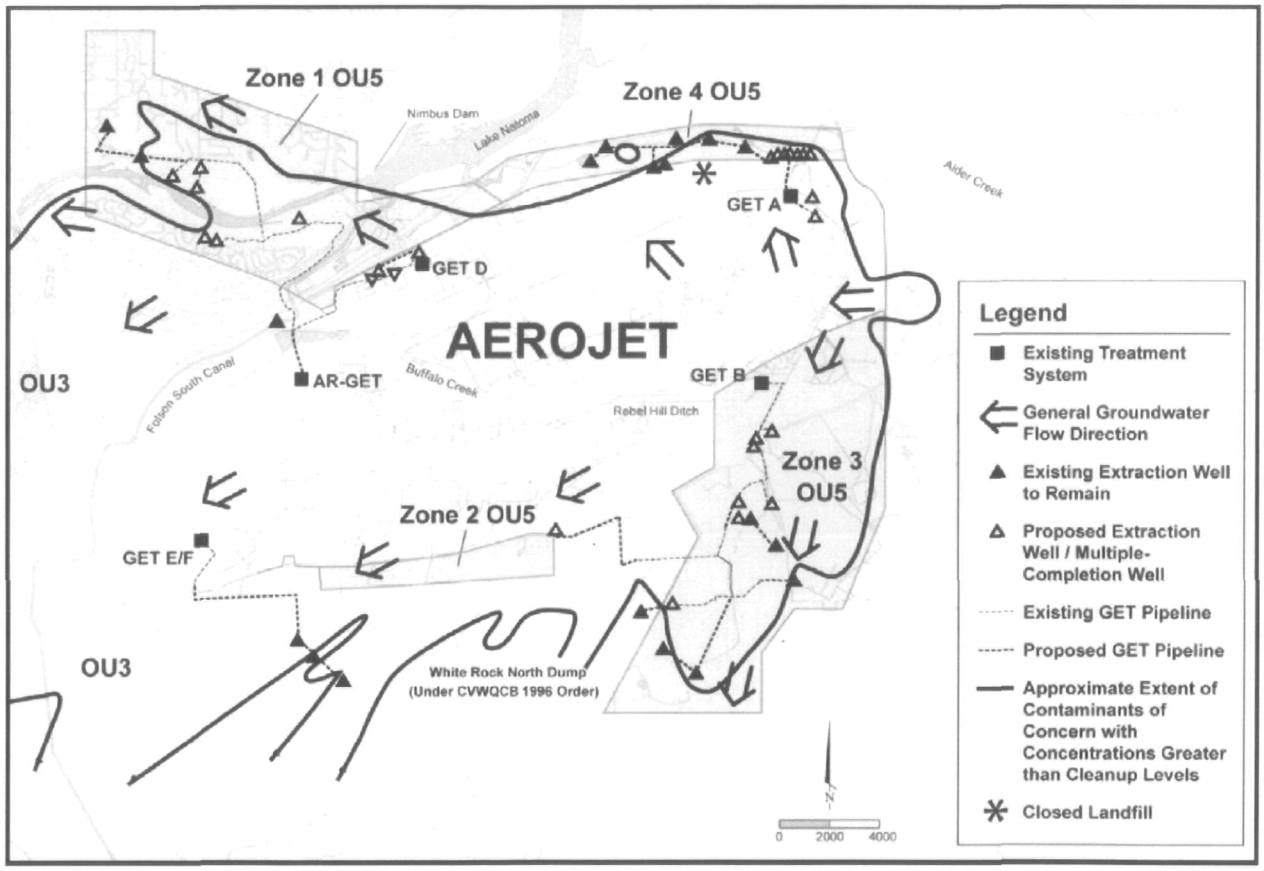


Figure 2-2 Aerojet Perimeter Groundwater Operable Unit (OU-5), Groundwater Zones 1-4. Groundwater flow direction and extraction well and treatment system locations are shown.

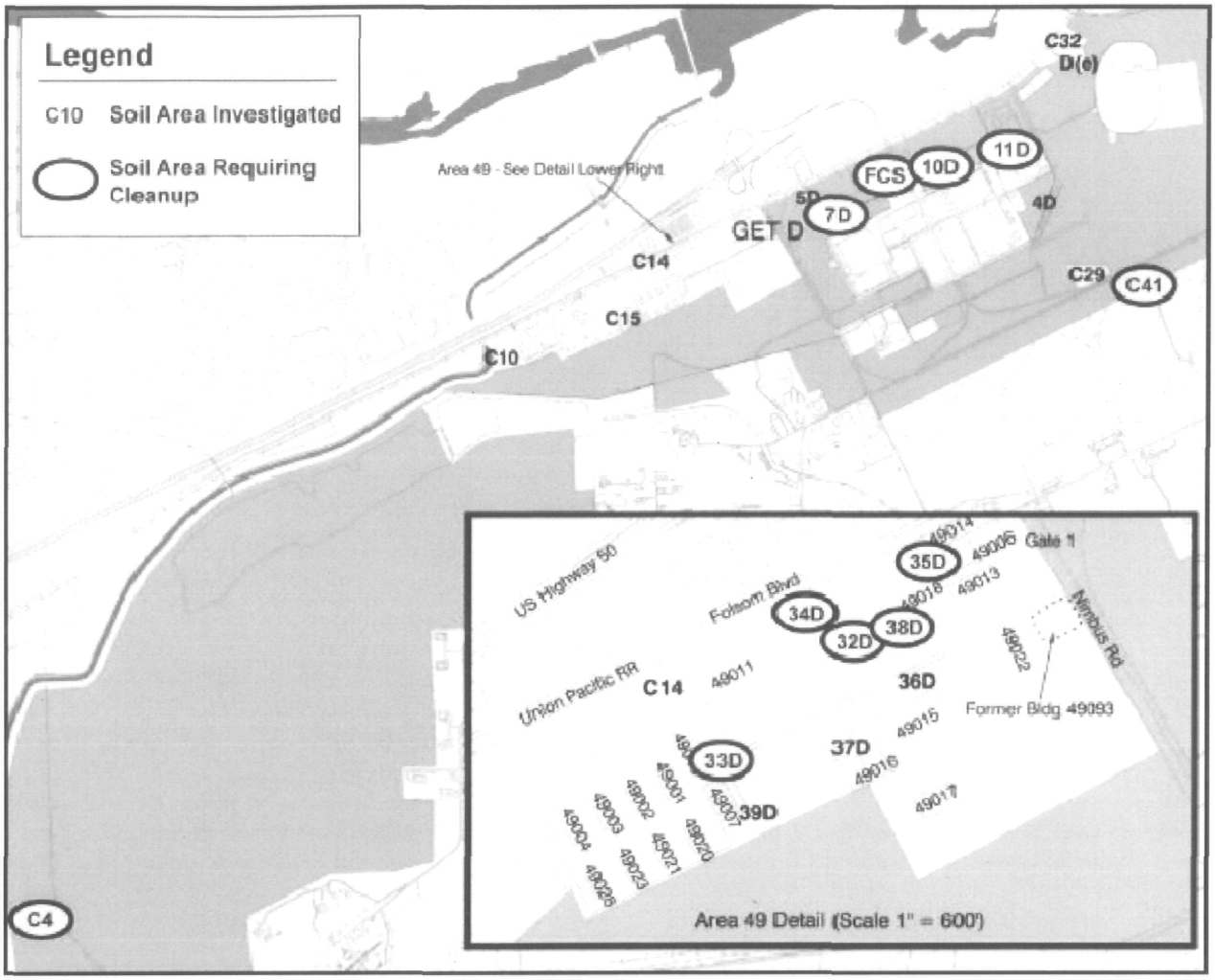


Figure 2-3. Aerojet OU-5 Contaminated Soil Areas. Areas included in remedy are circled.

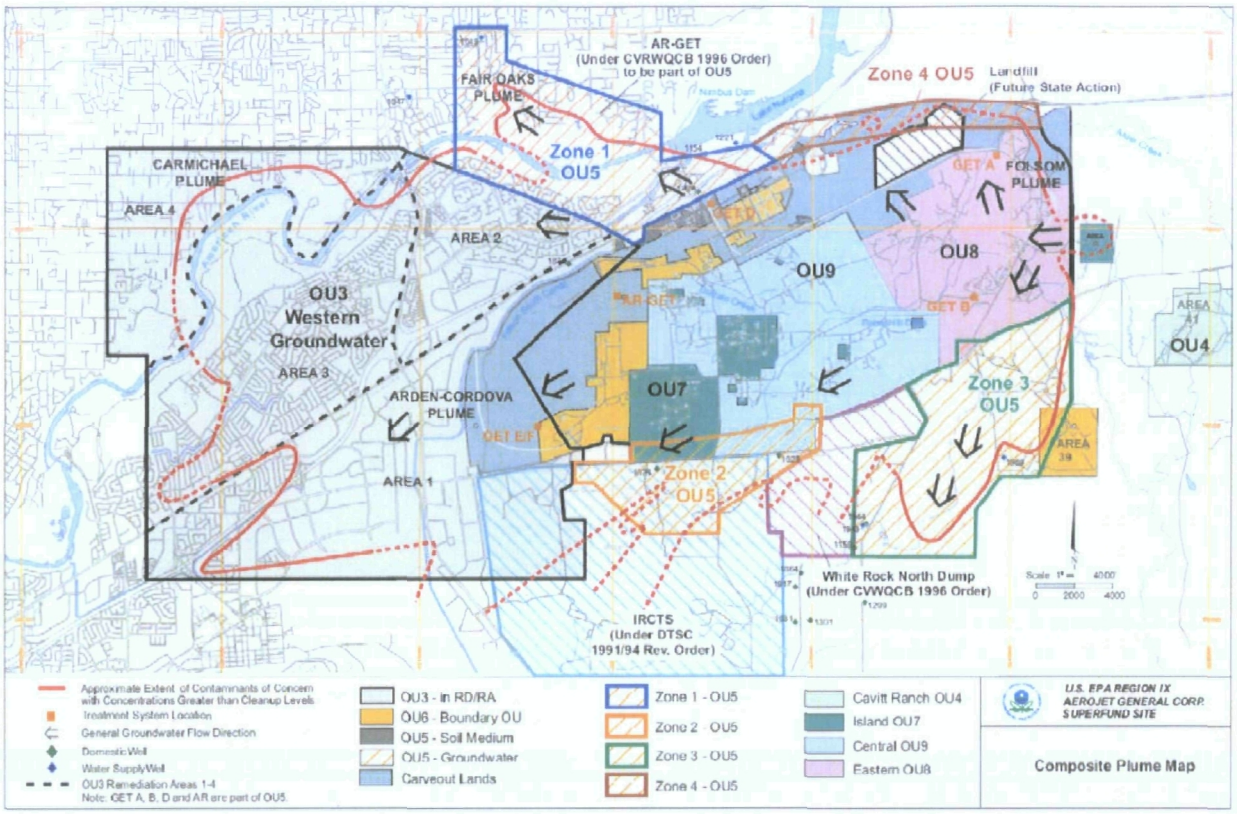


Figure 2-4. Aerojet Site - Relationship with all Operable Units and Groundwater Plume Extent.

2.2 Site History and Enforcement Activities

Aerojet is a wholly owned subsidiary of GenCorp. Aerojet has operated at this location since 1953. Operations included manufacturing liquid and solid propellants for rocket engines for military and commercial applications and formulating a number of chemicals, including rocket propellant agents, agricultural pesticides, pharmaceuticals, and other industrial chemicals. The Cordova Chemical Company operated chemical manufacturing facilities on the Aerojet complex from 1974 to 1979. Some wastes were disposed of on-property in surface impoundments, landfills, deep injection wells, leachate fields, and open burn areas. In 1979, volatile organic chemicals (VOCs) were found in private wells off-property. The most prevalent contaminants in groundwater are Trichloroethene (TCE), perchlorate, and NDMA. In 1997, the practical quantitation limit (PQL) for perchlorate was improved from 400 parts per billion (ppb) to four ppb and has been reduced even further since 2001. The NDMA PQL has also been improved from 150 ppb to 5 parts per trillion (ppt) and current analytic methods are under review by USEPA's Quality Assurance Office that will reduce the PQL to below 2 ppt. As a result of these improved detection methods it has been determined that perchlorate and NDMA contamination of groundwater off-property is extensive. Public drinking water wells on the west side of Aerojet have been removed from service and additional wells are threatened due to groundwater contamination.

The Aerojet Site was placed on the NPL on August 8, 1983. Portions of the state lead IRCTS are considered part of the Aerojet NPL site where hazardous substances originally on the Aerojet facility migrated to or otherwise came to be located on the IRCTS. On their own initiative, Aerojet installed, between 1983 and 1987, five groundwater extraction and treatment (GET) facilities as a perimeter barrier system, primarily to prevent further off-property movement of VOC contaminants. These systems have not been fully effective. Existing GETs E and F which are part of the remedy for OU-3 were initially designed only to treat for VOCs, resulting in perchlorate and NDMA reinjection into the aquifer. On June 23, 1989, a Partial Consent Decree (PCD) was entered by the United States District Court for the Eastern District of California. The PCD obligates Aerojet to complete a Remedial Investigation/ Feasibility Study (RI/FS) for the 8,500 acre main facility, 3,820 acre IRCTS area, and three other smaller parcels (Areas 39, 40 and 41) near the main Aerojet facility, where open burning was conducted. The parties to the PCD are Aerojet General Corporation, the Department of Toxic Substances Control (DTSC), the Regional Water Quality Control Board (RWQCB) and the USEPA. Requirements for the operation, maintenance and effectiveness evaluation of GETs A, B, D, E, and F were incorporated in the PCD. The PCD was modified in July 29, 1998 to add the contaminant perchlorate and to reduce the NDMA discharge limit. In December 1998 Aerojet installed a biological treatment system for perchlorate at GET F, which achieved full scale operation in December 1999. This treatment system treats perchlorate to less than 4 ppb. In July 1999, GETs E and F were combined to provide for treatment of perchlorate at GET E extraction wells and to add ultraviolet oxidation (UV/OX) treatment capability to destroy NDMA to below 2 ppt. The PCD was further modified in 2002 to expedite the cleanup by dividing the Site into OUs, beginning with OU-3, instead of waiting to complete a single Sitewide RI/FS before starting remediation. Completion of the RI/FS for OU-3 proceeded ahead of the 2002 Modifications of the PCD. The PCD Modification also removed certain uncontaminated portions of the Aerojet property from the CERCLIS Site ("Carve-Out Lands", see Figure 2-4).

In 1995 DTSC issued an order to Aerojet requiring soil and groundwater cleanup at the IRCTS property. In 1997 the RWQCB issued order 97-093 to Aerojet and McDonnell-Douglas Corporation, requiring groundwater control and remediation of perchlorate. To address contamination on the north of Aerojet, in 1996 the RWQCB issued order 96-230 for groundwater control and remediation of groundwater contamination not remediated by GET D. In 2000, the RWQCB issued order 500-718 for containment and control of perchlorate at GET D. In addition, in 1996, the RWQCB issued order 96-259 to add perchlorate treatment to the GET E and GET F treatment systems and to evaluate containment of perchlorate contamination not currently captured by the existing GET facilities.

USEPA signed the ROD for OU-3 on July 20, 2001 and issued a Unilateral Administrative Order on August 9, 2002 requiring Aerojet to implement the remedy. The groundwater portions of OU-5 extend the pump and treat system required for OU-3 to the remainder of the groundwater plume at and beyond the Aerojet property. As of 2010, nearly all the required extraction and treatment systems for OU-5 have been constructed and are in operation as part of the work required under the PCD including the 1998 and 2002 modifications of the PCD. As the completion of the final OU-3 GET approaches, USEPA, the State and Aerojet have begun initial activities to evaluate the effectiveness of the outer barrier and inner barrier containment systems in OU-3.

2.3 Community Participation

The RI/FS Report and Proposed Plan for OU-5 were made available to the public on July 31, 2009. These documents can be found in the Administrative Record file of the information repositories maintained at the USEPA Region 9 Superfund Records Center at 95 Hawthorne St. in San Francisco and at the California State University Sacramento Library Reference Desk, 2000 State University Drive East Sacramento, CA. The notice of availability of the RI/FS, proposed plan, date and location for the public meeting and public comment period (August 3, 2009 through September 1, 2009, which was later extended to October 1, 2009 on request from community members) was published the week prior to the start of the public comment period in the Sacramento Bee newspaper and sent to the Aerojet mailing list. The public meeting was held August 11, 2009. Transcripts of the public meeting are part of the administrative file at the repositories and USEPA's response to comments received at the public meeting and written comments are part of this ROD.

An overview of the proposed plan was presented by USEPA at the public meeting and questions were taken prior to acceptance of formal public comments. An Aerojet Community Advisory Group (CAG) formed subsequent to the OU-3 Proposed Plan has been active in discussions with USEPA throughout the development of the OU-5 RI/FS and Proposed Plan.

USEPA spent considerable effort interviewing and meeting with land use planning officials from Sacramento County, Rancho Cordova and Folsom. A great deal of planning has already been approved by local jurisdictions for the development of the Aerojet property near and including parts of OU-5. A report and presentation on the land use plans and the planning process were drafted and provided to the local officials and to the community for review. The information, current as of March 2010, is summarized in Figures 2-6 through 2-9.

2.4 Scope and Role of the Operable Unit or Response Action

The Aerojet Site is a large facility with groundwater contamination that has migrated off the Aerojet property. The USEPA and the State have negotiated with Aerojet to organize the Site into OUs through a modification to the PCD. The USEPA anticipates the OU-5 remedial actions will be implemented by Aerojet as they have implemented the OU-3 remedy. The interim action for groundwater containment will neither be inconsistent with, nor preclude, implementation of the final Sitewide remedy. This action is an interim containment remedy. Therefore EPA is not setting numeric cleanup goals for the groundwater in the aquifer at this time (i.e., "*in situ*" cleanup goals).

> Operable Unit 1: Is reserved for the Sitewide final ROD integration remedial actions for all the OUs.
>
> Operable Unit 2: OU-2 has been merged into OU-5. OU-2 was initiated in 1995 pursuant to a Unilateral Administrative Order (UAO) for control of off-property VOC groundwater contaminated on the north side of the Aerojet Site. OU-2 is also referred to as the American River OU. The UAO was withdrawn and work for this part of the Site was

accomplished under RWQCB Order 96-230 and Order 500-718 (for perchlorate treatment in Zone 1). In July 1998 the American River GET became operational as an interim groundwater action to contain VOCs not captured on the north side of the Aerojet Site by the existing GET D.

Operable Unit 3: OU-3 contains and remediates groundwater contamination on the western side of the Aerojet Site. A number of water supply wells have been lost to groundwater contamination and it had been projected that approximately 20 public water supply wells could be lost over the next 25 years without a successful OU-3 remedial action. Although all public water supplies around the Aerojet Site have been replaced with uncontaminated water, ingestion of untreated groundwater extracted from the aquifer would pose a current and potential risk to human health which exceeds the USEPA's acceptable risk range. Construction of remedial actions selected in the 2001 ROD for OU-3 is nearly complete.

Operable Unit 4: OU-4 will address remediation of soil and groundwater in Area 41 caused by Aerojet's burning of industrial wastes on 500 acres of property leased from others. Area 41 has VOC and perchlorate contamination in groundwater, and metals and perchlorate contamination in soil.

Operable Unit 5: **Perimeter Groundwater Operable Unit (OU-5) is the action covered by this ROD.** Perimeter Groundwater OU (OU-5) will contain and remediate groundwater around the remaining three sides of Aerojet (north, east and south) not addressed by OU-3. OU-5 includes Aerojet's GETs A, B, D, the American River GET and groundwater for Areas 39 and 40. USEPA and the State of California have a long history of collaboration in addressing the Aerojet Site, and this cooperation is particularly evident in groundwater contamination portions of OU-5. The work performed under interim RWQCB orders 96-230, 96-259, and 500-718 will be incorporated in OU-5 actions. Order 96-259 was rescinded on 25 January 2008 with the issuance of Order No. R5-2008-0025. Aerojet demonstrated to the RWQCB that they had complied with the order. Certain contaminated soil areas were also included in OU-5 as a result of terms included in the 2002 Modification of the PCD.

Operable Units 6-9: OUs 6-9 will address remediation of soil and groundwater contamination on-property. As part of the 2002 PCD RI/FS modification for OUs, Aerojet will assess the number of OUs and priority for remediating the over 300 source locations identified in the four hydrologic groundwater zones on-property. Dense non-aqueous phase liquids (DNAPLs) are known to exist in the areas to be covered by these OUs.

2.5 Site Characteristics

The land to the north of Aerojet's property has multiple uses including residential, recreational, office, commercial and industrial. The land to the south of Aerojet's property is used for recreation, ranching, agriculture and mining and is also undergoing planning for a mixed use development. Section 2.6 below discusses plans for future land use of the Aerojet property.

Groundwater in the area is designated for municipal use as a drinking water source in accordance with the Central Valley Regional Water Quality Control Board Basin Plan for the Sacramento and San Joaquin River Basins. Public water supply wells around the Aerojet Site are closely monitored, and public water supplies are obtained from uncontaminated sources. None of the monitoring and extraction wells on Aerojet's property are used for potable water. The general groundwater flow direction varies at the Aerojet Site and is grouped into four main zones based on flow direction: Zone 1 to the northwest; Zone 2 to the west and southwest; Zone 3 to the south; and Zone 4 to the north-northwest (see Figure 2-2). The groundwater aquifer is separated into multiple Layers A through F (from shallowest to deepest below ground). These layers consist of permeable materials which readily allow water to flow horizontally and are generally separated by less permeable layers which restrict vertical flow between layers. Groundwater flow within individual layers may differ from the general groundwater flow in that particular zone of OU-5. Surface water bodies in the area of OU-5 include Rebel Hill Ditch, Buffalo Creek and Alder Creek. Any water flowing in Rebel Hill Ditch drains back into the aquifer through the porous soil and does not flow off of Aerojet property. Buffalo Creek flows to the American River north of Aerojet. Buffalo Creek receives storm water discharge and industrial process water flows (primarily cooling water) from Aerojet under a RWQCB National Pollution Discharge Elimination System (NPDES) permit. Alder Creek flows into Lake Natoma from the northeast side of Aerojet and receives rainfall and some groundwater seepage. The remedial investigation found no groundwater contamination entering Alder Creek.

2.5.1 Groundwater Conceptual Site Model.

The Conceptual Site Model (CSM) for the risk assessment and response action was based on: 1) contact with contaminated groundwater in the future through use of private or domestic water supply wells; 2) calculation of hypothetical risks assuming present residential exposure to untreated groundwater from wells; and 3) thorough measurement and calculation of exposure to vapor intrusion into potential residential and commercial structures. Residential exposure through untreated water from drinking water wells would include ingestion, inhalation and dermal contact. The health-based concentrations used in the risk assessment are those that represent the current state of the plumes as well as maximum detected concentrations over the recent years of sampling. The major sources of the groundwater contamination are from Aerojet's facilities up-gradient of OU-5 which will be addressed in OUs that are still in the RI/FS phase. The Aerojet groundwater contamination in OU-5 is deep underground, generally as shallow as 50 feet below ground surface (bgs) near the eastern boundary of the Aerojet property and sloping downward to the west with distance from the property. (See Figure 2-5) The groundwater does not seep up to the surface or impact the nearby American River. As a result, there are no known receptors for an ecological assessment. Drinking water wells are monitored

and removed from service once contaminated, based on California Department of Public Health regulations. Water on-property is supplied from an up-gradient, off-property supply that is not contaminated.

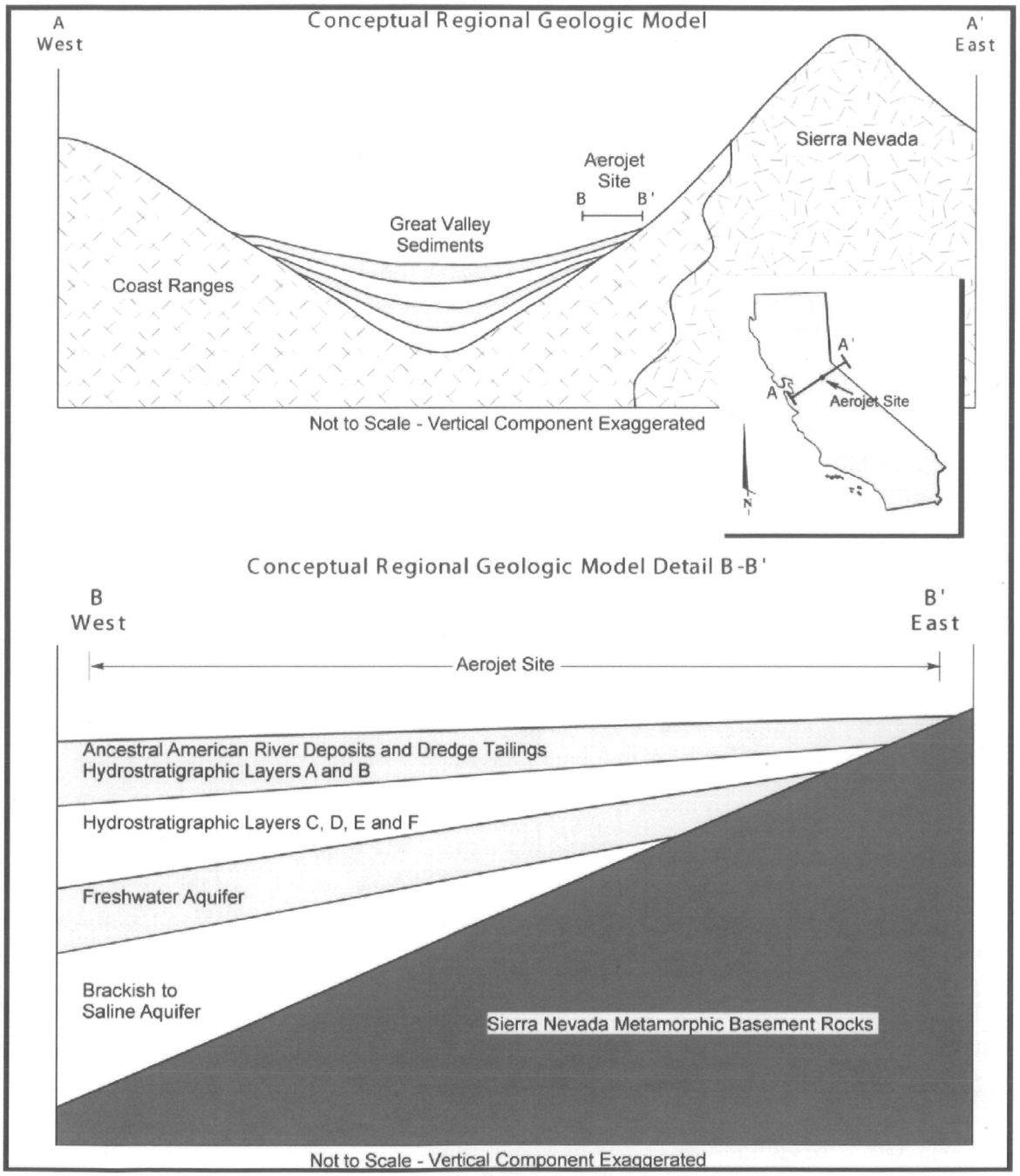


Figure 2-5. Conceptual Model of Groundwater Structure

2.5.2 Contaminated Soil Areas Conceptual Site Model.

A limited area of Aerojet land formerly used for administration and liquid fuel rocket manufacturing is on property surrounded by or adjacent to uncontaminated "carve-out" land. The potential exists for development of these contaminated soil areas for various residential, commercial or industrial uses in the future. The CSM for the risk assessment was based on contact and inhalation - including potential vapor intrusion into structures – and various potential ingestion pathways in residential scenarios including uptake into garden vegetables.

2.5.3 Overview of OU-5

- Size: The estimated area of the approximate extent of contaminated groundwater in the four zones of OU-5 is about 9 square miles, with the contaminated soil areas of OU-5 adding less than 20 acres. The depth to shallow groundwater varies from tens of feet in the east to about 100 ft. below ground surface in the west. The depth to groundwater in the deepest layer of concern, Layer F, is typically greater than 300 ft. below the ground surface.

- Topography: The Aerojet Site and the OU-5 areas are characterized by a relatively flat topographic surface sloping less than 1 degree to the west. Some areas in the eastern portion of the Site, south of GET B, dip to the south and east. The surface elevations range from approximately 200 feet above mean sea level (msl) in the east to approximately 60 feet above msl in the west. Most of the topography on the Aerojet facility is dominated by rows of dredge tailings remaining from gold mining operations that began in the early 1900's. The tailings consist of alternating rows of loose cobble mounds and intervening low areas comprised of silt and clay ("slickens"). Much of the area surrounding Aerojet, including Gold River, portions of the IRCTS, and areas south of GET B, was also dredged, although development has obscured most of the tailings. The dredging apparently disturbed the sediments to depths ranging from 20 to 80 feet below ground surface. Other topographic features include two ancestral American River terrace scarps that generally trend northeast-southwest across the Site. Alder Creek trends east-west through an incised channel cut through the sediments just south of the northern Site perimeter. To the north, a ridge of 30- to 60-foot high bluffs runs parallel to the north side of the American River.

- Surface and Subsurface Water: The American River meanders in a generally southwesterly direction through Zone 1 and the northwest part of OU-5. The Folsom South Canal originates at the southwest end of Lake Natoma. Lake Natoma is formed by Nimbus Dam, which is located one-quarter to one-half mile north of the Aerojet property boundary. In general, the canal parallels the Aerojet boundary. This concrete-lined canal was intended to provide water for a nuclear power plant that is currently being decommissioned, as well as for various municipal and agricultural water users. Other surface water features include the Administration Ditch, Buffalo Creek and the Westlake Stormwater Retention Basins. Most stormwater runoff originating in the northern (Administration Area) portions of Aerojet is diverted to the Westlake basins via the Area

20 Administration Ditches and Buffalo Creek. Stormwater runoff from the northeastern portions of the Site flows through Buffalo Creek to the Westlake storm-water retention cells. Analytical sampling of the storm-water runoff is conducted prior to discharging the water to Buffalo Creek and ultimately the American River. Storm-water discharges to Buffalo Creek/American River are regulated through the National Pollution Discharge Elimination System (NPDES). Aerojet also discharges treated groundwater from ARGET and GET E/F to Buffalo Creek under a separate NPDES permit. Most stormwater runoff generated in the southwestern portions of the Aerojet Site infiltrates locally and does not leave the Aerojet property. The Rebel Hill Ditch traverses the Aerojet Site from northeast to southwest and was constructed to provide water for gold dredging activities. Treated groundwater from GETs A and B, located in Zone 3, is discharged to the Rebel Hill Ditch, where it infiltrates into the ground along the southern boundary of the Aerojet Site

The Site is located near the eastern edge of the Sacramento Valley, near the contact between the Sierra Nevada metamorphic basement rocks and the Great Valley Sedimentary Sequence. The general structure of the subsurface is formed of fairly continuous layers of sediment as shown in cross-section in Figure 2-5. Each layer of permeable sediments is separated by relatively lower permeability sediments. Layer A is defined as the first encountered groundwater that is often, but not always, present or is unsaturated in many areas of the Site. Layer B is relatively thin and is also dry or absent in some areas of the Site. Layers C, D, E, and F are located within the deeper geologic formations and are generally continuous across the western and southern portions of the Site, but are not present in the northern and eastern portions of the Site due to the eastward thinning of the sediment.

Groundwater flow is radial from the interior of the Aerojet Site towards the various Aerojet property boundaries. (See Figure 2-2) Groundwater flows from the Aerojet Site in essentially all directions except east. As a result, multiple interim remedial action GET facilities were necessary to provide hydraulic containment at the property boundaries.

- Groundwater monitoring and contaminant analyses: Aerojet has installed over 2,000 monitoring wells throughout the Site in addition to installing and operating arrays of extraction wells for contaminant containment in some parts of OU-5. Numerous production wells have provided information on the physical and chemical characteristics of the aquifer and the flow of groundwater and chemicals in the water.

  The development of the analytical sampling program for OU-5 was complicated by the large number of chemicals handled at the Site. A systematic process of chemical identification, screening, and assessment was conducted during the Stage 1 RI and subsequent groundwater monitoring efforts. This process followed CERCLA guidance and has resulted in the development and refinement of analytical methods for identifying unique or specialty chemicals, the formation of Target Analyte Lists (TALs) for the groundwater, and an approach for managing tentatively identified chemicals.

- Known and Suspected Sources of Groundwater Contamination: Since the early 1950s, the

Aerojet Sacramento facility has been devoted to the development of rocket propulsion systems to support national defense, space exploration, and satellite deployment activities. Industrial activities at the Aerojet Site have included solid rocket motor manufacturing and testing, liquid rocket engine manufacturing and testing, and chemical manufacturing. Chemicals used in the manufacturing and testing areas on the Aerojet Site have included chlorinated solvents, propellants, metals, oxidizers, and a variety of chemicals produced in the chemical operations areas.

- Types of Contamination and Affected Media in Groundwater Portion of OU-5: Operations at the Aerojet Site have resulted in the discharge of COCs to the vadose zone and the underlying groundwater. Although numerous types of chemicals have been used historically on the Aerojet Site, TCE, perchlorate and NDMA comprise the chemicals that are the most prevalent and of main concern in this operable unit. TCE was utilized on the Aerojet Site for cleaning and degreasing purposes. In OU-5, the TCE concentration varies from below the 5 ppb drinking water standard at the leading edge of the plumes to over 600 ppb in the upgradient OU-5 groundwater near the property boundary. Detailed plume maps for TCE, perchlorate and NDMA in groundwater layers A and C, the most heavily contaminated groundwater layers, are presented in Appendix B. Perchlorate salts were utilized as an oxidizer in solid rocket propellants, with manufacturing, testing and disposal operations leading to the releases throughout the Aerojet facility. Perchlorate concentration in some parts of OU-5 exceeds 100 ppb, well above the California drinking water standard of 6 ppb. NDMA is a semi-volatile organic compound (SVOC) that was either an impurity in hydrazine-based liquid rocket fuels or was formed as a combustion product of these fuels. The maximum concentration of NDMA reported in OU-5 groundwater is 96,000 ppt, over 30,000 times the risk level and California Public Health Goal. The groundwater COCs are listed in Table 2.1.

- Known and Suspected Sources of Soil Contamination: Relatively minor discharges of various COCs occurred in the contaminated soil areas of OU-5, compared to the major manufacturing and testing operations that occurred in other OUs on the Aerojet property. In several soils areas, the pattern of groundwater contamination in the shallower layer of the aquifer indicated that the source of VOCs measured in the vadose zone was from upgradient activities to be addressed in other OUs. This limits the remedial actions in these areas to preventing unacceptable exposure from the soil vapor. The COCs in soil and soil vapor in OU-5 are listed in Table 2.2.

- Types of Contamination and Affected Media in Contaminated Soil Areas of OU-5: Contaminants at various soil areas include VOCs, PCBs, perchlorate and various metals. The relatively immobile metals and PCBs tend to be present in soil near the surface which can be excavated with reasonable effort. Perchlorate at area C41 has been measured throughout the 70 foot depth of the unsaturated soil. The mass of perchlorate totals several kilograms with potential to dissolve in water percolating through the soil and to be transported to groundwater. VOCs in the soil and underlying shallow groundwater can be present as soil vapor capable of movement to the ground surface and into structures.

Table 2.1 Chemicals of Concern in Groundwater

Non-Metal Anion
Perchlorate
SVOCs
N-Nitrosodimethylamine (NDMA)
VOCs
Trichloroethene (TCE)
1,1,2,2-Tetrachloroethane
1,1,2-Trichloroethane
1,1-Dichloroethene
1,2-Dichloroethane
cis-1,2-Dichloroethene
trans- 1,2-Dichloroethene
1,4-Dioxane
Bromodichloromethane
Carbon tetrachloride
Chloroform
Dibromochloromethane
Methylene chloride
Tetrachloroethene
Vinyl chloride

Table 2.2 Chemicals of Concern in Soil and Soil Vapor

Soil
2,3,7,8-TCDD (Dioxin)
Antimony
Bis(2-Ethylhexyl)phthalate
Cadmium
Diethyl phthalate
Di-n-butyl phthalate
Hexavalent chromium
Lead
Mercury
Perchlorate
PCB-1254
PCB-1260
Silver
Zinc
Soil Vapor
Benzene
Chloroform
cis-1,2 Dichloroethene
1,1,1 Trichloroethane
Trichloroethene
Tetrachloroethene

2.6 Current and Potential Future Land and Resources Uses

The Aerojet Superfund Site is designated as a Special Planning Zone (SPZ) with multiple uses from propulsion systems testing to office use. The SPZ has a provision for future development under the Sacramento County Land Use Master Plan which would allow for residential use. The contaminated soil areas of OU-5 including the carve-out property free of soil contamination, but underlain by contaminated groundwater, is proposed for development as mixed residential and commercial. The land immediately adjacent to the Site is entirely zoned as heavy and light industrial. The area further to the west and south of the El Dorado Freeway (Highway 50) is designated as an industrial-office park zone. The area north of Highway 50, south of the American River and west of Sunrise Boulevard is zoned approximately 90 percent residential and 10 percent commercial. The area to the east of Sunrise Boulevard, south of the American River and north of Highway 50 is approximately 40 percent industrial and 60 residential. The American River Flood Plain and the edges of the adjacent bluffs are designated as recreational zones. The cities of Rancho Cordova, Carmichael, Fair Oaks, Folsom and unincorporated Gold River are generally fully developed with residential, commercial and industrial properties.

The regional aquifer is extremely large and extends beyond the city of Sacramento, over 15 miles to the west. Much of the aquifer in OU-5 off Aerojet property is currently used for drinking water (Federal Groundwater Classification IIA) and demand on the aquifer is growing. The need for water around the Site is expected to increase over the next 20 years as it is developed. The contamination, if not contained, will continue to flow off the property degrading more of the drinking water aquifer.

Based on a review and analysis of GenCorp's proposed land use plans and municipal development approvals, EPA has identified planned future land uses that affect portions of the Aerojet Site within OU-5. The anticipated future uses and remedial considerations for OU-5 are outlined below.

2.6.1 Sacramento County

- GenCorp's proposed Easton Place and Glenborough at Easton Developments are located in Sacramento County and fall within the Aerojet Special Planning District. The OU-5 soils remedy will require cleanup to unrestricted future use levels, or include targeted use restrictions (e.g., deed restrictions, development standards, construction methods or engineering controls) in order to support the County-approved land uses for Easton Place and Glenborough at Easton.

- The Sacramento County Board of Supervisors approved the General Plan and Zoning Amendments, and Tentative Large and Small Lot Subdivision Maps for Easton Place and Glenborough at Easton in January 2009. (County of Sacramento Zoning Code. *Aerojet Special Planning Area.* Title V, Chapter 8, Article 3)

- County approvals for Easton Place allow for the development of a 183-acre transit-oriented community featuring high-density residential, retail and commercial office uses. High-density residential uses are approved for a portion of the Aerojet Site currently impacted by contaminated soils within OU-5.

- County approvals for Glenborough at Easton allow for a 1,200-acre mixed-use development including residential uses, a new regional town center, village centers, parks and open space, a high school and commercial uses.

2.6.2 City of Rancho Cordova

- GenCorp has submitted an application to the City of Rancho Cordova for the development of the Westborough at Easton Specific Plan (Westborough Plan).

- The proposed Westborough Plan envisions the phased development of a 1,695-acre mixed-use community with low and medium density residential uses, retail and commercial office uses, and natural preserve areas. The Westborough Plan area is primarily located within the City of Rancho Cordova's Aerojet Special Planning District; a small portion of the Westborough Plan is located in an area of Sacramento County proposed for annexation by the City of Rancho Cordova.

- The City of Rancho Cordova is in the process of completing an Environmental Impact Report for the Westborough Plan and has not yet approved the proposed land uses.

- GenCorp's Westborough Plan proposes residential and commercial uses for areas of the Aerojet Site currently impacted by OU-5 contaminated soil, specifically area C4. The OU-5 soils remedy will allow for unrestricted future use, or require targeted use restrictions (e.g., deed restrictions, development standards, construction methods or engineering controls) in order to support GenCorp's proposed Westborough Plan.

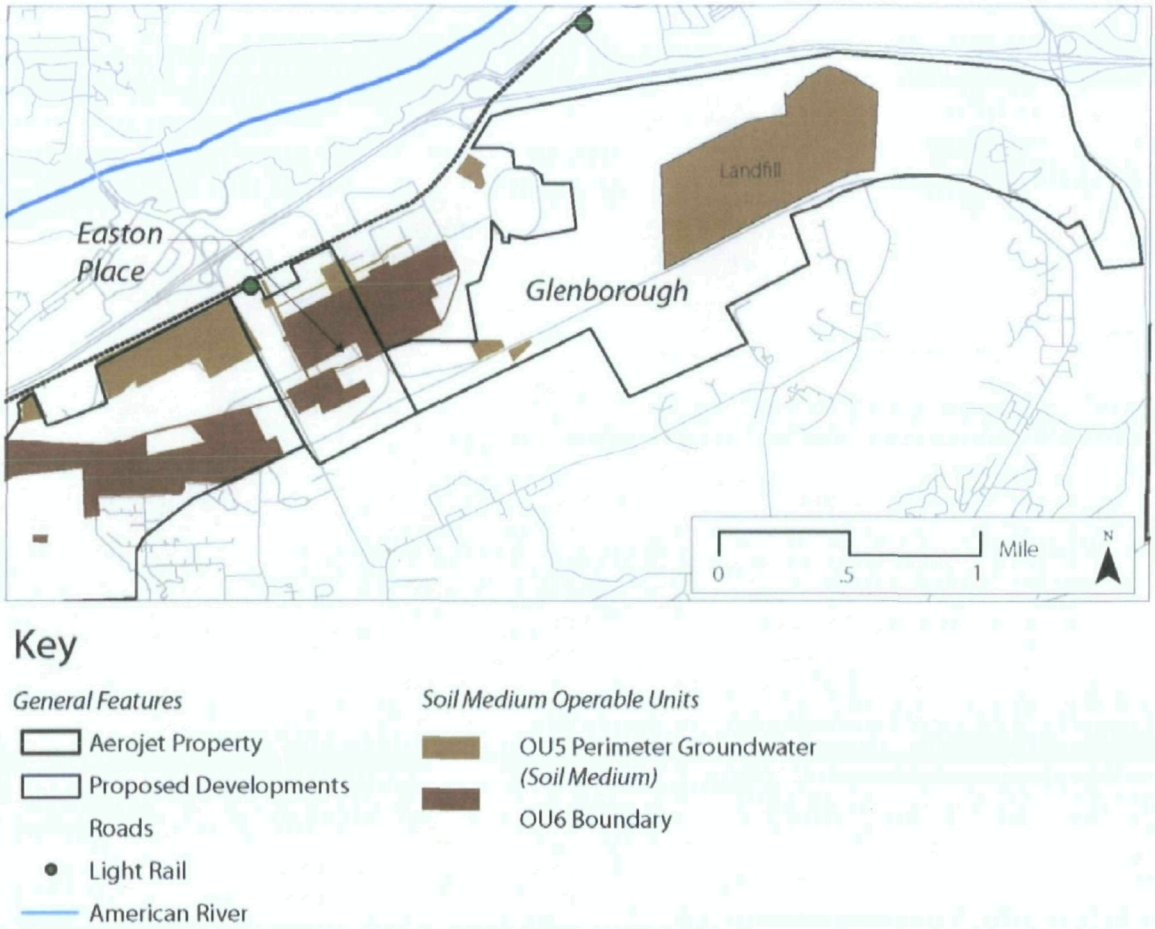


Figure 2-6 Aerojet OU-5 Land Development Plans

Key

General Features

- Aerojet Boundary
- Light Rail

Operable Units

- OU5 Perimeter Groundwater *(Soil Medium)*
- OU6 Boundary

Note: All boundaries are approximate.

Proposed Land Uses

- CMU
- Commercial
- Community Resource
- High Density Residential
- Low Density Residential
- Medium Density Residential
- Major Road
- **Office**
- Open Space
- Open Space/Alder Creek
- PQP
- Park
- Parkway
- School

Figure 2-7 Easton Development Plan

Key

General Features

- Aerojet Boundary
- Light Rail
- American River
- **Landfill**

Operable Units

- OU5 Perimeter Groundwater *(Soil Medium)*
- OU6 Boundary
- OU8 Eastern

Proposed Land Uses

- CMU
- Commercial
- Community Resource
- High Density Residential
- Low Density Residential
- Medium Density Residential
- Major Road
- **Office**
- Open Space
- Open Space/Alder Creek
- PQP
- Park
- Parkway
- School

Figure 2-8 Glenborough Development Plan

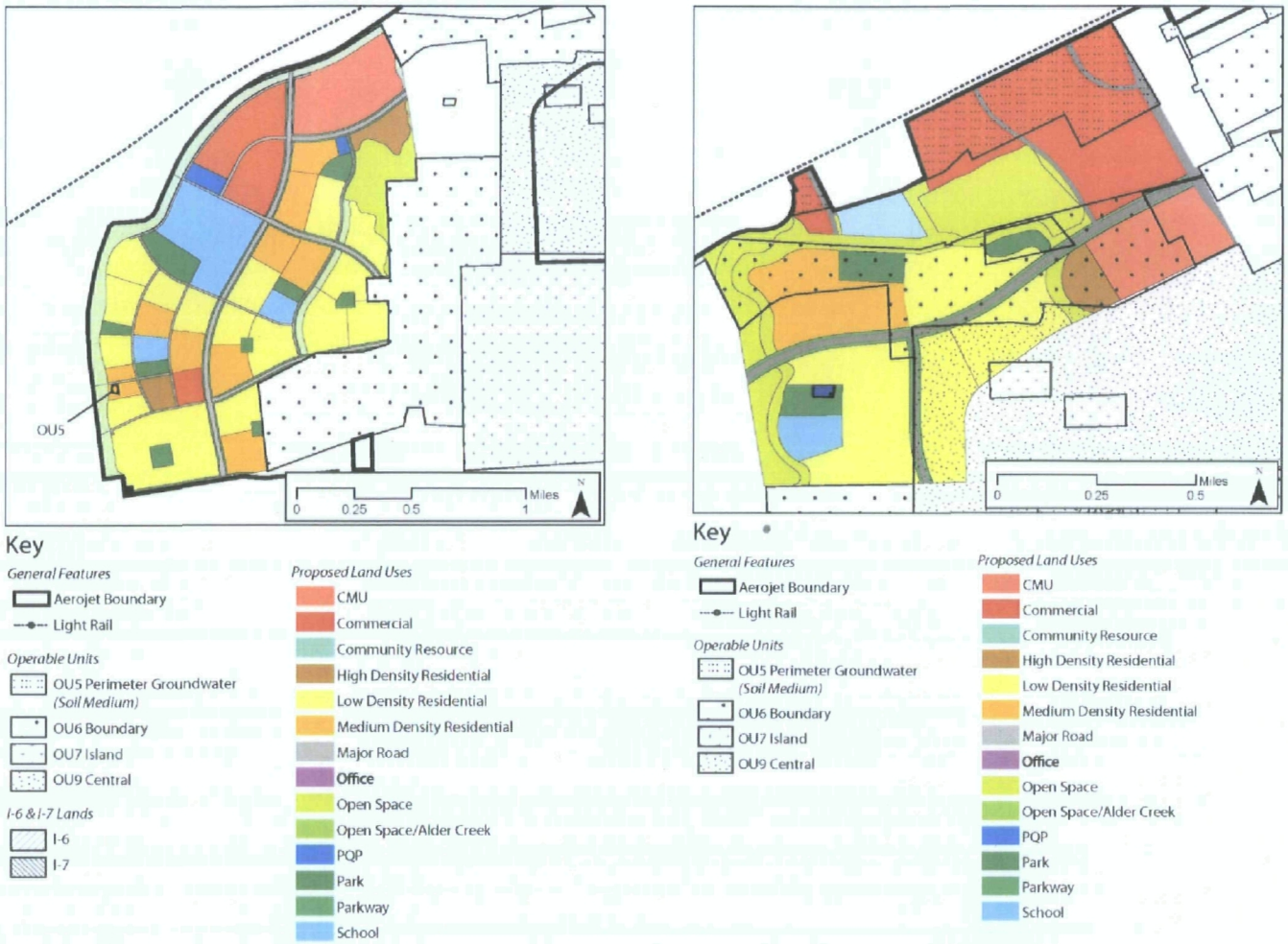


Figure 2-9 Westborough Phase 1 and Phase 2 Development Plans

2.7 Summary of Site Risks

Human health and ecological risk assessments were performed to identify and estimate potential risks to people and the environment from contamination of groundwater and soils, assuming current conditions and unrestricted future use of the contaminated soil areas within OU-5.

The Human Health Risk Assessment (HHA) assesses the human health risks from hypothetical exposure to groundwater, soil and soil vapors by future residential (both adult and child) commercial or industrial receptors if no action were taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes the results of the baseline risk assessment for the Site.

Potential risks from cancer-causing contaminants (carcinogens) are defined as the probability of a person getting cancer from a long-term exposure to those carcinogens. This probability is expressed as the number of additional cancers that might occur due to exposure to the Site's contamination. EPA's goal is to protect residents, workers and visitors at an NPL site from increased risks of cancer by keeping the risks extremely low. USEPA seeks to manage potential cancer risks so that they fall within or below a risk management range of one in ten thousand (1×10^{-4}) to one in one million (1×10^{-6}) chance of additional cancer that might occur due to exposure to the contamination. USEPA uses the 10^{-6} risk level as the point of departure for determining remediation goals when ARARs are not available or are not sufficiently protective because of the presence of multiple contaminants or multiple pathways of exposure. 40 C.F.R. § 300.430(e)(2) (2010). For contaminants that do not cause cancer but may cause other health effects (non-carcinogens), risk is expressed as a Hazard Index (HI). If the HI is less than or equal to 1.0, no adverse health effects are expected. An HI greater than 1.0 indicates an increased risk of health effects. The higher the HI, the more likely that health effects could be experienced, especially by people more sensitive to the chemical's effects.

The ecological health assessment determined there are no ecological risks within OU-5 that require action. Discharge to surface water on-Site will comply with the substantive requirements of an NPDES Permit; discharge to surface water off-Site will require an NPDES Permit.

2.7.1 Identification of Chemicals of Concern

The maximum level of contaminants of concern in any hydrostratigraphic layer on-property and off-property was used to calculate the maximum potential risk. Table 2.1 in Section 2.5.3 above provides the list of COCs for groundwater contamination and Table 2.2 lists all COCs for the soil areas in OU-5. Table 2.3 describes the specific types of COCs found in individual OU-5 soil areas.

Table 2.3 Contaminant Types in OU-5 Contaminated Soil Areas

Contaminated Soil Area	Contaminants Requiring Remedial Action – Residential Land Use	Contaminants Requiring Remedial Action – Commercial Land Use
11D	PCBs and Lead	None
10D	PCBs, Silver, Hexavalent Chromium, Mercury and Lead	PCBs
7D	VOCs	None
Former Company Store (FCS)	VOCs	VOCs
C41	Perchlorate	Perchlorate
32D	VOCs	VOCs
34D	VOCs	VOCs
35D	VOCs	VOCs
38D	VOCs	VOCs
33D	VOCs	None
C4	Dioxins/Furans and Lead	None

2.7.2 Exposure Assessment

Exposure pathways include ingestion, dermal contact while showering, and inhalation of volatiles. It was assumed that maximum contamination levels are contained in overlapping plumes (all contaminants in a layer are summed at the maximum concentration level), which may not occur at any given well. Thus, the maximum risk may be overestimated.

There is no known current use of groundwater for residential water supply from unmonitored or untreated wells either at or beyond the property boundary within OU-5. Additionally, future use of groundwater is restricted by existing institutional controls. However, recognizing the State's designation of the aquifer of OU-5 as a potential drinking water source, the analysis included the hypothetical use of untreated groundwater for residential water supply. This analysis considered hypothetical exposure to groundwater constituents via the following routes: ingestion, dermal contact, and inhalation of VOCs released during household non-ingestion use (i.e., showering, cooking, laundering, and dishwashing). Based on the hydrostratigraphic data and the detection of COPCs, the discharge of groundwater to surface water in Alder Creek and Administration Ditches was examined in the RI/FS as a potentially complete pathway in the Risk Assessment. However, exposures to constituents in Alder Creek and Administration Ditches are expected to be negligible and limited to occasional dermal contact under a recreational scenario which was evaluated in the Risk Assessment.

2.7.3 Data Evaluation

The HHA considered analytical results for all groundwater sampling conducted between January 2000 and June 2004 and supplemental data collected since then. Solvents (e.g., TCE) and rocket fuel components, including perchlorate and NDMA, are the most widely distributed chemicals in groundwater within OU-5. Other detected chemicals include tetrachloroethene (PCE); 1,2-dichloroethene (1,2-DCE); 1,1-DCE; and Freon 113.

2.7.4 Toxicity Assessment

Consistent with USEPA guidance, the noncarcinogenic effects of the COPCs were assessed by comparing the calculated chemical intakes with USEPA reference doses. Evaluation of potential cancer risk utilized slope factors published by USEPA and Cal-EPA's Office of Environmental Health Hazard Assessment. This Risk Assessment evaluated petroleum hydrocarbon mixtures through quantitative evaluation of the risks associated with exposure to petroleum constituents such as benzene, toluene, ethylbenzene, and xylenes (BTEX) and polynuclear aromatic hydrocarbons (PAHs).

2.7.5 Risk Characterization

Based on the risk analysis, the hypothetical use of untreated groundwater for residential water supply could result in unacceptable levels of risk. In addition, the HHA identified potential locations in the contaminated soil areas in which risks associated with the hypothetical or planned use of land for either residential or commercial use could result in risks greater than the 1×10^{-6} due to vapor migration from groundwater. The locations are areas 7D, 32D, 33D, 34D, 35D, 38D and FCS. In considering these findings, two points deserve emphasis: First, there is no current or likely future use of untreated groundwater for residential water supply. Second, this HHA incorporated a number of conservative assumptions to guard against the underestimation of risks. The uncertainties in risk assessment can be grouped into four main categories and include environmental sampling and analysis, fate and transport modeling, assumptions concerning exposure scenarios and toxicity data and dose response extrapolations.

For carcinogens, risks are generally expressed as the incremental probability of an individual's developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated from the following equations:

$$\text{Risk} = \text{CDI} \times \text{SF}$$

Where: Risk = a unitless probability (e.g., 2×10^{-5}) of an individual's developing cancer
CDI = chronic daily intake averaged over 70 years (mg/kg-day)
SF = slope factor, expressed as (mg/kg-day)-1

The risks are probabilities that usually are expressed in scientific notation (e.g., $1x10^{-6}$). An excess lifetime cancer risk of $1x10^{-6}$ indicates that an individual experiencing the reasonable maximum exposure estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an excess lifetime cancer risk because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual's developing cancer from all other causes has been estimated to be as high as one in three. USEPA's generally accepted risk range for site-related exposures is 10^{-4} to 10^{-6}. USEPA uses the 10^{-6} risk level as the point of departure for determining remediation goals when ARARs are not available or are not sufficiently protective because of the presence of multiple contaminants or multiple pathways of exposure. 40 C.F.R. § 300.430(e)(2) (2010).

The potential for non-carcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., life-time) with an RfD derived for a similar exposure period. An RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ less than one indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic non-carcinogenic effects from that chemical are unlikely. The hazard Index (HI) is generated by adding HQs for all chemicals of concern that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. An HI less than one indicates that, based on the sum of all HQ's from different contaminants and exposure routes, toxic non-carcinogenic effects from all contaminants are unlikely. An HI greater than one indicates that site-related exposures may present a risk to human health. The HQ is calculated from the following equation:

Non-cancer HQ = CDI/RfD

Where: CDI = Chronic daily intake
RfD = Reference dose

Some uncertainty is inherent in risk assessments. Uncertainty exists in the exposure assessment, toxicity values, and the risk characterization. In the human health risk assessment, exposure and the toxicity assessments are the largest sources of uncertainty and variability. For the exposure assessment, there is uncertainty in risk estimates because of 1) the use of the maximum detected concentrations for all COCs in each hydrostratigraphic layer during the RI/FS, 2) the use of upper-bound values for ingestion, inhalation, and dermal contact rates, and 3) the use of default values for exposure duration that are likely to overestimate exposures.

2.7.5.1 Groundwater

The HHA concluded that contaminated groundwater exceeds drinking water standards within the plume shown on Figure 2-2 (page 8) and the figures in Appendix B. The HHA also concluded that groundwater contamination must be contained to prevent further contamination of the existing drinking water aquifer. The three most prevalent contaminants detected in the

groundwater are perchlorate, NDMA and TCE. (See Table 2.1 for the list of all groundwater contaminants detected.) These were found in all four zones of OU-5, with the exception of NDMA, which is found in all zones except zone 2. The cancer risk for all four zones exceeds EPA's target risk range as shown in Table 2.5. The cancer risks in Zones 1 and 2 exceed 10^{-3} and in Zones 3 and 4 the maximum cancer risks exceed 10^{-2}. The non-cancer HIs exceed 1000 in Zones 1, 2 and 4, and the HI is well over 100 in Zone 4 (See Table 2.6). Remedial action to prevent further contamination and expedite final cleanup of the drinking water aquifer is justified by the potential risks.

Table 2.4 Detailed Groundwater Risk Values for All Zones and Layers

Layer	Property Boundary		Beyond Property Boundary	
	Total Lifetime Cancer Risk	Hazard Index (Child)[1]	Total Lifetime Cancer Risk	Hazard Index (Child)[1]
Zone 1				
B	7×10^{-4}	710	3×10^{-5}	1.1
C	1×10^{-3}	4,300	2×10^{-3}	870
D	9×10^{-3}	2,300	4×10^{-3}	700
E	1×10^{-3}	360	2×10^{-3}	400
F	2×10^{-5}	2	2×10^{-4}	16
Zone 2				
A	4×10^{-4}	430	NA	
B	3×10^{-3}	4,000	NA	
C	5×10^{-3}	47,000	NA	
D	1×10^{-5}	440	NA	
Zone 3				
A			NA	110
B	4×10^{-2}	650	2×10^{-3}	110
C	8×10^{-2}	1,400	1×10^{-1}	1,600
D	5×10^{-2}	820	9×10^{-2}	1,200
E	5×10^{-2}	570	4×10^{-2}	470
F	6×10^{-2}	640	5×10^{-2}	610
Zone 4				
Dredged	6×10^{-5}	17	NA	
A	4×10^{-2}	590	NA	
B	2×10^{-4}	8.3	NA	

[1] HIs have been summed across all target endpoints and are presented for the most sensitive population (children).
NA = Not Applicable

Table 2.5 Risk Characterization Summary - Carcinogens in Groundwater

Scenario Timeframe: Current Receptor Population: Resident Receptor Age: Adult + Child

Medium	Exposure Medium	Exposure Pt.	COC	Carcinogenic Risk			
				Ingestion	Inhalation	Dermal	Exposure Routes Total
GW	GW	Tap Water	Perchlorate	-	-	-	-
GW- Zone 1	GW	Tap Water	NDMA	-	-	-	-
GW- Zone 2				-	-	-	-
GW- Zone 3				2.3E-02	-	4 E-05	2.3E-02
GW- Zone 4				2.4E-03	-	4 E-06	2.4E-03
GW- Zone 1	GW	Tap Water	TCE	4.5E-05	2.1E-04	4.1E-04	2.9E-04
GW- Zone 2				4.5E-05	2.1E-04	4.1E-04	2.9E-04
GW- Zone 3				4.5E-06	2.1E-05	4.1E-06	2.9E-05
GW- Zone 4				4.5E-06	2.1E-05	4.1E-06	2.9E-05
- = Toxicity criteria not available to quantitatively address this route of exposure.					Maximum Total Risk		2.3E-02

Risk Characterization

This table provides the cancer risk estimates for the significant routes of exposure from the primary contaminants on OU-5 groundwater. These risk estimates are based on a reasonable maximum exposure using recent data used for the chemical-specific plume maps in Appendix B and were developed by taking into account various conservative assumptions about the frequency and duration of exposure.

NDMA toxicity from Provisional Peer Reviewed Toxicity Values; TCE toxicity values from California EPA

Table 2.6 Risk Characterization Summary – Non-Carcinogens in Groundwater

Scenario Timeframe: Current Receptor Population: Resident Receptor Age: Adult + Child

Medium	Exposure Medium	Exposure Pt.	COC	Non-Carcinogenic Risk – Hazard Quotient			
				Ingestion	Inhalation	Dermal	Exposure Routes Total
GW- Zone 1	GW	Tap Water	Perchlorate (Thyroid)	1.5	-	-	1.5
GW- Zone 2				20	-	-	20
GW- Zone 3				20	-	-	20
GW- Zone 4				2.5	-	-	2.5
GW- Zone 1	GW	Tap Water	NDMA	ND	-	-	ND
GW- Zone 2				ND	-	-	ND
GW- Zone 3				330	-	-	330
GW- Zone 4				34	-	-	34
GW	GW	Tap Water	TCE	-	-	-	-
						Groundwater Hazard Quotient Total	350

- = Toxicity criteria not available to quantitatively address this route of exposure.
ND –Not detected

Risk Characterization
This table provides non-cancer risk estimates for the significant routes of exposure from the primary contaminants on OU-5 groundwater. These risk estimates are based on a reasonable maximum exposure using recent data, and information from the chemical-specific plume maps in Appendix B. The maximum total Hazard Quotient is from Zone 3, although all Zones had HQs greater than the Hazard Index of 1.0.
Perchlorate toxicity from IRIS; NDMA toxicity from Provisional Peer Reviewed Toxicity Values; TCE toxicity values from California EPA

The containment levels for the COCs for OU-5 groundwater and the basis for establishing these containment levels are listed in the Table 2.7 Table 2.8 lists the residual risks for groundwater calculated at the groundwater containment levels. More detailed rationales for these levels are as follows:

- Perchlorate: The containment level selected for perchlorate is 6 ppb (6 µg/L). This is the drinking water standard (MCL) promulgated by the State of California in 2006. In January 2009, USEPA issued an Interim Health Advisory for perchlorate to assist state and local officials in addressing local contamination of perchlorate in drinking water while the Agency evaluates the opportunity to reduce risks through a national primary drinking water standard. The USEPA Interim Drinking Water Health Advisory level was published as 15 µg/L. This advisory level is not a promulgated standard. The California MCL is a promulgated standard and USEPA believes it is relevant and appropriate as the containment level.

- NDMA: The containment level selected for NDMA is 0.003 µg/L or 3 parts per trillion (ppt). There is no California or federal Maximum Contaminant Level (MCL) for NDMA. In 2006, the California Office of Environmental Health Hazard Assessment (OEHHA) developed a Public Health Goal (PHG) of 0.003 µg/L or 3 ppt for NDMA in drinking

water. The PHG is based on an extra cancer risk of 1 in 1 million (10^{-6}) for lifetime exposure to NDMA in drinking water. The California Notification Level (previously known as Action Level) for NDMA is 0.01 µg /L. Notification levels are defined by DHS as "health-based advisory levels established by DHS for chemicals in drinking water that lack maximum contaminant levels (MCLs)." Carcinogenic effects observed in animal studies were judged to be the most sensitive endpoint and are the basis of the PHG for NDMA. NDMA is one of over 100 nitrosamines, many of which have been shown to be carcinogenic by genotoxic mechanisms. There is a high cumulative risk because there are eight other carcinogens in the mix of COCs. In addition there is a relative source contribution to be considered because of the presence of NDMA in our dietary intake (e.g., bacon, beer, etc.). USEPA has published a Regional Screening Level (RSL) of 0.42 ppt. Based on the USEPA IRIS oral carcinogenic slope factor, the cancer risk at 3 ppt would be about 4×10^{-6}. Although the California PHG of 3 ppt is not a promulgated standard, USEPA this PHG is protective and should be used as the containment level.

- TCE and Other COCs: The containment level selected for TCE is the MCL of 5 ppb (5 µg/L). The groundwater containment levels for the remaining COCs such as the VOCs are also based on MCLs. For contaminants with federal or state MCLs, USEPA maintains a general policy of establishing Superfund groundwater cleanup or containment standards at the MCL. USEPA notes that the federal MCL establishes a maximum limit of 80 µg/L for the sum of the concentration of all four major trihalomethanes (chloroform, bromodichloromethane, dibromochloromethane, and bromoform). The total limit had not been clear in a table of containment levels included in the Proposed Plan fact sheet. When the maximum total risk at the MCL for trihalomethanes is considered, the cumulative cancer risk would remain within the acceptable risk range in OU-5 if all COCs were at the containment levels. Since TCE, NDMA and perchlorate are the major groundwater contaminants, it is expected that few if any of the other COCs in groundwater will be at the containment level when the primary contaminants reach containment goals. The State and other commenters expressed a preference for considering certain state and local policies that require more stringent non-promulgated standards for use of groundwater for public supply. However, the groundwater remedy for OU-5 is an interim rather than final remedy and USEPA is not setting numeric cleanup goals for the groundwater in the aquifer at this time. Coordination and integration of USEPA's containment and the State's remediation efforts and cleanup objectives for IRCTS and White Rock Road North Dump will be reviewed in the final Sitewide remedy selection. USEPA will evaluate final aquifer cleanup levels during the Sitewide remedy selection process. An evaluation of the effectiveness of the OU-5 groundwater remedy during the five year reviews will need to address these issues.

Table 2.7 Groundwater Chemicals of Concerns with Containment Levels for OU-5

Chemicals of Concern in Groundwater	Containment Level (micrograms per liter or ppb)	
Non-Metal Anion		
Perchlorate	6	CA Drinking Water Standard (MCL)
SVOCs		
N-Nitrosodimethylamine (NDMA)	0.003	CA Public Health Goal
VOCs		
Trichloroethene (TCE)	5	Federal MCL
1,1,2,2-Tetrachloroethane	1	CA MCL
1,1,2-Trichloroethane	5	Federal MCL
1,1-Dichloroethene	6	CA MCL
1,2-Dichloroethane	0.5	CA MCL
cis-1,2-Dichloroethene	6	CA MCL
trans- 1,2-Dichloroethene	10	CA MCL
1,4-Dioxane	1	CA DPH Notification Level
Bromodichloromethane*	80*	Federal MCL
Carbon tetrachloride	0.5	CA MCL
Chloroform*	80*	Federal MCL
Dibromochloromethane*	80*	Federal MCL
Methylene chloride	5	Federal MCL
Tetrachloroethene	5	Federal MCL
Vinyl chloride	0.5	CA MCL

* The federal MCL establishes a limit of 80 µg/L for the sum of the concentration of all four major trihalomethanes: chloroform, bromodichloromethane, dibromochloromethane, and bromoform.

Table 2.8 Risks Associated with Containment Levels for Chemicals of Concern (COC) in Groundwater at Aerojet OU-5

COC	Containment Level	Basis for Containment Level	Risk at Containment Level
Perchlorate	6.0 ppb	MCL California	Non-carcinogenic risk (NCR) Hazard index (HI) = 1
NDMA[1]	.003 ppb[1]	California Public Health Goal	Cancer risk $1x10^{-6}$ (see footnote)
Trichloroethene	5 ppb	Max. Contaminant Level (MCL) USEPA & California	Cancer risk $2.4x10^{-6}$
1,1,2,2-Tetrachloroethane	1 ppb	MCL California	Cancer risk $1x10^{-6}$
1,1,2-Trichloroethane	5 ppb	MCL USEPA & California	Cancer risk $1.8x10^{-5}$
1,1-Dichloroethene	6 ppb	MCL California	NCR, HI= 0.009
1,2,-Dichloroethane	0.5 ppb	MCL California	Cancer risk $2.9x10^{-6}$
cis 1,2-Dichloroethene	6 ppb	MCL California	NCR, HI = 0.3
trans 1,2-Dichloroethene	10 ppb	MCL California	NCR, HI = 0.3
1,4 -Dioxane	1 ppb	California DPH Notification Level	HI = 1
Bromodichloromethane*	80 ppb*	MCL USEPA	Cancer risk $6.7x10^{-4}$
Carbon Tetrachloride	0.5 ppb	MCL California	Cancer risk $2.3x10^{-6}$
Chloroform*	80 ppb*	MCL USEPA	Cancer risk $4.2x10^{-4}$
Dibromochloromethane*	80 ppb*	MCL USEPA	Cancer risk $5.3x10^{-4}$
Methylene Chloride	5 ppb	MCL USEPA	Cancer risk $1x10^{-6}$
Tetrachloroethene	5 ppb	MCL USEPA & California	Cancer risk $4.5x10^{-5}$
Vinyl Chloride	0.5 ppb	MCL California	Cancer risk $2.2x10^{-5}$

Notes: [1] Cancer risk estimated by California OEHHA 2006. The NDMA PQL is being improved. The current enforceable level is greater than 3 ppt. Best available monitoring method technology shall be used until a PQL of 3 ppt or lower is achieved.

* The federal MCL establishes a limit of 80 µg/L for the sum of the concentration of all four major trihalomethanes: chloroform, bromodichloromethane, dibromochloromethane, and bromoform.

Although the national Superfund policy is to establish groundwater cleanup or containment levels at the MCL, the toxicological information for contaminants of concern will continue to be developed over time. The five year review process reviews new information relevant to protection of public health and explicitly considers any new regulations promulgated since the ROD.

2.7.5.2 Surface and Subsurface Soil Contamination

The potential soil sources that were investigated are shown on Figure 2-3 on page 9. The majority of the locations were not contaminated above health based levels for unrestricted use such as residential development. Eleven soil areas were found to be contaminated with one or more chemicals of concern (Tables 2.2 and 2.3). The HHA found that further action is required at these 11 locations to protect residents or workers from exposure through direct contact, ingestion and/or inhalation of COCs. The contaminants found in these areas include lead, zinc, cadmium, polychlorinated biphenyls (PCBs), dioxins, furans, chloroform and TCE. The maximum concentrations of soil contaminants found in each area are listed in Table 2.9. The maximum measured soil vapor levels are listed in Table 2.10, along with the risk levels for that soil vapor level. Table 2.11 shows the cleanup goals and performance standards in soils for each COC based on the lowest cancer or non-cancer risks for potential land uses (residential or commercial). In some cases, cadmium and chromium contamination in the soil could be of concern for construction workers at the Site. The HHA concluded that remedial action for the vadose zone was justified in areas 32D, 34D, 35D and 38D (Figure 2-3) because the contaminants exceeded EPA's target risk range for protection from inhaling VOCs and the HI for the contaminants present were significantly over 1. Table 2.12 shows the vapor performance standards and risk basis for ambient air in the soil areas with VOC vapor levels exceeding the risk range for residential or industrial uses. The HHA identified three areas (7D, 33D and FCS) where VOCs were measured in soil gas exceeding EPA's target risk range.

Table 2.9 – Maximum Chemical Concentrations in Soil by Area, reported in milligrams per kilogram (mg/kg)

	Area 20				Area 49					
Chemical	**7D**	**10D**	**11D**	**C41**	**32D**	**33D**	**34D**	**35D**	**38D**	**C4**
2,3,7,8-TCDD (Dioxin)	--	--	--	--	--	--	--	--	--	3.5 E-7
Antimony	<5	<24	1 J	12 J	<1.2	<5	--	<6	--	1.7
Bis(2-Ethylhexyl)phthalate	--	0.049 J	--	<0.6	0.170 J	0.045 J	--	0.065 J	<0.0093	--
Cadmium	2.56	4.58	3.89	<1	<0.49	9.1	--	1.7	--	4.9
Diethyl phthalate	--	<0.33	--	0.190 J	0.051 J	0.2 J	--	0.058 J	0.33	--
Di-n-butyl phthalate	--	--	--	--	<0.012	<0.012	--	<0.012	<0.012	--
Hexavalent chromium	--	11.7	0.74	--	0.88	--	--	--	--	1.1
Lead	125	130	288	99.2	9.2	10.9	--	8.97	--	530
Mercury	3.07	1.9	0.34	0.061	0.13	<0.1	--	0.2	--	0.043
Perchlorate	--	--	--	1.9	--	--	--	--	--	--
PCB-1254	--	0.5	<0.033	--	--	--	--	--	--	--
PCB-1260	--	1.2	0.15	--	--	--	--	--	--	--
Silver	18.8	29	1.16	0.56	<0.34	<1	--	<1	--	<0.66
Zinc	1150	1700 J	2960	44.5	230	54.8	--	135	--	1000

--: The chemical not analyzed. <: The chemical not detected above the value. Soil vapor only was detected in area

34.

Table 2.10 Risk Characterization Summary – Soil Vapor at Contaminated Soil Areas

Contaminated Soil Area	Chemical of Concern Measured Above Screening Level	Soil Vapor Screening Level* mg/m³	Maximum Measured Concentration in mg/m³	Estimated Risk for Unrestricted Use
7D	Tetrachloroethene (PCE)	0.64	2.1	3.3E-06 Cancer Risk
FCS	Chloroform (CF)	0.7	0.92	1.3E-06 Cancer Risk
	PCE	0.64	7.6	1.2E-05 Cancer Risk
33D	CF	0.08	6.0	7.5E-05 Cancer Risk
	Trichloroethene (TCE)	0.96	4.1	4.3E-06 Cancer Risk
	Benzene	0.08	0.29	3.6E-06 Cancer Risk
34D	CF	0.08	0.22	2.8E-06 Cancer Risk
	PCE	0.32	5.0	1.6E-05 Cancer Risk
	1,1,1 Trichloroethane	0.12	0.5	HQ=4.2 non-cancer
	TCE	0.96	17	1.8E-05 Cancer Risk
35D	PCE	0.32	2.0	6.3E-06 Cancer Risk
	TCE	0.96	3.2	3.3E-06 Cancer Risk
38D	Cis-1,2 Dichloroethene	3.7	7.1	HQ=1.9 non-cancer
	PCE	0.32	40	1.3E-04 Cancer Risk
	1,1,1 Trichloroethane	0.12	2.4	HQ=20 non-cancer
	TCE	0.96	240	2.5E-04 Cancer Risk
	Benzene	0.08	0.15	1.9E-06 Cancer Risk

*Conservative estimated attenuation factor applied to RSLs to develop soil vapor screening level

Perchlorate in the soil at C41 poses a potential risk for both surface exposure and transport into the groundwater. Excavation of the surface soil to at least ten feet and replacement with clean soil will be protective from surface exposure for unrestricted use. However the highly soluble perchlorate remaining below the excavated depth could potentially flush into the groundwater. USEPA assessed a range of site-specific conditions and determined that the groundwater containment remedy would adequately address the perchlorate potentially transported to the

groundwater. At the most rapid transport rate, with relatively high flushing of water through the soil column, the groundwater concentration would be severely impacted for approximately ten years during which period the groundwater remedy would contain and remediate the perchlorate. At progressively slower rates of flushing, the impact on groundwater is reduced while remaining contained by the groundwater remedy. The groundwater downgradient from C41 will be monitored, and the protectiveness of the groundwater from contaminants remaining at C41 will be evaluated in the final Sitewide remedy selection process.

Table 2.11 Risk Basis for Performance Standards in OU-5 Surface Soil.

Chemical	Unrestricted Use Level (Residential Use)		Restricted Use (Commercial Use)	
	Soil concentration mg/kg soil	Risk basis	Soil concentration mg/kg soil	Risk basis
2,3,7,8-TCDD (Dioxin)	3.9E-06	Cancer	1.6E-05	Cancer
Antimony	31	Non-cancer	120	Non-cancer (construction worker)
Bis(2-Ethylhexyl)phthalate	35	Cancer	123	Cancer
Cadmium	48	Cancer (construction worker)	48	Cancer (construction worker)
Diethyl phthalate	49,000	Non-cancer	186,000	Non-cancer (construction worker)
Di-n-butyl phthalate	6,110	Non-cancer	23,280	Non-cancer (construction worker)
Hexavalent chromium	1.4	Cancer (construction worker)	1.4	Cancer (construction worker)
Lead	127	Non-cancer	531	Non-cancer (construction worker)
Mercury	23.5	Non-cancer	84	Non-cancer (construction worker)
Perchlorate*	55	Non-cancer	210	Non-cancer (construction worker)
PCB-1254	0.09	Cancer	0.3	Cancer
PCB-1260	0.09	Cancer	0.3	Cancer
Silver	390	Non-cancer	1,500	Non-cancer (construction worker)
Zinc	23,400	Non-cancer	90,000	Non-cancer (construction worker)

*Perchlorate cleanup goal for protection of groundwater quality is 0.06 mg/kg soil.

Table 2.12 Risk Basis for Performance Standards for Ambient Air Vapor Levels of VOC Chemicals of Concern at Aerojet Soil Areas, protective of residential and industrial inhalation risk. Protective soil vapor levels in subsurface soil are decreased by location- and depth-specific attenuation factors.

Chemical	Unrestricted Use Level (Residential Use)		Restricted Use (Industrial Use)	
	Soil Vapor Health-Based Levels µg /m^3 soil	Risk basis	Soil Vapor Health-Based Levels µg /m^3 soil	Risk basis
Benzene	3.1E-01	Cancer 10^{-6} risk level	1.6	Cancer 10^{-6} risk level
Chloroform	1.1E-01	Cancer 10^{-6} risk level	5.3E-01	Cancer 10^{-6} risk level
cis-1,2 Dichloroethene	1.1E02	Non-cancer	2.1E-01	Non-cancer
1,1,1 Trichloroethane	5.2E03	Non-cancer	2.2E04	Non-cancer
Trichloroethene	1.2	Cancer 10^{-6} risk level	6.1	Cancer 10^{-6} risk level
Tetrachloroethene	4.1E-01	Cancer 10^{-6} risk level	2.1	Cancer 10^{-6} risk level

2.7.4 Summary of Ecological Risk Assessment

2.7.4.1 Summary of Ecological Risk Assessment- Groundwater

The results of the OU-5 RI indicated that Alder Creek in Zone 4 is the only surface water feature that supports ecological receptors that could potentially receive discharge from OU-5 groundwater. The analysis of surface water samples collected from Alder Creek as part of the RI detected trace concentrations of acetone, chloromethane, naphthalene, perchlorate, NDMA, and various metals. Screening of these detected constituents against conservative ecological screening levels identified barium, boron, cadmium, manganese, and selenium as COPCs. Further evaluation indicated that the presence of those metals in Alder Creek did not appear to be site related and/or did not pose a potential risk to aquatic receptors.

A bioassessment of Alder Creek was also performed to further evaluate the potential effects on biota from the discharge of impacted groundwater in Zone 4. The bioassessment involved the collection, identification, and comparison of benthic macroinvertebrates (BMI) at three locations along Alder Creek. The bioassessment found that, in general, the BMI communities at the three locations were not substantially different and did not indicate a potential for site related impact. Minor variations in the BMI communities appear due to physical characteristics of the stream such as shading and sediment compaction. The results of the screening and bioassessment identified no specific impacts related to the Site, and therefore, no further sampling or ecological risk assessment was warranted.

Any discharge of remediated groundwater to surface water on-Site will meet the substantive requirements of an NPDES Permit or, if discharged off-Site, will require an NPDES Permit so that the discharge does not pose a threat to ecological receptors.

2.7.4.2 Summary of Ecological Risk Assessment - Contaminated Soil Areas

Using conservative procedures, there is a potential for contaminants in soil even in the largely disturbed areas to pose an adverse risk to ecological receptors under the exposure conditions assumed at several of the contaminated soil areas including FCS. However, the RI indicated a current lack of suitable habitat in impacted areas and exposure of the ecological receptors to elevated background levels of COPCs that are not associated with OU-5 releases. As a result, the ecological risk assessment concluded that no significant future ecological risk is likely.

2.8 Remedial Action Objectives

The Remedial Action Objectives (RAOs) describe what the proposed Site remediation effort is expected to accomplish. The containment levels for groundwater (Table 2.2) are based on Federal EPA Maximum Contaminant Levels (MCLs) for drinking water or on California MCLs, whichever is lower. Neither an MCL nor a Federal Public Health Advisory level has been established for NDMA, so the containment level for NDMA is the California Public Health Goal. Since 1,4-dioxane also has no MCL, the containment level for 1,4-dioxane is set at California Department of Public Health's Notification Level of 1 ppb for drinking water established in November 2010, which takes into account the 2010 federal risk evaluation for 1,4-dioxane. The current RSL corresponding to a 10^{-6} risk is 0.67 ppb. These groundwater containment levels ensure that public health and the environment are protected. For contaminated soil, the action objectives are based on Site-specific potential exposure information as used in the HHA and on current values for the hazards posed by the chemicals of concern. The soil action levels (Tables 2.11 and 2.12) are calculated to reduce human health risks to protective levels for unrestricted future land use.

2.8.1 Interim Groundwater RAOs

The remedial action for OU-5 is an interim remedy for the groundwater areas in OU-5 since the groundwater remedy is dependent on control of source areas in other OUs still in the Remedial Investigation/ Feasibility Study (RI/FS) phase. The OU-5 groundwater remedy does not establish final cleanup levels for restoration of the contaminated aquifer. These will be selected in the final Sitewide ROD. Complete cleanup of the entire Aerojet Superfund Site will require coordination of all seven groundwater and source operable units.

Specifically, the groundwater RAOs for OU-5 are as follows:

- Protect human health and the environment by preventing exposure to contaminated

groundwater through restricting withdrawal of the water within the containment area for purposes other than remediation;

- Achieve containment of the contaminated groundwater that exceeds the groundwater containment standards to prevent future migration of contaminants until cleanup levels are achieved to protect long-term beneficial uses of the groundwater;

- Remove contaminant mass from the aquifer through extraction and treatment of highly contaminated groundwater at or near the upgradient portions of the OU-5 groundwater zones. This action will improve the efficiency and effectiveness of contaminant containment of OU-5 groundwater.

2.8.2 Surface and Subsurface Contaminated Soil RAOs:

This action is the final remedy for cleanup of contaminated soil areas included in OU-5 through the PCD as modified in 2002. The RAOs are as follows:

- Eliminate exposure to concentrations of pollutants in soils and related drainage ditch sediments that pose an unacceptable risk for present and future occupants of the property and ecological receptors on the property;

- Prevent migration of VOCs and perchlorate in the soil that would impact long-term beneficial uses of groundwater;

- Control perchlorate in subsurface soil below the depth that can be removed by excavation, which may migrate to the shallow groundwater, through containment of the OU-5 groundwater;

- Prevent exposure to VOCs in soils or soil vapor exceeding the EPA health-based ambient air screening levels for residential land use. Potential exposure pathways include inhalation (breathing), ingestion and skin contact. Where commercial or industrial cleanup criteria are used, the land will be restricted to commercial or industrial use through a land use covenant.

2.9 Description of Alternatives: Summary of Remedial Alternatives

EPA is required by law to consider a No Action alternative and to evaluate viable cleanup or containment alternatives against nine criteria. The OU-5 soil and groundwater alternatives were compared against all of the nine evaluation criteria including community acceptance, which was solicited during the public comment period. For an alternative to be considered as a possible final remedy, it must meet EPA's two threshold criteria which are (1) to protect human health and the environment and (2) to comply with specific state and federal regulations known as Applicable or Relevant and Appropriate Requirements (ARARs). The No Action alternative for both soil and groundwater for OU-5 is not a viable remedy alternative because it does not meet either of EPA's

threshold criteria. Groundwater Alternatives in Zones 1 through 4 were each evaluated to determine if additional groundwater control was needed. The RI determined that each of the four zones required action to protect public water supplies. The FS assessed a range of possible actions in each zone needed to prevent further spread of groundwater contamination (Groundwater Containment) and additional steps to control elevated concentrations of groundwater contamination in order to improve containment efficiency and to expedite the remedy (Groundwater Containment with Mass Removal).

2.9.1 Description of Groundwater Remedy Components

Interim groundwater containment alternatives were consolidated into three alternatives 1) No Action; 2) Groundwater Containment Alternatives; and 3) Groundwater Containment with Mass Removal (EPA's preferred alternative). Each alternative requires thorough groundwater monitoring and evaluation to ensure that the containment is effective and protective, and institutional controls on groundwater extraction and use. The no action alternative would be neither effective nor protective. Both Groundwater Containment and Containment with Mass Removal alternatives involve the pumping of sufficiently large volumes of contaminated water to prevent the spread of contaminants above the containment levels into uncontaminated areas. It is estimated that either of these alternatives will pump between 10 and 15 million gallons of groundwater each day. The water will be piped to one of several treatment systems (see Figure 2-2) where a series of standard, reliable treatment systems will remove the various contaminants. The treated water may be used for non-potable purposes such as industrial cooling or discharged to surface water or land. Aerojet may provide the extracted water to drinking water providers for treatment for potable or non-potable uses. The water providers are subject to federal drinking water standards as well as California Department of Public Health, Division of Drinking Water and Environmental Management requirements. If treated water will be discharged on-Site, it will comply with the substantive requirements of an NPDES permit for surface water discharge or waste discharge requirement for discharges to land which are the same as the numerical water quality standards of the NPDES (see Table 2.8); off-Site discharge will require an NPDES permit. Treated water used for non-potable purposes must comply with all applicable regulations. Many of the details, such as monitoring design, final well location and pumping rates, will be determined in the design phase of the project. The value and demands for water supply for any of the end use options will change over the duration of the remedy, as will the various technical, logistical and administrative challenges. The selected remedy considers the listed range of uses and discharges to be acceptable. Selection of a particular end use or uses for the treated groundwater may be developed during the design phase of the remedy and may change over time based on the external factors.

USEPA typically uses an estimated 30-year cost to be able to evaluate options with varying capital and operation & maintenance (O&M) costs with a comparison of current net worth. The estimated 30-year cost for the Groundwater Containment alternative is $57 million. The Groundwater Containment with Mass Removal alternative includes additional extraction of more highly contaminated groundwater nearer the source areas to reduce the mass of contaminants more effectively. The estimated 30-year cost for Groundwater Containment with Mass Removal is over $61 million.

2.9.2 Description of Contaminated Soil Areas Remedy Components

More than 25 soil areas of potential concern in OU-5 were investigated (See Figure 2-3 on page 9). Fourteen of the 25 soil areas tested met residential use requirements. Of the 11 contaminated soil areas, some form of remedial action is required to allow the land to be developed. All options require careful and thorough soil sampling and monitoring of VOC vapor extraction and mitigation to ensure effectiveness and protectiveness. The 11 contaminated soil locations have a range of different contaminants that may be addressed effectively by different alternatives. Of the many alternatives considered, the most viable options were:

- Excavation (physical removal) of the contaminated surface soil to a minimum ten foot depth unless the cleanup levels are reached at a shallower depth, with various disposal options: disposal in an approved landfill, treatment and recycling as fill material, solidification/stabilization and biological treatment (for perchlorate). The ten foot minimum excavation requirement is based on the depths to which residential excavation would normally occur, in order to eliminate current and future exposure to surface materials and eliminate restrictions on disposal or use of surface soil excavated during and after land reuse. During the design phase, deeper excavation may prove feasible;

- Containment with an impermeable asphalt or membrane cap;

- Soil vapor extraction to remove VOCs without excavation;

- Vapor mitigation to reduce or prevent VOC intrusion into buildings through vapor barriers (synthetic membrane) and subslab venting systems and/or subslab depressurization systems;

- Institutional Controls such as deed notification to inform future owners of the presence of potentially hazardous substances at the Site and /or deed restriction to restrict future use of Site; and,

- Biological treatment of deeper perchlorate-contaminated soil using a method under development at the Site.

2.9.3 Summary of Remedy Alternatives

The alternatives for this remedial action are assembled from technologies screened in the RI/FS. The alternatives have been evaluated against EPA's nine evaluation criteria, including community acceptance which was evaluated through review of community responses to the proposed plan for OU-5.

2.9.3.1 Groundwater

Federal regulations require that Superfund remedies remain protective of human health and the environment and minimize untreated waste. EPA expects to use treatment to address the principal threats and to use engineering controls such as containment for relatively low long-term threats or where complete treatment is impracticable. Institutional controls, such as restrictions on land or water use, may be used to supplement treatment and engineering controls as appropriate for long-term management but are not substitutes for practicable active response measures. EPA regulations also anticipate prevention of further exposure to contaminants and spread of the contaminant plume as well as returning groundwater to beneficial uses within a timeframe that is reasonable, given the particular circumstances of the site. The OU-5 groundwater action is an interim remedy for containment of contaminated groundwater, with the final aquifer restoration goals to be evaluated in the final Sitewide remedy selection process. The evaluation of OU-5 groundwater remedy alternatives is presented in Table 2.13. Containment with Mass Removal is expected to maintain a more consistent and lower concentration of contamination at the outer containment line, improving the reliability of the hydraulic containment and treatment systems. Extraction of a lower volume of higher concentrations of groundwater contaminants improves the efficiency of removing and treating the water. Additionally, once the sources of contamination are controlled, the Groundwater Containment with Mass Removal alternative significantly reduces the estimated time to achieve groundwater containment goals compared to Containment alone.

Table 2.13 Groundwater Alternative Comparisons

Criteria	Groundwater Containment	Groundwater Containment with Mass Removal
Overall Protectiveness	Meets Criterion	Meets Criterion
Compliance with State and Federal Requirements	Meets Criterion for Interim Remedy	Meets Criterion for Interim Remedy
Long-term Effectiveness	Meets Criterion	Meets Criterion. Better for effectiveness
Reduction in Toxicity, Mobility, or Volume	Meets Criterion	Meets Criterion. Better for efficient removal of mass at high concentration with lower volume
Short-term Effectiveness	Meets Criterion	Meets Criterion
Implementability	Meets Criterion	Meets Criterion
Cost - 30 Year Present Value	$57 Million	$61 Million
State Acceptance	Meets Criterion with Exception for More Stringent State Restoration Objectives	Meets Criterion with Exception for More Stringent State Restoration Objectives
Community Acceptance	Generally Acceptable See Response to Comments, Appendix A	Generally Acceptable. See Response to Comments, Appendix A

2.9.3.2 Soil Areas

The detailed evaluation of soil remedy alternatives for the 11 locations with contaminated soil can be found in the RI/FS report available at the information repositories. A simplified analysis focusing on the preferred alternatives is presented in Table 2.14 a-c, and the alternatives considered are discussed below.

Soil areas 32D, 34D, 35D and 38D are contaminated with VOCs at concentrations above cleanup goals for either residential or commercial use. The only viable technology which has the potential for attaining unrestricted use levels for these areas is soil vapor extraction (SVE). Containing the VOCs in place with an impermeable cap would not meet the RAO for unrestricted use and could pose a risk for groundwater contamination.

The contaminants in areas 10D, 11D, C4 and C41 include lead, PCBs, dioxin and perchlorate. The only viable alternative to meet the criteria for protectiveness is to remove the contaminants by excavation. Three potential alternatives were considered during the screening phase for the contamination within the top 10 feet of soil: treatment of perchlorate in the near-surface soil, institutional controls restricting land use to non-residential, and excavating the contaminated soil. Proven methods for treating perchlorate in the surface soils at area C41 pose the risk of flushing some of the highest concentrations of perchlorate into the groundwater and would not meet EPA's protectiveness criteria. Land use restrictions alone are not protective because current contaminant levels would prevent even commercial or industrial uses in some areas. An option for areas planned for commercial or industrial uses would be to excavate enough contaminated soil to meet the restricted use action levels and limit the land use by institutional controls.

The VOCs at 7D and FCS originate from contaminated groundwater moving laterally from sources outside OU-5. The RI /FS indicated that SVE would not be effective for cleaning up the low concentrations of VOCs measured in soil vapor in areas 7D, FCS and 33D to meet the goals for unrestricted use. The only viable remedy for these areas to achieve residential use is vapor mitigation beneath buildings constructed in the areas to prevent movement of contaminants into the buildings. If any of these areas are to be used for commercial or industrial use only, institutional controls would be required.

Table 2.14 a. Contaminated Soil Areas Alternative Comparison-Areas 32D, 34D, 35D and 38D

Criteria	Capping and Land Use Restriction	Capping, Soil Vapor Extraction and Land Use Restriction
Overall Protectiveness	Partially Meets Criterion	Meets Criterion
Compliance with State and Federal Requirements	Partially Meets Criterion.	Meets Criterion
Long-term Effectiveness	Partially Meets Criterion.	Partially Meets Criterion. Better for active remediation and control of VOCs.
Reduction in Toxicity, Mobility, or Volume	Does not Meet Criterion	Partially Meets Criterion. Better for removal and treatment of VOCs.
Short-term Effectiveness	Meets Criterion	Meets Criterion
Implementability	Meets Criterion	Meets Criterion
Cost - 30 Year Present Value	$0.4 Million	$1.0 Million
State Acceptance	Meets Criterion.	Meets Criterion
Community Acceptance	Generally Acceptable with Comments See Response to Comments, Appendix A	Generally Acceptable with Comments, Generally Preferred More Rapid Cleanup See Response to Comments, Appendix A

Table 2.14 b. Contaminated Soil Areas Alternative Comparisons -Areas C4, C41, 10D and 11D

Criteria	Excavation of Contaminated Surface Soil and Related Ditch Sediment
Overall Protectiveness	Meets Criterion
Compliance with State and Federal Requirements	Meets Criterion
Long-term Effectiveness	Meets Criterion
Reduction in Toxicity, Mobility, or Volume	Meets Criterion. Perchlorate treatment of excavated soil to be examined in Remedial Design.
Short-term Effectiveness	Meets Criterion. Perchlorate treatment of excavated soil to be examined in Remedial Design.
Implementability	Meets Criterion
Cost - 30 Year Present Value	$0.6 Million
State Acceptance	Meets Criterion.
Community Acceptance	Generally Acceptable. See Response to Comments, Appendix A

Table 2.14 c. Contaminated Soil Areas Alternative Comparisons -Areas 7D, 33D and FCS

Criteria	Mitigation of Soil Vapor Intrusion and Land Use Restriction
Overall Protectiveness	Meets Criterion
Compliance with State and Federal Requirements	Meets Criterion
Long-term Effectiveness	Partially Meets Criterion. Neither soil excavation nor soil vapor extraction would be protective for these areas until levels of VOCs in the groundwater are reduced by controlling sources outside OU-5.
Reduction in Toxicity, Mobility, or Volume	Partially Meets Criterion. Mitigation actions have the potential to reduce some mass and limit mobility of VOCs.
Short-term Effectiveness	Meets Criterion. Mitigation actions control exposure.
Implementability	Meets Criterion
Cost - 30 Year Present Value	$0.03 Million
State Acceptance	Meets Criterion.
Community Acceptance	Generally Acceptable. See Response to Comments, Appendix A

2.9.4 Common Elements and Distinguishing Features of Each Groundwater Alternative

Both Groundwater Containment and Containment with Mass Removal alternatives involve the pumping of sufficiently large volumes of contaminated water to prevent the spread of contaminants above the containment levels into uncontaminated areas beyond the current extent of the contaminant plumes. It is estimated that either of the two groundwater alternatives would pump between 10 and 15 million gallons of groundwater each day. The water will be piped to one of several treatment systems (see Figure 2.2) where a series of standard, reliable treatment systems remove the various contaminants.

Both groundwater alternatives would continue the operation and optimization of the existing GETs. Both would require the installation of additional wells to effectively contain the groundwater contamination through a hydraulic barrier. Groundwater treatment using tested reliable treatment methods for NDMA, VOCs and perchlorate would continue and expand as necessary to treat the extracted groundwater to the required end uses. Improvement and optimization of the GETs including the extraction system and treatment methodologies are components of both groundwater alternatives. Both alternatives include end use of the water for non-potable or industrial use, or discharge to surface water at levels consistent with the substantive NPDES requirements in Table 2.16. Any temporary discharge to ground on–Site for either alternative shall also meet substantive requirements contained in Waste Discharge Requirements issued by the RWQCB (also Table 2.16). Both alternatives allow Aerojet to provide the extracted water to drinking water providers for treatment for potable or non-potable uses. In California any treatment system that supplies potable water is required to be operated by a certified water provider. Water providers are subject to all applicable federal drinking water standards as well as California Department of Public Health, Department of Drinking Water and Environmental management requirements. Both alternatives require management of groundwater within the hydraulic influence of the OU-5 groundwater remedy to maintain optimum water levels, to prevent adverse impact on the remedy and to mitigate impacts on downgradient beneficial use.

The difference between the two groundwater alternatives is the use of an extraction system for contaminant mass removal near the Aerojet property boundary and closer to the main contaminant sources of the contamination. This alternative more efficiently removes contaminant mass before it migrates into lower concentration areas of the plume. Assuming the contaminant sources are controlled and that the final cleanup goals are approximated by the containment levels, the Containment with Mass Removal alternative would reduce the estimated time required to restore the aquifer by up to 40 percent, on the order of decades. Both the initial capital cost and annual operational costs would be higher for the Mass Removal alternative. However the long-term costs for Containment with Mass Removal would decrease due to the substantially shorter estimated period of operation of the remedy compared to the alternative with Containment alone.

2.9.5 Common Elements and Distinguishing Features of Contaminated Soil Area Alternatives

For seven of the eleven soil areas (Areas C4, C41, 10D, 11D, 7D, 33D and FCS), only one viable alternative, excavation with treatment or disposal of the excavated soil, was available after considering the many alternatives during the screening phase. Perchlorate in Area C41 was measured in subsurface soil throughout the 70 foot depth to the water table, far below the feasible excavation depth. The groundwater containment remedy for OU-5 will provide protection of the groundwater that could potentially be affected by the perchlorate remaining at C41. For the soil excavated from C41, factors to be analyzed during remedial design will determine whether the perchlorate-contaminated soil will be treated or disposed off-Site.

The two alternatives for Areas 32D, 34D, 35D and 38D are distinguished by soil vapor cleanup objectives. The less expensive method relies on capping with institutional controls to limit exposure to VOC vapors. USEPA's preferred alternative is to remove VOCs more aggressively through active Soil Vapor Extraction. Physical limitations on soil vapor extraction methods will require both alternatives to restrict land use until the soil vapor cleanup goals are attained.

2.10 Summary of Comparative Analysis of Remedy Alternatives

In accordance with the NCP, the alternatives were evaluated by the USEPA using the nine criteria. 40 C.F.R. § 300.430(e)(9). For an alternative to be an acceptable remedy it must pass the USEPA's two threshold criteria: 1) Overall Protective of Human Health and the Environment, and 2) Compliance with ARARs. The No-Action Alternatives for either the groundwater or contaminated soil areas portions of OU-5 do not comply with the threshold criteria and are not discussed beyond the threshold criteria.

> Overall Protection of Human Health and the Environment: Both of the retained groundwater alternatives are protective of human health and the environment and eliminate, reduce, or control risks posed by the contamination at OU-5 through treatment and institutional controls. The retained soils alternatives are protective of human health and the environment and eliminate, reduce, or control risks posed by the contamination if future land uses are limited to commercial or industrial uses in some cases. Institutional controls of future land uses would be necessary for cleanup to commercial levels only in areas 32D, 34D, 35D and 38D.
>
> Compliance with ARARs: The groundwater action is an interim remedy, so final cleanup goals for restoration of the aquifer will be addressed in the final Sitewide remedy selection process. Both retained groundwater alternatives comply with ARARs by providing various means of containing the groundwater contamination and replacing lost water supplies. Assuming that the groundwater contaminant sources are contained through actions to be determined in future RODs, the alternative with containment plus mass removal is projected to restore the aquifer up to 40 percent faster than the other alternative with containment alone.

Cleanup actions for the contaminated soil areas of OU-5 are final remedies. All contaminated soil area alternatives will comply with ARARs, as long as institutional controls for areas 32D, 34D, 35D and 38D are effective in limiting future land use to commercial or industrial activities.

Long-term Effectiveness and Permanence: Long-term effectiveness and permanence refers to residual risk, and the ability of a remedy to maintain reliable protection of human health and the environment over time, once the RAOs are met. Residual risk can result from exposure to untreated waste or treatment residuals.

For the interim groundwater containment alternatives, the untreated waste refers to contaminants not removed from the aquifer. Both groundwater alternatives prevent the migration of contaminated groundwater above the containment levels into clean and less-contaminated portions of the aquifer. The Containment with Mass Removal alternative inhibits downgradient migration of contamination into OU-5 from source areas and removes substantial contaminant mass. As a result, this alternative improves the long-term effectiveness of the interim action by reducing the cost and difficulty of operating existing extraction and treatment facilities by preventing highly contaminated groundwater from reaching these systems. Assuming control of contaminant sources, the Mass Removal alternative would reduce the eventual cost, difficulty, and time required for hydraulic control and restoration of the aquifer.

Alternatives considered for the final remedy for contaminated soil areas with immobile contaminants (Areas C4, C41, 10D and 11D) will permanently remove known contaminants from the surface soil to levels that are protective for unrestricted uses. Combined excavation and control of groundwater migration provides protection from perchlorate contamination from Area C41.

Neither soil excavation nor soil vapor extraction for areas 7D, 33D and FCS would achieve permanent removal of residual risk from untreated soil vapor for these areas until levels of VOCs in the groundwater are reduced by controlling sources outside OU-5. However combined mitigation of soil vapor intrusion and land use restriction will effectively protect human health and the environment over time.

Capping of the VOC-contaminated areas 32D, 34D, 35D and 38D does not meet the criterion for long-term effectiveness and permanence as well as the alternative that adds Soil Vapor Extraction (SVE) for active remediation and control of VOCs. Even with SVE, this area poses physical limitations to achieving long-term cleanup in a timely fashion. However, land use restrictions will effectively protect human health and the environment over time.

Reduction of Toxicity, Mobility, or Volume through Treatment: Although the groundwater interim action is not intended to fully address the statutory mandate for permanence and treatment "to the maximum extent practicable," both groundwater alternatives utilize treatment and thus support the statutory mandate. Because the

groundwater action does not constitute the final remedy for the Site, the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element, although partially addressed in this remedy, will be addressed by the final response action. Subsequent actions are planned to fully address the threats posed by groundwater conditions at this Site.

Residual amounts of COCs with residual risk within the acceptable risk range are expected to remain in portions of the groundwater aquifer after RAOs and containment standards for these chemicals have been achieved. Assuming the contaminant sources are controlled, the alternative with containment plus mass removal is projected to achieve containment goals throughout the OU-5 aquifer up to 40 percent faster than the other alternative with containment alone.

The final contaminated soil area remedy alternatives for areas C4, C41, 10D and 11D with immobile contaminants will permanently remove known contaminants from the surface soil to levels that are protective for unrestricted use. Alternatives using soil vapor extraction for areas with VOCs will permanently remove most VOCs originating at those locations. Subsurface soil conditions will physically limit the effectiveness of SVE to achieve cleanup levels in a timely fashion. The alternative for the VOC-contaminated soil areas with capping alone would not meet the criterion for permanence and treatment to the maximum extent possible.

All the evaluated alternatives have the ability to maintain reliable protection of human health and the environment over time. Institutional Controls for groundwater and soil areas include environmental and land use restrictions; existing CADPH regulations on operations of potable water suppliers (i.e., monitoring, sampling, shut-down of wells as necessary and approval of new well locations); and county approval of new well use permits. Aerojet will also be required to provide public notice of new well restrictions.

Short-term Effectiveness: Short-term effectiveness addresses adverse impacts that may be posed to workers, the community, and the environment during construction of the remedy.

Both interim groundwater alternatives are assigned a high ranking for short-term effectiveness, although the Containment with Mass Removal alternative is likely to result in longer construction time. Neither alternative poses unmitigable risks to the community during construction, nor do any of the alternatives pose unmitigable risks to workers beyond typical hazards associated with large construction projects. Noise and dust abatement during construction, and on-Site treatment or off-Site disposal of the contaminated drill cuttings and purge water, would protect the community during construction.

Excavation and soil vapor extraction alternatives for contaminated soil area cleanup similarly could involve potential risks to workers during implementation of the remedy. These short-term risks to workers can be readily mitigated through noise and dust abatement during construction, and on-Site treatment or off-Site disposal of the contaminated soil and soil vapors. Soil vapor mitigation is required for construction in

areas where VOCs may pose a short-term inhalation risk. Aerojet controls access at all contaminated soil areas and surrounding areas; noise and dust abatement and management of off-property vehicle traffic will provide effective short-term protection of the community.

Implementability: Clear evidence at the Aerojet Site demonstrates the implementability of the groundwater remedy. Much of the remedial action for the groundwater remediation in OU-5 has been constructed and is currently operating. Also, a similar groundwater remedy is operating successfully at OU-3. All soil remedies are proven remedial technologies. The soil vapor extraction systems are expected to have limitations in achieving final cleanup objectives. Control of sources in future OUs and long-term mitigation in buildings constructed on these areas will be needed.

Cost: Tables 2.13 and 2.14 provide specific cost estimates for each groundwater and contaminated soil area alternative, with detailed costs presented in Appendix C for groundwater and Appendix D for contaminated soil areas.

Using a 30-year present-worth method, the interim groundwater alternative with Containment plus Mass Removal may be less than ten percent more expensive than Containment alone. However, the costs for Containment with Mass Removal becomes less expensive than containment alone considering a more realistic comparison of costs that incorporate the potential duration of the action, assuming control of the contaminant sources.

The cost for adding SVE to areas 32D, 34D, 35D and 38D increases the overall costs of remediation of the soil areas by an estimated $0.67 million, which is about 65 percent more expensive than capping alone. In terms of overall cost of OU-5, an increase of this level is quite small while achieving improvement in several criteria including long-term effectiveness, reduction of mobility through treatment, and state and community acceptance.

State Acceptance: The State of California supports both groundwater and soil alternatives to prevent potential migration of the contaminant plumes. USEPA addressed certain State comments regarding final cleanup standards for groundwater by acknowledging that the groundwater actions are interim remedies with the final cleanup objectives to be addressed in the final Sitewide remedy selection process consistent with national Superfund policy. The State is overseeing implementation of groundwater cleanup remedies at IRCTS and White Rock Road North Dump areas in the southwestern and southeastern corners of the Aerojet Site. Differences in cleanup goals between those projects and OU-5 may produce inconsistencies in current remedies. An evaluation of the effectiveness of the groundwater remedy during the five year reviews will need to address this issue. Coordination and integration of USEPA's cleanup and the State's remediation efforts for IRCTS and White Rock Road North Dump also will be reviewed in the final Sitewide remedy selection.

Community Acceptance: The community including local water providers expressed a preference for a remedy with lower cleanup standards consistent with state policies. The groundwater containment is an interim remedy and USEPA will evaluate groundwater restoration and cleanup levels in the final Sitewide remedy selection. The community supported the Proposed Plan's approach to more rapid migration control and remediation of contaminated groundwater. Community members raised issues regarding the suitability of development of the contaminated soil areas. USEPA rigorously researched the local land use planning process and current planning effort and incorporated these considerations in the remedy. The community generally endorsed cleanup to unrestricted use wherever possible in preference to the use of commercial or industrial future use assumptions.

2.11 Principal Threat Wastes

The principal threat concept is applied to the characterization of source materials at a Superfund site considered to be highly toxic or highly mobile which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. OU-5 applies primarily to contaminated groundwater. Contaminated groundwater generally is not considered to be a source material but NAPLs may be viewed as source material. There are no known source areas or NAPLs in the groundwater portion of OU-5 and as a result principal threat waste was not considered for the groundwater portion of OU-5.

Surface soil containing chemicals of concern that are relatively immobile or readily contained, such as in areas 10D, 11D, and C4, are not considered to be principal threat wastes. The VOCs in the soil and vadose zone in areas 32D, 33D, 34D, 37D, and 38D could be considered mobile. The selected remedy removes the contaminants by extracting the VOCs at those locations where the source is primarily from the soil or vadose zone within OU-5. The selected remedy also addresses the VOCs in areas 7D and FCS, although the source is from water contamination migrating laterally from parts of the Aerojet Site which will be fully addressed in other OUs. The perchlorate contamination in area C41 that is not removed by excavation of the surface soil to ten feet bgs will be readily contained by the groundwater containment and remediation remedy.

2.12 Selected Remedy: Preferred Alternative

Based on current information, USEPA is selecting as the remedy for OU-5 Groundwater Containment with Mass Removal, Soil Cleanup to Unrestricted Use, and SVE at contaminated soil areas 32D, 34D, 35D and 38D.

The Groundwater Containment with Mass Removal alternative inhibits downgradient migration of contamination into OU-5 from source areas and removes substantial contaminant mass, improving the long-term effectiveness of the interim action by reducing the cost and difficulty of operating existing extraction and treatment facilities by preventing highly contaminated groundwater from reaching these systems. Assuming control of contaminant sources, the Mass

Removal alternative would reduce the eventual cost, difficulty, and time required for hydraulic control and eventual restoration of the aquifer. The cost difference between alternatives is less than ten percent, which is not significant.

The more rigorous treatment of contaminated soil areas to residential risk levels, including SVE at contaminated soil areas 32D, 34D, 35D and 38D, is warranted by plans for future mixed residential, commercial and industrial land use. The active soil vapor extraction alternative at these areas also better meets the criteria for long-term effectiveness and reduction of toxicity, mobility or volume through treatment. The alternatives selected as final remedies for contaminated soil areas are supported by the State and the community.

USEPA believes these alternatives meet the threshold criteria and provides the best balance of tradeoffs among the alternatives. The USEPA expects the preferred alternative to satisfy the following statutory requirements of CERCLA Section121 (b): (1) to be protective of human health and the environment; (2) to comply with ARARs; (3) to be cost effective; (4) to utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and (5) to satisfy the preference for treatment as a principal element.

2.12.1 Summary of the Rationale for the Selected Interim Groundwater Remedy

The principal factors considered in selecting the preferred groundwater remedy are: 1) Contaminated groundwater is contained within the existing plume, completing the containment of the off-property Aerojet plume; 2) Mass Removal effectively reduces the amount of residual contamination migrating into the OU-5 groundwater area, improving the reliability and long-term effectiveness of the containment by maintaining a more consistent and lower concentration for the extraction and treatment systems at the outer edge of the plumes; and 3) Long-term cleanup goals for aquifer restoration, which will be selected in the Sidewide remedy, can be attained as much as 40 percent faster with Mass Removal than with Containment alone, assuming control of the contaminant sources migrating into OU-5.

2.12.2 Summary of the Rationale for the Selected Contaminated Soil Areas Remedy

The principal factors considered in selecting the preferred contaminated soil area remedies are: 1) Active excavation and Soil Vapor Extraction provides effective permanent long-term remedies that achieve the USEPA preference for treatment to reduce toxicity and mobility of the contaminants, 2) Cleaning to unrestricted use levels provides a greater protectiveness and flexibility for planned and unplanned changes in future land uses ; and, 3) Active SVE provides a more rapid remediation than capping of VOC-contaminated soil alone. The 30 year present value cost for the preferred soil remedies is $0.67 M more expensive than the alternative without active SVE at areas 32D, 34D, 35D and 38D. With the potential for change in future land use, this increased cost is relatively minimal for the flexibility in future land use options.

2.12.3 Description of the Selected Interim Groundwater Remedy

The groundwater portion of the OU-5 remedy includes the following actions:

- Contain contaminated groundwater off-property within OU-5 to the levels set forth in Table 2.7 with groundwater extraction and treatment (GET) in all contaminated layers of the aquifer to prevent further contamination of the aquifer, utilizing existing GET components where effective and practicable;

- Remove additional contaminant mass from the contaminated groundwater on- property using groundwater extraction and treatment in all contaminated layers of the aquifer;

- Treat extracted groundwater using reliable, proven treatment methods including biological treatment or resin adsorption for perchlorate, ultraviolet oxidation for NDMA, and carbon filtration, chemical oxidation or air stripping for residual Volatile Organic Compounds (VOCs) and 1,4-dioxane;

- Use the treated groundwater for non-potable purposes such as industrial cooling, discharge to surface water or discharge to land. Aerojet may provide the extracted water to a drinking water providers for treatment for potable or non-potable uses. The water providers are subject to all applicable federal drinking water standards as well as California Department of Public Health, Division of Drinking Water and Environmental Management requirements. Discharge of treated water to on-Site surface water will comply with the substantive requirements of the current National Pollution Discharge Elimination System (NPDES) permit in effect at the Aerojet site (See Table 2.16). Any temporary discharge to ground on–Site will also meet substantive requirements contained in Waste Discharge Requirements issued by the RWQCB (also Table 2.16). Discharge of treated water to off-Site surface water or off-Site use as non-potable water will comply with applicable federal and State water standards;

- Prepare plans for water replacement contingencies in OU-5 consistent with the requirements for OU-3, and implement the plans as necessary;

- Implement selected Institutional Controls (ICs) including prohibitions on access to groundwater on the land overlying the contaminated groundwater. These restrictions will be implemented through a recorded declaration of Covenants and Environmental restrictions pursuant to California Civil Code Section 1471, whereby Aerojet covenants to impose these restrictions. These covenants and environmental restrictions will be binding to Aerojet's successors and assigns as covenants running with the land. The State of California and USEPA (as a third party beneficiary) will have the right to enforce these restrictions. Any lease or sale of Aerojet property overlying the contaminated groundwater in OU-5 shall be subject to the following restrictions:

    - No recharge of groundwater unless and until expressly permitted in writing by USEPA and the RWQCB;

- No injection into the groundwater unless approved in writing by USEPA and the RWQCB;
- No sustained extraction of groundwater encountered during construction without written approval by USEPA and the RWQCB.

Aerojet shall give written notice of the groundwater contamination to each buyer, lessee, renter and mortgagee of any of these lands and every lease, deed, mortgage or instrument conveying any part of these lands shall expressly provide that it is subject to this Declaration of Covenants and Environmental Restrictions.

- Monitor groundwater at existing and new monitoring wells, drinking water wells, irrigation wells and up-gradient sentinel wells, to verify and evaluate plume control, and effectiveness of the remedy conducted as part of the existing Groundwater Monitoring Plan for the Aerojet Site. Additional monitoring wells may be required as necessary to evaluate the effectiveness of the remedy;

- Manage groundwater within OU-5 in coordination with the OU-3 groundwater management zone to maintain water levels and to prevent adverse impact on the remedy.

2.12.4 Description of the Contaminated Soil Area Remedy

- **Areas 10D and 11D.** Excavate the contaminated surface soils and sediments in areas 10D and 11D to the performance standards listed in Table 2.11 for unrestricted use of the land based on residential risk levels;

- **Areas C4 and C41.** Excavate contaminated surface soil in area C4 and C41 laterally and to a minimum ten foot depth to the performance standards listed in Table 2.11 for unrestricted use of the land based on residential risk levels unless the cleanup levels are reached at a shallower depth. Lateral as well as horizontal surfaces shall be tested to ensure attainment of soil cleanup goals. Treat the excavated soil to remove the contaminants to cleanup levels or transport contaminated soil to an approved landfill. The excavated area shall be refilled with material that meets the residential soil criteria. If waste is left in place deeper than ten feet, land use controls will be necessary to protect against exposure resulting from excavation to depths greater than ten feet;

- **Areas 32D, 34D, 35D and 38D.** Install and operate a vapor extraction system in soil areas 32D, 34D, 35D and 38D to remove VOCs from subsurface soil to the performance standards listed in Table 2.12 for unrestricted use of the land based on residential risk levels. A temporary asphalt cap or equivalent shall be constructed over the surface to improve capture of the VOCs. Contaminants in the vapors shall be captured and treated by granulated carbon or destroyed using a catalytic oxidation system with air monitoring. Land use will be restricted to commercial or industrial use through appropriate land use covenants and employing soil vapor mitigation methods as necessary, until the cleanup

attains unrestricted use levels of VOC COCs based on USEPA Region 9 Soil Vapor Screening Levels (Table 2.12), adjusted with location- and depth-specific attenuation factors approved by USEPA;

- **Areas 7D, 33D and FCS.** Control the risks from elevated VOCs measured in the vadose zone in soil areas (each about 0.1 acres) and the Former Company Store location (FCS, approximately 3.4 acres), using vapor mitigation systems that prevent movement of contaminant vapors into buildings constructed at these locations. The RI concluded that neither soil excavation nor soil vapor extraction would be protective until levels of VOCs in the groundwater are reduced by controlling sources outside OU-5. Vapor mitigation systems may include vapor barriers and venting of vapors from beneath the structure. Appropriate monitoring and land use covenants are required for either residential or commercial use of these locations until the potential threat of vapor intrusion is removed, based on USEPA Region 9 Soil Vapor Screening Levels (Table 2.12), adjusted with location- and depth-specific attenuation factors approved by USEPA;

- **Institutional Controls.** Implement restrictions on the future use of contaminated soil areas that have not attained residential cleanup objectives through a recorded Declaration of Covenants and Environmental Restrictions pursuant to California Civil Code Section 1471, whereby Aerojet covenants to impose these restrictions. These covenants and environmental restrictions will be binding to Aerojet's successors and assigns as covenants running with the land. The USEPA and California EPA will have the right to enforce these restrictions. Aerojet shall give written notice of the groundwater contamination to each buyer, lessee, renter and mortgagee of any of these lands and every lease, deed, mortgage or instrument conveying any part of these lands shall expressly provide that it is subject to this Declaration of Covenants and Environmental Restrictions;

- **Zone 4 Landfill.** The landfill in the northern portion of OU-5 (Zone 4) is not included in the proposed actions for OU-5. EPA will review the monitoring results of the solid waste landfill closure to ensure both soil and groundwater protectiveness from this potential source of contamination. EPA expects that all potential risks from this landfill will be satisfactorily addressed by the approved landfill closure process with State and County oversight. If potential risks from the landfill are not adequately addressed, EPA will evaluate alternatives in an Explanation of Significant Differences or a ROD amendment.

2.12.5 Expected Outcomes of the Selected Remedy

The expected outcomes of the Selected Interim Groundwater Remedy are the containment of groundwater contamination at the current extent of the plumes to protect uncontaminated drinking water sources, reliable long-term operation of the containment through mass removal of highly contaminated groundwater migrating into OU-5, and reducing the time and cost for restoration of the aquifer to beneficial use (drinking water source) once the final Sitewide remedy is selected and assuming control of contaminant sources. Containment levels for groundwater are provided in Table 2.7.

The expected outcomes of the contaminated soil area remedies include the restoration of the contaminated areas to levels protective of expected future land uses. Additionally the remedy will monitor and control remaining contamination.

2.13 Statutory Determinations

This section provides a brief, Site-specific description of how the selected interim groundwater remedy and the final contaminated soil area remedy satisfy the statutory requirements of CERCLA §121 (as required by NCP §300.430(f)(5)(ii)), and explains the five-year review requirements for the selected remedy.

2.13.1 Protection of Human Health and the Environment

Under its legal authorities, USEPA's primary responsibility at Superfund sites is to undertake remedial actions that achieve adequate protection of human health and the environment.

The selected interim groundwater remedy will reduce human health risk by limiting the spread of highly contaminated groundwater into clean and less contaminated portions of the aquifer, reducing the likelihood and magnitude of human exposure to contaminated groundwater. The mass removal aspect of the remedy targets highly contaminated groundwater in the portions of OU-5 nearer the contaminant sources on Aerojet property. Exposure to contaminated groundwater through drinking water supplies is the area of potential risk addressed by the interim groundwater remedy. The selected remedy will contain the off-property contamination in all four OU-5 groundwater Zones and treat the water to discharge standards meeting the substantive requirements of a National Pollution Discharge Elimination System (NPDES) permit (See Table 2.16) or all applicable standards for off-Site reuse or disposal. Exposure levels will be within the acceptable risk range of 10^{-4} to 10^{-6} for carcinogenic risk and below the Hazard Index of 1 for non-carcinogens.

If no action is taken, contaminated groundwater will continue to spread, increasing the likelihood of future increases in contaminant concentrations in downgradient portions of the aquifer, increasing risk by increasing the likelihood of and magnitude of exposure, and increasing the eventual cost, difficulty, and time required for restoration of the aquifer.

The selected interim groundwater remedy includes above-ground water treatment systems to remove the COCs (primarily VOCs, perchlorate, and NDMA) from the extracted groundwater. After treatment, the extracted groundwater will achieve all containment goals identified in this ROD. The remedy also requires compliance with ARARs associated with the disposal of treatment residuals and control of air emissions, if any, to eliminate or minimize short-term risks and cross-media impacts. The remedy includes an extensive monitoring program to evaluate the performance of the remedy.

There is no known exposure pathway in which ecological receptors could be exposed to contaminated groundwater at the Site.

The selected final remedy for contaminated soil areas addressed potential risks to eleven areas on Aerojet property that may be considered for future residential and non-residential uses. The remedy will reduce the potential for human health risk by removing contaminated surface soils to levels protective of residential land use. Areas with VOCs that pose a potential risk for soil vapor intrusion are addressed by active soil vapor extraction and, as necessary, mitigation of vapor intrusion for future structures and Institutional Controls to limit exposure.

If no action is taken on contaminated soil areas, potential exposure for either residents or workers would exceed acceptable risk levels.

The selected final remedies include excavation of surface soils with on-Site treatment (e.g., standard biological treatment for perchlorate) or off-Site disposal at a secure landfill, monitoring to ensure protectiveness of the groundwater through the interim groundwater containment remedy, capping and soil vapor extraction of VOCs and vapor mitigation and institutional controls as necessary to limit exposure.

After the remedies are implemented, the soil areas will achieve all ARARs identified in this ROD. The remedy also requires compliance with ARARs associated with the disposal of treatment residuals and control of air emissions, if any, to eliminate or minimize short-term risks and cross-media impacts. The remedy includes an extensive monitoring program to evaluate the performance of the remedy.

. The ecological health assessment determined there are no ecological risks within OU-5 that require action. The RI indicated a current lack of suitable habitat in impacted areas and exposure of the ecological receptors to elevated background levels of COPCs that are not associated with OU-5 releases.

2.13.2 Compliance with Applicable or Relevant and Appropriate Requirements

Remedial actions selected under CERCLA must comply with all ARARs under federal environmental laws or, where more stringent than the federal requirements, State environmental or facility siting laws. Where a State has delegated authority to enforce a federal statute, such as RCRA, the delegated portions of the statute are considered to be a Federal ARAR unless the State law is broader in scope than the federal law. Applicable or relevant and appropriate requirements are identified on a site-specific basis from information about site-specific chemicals, specific actions that are being considered, and specific features of the site location.

There are three categories of ARARs: (1) chemical-specific requirements; (2) location-specific requirements and (3) action-specific requirements. Chemical-specific ARARs are risk-based cleanup or containment standards or methodologies which, when applied to site-specific conditions, result in the development of standards for COCs. For interim groundwater containment actions, ARARs for the final chemical-specific standards will be addressed and modified as necessary during the final Sitewide remedy selection process.

Location-specific ARARs are restrictions placed on concentrations of hazardous substances or the conduct of activities because of the special locations, which have important geographical, biological or cultural features. Examples of special locations include wetlands, flood plains, sensitive ecosystems and seismic areas.

Action-specific ARARs are technology-based or activity-based requirements or limitations on actions to be taken to handle hazardous wastes. They are triggered by the particular remedial activities selected to accomplish a remedy.

Where no ARARs exist for a given chemical, action or location, USEPA may consider non-promulgated federal or State advisories and guidance as To Be Considered criteria (TBC). Although consideration of a TBC is not required, if standards are selected based on TBC, those standards are legally enforceable as performance standards.

The ARARs are frozen at the time the ROD is signed, but off-Site requirements are not,, including requirements applicable to treated water delivered to the drinking water supply., Offsite requirements in effect at the time the action occurs must be met, even if they differ from those in effect at the time the ROD is signed.

The OU-5 interim groundwater remedy and the final contaminated soil remedy will comply with ARARs as described in Table 2.15, except when additional studies and investigations may be undertaken pursuant to CERCLA section 104(b), 42 U.S.C. § 9604(b), ("CERCLA section 104(b) activities") during remedial design. USEPA expects to fully comply with ARARs during most CERCLA Section 104(b) activities, but there may be activities during which USEPA concludes that it is not practicable to fully comply. Such activities may include discharges of untreated or partially treated groundwater resulting from the development and testing of new groundwater extraction wells, but may also include other temporary high flow, high volume discharges. In such cases, EPA will evaluate the practicability of fully complying with ARARs, and comply with the USEPA policy that removal actions "will comply with ARARs to the extent practicable, considering the exigencies of the circumstances" 55 Fed. Reg. 8666, 8756 (Mar. 8, 1990); *see also* 40 C.F.R. § 300.415(j). Studies and investigations undertaken pursuant to CERCLA section 104(b), such as activities conducted during RI/FS, are considered removal actions." *Id.*

Table 2.15 provides a complete list of ARARs for OU-5. As an interim ROD for groundwater containment, the remedy is designed to minimize further contaminant migration and reduce the risk of exposure to contaminated groundwater. Because this remedy is an interim action that does not include restoration of the aquifer as an objective, EPA is not, at this time, establishing chemical-specific ARARs as *in situ* cleanup goals for contaminated groundwater at OU-5. *In situ* cleanup goals will be addressed in the final Sitewide decision document. ARARs are frozen at the time the ROD is signed, but offsite requirements are not (e.g., drinking water standards applicable to treated water delivered for potable use).Because MCLs, non-zero MCLGs or more restrictive state ARARs will be considered as *in situ* cleanup standards as part of the final Sitewide cleanup remedy in the future. *See Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration* (Interim Final), U.S. EPA OSWER Directive 9234.2-25 at 5 (Sept. 1993).

Performance Standards for containment of groundwater are the Containment Standards listed in Table 2.7. The Containment Standards for perchlorate, TCE and most of the other VOC COCs are the state and federal MCLs. As of November 2010, no state or federal MCLs have been promulgated for NDMA or 1,4-dioxane. For these emerging chemicals that lack MCLs, EPA is treating the California EPA's Public Health Goal (PHG) for NDMA and the CDPH notification level for 1,4-dioxane (for which there is no PHG), which are health-based advisory levels for drinking water use, as criteria to be considered in setting alternative performance standards for containment of groundwater contamination in OU5. PHGs and Notification Levels are established as precautionary measures for contaminants that may be considered candidates for establishment of MCLs.

Performance standards for treatment of extracted groundwater prior to discharge to on-Site surface water or non-potable uses are the substantive requirements of the current National Pollution Discharge Elimination System (NPDES) permit in effect at the Aerojet Site (See Table 2.16). Any temporary discharge to ground on–Site shall also meet substantive requirements contained in Waste Discharge Requirements issued by the RWQCB (also Table 2.16). Discharge of treated water to off-Site surface water or off-Site use as non-potable water shall comply with applicable federal and State water standards in effect at the time of discharge.

Potable supply is one authorized end use for any treated groundwater. If treated water is placed into a conveyance system on-Site for delivery as potable supply, MCLs are ARARs for treatment of the water on-Site. For the purposes of determining compliance with these performance standards, the point of compliance shall be the effluent from an on-Site treatment facility, just prior to its delivery to a water provider for potable end use. The ARARs are frozen at the time the ROD is signed, but off-Site requirements, including requirements applicable to treated water delivered to the drinking water supply, must be met in order to comply with the end use as potable water regardless of whether those requirements change over time. As a result, if an off-Site drinking water requirement changes, the treatment system must meet whichever standard - the performance standard selected in the ROD or the off-Site requirement - is lower.

Performance standards in the contaminated soil areas for soil contaminants and soil vapor are the risk-based soil concentrations for unrestricted use listed in Tables 2.11 and 2.12. Restrictions on the future use of contaminated soil areas that have not attained residential cleanup objectives will be implemented through a recorded declaration of Covenants and Environmental restrictions pursuant to California Civil Code Section 1471, whereby Aerojet covenants to impose these restrictions.

Table 2.15 - Description of ARARS for Selected Remedy

Authority	Medium	Requirements	Status	Synopsis of Requirements	Action to be Taken to Attain Requirements
Chemical-Specific ARARs					
Federal Regulatory Requirement	Ground-water (GW)	Federal Safe Drinking Water Maximum Contaminant Levels (MCLs); 42 U.S.C. § 300(f), *et seq.*; 40 C.F.R. Part 141 (2010)	Relevant & Appropriate (R&A)	MCLs have been adopted for a number of common organic and inorganic contaminants. These levels regulate the concentrations of contaminants in public drinking water supplies and may be relevant and appropriate for final RODs restoring ground-water aquifers potentially used for drinking water. MCLs are Relevant and Appropriate as performance standards for on-Site treatment of water delivered for potable end use.	MCLs are Relevant and Appropriate Standards for on-Site treatment of water placed into an on-Site conveyance system for potable end use. Where there are no federal MCLs for the contaminants, e.g., NDMA and 1,4-dioxane, the treatment standards are based on State MCLs or values developed by the State of California for drinking water. See Table 2.7.
State Regulatory Requirement	GW	California Safe Drinking Water Act , Cal. Health & Safety Code § 116365; 22 CCR §§ 64431 & 64444	R&A	The State has promulgated MCLs for some of the COCs that are more stringent than federal MCLs.	More stringent State MCLs are Relevant and Appropriate Standards for on-Site treatment of water for potable end use. Where there are no State MCLs for the contaminants, such as NDMA and 1,4-dioxane, the treatment standards are based on CA PHG or Drinking Water Notification Levels. See Table 2.7.
Federal Regulatory Requirement	Soil	US EPA Regional Screening Levels (RSLs) (2010)	To Be Considered (TBC)	USEPA has developed regional screening levels that are risk-based levels that are used to screen sites that may require additional investigation or possible remediation. RSLs may also be considered in setting soil cleanup levels or groundwater cleanup levels in the absence of promulgated MCLs for contaminants.	RSLs are considered in setting soil cleanup levels, including soil vapor levels, to be protective for residential, commercial or industrial land use scenarios. Groundwater cleanup values are based on MCLs, CA PHGs or CA Drinking Water Notification Levels as listed in Table 2.7.
California PHGs, California Environmental Protection Agency, and OEHHA	GW	California Calderon-Sher SDWA of 1996, California Health and Safety Code §116365	TBC	OEHHA has adopted PHGs for chemicals in drinking water. PHGs are levels of drinking water contaminants at or below which adverse health effects are not expected.	In the absence of MCLs for NDMA, the state PHGs adopted by OEHHA have been considered during selection of performance standards for groundwater containment.
CDPH Drinking Water Notification Levels	GW	California Health & Safety Code § 116455	TBC	CDPH has established drinking water notification levels (formerly known as action levels) based on health effects, but in some cases they are based on organoleptic (taste and odor) values for chemicals without MCLs.	In the absence of MCLs for 1,4-Dioxane, the drinking water notification levels established by CDPH have been considered during selection of performance standards for groundwater containment.

Authority	Medium	Requirements	Status	Synopsis of Requirements	Action to be Taken to Attain Requirements
Chemical-Specific ARARs (continued)					
State Regulatory Requirement	GW	Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins (2009 revisions), adopted in accordance with CA Water Code, Division 7, Sections 13240, and 13050 (Porter-Cologne Act); Chaps. II & III	Applicable	Those portions of the Basin Plan which set out the designated uses (i.e., beneficial uses) and the water quality objectives based upon such uses are applicable requirements.	The designated use for the aquifer at the Aerojet Site is municipal and aquatic water supply. The containment levels for the contaminated groundwater and surface water comply with the Basin Plan's water quality objectives based upon such use.
State Regulatory Requirement	GW	SWRCB Resolution No. 88-63 (Sources of Drinking Water Policy)	Applicable	Designates all ground and surface waters of the State as drinking water except where the Total Dissolved Solids (TDS) is greater than 3,000 ppm, the well yield is less than 200 gpd from a single well, the water is a geothermal resource or in a water conveyance facility, or the water cannot reasonably be treated for domestic use using either best management practices or best economically achievable treatment practices.	The aquifers under the Aerojet Site have been identified as sources of drinking water.
Location-Specific ARARs					
Federal Regulatory Requirement	Floodplain and wetland protection	Executive Order Nos. 11990 & 11988	TBC	Require avoidance of adverse effects, minimization of potential harm, and restoration and preservation of natural and beneficial values of floodplains.	Constructing groundwater treatment facilities in a 100 year flood plain will be avoided. If it cannot be avoided, the potential harm to the flood plain shall be minimized.
Federal Regulatory Requirement	Within 100-year flood-plain	40 C.F.R. §264.18(b) (2010) and 22 CCR §66264.18(b)	Applicable	A RCRA facility located in a 100-year flood plain must be designated, constructed, operated and maintained to prevent washout of any hazardous waste by a 100-year flood	Because any new treatment facilities in OU-5 may generate hazardous waste, any such facility constructed within a 100 year flood plain must comply with this requirement.

Authority	Medium	Requirements	Status	Synopsis of Requirements	Action to be Taken to Attain Requirements
Location-Specific ARARs (continued)					
Federal Regulatory Requirement	Sites on or eligible for inclusion on the National Register of Historic Places	National Historic Preservation Act (16 U.S.C. §§ 470, *et seq.*); 36 C.F.R. Part 800 (2010)	Applicable	Provides for protection of sites with historic places and structures. Federal agencies are required to take into account their undertakings on historic properties and afford the State Historic Preservation Office a reasonable time to comment.	Applicable if a federal undertaking (cleanup) could adversely affect historic properties which are included in or eligible for inclusion in the National Register of Historic Places. The proposed remedial alternatives are not expected to not alter or destroy any known prehistoric or historic archeological features in OU-5 of the Aerojet Site. However, because there is always a possibility that buried historic or prehistoric remains could be discovered during such actions, this requirement would require action to address such areas.
Federal Regulatory Requirement	Endangered species or threatened species	Substantive portions of the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.); 50 C.F.R. Part 200 and 50 C.F.R. Part 402 (2010)	Applicable	Federal agencies are required under Section 7 of the ESA to insure that their actions do not jeopardize the continued existence of a listed species or result in destruction of adverse modification of its critical habitat (16 U.S.C. § 1536). If the proposed action may affect the listed species or its critical habitat, consultation with the USFWS may be required (50 C.F.R. § 402.14). Additionally, Section 9 of the ESA prohibits the illegal taking of a listed species (16 U.S.C. § 1538(a)(1).	Two endangered floral species are known to occur within Sacramento County: the Sacramento Orcutt grass (Orcuttia Viscinda) and the Boggs Lake hedge hyssop (Gratiola Heterospala). Four listed wildlife species are expected to occur within 25 miles of the Aerojet Site: Bald Eagle, Peregrine Falcon, Giant Garter Snake, and the Valley Elderberry Longhorn Beetle. The Aerojet Site may be a habitat for the Burrowing Owl, a species of concern in CA. Any action that may impact or threaten to impact an endangered species shall comply with this requirement.
State Regulatory Requirement		CA Endangered Species Act, Cal. Fish & Game Code § 2080	Applicable	Prohibits the illegal taking of plant and animal species designated as either threatened or endangered in the state of California	See Federal ESA above.
Federal Regulatory Requirement	Listed migratory birds	Migratory Bird Treaty Act; 16 U.S.C. §§ 703, *et seq.*	Applicable	Prohibits the illegal taking of migratory birds	The Aerojet Site may be a habitat for the Burrowing Owl, a species of concern in CA.
Federal Regulatory Requirement	Areas affecting stream or river	Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.) And 40 §302 (2010)	Applicable	Restrictions on diversion, channeling or other activity that modifies a stream or river and affects fish or wildlife.	Applicable if a water body will be controlled or modified by the action.

Authority	Medium	Requirements	Status	Synopsis of Requirements	Action to be Taken to Attain Requirements
Location-Specific ARARs (continued)					
State Regulatory Requirement	Streambed or riverbed alterations	Substantive Requirements of Cal. Fish & Game Code § 1602	Applicable	Prohibits substantial diversion or obstruction of the natural flow of, or a substantial change of the bed or channel of a river, stream or lake. Prohibits the deposit or disposal of debris or waste where it may pass into any river, stream or lake.	Applies to grading and filling activity.
State Regulatory Requirement	Restrictions relating to land and groundwater	Cal. Civ. Code §1471; 22 CCR § 67391.1(a), (d) (2010)	R&A	Substantive requirements for placing an environmental restrictive covenant on contaminated land in the state of California.	Require Aerojet to record environmental restrictive covenants on contaminated land and to name EPA as a third party beneficiary in the covenants.
Action-Specific ARARs					
Federal Regulatory Requirement	Dredge and Fill	33 U.S.C. §§ 1251, *et seq.* and 40 C.F.R. Parts 230 & 231 (2010)	R & A	Regulates discharge of dredged or fill material into waters of the United States, including wetlands.	Substantive portions applicable. Permit is not required for on-Site activities.
Federal Regulatory Requirement	Generation of waste from construction & operation due to remedial action selected	40 C.F.R. Part 261(2010) and 22 CCR § 66261 (2010)	Applicable	Establishes procedures and numeric limits for identification and management of characteristic hazardous wastes, listed hazardous wastes, and State-only (non-RCRA) hazardous wastes.	These requirements are applicable to management of waste materials generated as a result of construction of the selected remedial action or operation of a groundwater treatment plant.
Federal Regulatory Requirement	Generation of waste from construction & operation due to remedial action selected	40 C.F.R. §262.11 (2010) and 22 CCR §66262.11 (2010)	Applicable	Requires waste generators to determine if wastes are hazardous wastes and establishes procedures for such determinations	These requirements are applicable to management of waste materials generated as a result of construction of the selected remedial action or operation of a groundwater treatment plant.
Federal Regulatory Requirement	Storage of hazardous wastes for treatment or disposal off-Site	40 C.F.R. §262.34 and 22 C.C.R. §66262.34 (2010)	Applicable	Specifies maximum amounts and maximum periods for accumulation of hazardous waste on-site under generator status	These requirements are potentially applicable to management of waste materials generated as a result of construction of the remedial action and operation of any groundwater treatment plant if these waste materials are hazardous wastes.
Federal Regulatory Requirement	Shipment of hazardous substances off-Site	42 U.S.C. § 9621(d)(3); 40 C.F.R § 300.440 (2010) ("Offsite Rule")	Applicable	Hazardous substances from a CERCLA response action that must be transferred off-Site for disposal or treatment must be transferred to a facility in compliance with RCRA, TSCA, and other applicable federal and state law.	Applicable to hazardous wastes from treatment facilities and to wastes from remedial actions that must be disposed of off-Site.

Authority	Medium	Requirements	Status	Synopsis of Requirements	Action to be Taken to Attain Requirements
Action-Specific ARARs (continued)					
Federal Regulatory Requirement	Discharge to inland surface water	National Toxics Rule, 40 C.F.R. §§ 131.6 & 131.38 (2010) (CA Toxics Rule)	Applicable	Establishes the appropriate aquatic and human health criteria for priority toxic pollutants in inland surface waters and enclosed bays and estuaries. Included in the National Rule are EPA promulgated specific criteria for certain water bodies in California the presence or discharge of which could reasonably be expected to interfere with maintaining designated uses.	May be applicable for off-Site discharge subject to NPDES permits and for on-Site discharge subject to substantive requirements of an NPDES permit.
State Regulatory Requirement	Discharge to surface water	SectionIV-16 (Policy for Application of Water Quality Objectives) of the Basin Plan for Sacramento River and San Joaquin River Basins (2009 rev.)	TBC	Allows for the use of mixing zones as part of a determination of whether water quality is being maintained in the receiving water.	This requirement may be a performance standard if treated water is discharged to surface water.
Federal Regulatory Requirement	Discharge to surface water	National Pollutant Elimination Discharge System (NPDES) Permit 40 C.F.R. Parts 122 and 125 and 23 CCR 2235 et seq.	Applicable	Establishes treatment and monitoring requirements for discharges to surface water.	Discharge to surface water on-Site will comply with the substantive requirements of an NPDES Permit (See Table 2.15); discharge to surface water off-Site will require a NPDES Permit.
Federal Regulatory Requirement	Storm-water manage-ment	40 C.F.R. Part 122.26 (2010) and 23 CCR §2235 et seq. (2010)	Applicable	Establishes, monitoring, and pollutant control requirements for storm water from industrial activities	The substantive requirements would be applicable if construction activities associated with the remedial action disturb an area of 5 acres or greater.
Federal Regulatory Requirement	Air	Air Emission Standards for Process Vents; 40 C.F.R. §§ 265.1030-1035 (2010);22 CCR §§66265.1030-66265.1035	R&A	Applies to treatment, storage, and disposal facilities with process vents associated with solvent extraction or air or steam stripping operations managing RCRA hazardous wastes with organic concentrations of at least 10 ppm. These operations must reduce total organic emissions below specified device to reduce total organic emissions by 95 percent by weight.	The requirements are relevant and appropriate for groundwater extraction and air-stripping operations for the remedy where organic concentrations are at least 10 ppm.

Authority	Medium	Requirements	Status	Synopsis of Requirements	Action to be Taken to Attain Requirements
Action-Specific ARARs (continued)					
State Regulatory Requirement	Air	Sacramento Metropolitan Air Quality Management District Rules Cal. Health & Safety Code, §§ 39602, 39606, 40001 Rule 402 Nuisance Rule 403 Fugitive Dust Rule 404 Particulate Matter Rule 441 Organic Solvents	Applicable	Limits emissions of dust, particulates and organic solvents to the air.	May apply to remedial actions involving ground disturbing activities and to emissions from treatment facilities.

Table 2.16 – Substantive Requirements in Current (November 2010) NPDES Effluent Limitations at Aerojet Site

Effluent Discharge Limitations		
Constituents	Daily Maximum in µg /l	Monthly Average in µg /l
Volatile Organics 1)	0.7	0.50
Perchlorate	6	4
1,4 -Dioxane	6	3
N-Nitrosodimethylamine	0.010	0.002
1) All volatile organic constituents listed in USEPA Method 8010 and 8020. The monthly average concentration of each constituent shall not exceed 0.5 µg /l.		

2.13.3 Cost-Effectiveness

EPA must select a remedy that is cost effective. The NCP defines a cost-effective remedy as one whose "costs are proportional to its overall effectiveness." More than one remedial alternative can be cost effective, and EPA is not required to select the most cost-effective alternative. Overall effectiveness is determined by evaluating three of the balancing criteria: long-term effectiveness; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness.

In USEPA's judgment, the selected interim groundwater remedy for OU-5 is cost-effective. EPA made this judgment after evaluating the overall effectiveness of the two alternatives that satisfied the threshold criteria and then comparing overall effectiveness to costs. EPA's judgment is based on the high ranking assigned the long-term effectiveness and reduction in toxicity, mobility, and volume through treatment to the Containment with Mass Removal alternative. Estimated costs for the two alternatives were within ten percent, with Containment alone less expensive with a 30-year-present-worth method and Containment with Mass Removal less expensive considering the estimated duration of the remedy.

In USEPA's judgment, the selected remedy is cost-effective for the final remedy for the contaminated soil areas: excavation for Areas C4, C41, 10D and 11D;
for Areas 7D, 33D and FCS; and
Areas 32D, 34D, 35D and 38D. . USEPA made this judgment after evaluating the overall effectiveness of the alternatives that satisfied the threshold criteria and then comparing overall effectiveness to costs. USEPA's selection of the remedy for Areas 32D, 34D, 35D and 38D is also based on the higher ranking assigned to Capping with SVE for long-term effectiveness and reduction in toxicity, mobility, and volume through treatment compared to Capping alone. Although Capping with SVE is $0.67 Million more expensive than Capping, USEPA has concluded that the incremental cost of the remedy provides a significant increase in overall effectiveness in preventing VOC exposure, given the planned future development of the area and surrounding Aerojet property.

EPA judges the No-Action Alternatives as neither protective of human health nor cost-effective.

2.13.4 Utilization of Permanent Solutions and Alternative Treatment Technologies to the maximum Extent Practicable

USEPA has determined that the Selected Remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the Site. Of those alternatives that are protective of human health and the environment and comply with ARARs, USEPA has determined that the selected alternatives provide the best balance of trade-offs in terms of the five balancing criteria, while also considering the statutory preference for treatment as a principal element and considering State and community acceptance

2.13.5 Preference for Treatment as a Principal Element

There are no known source materials or NAPL in OU-5. The largest human health risk is exposure to contaminated groundwater. The selected remedy will treat the contaminated groundwater between the on- and off-property extraction well systems to the containment levels, but will require coordination with other OUs to be fully effective. The off-property extraction system will contain the contamination at the leading edge, preventing further spread of contamination above containment levels into clean portions of the regional aquifer. The extraction systems in more highly contaminated parts of the OU-5 groundwater will help contain the contamination moving from the source areas and efficiently remove a significant mass of contaminants. The selected remedy provides the best reduction in volume by containing contamination at the containment levels, thus preventing the spread of contamination into other portions of the aquifer. The remedies for the soil areas are specific to each set of conditions, focusing on cleanup to levels allowing unrestricted future residential land use. The soil and vadose zone contaminated with VOCs will be treated to remove the contamination where possible. Actions to prevent exposure will be required until the sources of VOCs in shallow groundwater originating in upgradient OUs can be remediated. Relatively immobile contaminants in surface soils will be removed (e.g., metals, PCBs and perchlorate) to allow for unrestricted future land use. Deep subsurface soil treatment of percolate in area C41 is not currently available, so the remedy combines surface soil removal and containment of groundwater.

2.13.6 Five-Year Review Requirements

Because the interim groundwater remedy will result in hazardous substances, pollutants, or contaminants remaining within OU-5 above levels that allow for unlimited use and unrestricted exposure, a statutory review for the entire OU-5 will be conducted within five years after initiation of the remedial action, and every five years thereafter, to ensure that the remedy is, or will be, protective of human health and the environment.

2.14 Documentation of Significant Changes

Following many comments regarding attainment of the cleanup standards and the appropriate consideration of final and draft Public Health Goals, USEPA is selecting an interim groundwater containment remedy for OU-5. Aquifer restoration goals are not being selected at this time and will be evaluated in the final Sitewide remedy selection process.

The Proposed Plan fact sheet incorrectly listed the State's cleanup level for perchlorate in soil that is considered generally protective of groundwater. The fact sheet inadvertently omitted the soil vapor concentration that is protective for inhalation exposure at 10^{-6} risk range for VOCs including TCE. These are stated correctly in the ROD. The ROD explicitly states that the federal MCL establishes a limit of 80 µg/L for the sum of the concentrations of all four major trihalomethanes, which had not been clear in a table of cleanup levels included in the Proposed Plan fact sheet.

In November 2010, CDPH revised its notification level for 1,4-dioxane to 1 ppb following USEPA's August 2010 revision of the reference dose for this chemical. The current State notification level replaces the earlier level of 3 ppb, established in 1998 and based on a 1990 USEPA reference dose. USEPA's Regional Screening Level (RSL) was changed to 0.67 ppb to correspond to a 10^{-6} incremental cancer risk level calculated using the 2010 reference dose. The California notification level is slightly greater than the 10^{-6} incremental cancer risk level commonly used by CDPH for notification levels, reflecting difficulty in monitoring 1,4-dioxane at very low concentrations. Based on the above changes, the ROD has selected 1 ppb as the containment level for 1,4-dioxane.

Aerojet may provide the extracted water to drinking water providers for treatment for potable or non-potable uses. Water providers are subject to federal drinking water standards as well as California Department of Public Health, Division of Drinking Water and Environmental Management requirements. Discharge of treated water to on-Site surface water or land shall comply with the substantive requirements of the National Pollution Discharge Elimination System (NPDES) permit currently in effect. Discharge of treated water to off-Site surface water or off-Site use as non-potable water shall comply with applicable federal and State water standards in effect at the time of discharge.

PART 3: RESPONSIVENESS SUMMARY

3.1 Stakeholder Issues and USEPA Responses

There was significant community response received at the public meeting and provided in writing during the comment period. The comments and USEPA responses are included in the Responsiveness Summary as Appendix A of this document. The water providers and the community supported completing the remedy as expeditiously as possible but largely were concerned that the interim groundwater containment standards were not strict enough.

3.2 Technical and Legal Issues

3.2.1 Technical Issues:

The NDMA PQL is being improved. The current enforceable level is 5 ppt. Best available monitoring method technology shall be used until a PQL of less than 3 ppt is achieved.

3.2.2 Legal Issues:

Sacramento County and Aerojet have not completely resolved issues over water replacement.

Aerojet General Superfund Site
Responsiveness Summary to OU-5 Proposed Plan Public Comments

The comments listed below are summarized from comments submitted directly to EPA via letter or email, or provided during the 08/11/2009 public meeting.

There were several general topics that came up in a number of comments, which warrant a general discussion as well as specific responses to each comment.

General Response #1 - The groundwater cleanup values proposed are not adequate: In considering comments received during the Proposed Plan comment period, USEPA has reclassified the groundwater cleanup as an interim remedy which will contain the contaminant plume until USEPA develops the final cleanup standards for restoration of the groundwater in the final Sitewide remedy selection.

Final cleanup levels for water in the aquifer are based on the objective of restoring the resource to its beneficial use. The aquifer surrounding the Aerojet site is used as a source of drinking water. The lower of either the promulgated federal or state drinking water standard (Maximum Contaminant Level or MCL) is used for chemicals that have been through the lengthy public process to balance scientific information and other societal values. For contaminants with federal or state MCLs, USEPA maintains a general policy of establishing Superfund groundwater cleanup standards at the MCL. At the time of selecting the final Sitewide remedy, USEPA will evaluate whether any state Applicable or Relevant and Appropriate Requirements (ARAR) may require an *in situ* groundwater cleanup level lower than the MCL.

The Superfund program also must address risk above the general range of one additional case of cancer per 10,000 (10^{-4}) to one additional cancer per one million (10^{-6}). For chemicals without a promulgated standard, the Superfund program considers what is known about risk to public health, ideally to clean up each chemical of concern to reach a one in a million (10^{-6}) risk for cancer or a protective level for non-carcinogens (Hazard Index = 1). A similar evaluation is done for the cumulative risk from all contaminants of concern at the site. USEPA calculated that the cumulative cancer risk would remain within the acceptable risk range in OU-5 if all COCs were at the cleanup levels.

Often the risk information for chemicals without drinking water standards is not "settled" and the Agency must rely on estimates based on published risk information, public health advisories or public health goals which can be contradictory particularly for chemicals with relatively limited health research. Even for chemicals with formal drinking water standards, the health information continues to develop.

Coordination and integration of USEPA's cleanup and the State's remediation efforts and cleanup objectives for IRCTS and White Rock Road North Dump will be reviewed in the Sitewide remedy selection. An evaluation of the effectiveness of the OU-5 groundwater remedy during the five year reviews will specifically address these issues. USEPA is required to review the protectiveness of the remedy every five years at a site. The Agency anticipates that the five year review for the Aerojet site will occur in 2015 or 2016. The review checks for changes in environmental standards and other new information that might affect the protectiveness of the remedy. It also evaluates effectiveness of the action in attaining the objectives of the ROD.

General Response #2 - The proposed soil cleanup levels may not be protective, particularly for residential use of the land: There are no promulgated cleanup standards for soil. For surface soil, the most critical exposure pathway is the dirt and dust that a child will ingest, for example, from putting their hands and toys to their mouths. Some chemicals can be absorbed through skin. Garden vegetables may also take up chemicals through their roots, and food consumed from back-yard gardens may be an important pathway for some chemicals and for some people. If the contaminated soil is within ten feet of the ground surface, the contamination may eventually reach the surface through digging, including construction projects. Some chemicals like perchlorate salts can dissolve in water from rain or irrigation that percolates through the soil, eventually reaching the groundwater. In that case, the Superfund program must consider both surface soil and groundwater objectives. Soil will also "breathe" and allow vapor to reach the surface. Soil vapor intrusion into buildings has been a major issue at some cleanup sites, particularly where the groundwater with volatile chemicals is fairly close to the ground surface. The risks from this pathway involve many site-specific factors including the type of soil, how well the chemical vapor can move through open space between the soil particles, and the type of structures on the site. The objective for soil vapor intrusion is to prevent exposure to unsafe levels of chemicals indoors. As for many chemicals of concern, removing the source of the contamination is ideal. If it proves infeasible to remove the source sufficiently, other means, such as indoor air mitigation systems, must be used to prevent exposure. The cleanup levels in the ROD (Table 2.12) are established to achieve a one in a million (10^{-6}) risk level for cancer or a protective level for non-carcinogens (Hazard Index = 1).

General Response #3 - Land use restrictions are not protective: One alternative to preventing or limiting exposure to chemicals of concern is to restrict how water or land can be used for those areas where it is infeasible to remove source materials sufficiently to protect against exposure to unsafe levels of chemicals of concern. As a number of commenters have correctly pointed out, this is not ideal because of the challenges faced in enforcing the way land is used and how permits are followed. The long time required to reach the cleanup goals could also erode confidence in regulatory restrictions often called "Institutional Controls". In the region around Aerojet, groundwater used for public water supply is monitored for changes in

water quality and water levels in the aquifer. This provides some assurances about groundwater restrictions. EPA will ensure the protectiveness of the engineering controls and institutional controls through monitoring and Five Year Reviews.

General Response #4 - The remedy inadequately addresses impacts on surface water such as the American River: Impacts on surface water involve consideration of a complex set of issues that include the volume of water discharged to surface water, the volume in the receiving water and how it mixes, the chemistry of both waters and what effects might occur. Transport directly from groundwater into surface water does not occur at OU-5. EPA respects the site-specific effort that has been made by the State of California in developing standards (National Pollution Discharge Elimination Standards) for the water from the treatment plants that incorporate these considerations specifically for the local water bodies. The Record of Decision (ROD) cites the NPDES permit as the basis for treatment objectives for water that will be released to surface water.

General Response #5 - The remedy inadequately addresses ecological risks: Evaluation of ecological risks for the contaminated soil areas at OU-5 posed some challenges. USEPA is concerned about the potential risk to sensitive plant and animal populations from the existing contamination and the effects of the cleanup on these populations. Section 4.3.2 of the 2009 Remedial Investigation/ Feasibility Study provides further information supporting the statement for no action for ecological risks. No action is warranted at OU-5 to address ecological risks due to the absence of suitable habitat in impacted areas, and Aerojet's plans to develop much of OU-5 for commercial and residential uses. USEPA recognizes that the local, county and city agencies are following processes that are not under the direct control of the Superfund program which could lead to eventual commercial and residential development on part of OU-5. This change in land use may affect the ecosystem at the Site.

General Response #6 - The groundwater contamination is neither fully contained nor sufficiently monitored, threatening the public water supply: USEPA remains committed to rigorous evaluation of the effectiveness of the contaminant containment and long-term restoration of the aquifer. The Agency has initiated the formal evaluation of the OU-3 remedy. The OU-5 evaluation process may be combined with that for OU-3 for coordination and timeliness. For both OU-3 and OU-5, USEPA and the State actively search for any indication that either the containment system or monitoring program requires augmentation.

A. WRITTEN COMMENTS RECEIVED BY MAIL OR EMAIL

Commenter: Alex MacDonald, Senior Engineer, California Central Valley Regional Water Quality Control Board

1. The proposed cleanup value for TCE (5 µg/L) which is the current Maximum Contaminant Level [MCL]) of is not consistent with those that are being applied at the adjacent Inactive Rancho Cordova Test Site, at which Aerojet is a responsible party, and which will be affected by the containment levels proposed for OU-5. By allowing concentrations up to 5 µg/L to continue to migrate from Aerojet, the remedy for the IRCTS will be extended an indeterminate length of time having to remove the extra TCE that is above 0.8 µg/L or even 1.7 µg/L if the new PHG were used. Is USEPA willing to fund the regulatory oversight costs for the extended period of time it will take to cleanup at the IRCTS due to the addition of TCE from the Superfund site?

   USEPA Response to Comment #1: As indicated in the ROD, the groundwater remedy at OU-5 is an interim remedy. USEPA is not attempting to set a cleanup standard in the aquifer at this time. See General Response #1. The Superfund program uses promulgated drinking water MCLs as cleanup goals whenever possible because the adoption of formal drinking water standards incorporates a wide range of factors in a more thorough public and scientific process. The protectiveness and effectiveness of the OU-5 interim remedy will be reviewed at the five year review, and USEPA will work with the State regarding the protectiveness of the OU-5 and OU-3 remedies and the relationships with IRCTS. The Agency will review and develop the final cleanup standards for the groundwater in the final Sitewide remedy selection. Coordination and integration of USEPA's cleanup and the State's remediation efforts and cleanup objectives for IRCTS and White Rock Road North Dump will be reviewed in the final Sitewide remedy selection. The question about funding of oversight may be addressed after future cleanup actions are in place and can be evaluated.

2. The cleanup value for TCE is not consistent with that being applied at the remediation of the adjacent White Rock North Dump (WRND) where Aerojet is the responsible party and includes ground contamination associated with the Aerojet-General Superfund Site. The State Order for the WRND requires Aerojet, the remaining responsible party for the WRND, to clean up the plumes of pollutants underneath and down gradient from the WRND, to 0.8 µg/L TCE and 6 µg/L perchlorate, among other pollutants.

   USEPA Response to Comment #2: USEPA notes the difference between USEPA and the State of California's policy to set groundwater cleanup levels below the drinking water standard.

3. The proposed remedy for Zone 1 does not fully take into account ARARs in establishing cleanup values. The RWQCB may consider revision of Order No. 96-230 to assure that cleanup in the American River Study Area (ARSA) will be according to State requirements.

   USEPA Response to Comment #3: *The State has the authority to establish enforceable drinking water standards and may take other regulatory and permitting actions consistent with its authority. USEPA is not setting a cleanup standard in the aquifer at this time. USEPA will review the cleanup goals in the final Sitewide remedy selection. The Agency will also examine the effectiveness and protectiveness of the OU-5 interim remedy in the five year review process.*

4. Institutional controls should not be used unless it is clearly demonstrated that active soil remediation is not technically feasible;

   USEPA Response to Comment #4: *USEPA agrees with this comment and the alternative selected in the ROD is consistent with this view.*

5. The perchlorate cleanup level for soil remediation specified in the Record of Decision should be 0.06 mg/kg and not the 0.6 mg/kg found in the proposed plan.

   USEPA Response to Comment #5: *This inadvertent error has been corrected in the ROD and noted in the ROD as a significant change from the Proposed Plan. The state's risk-based soil cleanup goal for perchlorate for protection of groundwater is 60 µg/kg, which equates to 0.06 mg/kg, as presented in Table 7-4 of the RI/FS.*

6. Remediation of soils at C41 should require use of ex-situ bioremediation of the soils after excavation and returning the soils back to the excavation or alternate location on Aerojet, following remediation. Thus, a majority of the soils that are proposed for excavation (outside of the landfill) would be retained on-site and not require transport to a disposal facility.

   USEPA Response to Comment #6: *EPA agrees that ex-situ bioremediation would have certain advantages over disposal. Treatment and replacement of the soil from site C41 is included as an option in the ROD. This will be a consideration in the remedial design phase.*

7. Groundwater cleanup levels in general should be below the Maximum Contaminant Levels in order to fully restore the functionality of the groundwater to beneficial uses;

   USEPA Response to Comment #7: *This ROD is selecting an interim containment remedy. USEPA is not setting cleanup standards in the aquifer at this time. USEPA will evaluate cleanup standards at the time of the final Sitewide ROD. As a matter of policy, USEPA sets cleanup standards for groundwater at the MCL. Our criteria for evaluating whether that level is consistently achieved will use a*

conservative analytical approach to account for variability in measurement and other sources of uncertainty. Under the Safe Drinking Water Act, water treated to at or below federal MCLs is safe for human consumption. At the time of selection of the final remedy, USEPA will evaluate whether any state ARARs will require an in situ *groundwater cleanup level lower than the MCL. USEPA understands that state and local policies and other considerations will affect whether or not the treated groundwater is used as a source of drinking water.*

8. One ppb (1 μg/L) should be considered when developing the cleanup values for groundwater. The Proposed Plan has a cleanup value for chloroform in groundwater of 80 μg/L, which is based on the MCL for total trihalomethanes. Allowing the remaining concentration of chloroform to be 80 μg/L would not only allow the incremental cancer risk arising from using the groundwater for domestic purposes associated solely with chloroform to be $8x10^{-5}$, it would not allow any additional chloroform to be formed during the chlorination of the water in preparing it for public consumption

   USEPA Response to Comment #8: The federal MCL does establish a limit of 80 μg/L for the sum of the concentrations of all five trihalomethanes and the language in ROD clearly reflects this. The toxicological information for chloroform and the other three trihalomethanes will continue to be developed over time. This will be reviewed before setting final Sitewide cleanup (restoration) levels for the Site.

9. The cleanup value for hexavalent chromium in soils is proposed to be 1.4 mg/kg, based on a construction worker exposure. The cleanup level also needs to be protective of groundwater and should consider the recent completed toxicological studies of hexavalent chromium that were used by OEHHA in developing the draft public health goal of 0.06 μg/L and by the New Jersey Department of Environmental Protection in drafting proposed soil cleanup levels.

   USEPA Response to Comment #9: It is our understanding that the draft PHG for hexavalent chromium was released in August 2009, after the preparation of the RI/FS and the Proposed Plan. The April 2009 USEPA Regional Screening Level (RSL) for protection of groundwater was 2.1 mg/kg, which is above the construction worker cleanup value. In the December 2009 RSL table, the soil value for protection of groundwater is 0.83 mg/kg for Chromium VI, which is based on a tap water RSL of 0.043 μg/L. Adjusting this value to the OEHHA draft public health goal of 0.06 μg/L results in a soil value of 1.2 mg/kg, which is numerically similar to the construction worker cleanup value. Thus, the existing cleanup level for chromium VI is expected to be protective of the groundwater pathway. The State has reviewed the draft ROD and does not object to the hexavalent chromium cleanup value for OU-5.

10. Placement of contaminated soils beneath roadways and applying an institutional control in the form of a deed restriction should not be a remedial alternative. With roadways subject to disturbance and relocation from time to time, it would be best to place the soils in an area on-site where it is easier to maintain isolation of the wastes. With Aerojet performing remediation of soils at subsequent OU's, the establishment of a facility on Aerojet where the soils can be stored should be considered.

USEPA Response to Comment #10: *EPA agrees that soil treatment is a preferable alternative to institutional controls such as deed restrictions. The description of the relevant soil remedy in the ROD specifies: "Treat the excavated soil to remove the contaminants to cleanup levels or transport contaminated soil to an approved landfill."*

Commenter: Larry Ladd, citizen

11. Nitrosodimethylamine, nitrosomethylethylamine, and nitrosodiethylamine are all detected by method 521 at levels comparable to the neutron bombardment method we now use for nitrosodimethylamine alone, but method 521 is significantly cheaper. It is unclear if the NDMA-specific frequency of the UV oxidation treatment system breaks up the other nitrosamines likely to be in groundwater beneath Aerojet. Aerojet should use method 521 at Aerojet to protect public health and reduce analytical costs.

USEPA Response to Comment #11: *USEPA appreciates this information and the Agency will consider the comment during the remedial design phase. USEPA has been in the process of reviewing quality assurance information for alternative analytical methods for NDMA.*

Commenter: Cynthia Crowley, Gold River resident

12. Citizen's health is in jeopardy because acceptable cleanup levels for perchlorate have not been established.

USEPA Response to Comment #12: *USEPA is using the State of California's drinking water standard for perchlorate as the containment objective for OU-5. The MCL is based on the State's current Public Health Goal for perchlorate. Any changes in the State MCL or establishment of a more stringent federal MCL for perchlorate will be examined and incorporated in the final Sitewide remedy selection process if scientific evidence indicates that the original level is no longer considered protective of human health.*

13. Water supply protection needs to come before Aerojet property development.

USEPA Response to Comment #13: *USEPA agrees with this prioritization. Development may be possible while the groundwater cleanup is proceeding. Land use has continued along with groundwater remediation at many cleanup sites in California and throughout the US. Construction and development has continued in areas above the Aerojet off-property plume and other construction projects have continued on the Aerojet property.*

14. Aerojet has an obligation to clean up the site and insure water supply quality, and the government needs to hold them accountable.

USEPA Response to Comment #14: *USEPA continues to require Aerojet to implement cleanup activities through enforceable orders. The State of California uses its authority to require Aerojet to clean up outside the Superfund site. USEPA and the state recover oversight costs from Aerojet.*

Commenter: Warren Truitt, President of Save the American River Association

15. Contamination plume is still spreading and new strategies are needed to control and cleanup groundwater.

USEPA Response to Comment #15:
USEPA's interim containment remedy is intended to prevent the plume from spreading. USEPA and the State actively oversee the cleanup. Due to a better understanding of subsurface conditions (i.e., groundwater plume extent, hydrogeology of contaminated aquifers), the groundwater containment strategies for OU-5 will improve the effectiveness of the plume capture using existing GETs. Groundwater modeling techniques have also improved which has enhanced the ability to design more effective extraction systems. Methods for monitoring extraction system effectiveness have also improved to allow necessary revisions to optimize containment and eventual restoration of the aquifer.

16. Current plume monitoring is inadequate and needs to be expanded.

USEPA Response to Comment #16: *Methods for monitoring extraction system effectiveness are improving. System revisions that may be needed can be more readily identified. Recent EPA guidance for effectively monitoring the pump and treat systems (i.e.; Systematic Approach for Evaluation of Capture Zones at Pump and Treat Systems, 2008) is currently being implemented.*

17. Aerojet and Boeing have yet to accept their responsibility and provide any meaningful proposal to resolve the very serious damages to the area's water supply.

USEPA Response to Comment #17: *USEPA continues to require Aerojet to implement the cleanup activities through enforceable orders. The State of California uses its authority to require Aerojet to clean up outside the Superfund site. USEPA and the State recover oversight costs from Aerojet.*

Commenter: Stephen Green, Immediate Past President, Lake Natoma Heights Neighborhood Assn.

18. Contamination plume is still spreading and new strategies are needed to control and cleanup groundwater.

USEPA Response to Comment #18: *See response to Comment 15.*

19. Current plume monitoring is inadequate and needs to be expanded.

USEPA Response to Comment #19: *See response to Comment 16.*

20. The time frame of 150 to 350 years that is needed to clean up the aquifer is too long and this alternative should be stricken from the proposed plan.

USEPA Response to Comment #20: *USEPA acknowledges that the estimated length of groundwater restoration is significant. Immediate actions to prevent exposure to unacceptable levels of the contamination have been in place at the site and will continue to operate until no longer necessary for public health protection. The Agency will continue to review the effectiveness and efficiency of the OU-5 remedy through five year reviews and make any adjustments warranted by new information.*

21. There is an urgent need to address contaminants leaking into Buffalo Creek. Deformed species have been observed.

USEPA Response to Comment #21: *Buffalo Creek was not included in the OU-5 remedy because it is located upgradient and outside of OU-5, as shown in Figure 2 of the Proposed Plan. The RI states that groundwater does not discharge to Buffalo Creek. Buffalo Creek will be addressed, if warranted, in the RODs for OUs-6 through 9.*

22. An approach to protect federally listed threatened species (Valley Elderberry Longhorn Beetle) and state-listed threatened species (Swainson's hawk) needs to be included in the plan.

USEPA Response to Comment #22: *The screening level ecological risk assessment considered threatened and endangered species, including the Valley Elderberry Longhorn beetle and the Swanson's Hawk, as receptors of concern. No threatened and endangered species were directly observed during the site-specific habitat characterization, though habitat suitable for use by these species was observed. Though not detailed in the proposed cleanup plan, the protection of endangered species during implementation will be included in the remedial design. In addition, a Resource Conservation Management Plan (RCMP), which ties together all the resource, mitigation, enhancement, education, and recreation elements of the development project, is a component of Aerojet's proposed redevelopment. Aerojet's proposed development plans include implementation of compensatory mitigation for project-related effects to waters of the United States, potential habitat for special-status species (vernal pool branchiopods, Valley elderberry longhorn beetle, and Swainson's hawk), and other sensitive resources such as oak trees.*

23. If the soil cannot be cleaned up to residential standards then it cannot be safe for commercial use either.

USEPA Response to Comment #23: *Residential standards are considered to be the most protective maximum beneficial use of a property. Residential standards account for daily 24 hour exposure throughout the calendar year by both a child and an adult, while commercial standards take into account more limited durations for exposure based adult exposure during work hours. Thus a residential cleanup standard and a commercial cleanup standard are different but each is protective for the intended use.*

24. No development of Aerojet land should be allowed until the soil and water on this Superfund site is restored to safe levels.

USEPA Response to Comment #24: *See response to Comment 13.*

25. EPA should become a party to the County of Sacramento suit that was filed on 1 July 2009.

USEPA Response to Comment #25: *USEPA is aware of this legal action, which may be driven, in part, by a requirement that Aerojet ensure replacement water supplies. USEPA can require remedial action at the Aerojet site without becoming a party to the July 2009 lawsuit. Provisions for water supply replacement arrangements are included in both OU-3 and OU-5 RODs.*

Commenter: Tom Gray, Fair Oaks Water District

26. Although the RI/FS is dated June 2009, most of the technical appendices that are summarized in the RI/FS or used to derive conclusions in the RI/FS are dated to prior years. The information and analysis developed as part of the 2008 Agreement appears to not have been used to perform the analysis specific to the preferred alternative Z1-3. FOWD is concerned that the chosen remedial action has not recognized FOWD operations and therefore may not protect FOWD public water supply wells, especially the Town well. For instance, Appendix H is dated August 1, 2005. This particular appendix documents *the Groundwater Flow Simulations Conducted in Support of the Perimeter Groundwater Operable Unit Feasibility Study*, including the analysis focused in Zone 1, which is inclusive of much of the FOWD service area.

    USEPA Response to Comment #26: *As stated in Section 4.2 of the PGOU RI/FS, the preparation of the report has occurred over a multi-year timeframe and therefore the RI/FS may not reflect the latest data for the site. Groundwater modeling was conducted as part of the OU-5 RI/FS to assess and compare potential remedial alternatives for Zones 1 through 4. However, EPA believes that the FS-level evaluations provided in the report are adequate for selection of the remedial actions identified, as critical information will be updated during the remedial design phase. The final number, location and flow rates of the remedial extraction wells for each zone will be determined during the remedial design phase by incorporating the current and projected flow rates of surrounding water supply wells into the groundwater model.*

27. Section 1.2.2.4 of the RI/FS notes that FOWD operates two public water supply wells within 1-mile of the PGOU boundary. On the accompanying table, the wells are listed as "Town" and "Chicago" (Aerojet has numbered these wells as 1047 and 1049, respectively). As of the 2008 Agreement the Chicago well is now owned by Aerojet and is no longer operated. FOWD is very concerned that continued operations of the Town well will be adversely impacted without immediate installation of the planned remedial wells up-gradient of the Town well. Without remedial wells in place a full year and a half after signing the 2008 Agreement, and the need for FOWD to continue to operate the Town well to help meet customer demands, the potential for TCE to be discovered in the Town well is increasing daily.

    a. In the 2008 Agreement, Aerojet and FOWD both agreed to operate supply and remediation wells in a manner to minimize any adverse impact to remediation and to FOWD operations. Without remedial wells in place these operational agreements cannot be realized.

    USEPA Response to Comment #27 a.: *A critical component of both the OU-3 and OU-5 remedies includes thorough evaluation of information to ensure the effectiveness of the containment systems. USEPA plans to coordinate*

the evaluations of the two OUs to expedite an evaluation of Zone 1 of OU-5 upgradient from where the Town well is located.

b. As also agreed to by Aerojet in the 2008 Agreement, if TCE is found in the Town well, replacement water supplies will need to be provided. FOWD greatly prefers to maintain operations of the Town well and not need to work with Aerojet to find costly replacement water.

USEPA Response to Comment #27 b.: A major objective of the OU-5 remedy is to contain the contaminant plume to protect downgradient water supplies such as the groundwater critical to FOWD.

28. Though the RI/FS indicates two remedial wells to be located up-gradient of the Town well (namely Z1-C1 modeled at 500 gpm, and Z1-D1 modeled at 600 gpm), it is unclear if these well locations and flows are the same as modeled during development of the 2008 Agreement. Therefore, it is unclear whether these wells will provide the desired remediation. FOWD would like to be provided with a comparison of the information modeled in the RI/FS and that represented during the 2008 Agreement negotiations.

USEPA Response to Comment #28: See EPA response to Comment #26.

29. Because the California Department of Health Services, Office of Drinking Water has established a Public Health Goal (PHG) of 0.8 µg/L for TCE, FOWD believes that the EPA preferred alternative in the Plan should accommodate this PHG.

USEPA Response to Comment #29: See USEPA's General Response #1 and responses to Comments 1, 2 and 3 regarding the State's use of PHGs and other non-promulgated standards versus MCLs.

30. In several locations within the RI/FS there is mention of alternative considerations that would send extracted groundwater to a treatment facility next to the FOWD Town well instead of pumping the remedial water to the ARGET treatment facility. During early discussions with Aerojet for development of the 2008 Agreement, FOWD offered an opportunity to locate a treatment facility on property within the FOWD service area. Aerojet declined. There have been no further discussions on this matter with FOWD. FOWD requests that representation of this option in the RI/FS and supporting appendices be removed.

USEPA Response to Comment #30: USEPA no longer considers an additional treatment facility within the FOWD service area to be necessary based on a

preliminary evaluation of the containment effectiveness in Zone 1. The alternative for constructing a treatment system within the FOWD service area was considered during conceptual development of alternatives in the RI/FS report several years before the proposed plan was published. If this approach is evaluated during the design phase, further discussions with FOWD will be needed.

31. The cost to install the preferred alternative (Z1-3) indicated in the RI/FS (section 5.2.3.7) is not consistent with the detailed cost information included in Appendix I.

    a. The cost table included in Appendix I does not include the cost for potential treatment at a location other than the ARGET facility (e.g. as stated in comment #5 above, the RI/FS indicates the potential for treatment located at or near the FOWD Town well). The cost table in Appendix I for the Z1-2 alternative did include this additional cost, listed to be $395,000. This cost is missing from the estimate for Z1-3.

    USEPA Response to Comment #31 a.: Although the Alternative Z1-3 cost table in Appendix I does not repeat the itemized cost estimate for the optional treatment system near Well 1047, this cost is included in the cost summary in Section 5.2.3.7 (page 94) of the RI/FS. The estimated capital cost of $3,500,000 for construction of a treatment system adjacent to the FOWD Town well (Well 1047) is the same for Alternatives Z1-2 and Z1-3. This is because: 1) the additional extraction wells that would be included in the mass removal option are existing wells; and 2) the additional groundwater extracted from these wells would be treated at the ARGET treatment facility.

    b. The cost listed for treatment at the FOWD well of $395,000 does not include any cost that might associate with the routing of the treated water to and through storm water discharge facilities. Pumping to the storm water system of a constant stream of 1,100 gpm (the combined rate from the Z1-C1 and Z1-D1 new extraction wells) may require various modifications to channels, culverts and other ancillary facilities as the water is conveyed from the treatment location to the American River. If the water were to be directly used by FOWD after treatment, there may also be costs associated with the connection to the FOWD potable water delivery system.

    USEPA Response to Comment #31 b.: The feasibility study costs are estimated within the +50%/-30% accuracy range specified in EPA's RI/FS guidance. During the design phase more detailed estimates will be prepared.

Commenter: Kenneth Payne, City of Folsom

32. Remediation goals in the Plan are not adequate. Maximum protection of human health should be the primary criteria to be considered in the development of the cleanup goals for the Plan. Therefore, the applicable, relevant and appropriate requirement (ARAR) for the cleanup goals for the contaminants of concern (COC) should be the Maximum Contaminate Level Goal (MCLG), not the Maximum Contaminate Level (MCL) as proposed in the Plan. California Department of Health (CDPH), who has primacy over the water quality regulations in California, specifically requires that water from extremely impaired sources must be treated to the MCLG to even be considered as a source of supply. Remediation goals presented in the Plan, MCLs, do not provide the requisite level of protection for human health.

    Treating the contaminated groundwater to the individual MCL value does not fully restore the groundwater basin to its beneficial use. If the City of Folsom attempted to develop a groundwater supply from the basin, the water would still have to be treated to meet requirements of the CDPH.

    Treating to the MCLs compromises the assimilative capacity of the groundwater basin when considering the individual and cumulative risks associated with the various COCs.

    USEPA Response to Comment #32: In considering comments received during the Proposed Plan comment period, USEPA determined that the groundwater cleanup is an interim remedy. USEPA will review the final cleanup standards for the groundwater in the final Sitewide remedy selection. See the USEPA's General Response #1 at the start of this Responsiveness Summary. USEPA is required to review the protectiveness of the remedy every five years at a site after the remedy is in place.

33. Both the California Water Code (CWC) and Federal Water Pollution Control Act (Clean Water Act) require the preparation and adoption of water quality control plans (basin plans). Basin plans are a comprehensive document that designates the beneficial uses of the water to be protected, water quality objectives and implementation actions to achieve the water quality objectives. The Central Valley Basin Plan as adopted must conform to statewide policies in accordance with the CWC. State Water Resources Control Board Resolution No. 92-49 (Resolution 92-49) contains policies and procedures related to oversight and regulation of cleanup or abatement activities from all types of discharges. Resolution 92-49 directs the Regional Board to ensure that dischargers are required to cleanup in a manner that promotes attainment of background water quality or highest water quality reasonable.

    Cleanup to the MCL level is not the highest water quality and does not provide the maximum benefit to the people of the region and state and unreasonable impacts present and future beneficial uses of the water in this basin. The City of Folsom would seek to use this water for any possible purpose.

USEPA Response to Comment #33: ***Both USEPA and the State have identified drinking water use of the groundwater as the primary beneficial use of the water in the aquifer. Containment levels in the ROD are based on MCLs rather than on background levels consistent with USEPA policy. USEPA will review the final standards for the groundwater in the final Sitewide remedy selection. See USEPA's General Response #1.***

34. It is stated in the Plan that incorporation of the management of the treated groundwater into the overall water supply picture for this area of Sacramento County could minimize the need for major new facilities to divert and treat surface water from the Sacramento River. However, it also states that all costs above the basic remediation action (MCL) costs, necessary to allow for integration of the this water source into the regional water supply picture would be become part of the new developments financing program.

    The costs for remediation to allow for beneficial use of the groundwater basin should be borne by Aerojet who created the problem, not existing and future water rate payers. The City of Folsom could use this groundwater for potable supply, and non-potable purposes absent cleanup to the highest possible levels, and the ratepayers will suffer while Aerojet will benefit from a reduced standard.

    USEPA Response to Comment #34: ***There are a number of successful projects in California where Superfund cleanup actions are fully integrated with the public water supply systems. The OU-5 remedy does not preclude use of the extracted water as a source of drinking water supply following treatment, despite the lack of any current plans for use as a potable water supply. USEPA appreciates the perspective of water purveyors regarding obstacles and challenges to providing potable water supply. The language in the ROD clarifies that state drinking water policies regarding impaired sources will be important considerations for use of the water as a potable supply.***

35. The Plan is replete with the statement that the "*Treated groundwater could be used as the source of water for the Aerojet industrial water system in lieu of the untreated surface water.*" This can only be accomplished if the water is either delivered to the City of Folsom, as we are the water purveyor, or contractual arrangements made for Aerojet to be self supplied. In either case this will require a significant amount of coordination with the City, GenCorp and CDPH, which to date has not occurred.

    The Plan is deficient in that it makes speculative statements regarding permitting requirements from CDPH, but provides no history of correspondence or other evidence that this use would be allowed, and if so under what conditions.

USEPA Response to Comment #35: *USEPA agrees that the provision of treated groundwater as drinking water will need to meet the requirements of CDPH. See response to Comment #34.*

36. The overall goal of any remediation alternative considered, as stated, is to protect human health and the environment. One of the Remedial Action Objectives (RAOs) listed in the Plan is as follows: "*Protect public drinking water wells and provide treatment or alternative supply for those drinking water wells that have been or potentially may become impacted by chemicals at unacceptable levels.*" Public drinking water wells have already been impacted by chemicals at unacceptable levels and treatment is currently being provided with the water being discharged to the American River. In light of the current political and market climate in California, with regard to water rights and availability, an alternative water supply needs to be identified and potentially secured.

    USEPA Response to Comment #36: *USEPA agrees with the basic concern expressed in the comment. A requirement for contingency plans for alternative water supply is incorporated into the remedy. More detailed development of such plans will occur in subsequent phases of the design and implementation of the remedy.*

Commenter: Herbert Niederberger, Sacramento County Water Agency

37. Using Maximum Contaminant Levels (MCLs) as the cleanup goal does not provide sufficient protection for present and future beneficial uses of the basin. SCWA recognizes that many trade-offs are considered during the development of an MCL, but limiting clean-up operations to the MCL not only eliminates any future assimilative capacity for contaminants within groundwater basin, it is also not protective of human health. With this in mind, clean-up goals are more appropriately reflected in the Maximum Contaminant Level Goals (MCLG) as established by the United States Environmental Protection Agency or Public Health. In the event remediated water is used for drinking water purposes, as proposed by the plan, treating to the MCLG level is consistent with California Department of Public Health's Policy Memo 97-005, "Policy Guidance for Direct Domestic Use of Extremely Impaired Sources." In accordance with this policy Memo, proposed treatment of extremely impaired sources should be designed and operated to meet the MCLG or less. While treating to the MCLGs will not guarantee that the remediated groundwater can be used directly for domestic purposes, it is the first step that will be required for any reuse proposal.

    USEPA Response to Comment #37: *See USEPA's General Response #1 and response to comments #33, #34 and #35.*

38. The Remedial Investigation/Feasibility Study (RI/FS) for the Plan states that: *"[I]ncorporation of the management of the treated groundwater into the overall water supply plans for the eastern portion of the County could be used to minimize potential investment by Sacramento County and would delay if not eliminate the need for a new major Sacramento River diversion and accompanying treatment and pumping facilities at least for service to the portions of eastern Sacramento County that are farthest from the river. It would allow for staged development of water supply facilities meeting all public health and environmental requirements. All costs above the basic remedial action cost would become part of the new development financing program with potentially significant savings to both the remediating and development efforts."*
Absent groundwater contamination, SCWA would not have to consider making significant additional investments in surface water facilities to convey water to areas proposed to be developed by Aerojet. Cost related to contaminated groundwater impacts should be the responsibility of Aerojet and not part of a new development financing program.

USEPA Response to Comment #38: *See response to comments #25, #33, #34 and #35.*

39. The RI/FS for the Plan identifies several possible process options for: *"[M]anagement and/or possible reuse of untreated or treated groundwater produced by any hydraulic containment or groundwater collection/treatment alternatives."* This can only be accomplished if agreements are reached on the disposition of the remediated groundwater and any damages are addressed that are associated with the presence of groundwater contamination.

USEPA Response to Comment #39: *A requirement for management of the groundwater and reuse is incorporated into the remedy. USEPA's experience with implementation of the OU-3 remedy has made us aware of the many challenges involved in subsequent phases of the design and implementation of the remedy. The Agency is also aware of legal actions between Sacramento County and Aerojet.*

40. The RI/FS for the Plan states that: *"[T]he long-term yield of the basin is unaffected by the extraction and/or recharge of the quantities of water described in this report."* This is a false conclusion since very little of the groundwater extracted and treated as part of the proposed OU-5 plan will actually recharge the basin. Furthermore, while the amount of groundwater extracted and treated as part of the proposed OU-5 plan is relatively small the current extraction rate for on-going remediation activities is approximately 20,000 acre-feet per year or about 7 percent of the sustainable yield of the basin. This is a significant amount, and it will continue to increase as other Operable Units are brought on line. In addition, this statement does not take into account the impacts of water supplies lost due to contamination. If purveyors replaced the 20,000 acre-feet per year with groundwater pumped from other areas in the basin, the impact is essentially double. Currently, the majority of the remediated groundwater is discharged to surface water streams and is lost to

the basin. In order to keep this groundwater in the basin and to minimize impacts to its long-term sustainable yield, appropriate agreements for the replacement of water supplies lost due to contamination and the re-use of this water should be reached so that this valuable resource will not simply be discharged to waste.

USEPA Response to Comment #40: *USEPA agrees that long-term management of the groundwater resource is an important consideration and such a requirement is incorporated into the remedy. As in the response to comment #39, there will be challenges to developing and implementing a management program.*

41. SCWA requests a description of how the operations of surrounding water purveyors were incorporated into the design of the proposed containment and remediation strategy for contaminated groundwater, as well as contingencies for changes in their future operations. Detections of contaminants at increasing distances from Aerojet have, unfortunately, demonstrated that past strategies may have been inadequate to arrest movement of contaminants in the aquifer. Several regional factors will potentially result in increased reliance on the groundwater basin, particularly in drier periods in the future. SCWA is interested in seeing that the plan can demonstrate effective capture under near-term and long-term public water supply operations in the underlying groundwater basin.

USEPA Response to Comment #41: *Groundwater modeling was conducted as part of the OU-5 RI/FS to assess and compare potential remedial alternatives for Zones 1 through 4. The final configuration of the remedial extraction system for each zone will be determined during remedial design phase which will commence following completion of the OU-5 ROD. During the remedial design phase, the current and projected flow rates of surrounding water supply wells will be incorporated into the groundwater model.*

Commenter: Steve Nugent, Carmichael Water District

42. OU-5 Potential Multi-Basin/Multi-Jurisdictional area of environmental impact.

    a. The National Environmental Policy Act (NEPA) Environmental Impact Study was completed at a time that containment within the existing Aerojet site was considered possible. CWD requests EPA require an update to the NEPA cumulative impact evaluation addressing expanded scope of the cleanup to an area well beyond the Aerojet plant site. This effort should include, but not be limited to, impact of the MCL cleanup goal on future beneficial use by public and private water purveyors.

    USEPA Response to Comment #42 a.: *USEPA agrees that the Aerojet contaminant plume extends beyond the property boundary of the Aerojet facility. OU-5 and OU-3 are intended to address the contamination*

beyond the property boundary, in a CERCLA process that is considered the functional equivalent of NEPA. As mentioned in response to comment # 41, the interaction of the remedy with the surrounding basin will be examined.

b. The clean-up and containment approach was in part based on the groundwater south of the American River being unique and separate from the groundwater north of the American River and that the American River formed a boundary condition.

   CWD requests EPA require that NEPA documents address cumulative impacts both south of the American River and north of the American River.

   USEPA Response to Comment #42 b.: The remedies for both OU-5 and OU-3 extend north of the American River. See the response to comment #42a regarding CERCLA functional equivalency to NEPA.

c. The gross regional extent of the contaminant plume impacts multiple local special districts and private water providers who rely on the groundwater as a key element to meeting existing and future water supply demands.

   CWD requests EPA require evaluation of cumulative impacts on maintaining and management of the groundwater resource as a viable water supply considering the impacts of the Aerojet cleanup on the viability of conjunctive use.

   USEPA Response to Comment #42 c.: A critical component of both the OU-3 and OU-5 remedies includes thorough evaluation of information to ensure the effectiveness of the containment systems, as well as consistency with basin management considerations. USEPA will consider coordinating the evaluations of the two OUs to expedite an evaluation of Zone 1 of OU-5.

d. The State of California Department of Water Resources is advocating increased use of groundwater as one key strategy to addressing climate uncertainty and change. The State of California Regional Water Quality Control Board is enforcing an anti-degradation policy for direct injection using aquifer storage and recovery wells disallowing public water purveyors from using potable waters meeting all Maximum Contaminant Levels (MCL) for recharge.

   CWD requests EPA acknowledge that the use of the MCL as the clean-up standard is inconsistent with State of California ASR well use policy enforcing an anti-degradation standard for public water purveyors managing conjunctive use programs.

   USEPA Response to Comment #42 d.: See response to comment #34.

e. CWD requests that until such time as the NEPA Cumulative Impacts evaluation update is completed the EPA require additional redundancy in extraction well coverage and capacity combined with increased density of monitoring wells, aquifer characterization test holes and water purveyor supply sentry wells to reduce the uncertainty as to the adequacy of the OU-5 plan being protective of existing and future beneficial use of the basin as a public water supply.

USEPA Response to Comment #42 e.: ***USEPA and the State will oversee the design and implementation of the remedy, including a requirement for rigorous evaluation of the systems' effectiveness. USEPA will examine the need for additional monitoring points and alteration of the hydraulic containment action to optimize the effectiveness of the containment.***

43. OU-5 plan establishes clean up goals based on current drinking water Maximum Contaminant Levels (MCL) for those constituents where an MCL exists. The use of the Federal MCL as OU-5 Clean-up Goals transfers the economic risk for uncertainty and additional groundwater treatment as a drinking water supply to the local public water system rate payers. The State of California MCL treatment compliance enforcement through California Department of Public Health (CDPH) for public water supplies will likely require additional treatment before issuing a Water Supply Permit for water marginally at the MCL. The clean up goals should be significantly below the State of California MCL to be protective of future beneficial uses of the waters of the State of California and to prevent shifting the economic legacy for cleanup to the local public and private water system rate payer.

USEPA Response to Comment #43: ***See General Response #1 and responses to comments #1, #2 and #3.***

a. Public and Private water purveyors are responsible for monitoring and providing a safe and reliable water supply under the regulatory jurisdiction of the CDPH. CDPH policy is, where alternate water supplies are unavailable, to require a groundwater treatment design goal for public water supplies of approximately 20% below the MCL to provide for treatment upset and uncertainty.

CWD requests EPA acknowledge that the MCL limit may be insufficiently protective of existing beneficial use for public and private water purveyors under the CDPH jurisdiction for enforcement of Drinking Water Maximum Contaminant Levels.

USEPA Response to Comment #43a.: ***The process for developing and promulgating both federal and State MCLs considers uncertainty from many sources.***

b. Drinking water MCL standards are set in California though set in Code of California Regulations Title 22 and are often more conservative than the Federal MCL to address members of the population that are more highly susceptible to health risk.

CWD requests EPA acknowledges that California MCL health based criteria is more conservative than Federal MCL health based criteria.

USEPA Response to Comment #43b.: *USEPA is required by CERCLA to adopt more-stringent State MCLs in developing final cleanup objectives. The OU-5 groundwater action is an interim remedy that will contain the existing contamination. Final cleanup objectives will be set at the time of the final Sitewide ROD.*

c. EPA established and amends MCL's at the Federal level and in practice address uncertainty with regard to health risk through including Factors of Safety.

CWD requests EPA acknowledge that there is no Factor of Safety provided in the use of the Federal MCL as the cleanup criteria for uncertainty as to future beneficial use by public and private water purveyors.

USEPA Response to Comment #43c.: *The process for developing and promulgating both federal and State MCLs considers uncertainty from many sources.*

44. California Division of Drinking Water and Environmental Management Policy Memo 97-005 Section A General Philosophy states the following:"... only the best quality sources of water reasonably available to a water utility should be used for drinking." In addition, the Policy Memorandum further states:

"Water utilities (including wholesalers) should be encouraged to minimize the concentration of man-made toxic substances, natural occurring contaminants, and pathogenic microorganisms in drinking water supplies, maximum contaminant levels (MCLs) notwithstanding."

And further:

"...sources that contain or are likely to contain high concentrations of contaminants, multiple contaminants, or unknown contaminants (such as groundwater subject to contamination from a hazardous waste disposal site) should not be considered for direct human consumption where alternatives are available."

USEPA Response to Comment #44: *See response to comments #34 and #35.*

a. CWD requests EPA acknowledge that water purveyors are held to a much higher resource management standard than an MCL for multi-contaminant and contaminated groundwater as part of Water Supply Permitting of new public water supply wells. This includes replacement wells exempt from the California Environmental Policy Act.

USEPA Response to Comment #44a.: *See response to comments #34 and #35.*

b. CWD requests EPA acknowledge that the OU-5 plan provides no allowance for lost resource management for maintaining existing public water supply planning for impaired groundwater supplies.

USEPA Response to Comment #44b.: *USEPA agrees that short- and long-term replacement of water supplies and the management of the groundwater resource are important considerations of this large groundwater remedy. Such requirements are incorporated into the remedy, but will involve further development for specific details. As in the response to comment #39, there will be challenges to developing and implementing a management program.*

c. CWD requests that the EPA require Aerojet collaborate with local water purveyors or the Regional Water Authority, or the Sacramento Groundwater Authority to complete replacement water supply plans for all groundwater supplies within limits of groundwater at risk of containing man-made contaminants, multiple contaminants, or unknown contaminants from Aerojet, consistent with the General Philosophy section of California Division of Drinking Water and Environmental Management Policy Memo 97-005 Policy Guidance for Direct Domestic Use of Extremely Impaired Sources with special emphasis on the following: ""...sources that contain or are likely to contain high concentrations of contaminants, multiple contaminants, or unknown contaminants (such as groundwater subject to contamination from a hazardous waste disposal site) should not be considered for direct human consumption where alternatives are available."

USEPA Response to Comment #44c.: *Groundwater management outside the Superfund Site must comply with all applicable regulations including permitting activities required by state and local authority. USPEA has included a requirement for OU-5, similar to that for OU-3, for management of water levels to prevent the spread of contamination beyond the current extent of the plume.*

d. CWD requests EPA require a sustaining funding mechanism for funding the public cost of collaboration and participation in the replacement water supply planning of groundwaters at risk as described above.

USEPA Response to Comment #44d.: *USEPA expects details of developing and implementation of short- and long-term water replacement contingency plans, including funding for public participation in technical aspects, will be addressed during the design phase of the project.*

e. CWD requests EPA specifically request participation and comments from CDPH regarding suitability of OU-5 with regard to protecting future beneficial use and conjunctive use as interpreted through Policy Memo 97-005.

USEPA Response to Comment #44e.: *USEPA's experience at other large groundwater sites in California has shown that CDPH is closely involved in the potable use of groundwater or treated groundwater extracted from a Superfund site. Use of water outside the NPL site must comply with all applicable federal, state and local regulations.*

45. The extraction of groundwater for remediation is a significant percentage of the potential groundwater basin yield that is not currently integrated into the regional conjunctive use and groundwater management plans. Combined pumping with transfers for indirect reuse using surface water provides a benefit to the responsible party. This potential benefit is contradictory to the potential liability shift of long term groundwater treatment for groundwater users contending with CDPH permitting authorities.

USEPA Response to Comment #45: *See response to comment #44c.*

a. CWD requests that EPA prohibit OU-5 groundwater extractions direct or indirect reuse benefits to the responsible party until all public water supply options, including, but not limited to, groundwater banking and upstream storage credits for critically dry years for CWD.

USEPA Response to Comment #45a.: *The details of groundwater management as required to "...*Create a groundwater management zone within OU-5 to maintain water levels and to prevent adverse impact on the remedy..." *will be developed during subsequent stages of the design and implementation of the remedy.*

b. CWD requests the EPA require the OU-5 plan address the loss of groundwater recharge potential due to contamination of the Aerojet Site as it relates to the long term decline in the regional groundwater table and sustainability of the groundwater supply as a public resource.

USEPA Response to Comment #45b.: *See response to comment #45a. USEPA will consider these comments during review of the remedial design for OU-5.*

Commenter: Janis Heple, Citizens Advisory Group for the Aerojet Superfund Site (CAG-AJ)

The CAG-AJ reviewed comments made by Alexander MacDonald, on behalf of the Water Quality Control Board, and concurs with the issues raised in his letter.

46. Cleanup values for OU-5 should address the following issues:

    a. Proposed cleanup value for TCE is not consistent with the neighboring Inactive Rancho Cordova Test Site;

    USEPA Response to Comment #46a.: *USEPA is grateful for the thoughtful participation of the Citizens' Advisory Group during all stages of the Aerojet Superfund project. EPA has addressed many of the comments below in General Response #1 at the start of this Responsiveness Summary and in the earlier comments cited. See also response to comment #1.*

    b. Proposed cleanup value for TCE is not consistent with the remediation of the White Rock Road North Dump;
    USEPA Response to Comment #46b.: *See response to comment #2.*

    c. Perchlorate cleanup level for soil remediation in ROD should be 0.06 mg/kg;
    USEPA Response to Comment #46c.: *USEPA agrees and the language in the ROD corrects this typographical error in the proposed plan fact sheet.*

    d. Groundwater cleanup levels should be below the MCL;
    USEPA Response to Comment #46d.: *Please see General Response #1.*

    e. The draft Public Health Goal for chloroform should be considered;
    USEPA Response to Comment #46e.: *See response to comment #8.*

    f. The cleanup value for hexavalent chromium in soils should consider recent studies.
    USEPA Response to Comment #46f.: *See response to comment #8.*

47. The use of institutional controls instead of active remediation should be minimized.

USEPA Response to Comment #47: *Whenever possible EPA prefers active remediation instead of institutional controls. In areas 7D, 33D and the Former Company Store, the RI concluded that neither soil excavation nor soil vapor extraction would be effective until levels of VOCs in the groundwater are reduced by controlling sources outside OU-5. In this case institutional controls would be needed until the groundwater cleanup is achieved.*

48. CAG-AJ requests that EPA require the use of EPA method 521 to evaluate the presence of NDMA and other nitrosamines. EPA method 521 is considerably cheaper than the current method used to detect nitrosodimethylamine in groundwater, and just as sensitive in terms of detection level. The current detection method is not approved nationally by the EPA. Unlike the current detection method, EPA method 521 detects nitrosamines other than NDMA that might be formed by degrading methylated hydrazine rocket fuels, like nitrosomethylethylamine and nitrosodiethylamine. The issue of additional chemicals produced by the degradation of rocket fuel is an important issue to the CAG-AJ, and any steps that may be taken to further identify breakdown products should be introduced to the process.

USEPA Response to Comment #48: *See response to comment #11.*

49. In terms of the soil contamination, Mr. MacDonald has additionally noted the difficulties in maintaining institutional controls, particularly in regards to roadway issues. Institutional controls are a major concern of the CAG-AJ. Institutional controls should not be used unless it is clearly demonstrated that active remediation is not technically feasible. It has not been shown that soil remediation to protect groundwater or direct or indirect soil contact is not economically feasible. At the Aerojet site the remediation effort will exceed a century, making institutional controls very difficult and costly to enforce. While institutional controls may be adequately implemented in the first 10 years or in the first set of real estate documents, in later years it becomes much more difficult to implement them. People's memories fade, and the extra verbiage gets buried deeper in real estate documents. The life-cycle cost for institutional controls needs to be taken into consideration as part of the institutional control evaluation, not just the first 30 years. If institutional controls continue to be included as a control strategy, the Record of Decision (ROD) should stipulate that all institutional controls will be reviewed against technical feasibility as part of the OU-5 remedy 5 year reviews.

USEPA Response to Comment #49: *Whenever possible EPA prefers active remediation instead of institutional controls. During the five year reviews USEPA considers the adequacy of any institutional controls to reliably protect human*

health and the environment. USEPA may recommend amendment of the ROD to include new or feasible technical remedies to improve the protectiveness.

50. In regards to the use of contaminated soil for the building of roadways, if contaminated soils are to be used for road fill, what are the contaminants of concern and what scientific assurance is there that the contaminants will remain immobile?

    USEPA Response to Comment #50: *Section 7.6.2.4 of the Lands RI/FS states that only non-hazardous soil would be used as backfill and only if there is no threat to groundwater. If soil reuse is proposed in the remedial design, USEPA and the state would need definitive assurances of effective and reliable means to prohibit direct contact and minimize the potential for contaminant migration.*

51. Continuing with the issue of unresolved cleanup levels, the future re-use of the property creates difficulties in specifying the cleanup standard. It is difficult to agree to a cleanup remedy when it is stated "If the cleanup does not attain unrestricted use levels, the land would be restricted to commercial use with a land use covenant." When would they assess this and would the community have an opportunity to be involved in the decision? Instead of restricting to commercial property, the assessment should again show that soil remediation to protect groundwater or direct or indirect soil contact is not economically feasible. And what is not economically feasible today could change in the future. Future cleanup strategies could emerge that would provide alternatives; during the 5 year review of the OU-5 remedy the technical feasibility of new alternatives could be evaluated.

    USEPA Response to Comment #51: *USEPA has attempted to resolve the cleanup levels as much as possible while clarifying potential contingencies. The community would be notified of any significant change or amendment to the ROD. As mentioned in response to comment #49, EPA prefers active remediation instead of institutional controls whenever possible. During the 5-year reviews USEPA considers the adequacy of any institutional controls to reliably protect human health and the environment. USEPA may recommend amendment of the ROD to include new or feasible technical remedies to improve the protectiveness.*

52. There is yet another strong argument for cleanup versus institutional controls, and that is the perchlorate cleanup level for soil remediation in the ROD. We agree with Mr. MacDonald that the cleanup level should be 0.06 mg/kg rather than the 0.6 mg/kg as currently stated. As you are aware, site remediation experience has shown that source material remediation is the key to expedited site restoration. The Proposed Plan clearly demonstrates that the groundwater cleanup will take longer than 100 years because of the perchlorate source material existing in the soil. Thus, before Aerojet reaps the benefit of releasing the land for development, priority needs to be given to removing the perchlorate source material to at least 0.06 mg/kg to adequately protect the groundwater. It has not been demonstrated that the added cost of perchlorate soil remediation to 0.06 mg/kg is not justified.

USEPA Response to Comment #52: *See EPA response to Comment #5 as well as General Responses #1 and #2.*

53. The C4 and C41 Proposed Plan specified final remedy is a list of options and needs to be more specific. The remedy selected needs to remediate the contaminated soil on-site to residential soil action levels unless it is not technically feasible to do so. If Aerojet wants to develop the land, contaminated soil that is not technically feasible to be remediated should be stored on-site in areas that are not planned for residential or commercial development. Moving the contaminated soil to an off-site landfill just perpetuates the problem and needlessly exposes the community to risk. During the remedy 5-year-reviews, remedial technology improvements can be assessed for any stored on-site contamination.

USEPA Response to Comment #53:

EPA agrees that soil treatment, such as ex-situ bioremediation, would have advantages over disposal. Treatment and replacement of the soil from site C41 is included as an option in the ROD. Soil treatment will be a strong consideration in the remedial design phase.

54. In areas 7D and 33D, VOCs will be allowed to go into the air without cleanup. The plan proposes vapor barriers; but the VOCs still go into the air via diffusion. How will maintenance workers and people working in the commercial buildings or living in residential buildings be protected? What is "appropriate monitoring?" Again, we do not consider land use covenants as an effective strategy in the long run, and, as indicated by the fact sheet, this area could include either residential or commercial properties.

USEPA Response to Comment #54: *Vapor mitigation systems are proposed until the groundwater contamination sources outside OU-5 are remedied. These systems restrict movement of vapors into indoor air, similar to a radon reduction system. Land use covenants are needed to ensure vapor mitigation system are used. Monitoring must be performed with USEPA and State oversight to ensure the system is operating properly and that it is protective.*

55. In regards to the contaminants in areas 7D, FCS and 33D it is noted on page 10 of the fact sheet that "the only viable remedy for residential use is vapor mitigation beneath buildings constructed in the areas to prevent movement of contaminants into the buildings." If commercial development were to occur, institutional controls would be required. Is this a suggested remedy? This does not appear to be an appropriate remedy, and should not be approved.

USEPA Response to Comment #55: *USEPA agrees that it is preferable to utilize permanent solutions to the maximum extent possible and to reduce toxicity,*

mobility or volume mitigation rather than mitigate the risks from exposure. In the case of certain soil areas in OU-5, information developed during the RI indicates that the alternatives for a permanent solution to VOCs in the vadose zone may be limited and may entail a long time period before the objectives for unrestricted use can be attained. USEPA has experience at other Superfund sites, including sites in California, where appropriate land use can proceed with proper mitigation of soil vapor risks, including careful monitoring.

56. The vadose zone issues within the OU-5 soil contamination properties are discussed and strategies of control are proposed. Are there vadose zone issues also in existence off of the Aerojet property? Do vadose zone issues exist in the slickens beneath Gold River, Sunriver (Citrus Ponds), and Sacramento Bar? The Proposed Plan did not make this clear.

    USEPA Response to Comment #56: A considerable amount of effort was expended in assessing the risks for vapor intrusion throughout OU-5 including the communities mentioned. This effort delayed the completion of the RI/FS for several years while over 300 subsurface monitoring stations were installed and the results analyzed. USEPA attempted to explain these results in summary in the Proposed Plan presentation on August 11, 2009. The risks within OU-5 from vapor intrusion were limited to those VOC locations identified in the proposed plan.

Commenter: Allen Tsao, citizen

57. Page 5. Summary of Ecological Risk. The text states, "...the ecological health assessment determined there are no ecological risks within OU-5 that require action."

    a. This statement does not appear to be quite technically correct. According to the screening-level ecological risk assessment in Section 4.3.1.10 of the Remedial Investigation/Feasibility Study (Aerojet, 2009), the ecological risk model acknowledges that "there is a potential for constituents in soil to pose an adverse risk to ecological receptors under the exposure conditions assumed at Sites 4D, FCS, and C29 in Area 20; Sites D(e) and C32 in Area 21; and Sites C14 and C15 in Area 49." The real reason for no action seems to be in the next sentence, which states "However, currently planned development of the property (Easton project) into residential and commercial land may [emphasis added] eliminate the available habitat for these receptors, with the possible exception of Site C15. Hence, no significant ecological risk is likely in the future [emphasis added]." (p. 4-39 of the RI/FS [Aerojet, 2009]). Please revise the statement because the assessment is based on current conditions, not on future developments.
    USEPA Response to Comment #57a.: Section 4.3.2 of the Remedial Investigation/Feasibility Study (Aerojet, 2009) provides further information supporting the statement on no action for ecological risks. Future

development is only one of several reasons supporting no ecological remediation in addition to that required for protection of human health. Other reasons include current lack of suitable habitat in impacted areas, and the current exposure of the ecological receptors to elevated background levels of COPCs that are not associated with releases of hazardous substances.

b. Based on the assessment by Aerojet, there is potential for chemicals to pose adverse effects to ecological receptors under current conditions. Given the current economy, I'd venture to say that any development may not be realized until 10 years later or perhaps more. Thus, please explain what the agencies plan to do to protect ecological receptors, including listed species and species of special concern, before development begins.

USEPA Response to Comment #57b.: *USEPA does not anticipate that habitat suitable for ecological receptors will become available in contaminated and disturbed areas of OU-5 prior to remedial activities nor prior to development of the area. The evaluation of exposure to background levels of COPCs should also be unaffected by economic delays in development. It is reasonable to assume that remedial activities would commence prior to major land development. EPA has determined that it will be necessary to comply with regulations governing the protection of special status species and their habitat during remediation activities for the protection of human health.*

58. Areas 21 and 49 appear to be in an area that provide potential foraging and nesting for special-status species (p. 4-27 of the RI/FS [Aerojet, 2009]. On p. 4-40, Aerojet states that the future development of the area will be "limited to dredger tailings and previously disturbed areas." The remaining habitat will be encompassed by the Easton Open Space Preserve "having the potential to support the greatest diversity of plant and wildlife species with the proposed area of development." So, based on Comment 1a above, it appears that even if it were to be developed, it will not be developed in areas of suitable habitat for wildlife. Accordingly, the ecological risk would continue to pose adverse effects to ecological receptors in the absence or presence of the development of the Easton Open Space Preserve.

USEPA Response to Comment #58: *The Easton Open Space Preserve will encompass mostly undisturbed areas. The previously disturbed areas, where the significant majority of contamination is found, will be developed into a commercial and residential area with minimal habitat. The contamination within the areas of suitable habitat (i.e., undisturbed areas) is de minimis, thus posing no significant risk to ecological receptors.*

59. According to the RI/FS (Aerojet, 2009), under Section 4.3.1.9, Identification of Limitations and Uncertainties, the text states "Bioaccumulative constituents such as PCBs, dioxins and furans, and mercury were found in soil, presenting the possibility of exposure through the food chain. However, as described above, the sampling was conducted primarily in disturbed areas where significant exposure potential is unlikely. Migration of bioaccumulative constituents through the ditches into adjacent habitats may present a food chain exposure under current conditions, but is unlikely to be a concern in the future given the elimination of habitat that will occur as a result of development of the property."

a. It appears that very limited sampling was conducted in un-disturbed areas. Thus, it appears that potential data gap exist on what the hazard is in the un-disturbed areas.

USEPA Response to Comment #59a.: Soil and groundwater characterization at Aerojet has been ongoing since the early 1980s. Numerous studies have been conducted within OU-5 to determine source areas and define nature and extent. All sampling plans underwent various agency reviews prior to implementation in the field. It is common practice in environmental investigations to focus sampling in areas expected to be impacted by hazardous substances (i.e., recognized environmental conditions (RECs)). Sampling undisturbed areas other than for analysis of background conditions is not warranted since such conditions in those areas would not be considered as RECs.

b. Aerojet assumes that contamination in the un-disturbed habitat can only be reached by migration but does not account for contaminants that may already exist in the undisturbed areas. For samples that were taking in habitat areas, levels of contaminants exceeded ecological benchmarks. Table 4-6 of the RI/FS indicates that several metals exceeded the plant benchmarks in three different types of habitats. Of those chemicals that exceeded benchmark, the hazard quotients range was 1.1 to 880 (for chromium). It is remarkable that the maximum zinc concentration was 1160 mg/kg whereas the maximum zinc concentration samples in California (UC-Riverside, 1996) were 236 mg/kg. Obviously, zinc exceeded the plant benchmark as well. It appears that the next step should have been to conduct more samples to delineate the extent of contamination and assess any potential hotspots. It is unclear if the site or risk was adequately characterized before risk management decision was made.

USEPA Response to Comment #59b.: The native and disturbed soils at the Aerojet site are known to contain naturally elevated concentrations of some elements. Section 4.3.1.10 of the Remedial Investigation/Feasibility Study (Aerojet, 2009) discusses the contribution of background levels of elements to ecological risk. The results of statistical background evaluation found that several metals, including chromium and zinc, appear to represent

background conditions rather than contamination resulting from site-related activities. Background information is important to risk managers because the CERCLA program, generally, does not clean up to concentrations below natural or anthropogenic background levels.

c. The future elimination of habitat is contradictory with the intent of the Easton Open Space Preserve (see Comment 2). Please clarify.

USEPA Response to Comment #59c.: The habitat referred to in this text selection is in the disturbed area and includes areas proposed for redevelopment. The contamination within the areas of suitable habitat (i.e., undisturbed areas) is de minimis, thus posing no significant risk to ecological receptors.

60. Page 6. Table 2.

a. Unrestricted Use Level vs. Restricted Use. Please clarify that the "unrestricted use" is a land development terminology, and does not necessarily mean that cleanup numbers under this scenario is suitable for ecological receptors or their habitats.

USEPA Response to Comment #60a.: "Unrestricted use" and similar terminology is used to describe potential exposure conditions for human health risk assessment. The term makes no reference to the suitability of the land for ecological receptors or habitat.

b. The proposed perchlorate cleanup level was 55 mg/kg under "unrestricted use". It does not appear that perchlorate was assessed in the ecological risk assessment portion of previous documents. Therefore, there is a knowledge gap on the level of hazard perchlorate is posing on ecological receptors. Although the USEPA appears to have no official position what the unacceptable level of perchlorate would be for ecological receptors, it seems that USEPA in its draft perchlorate assessment would consider a lowest observable adverse effects level of 25 mg/kg/d and a no observable effects level of 2.5 mg/kg/d (USEPA, 2002) . Given the high propensity for perchlorate to bioaccumulate in plants and that perchlorate affects the developmental phases of vertebrates, please ensure that perchlorate is not at an unacceptable level to ecological receptors at current and future habitat areas, as well as areas that are currently habitat (I would consider any non-pavement area would be habitat for ecological receptors).

USEPA Response to Comment #60b.: Table 2 in the Proposed Plan presents a perchlorate cleanup goal for protection of groundwater quality, since corrected to 0.06 mg.kg soil, which is well below the USEPA screening levels. Thus, the perchlorate cleanup level is also protective of ecological receptors. The Screening Level Ecological Risk Assessment (SLERA) states "Perchlorate was only detected in soil samples collected at Site C41..."

Perchlorate concentrations in the surface soils (0 to 1 foot below ground surface) ranged from less than 10 µg/kg to 1,900 µg/kg. No screening level was presented in the SLERA for perchlorate. USEPA (2002) presents a soil invertebrate threshold for soil community effects at 1 mg/kg and a screening benchmark of 4 mg/kg for terrestrial plants. The soil cleanup level for perchlorate is well below these levels, and will be protective for ecological receptors.

Commenter: John Woodling, Sacramento Groundwater Authority

61. We are concerned that proposed cleanup to the current maximum contaminant level (MCL) is not protective enough of the basin's beneficial uses. An MCL includes many trade-offs that are considered during its adoption process. Cleanup to the MCL provides no future assimilative capacity for contaminants in the groundwater basin. We believe that the cleanup goal should be to maximize protection of human health, which is more appropriately reflected in the State Water Quality Objectives. The Proposed Plan indicates (Table 3 of Proposed Plan) that the incremental cost between containment and containment with mass removal is not that different. We believe that further consideration should be given to the next increment of cleanup to basin water quality objectives.

    USEPA Response to Comment #61: *Please see General Response #1 at the start of this Responsiveness Summary, as well as USEPA's responses to Comment #1 and #3.*

62. We request a description of how the operations of adjacent water purveyors were incorporated into the design of the proposed containment and remediation strategy for contaminated groundwater, as well as contingencies for changes in their future operations. Our experiences of detections of contaminants at increasing distances from Aerojet have, unfortunately, demonstrated that past strategies may have been inadequate to arrest movement of contaminants in the aquifer. Several regional factors will potentially result in increased reliance on the groundwater basin, particularly in drier periods, in the future. We are interested in seeing that the Proposed Plan can demonstrate effective capture under near-term and long-term public water supply operations in the underlying groundwater basin.

    USEPA Response to Comment #62: *See EPA response to Comment 41.*

63. SGA is currently commencing a study using a regional groundwater flow model to better understand the movement of water over the long-term in the basin. The results of this study may better inform whether sufficient facilities are in place for capture and

containment of the Aerojet plumes. We request that the results of our study, which are expected in mid-2010, be included in any future review of the remediation system in place to address the Aerojet contamination.

USEPA Response to Comment #63: *EPA would appreciate the opportunity to review the findings of your study. Depending on the completion date of your study, EPA should be able to review the results before the OU-5 remedial design is completed by Aerojet. It should be noted that the OU-5 remedial design will be completed following preparation of the OU-5 ROD.*

Commenter: Darrell Eck, Sacramento Central Groundwater Authority

64. Using Maximum Contaminant Levels (MCLs) as the cleanup goal does not provide sufficient protection for present and future beneficial uses of the basin. SCGA recognizes that many trade-offs are considered during the development of an MCL and that limiting clean-up operations to the MCL eliminates any future assimilative capacity for contaminants within the groundwater basin. With this in mind, clean-up goals should be set to maximize protection of human health, which are more appropriately reflected in the Maximum Contaminant Level Goals (MCLG) as established by the United States Environmental Protection Agency (EPA) or Public Health Goals (PHG) as established by the California Department of Public Health. In the event remediated water is used for drinking water purposes, as proposed by the Plan, treating to the MCLG (or PHG, as applicable) level is consistent with California Department of Public Health's Policy Memo 97-005 "Policy Guidance for Direct Domestic Use of Extremely Impaired Sources." In accordance with this Policy Memo, proposed treatment of extremely impaired sources should be designed and operated to meet the MCLG or less. While treating to the MCLGs will not guarantee that the remediated groundwater can be used directly for domestic purposes, it is the first step that will be required for any reuse proposal. Additionally, using PHGs is not inconsistent with the Plan as they are being proposed by as the goal for NDMA.

The disposal alternatives of non-potable use and discharge to surface water of groundwater treated to the MCL has the potential to further exacerbate the groundwater contamination issue. In the Plan, it is acknowledged that in several locations treated groundwater that is discharged to surface waters infiltrates back into the groundwater basin. This practice is therefore in conflict with the beneficial uses outlined in the Basin Plan, and in particular the State Water Resources Control Board (SWRCB) Resolution 68-16 "Anti-degradation Policy" which requires maintenance of existing water quality that is better than that required by other policies. This practice therefore impacts the reliability and suitability of the groundwater in the basin, which is contrary to the adopted GMP, and the Basin Plan.

The Plan indicates that the incremental cost between "containment" and "containment with mass removal" is not that different. SCGA believes that further consideration should be given to set clean-up goals based on appropriate Federal MCLGs and State PHGs.

USEPA Response to Comment #64: *Please see General Response #1 at the start of this Responsiveness Summary, as well as USEPA's responses to Comment #1 and #3.*

65. SCGA requests a description of how the operations of adjacent water purveyors were incorporated into the design of the proposed containment and remediation strategy for contaminated groundwater, as well as contingencies for changes in their future operations. Detections of contaminants at increasing distances from Aerojet have, unfortunately, demonstrated that past strategies may have been inadequate to arrest movement of contaminants in the aquifer. Several regional factors will potentially result in increased reliance on the groundwater basin, particularly in drier periods, in the future. SCGA is interested in seeing that the Plan can demonstrate effective capture under near-term and long-term public water supply operations in the underlying groundwater basin.

USEPA Response to Comment #65: *See EPA response to comment #41.*

66. In order to provide for consideration and incorporation of the latest science and information on the fate and transport of contaminants within the basin, the Record of Decision needs to be reopened on a frequent basis. Various agencies and authorities that are responsible for the management of impacted basins are committing a considerable amount of effort and resources to better understand the impact of this ever changing contamination issue, in an effort to develop management strategies. Thus the value of this effort and its potential benefit to the region should not be overlooked or ignored, and should be used by the EPA and the Central Valley Regional Quality Control Board to continually evaluate the effectiveness of the remediation efforts.

USEPA Response to Comment #66: *The Five Year Review process includes consideration of new science. Please the General Responses at the start of this Responsiveness Summary, as well as USEPA's responses to Comments #8, #20 and #49.*

Commenter: Robert Roscoe, Sacramento Suburban Water District,

67. Staff at SSWD is concerned that proposed cleanup to the current maximum contaminant level (MCL) is not protective enough of the basin's beneficial uses. An MCL includes many trade-offs that are considered during its adoption process. Cleanup to the MCL provides no future assimilative capacity for contaminants in the groundwater basin.

Furthermore, since it is not possible to monitor all locations, once any monitoring network shows concentrations have dropped to the MCL there will undoubtedly remain areas above the MCL, as it is extremely unlikely that the monitoring network has pinpointed every location of maximum concentration. We believe that the cleanup goal should be to maximize protection of human health, which is more appropriately reflected in the State Water Quality Objectives. The Proposed Plan indicates (Table 3 of Proposed Plan) that the incremental cost between containment and containment with mass removal is not that different. We believe that further consideration should be given to the next increment of cleanup to basin water quality objectives.

USEPA Response to Comment #67: *Please see General Response #1 at the start of this Responsiveness Summary, as well as USEPA's responses to Comment #1 and #3.*

68. SSWD is concerned about how the operations of adjacent water purveyors were incorporated into the design of the proposed containment and remediation strategy for contaminated groundwater, as well as what contingencies for changes in their future operations were considered. Unfortunately detections of contaminants at increasing distances from Aerojet have demonstrated that past strategies may have been inadequate to arrest movement of contaminants in the aquifer. Regional water supply planning includes increased reliance on the groundwater basin, particularly in drier periods, in the future. We are interested in seeing that the Proposed Plan can demonstrate effective capture under near-term and long-term public water supply operations in the underlying groundwater basin.

USEPA Response to Comment #68: *See EPA response to comment #41.*

69. SSWD is participating in studies using regional groundwater flow models to better understand the movement of water over the long-term in the basin. The results of these studies may better inform whether sufficient facilities are in place for capture and containment of the Aerojet plumes. We request that the results of these studies, which are expected in mid to late 2010, be included in any future review of the remediation system in place to address the Aerojet contamination.

USEPA Response to Comment #69: *EPA would appreciate the opportunity to review the findings of your study. Depending on the completion date of your study, EPA should be able to review the results before the OU-5 remedial design is completed by Aerojet. It should be noted that the OU-5 remedial design will be completed following preparation of the OU-5 ROD.*

Commenter: Dave Brent, City of Sacramento

American River Cumulative Risk:

70. It is unclear to the City whether the impacts of the remedy on the Lower American River have been evaluated. There needs to be a clear review of impacts to the American River. Cumulative impacts on the Lower American River are occurring from both the Western Groundwater and Perimeter Groundwater remedies. If the Inactive Rancho Cordova Test Site (IRCTS) remedy is combined with PGOU and results in a discharge to the Lower American River, then it should be added to the cumulative assessment as well.

    USEPA Response to Comment #70: Ecological and human health impacts on the American River have been considered in the RI/FS. Treatment requirements for discharges to the River, both directly and indirectly, are established at the State's NPDES levels.

71. In the RI/FS there is a discussion on the alternatives to satisfy varying demands with respect to treated groundwater management. There are four options outlined, including the potential to discharge more water to surface water in winter. The City would like to stress the importance of limiting treated groundwater discharges to account for actual flows in the American River or its tributaries and ensure appropriate dissipation. The City recommends incorporating minimum river flows when determining suitability of increased discharges. We also recommend that EPA evaluate surface water discharges and suitable river conditions using quantifiable conditions such as river flow, precipitation, reservoir releases, and other operational and hydrologic information rather than a general approach assuming flows are higher during winter months, which is not always the case on the Lower American River.

    USEPA Response to Comment #71: USEPA appreciates these insights on American River issues and will evaluate these flow management concerns during the design and implementation phases of the project.

72. In the RI/FS it is stated that several areas of groundwater contamination are not well understood and will be further delineated when additional wells are developed. Well development water from the Aerojet site should be monitored appropriately to characterize its risk and not automatically classified as a "low-threat" discharge under the Aerojet National Pollutant Discharge Elimination System (NPDES) permit for the GETs and low threat discharges. The City recommends that these flows be managed so as to not result in contamination of storm drains or surface waters.

    USEPA Response to Comment #72: USEPA agrees with the essence of this comment and will work with the State regarding requirements for management of well drilling and development water.

Alder Creek

73. In the RI/FS and supporting appendices there appears to be conflicting information related to the quality of Alder Creek and the potential impact from groundwater seeps located on the adjacent south hillside. The report documents the possible impact of the groundwater seeps, through the upward movement of groundwater, either from surface saturation or actual flow from contamination Layer A. There has been limited monitoring of Alder Creek, which has resulted in detectable NDMA and perchlorate, as well as other organics and high levels of iron and manganese. There is discussion on why the levels of detectable constituents in Alder Creek are considered insignificant, based on lack of detection and low levels.

The City is concerned that insufficient investigation may have been conducted regarding the water quality of the seeps and the potential impact on Alder Creek. Clearly, there is a source (or sources) of contamination to Alder Creek that should be identified and managed to protect public health and the environment. Alder Creek is tributary to the American River; and the drinking water beneficial use applies to this creek as well as recreation; therefore, the Alder Creek evaluation should be expanded to include drinking water considerations.

USEPA Response to Comment #73: *The human health assessment (HHA) evaluated recreational exposure to surface water and seep concentrations in Alder Creek. Risks were evaluated for groundwater that potentially discharges to Alder Creek, which provides a conservative evaluation of potential risks from using the creek as a drinking water source. The HHA determined that exposures to constituents in Alder Creek would be negligible and limited to occasional dermal contact under a recreational scenario. The maximum incremental lifetime cancer risk was less than 10^{-7} and the Health Index was less than 0.0007.*

Facility Implementation

74. It is important that a sufficiently long public review and comment period is provided related to any new or revised NPDES permits to account for the potential changes caused by the Proposed Plan and allow for input by drinking water utilities.

USEPA Response to Comment #74: *NPDES permits are issued by the Regional Water Quality Control Board following its public review and comment requirements.*

75. All proposed alternatives will result in a significant amount of new piping. Some of these pipelines may transport untreated groundwater and will cross or come in close contact with surface waters. These pipelines should be designed, operated, and maintained to ensure that spill risk is minimized. Also, there should be specific procedures in place to monitor the

flow in the pipelines and provide notification to impacted agencies, such as the water utilities, in the event of a failure that impacts receiving waters.

USEPA Response to Comment #75: ***USEPA agrees that the operation of transmission pipelines must be monitored for the reasons expressed by the commenter. The monitoring procedures will be reviewed during development of the designs and operating plans, with oversight by USEPA and the State.***

76. All proposed alternatives will result in increased flows at the existing GET facilities. The majority of the increases will bring the facilities up to near design capacity. The increase in flows should be monitored and paced carefully to ensure that the facility performance is not degraded by the increase in flow.

USEPA Response to Comment #76: ***Treatment system effluent concentrations will be closely monitored as required by the NPDES permit.***

77. Appendix G of the RI/FS provides a copy of Facility Reports for the GET facilities. Most of the Reports or Operation and Maintenance Manuals for the GETs are listed in the references as being greater than 10 years old. These reports and plans should be required to be modified to include all current facilities as well as plans and procedures to ensure the consistency of treated water quality. This should include required elements, including as a minimum operational parameters, preventative maintenance, planning for emergencies (power outages, alarms), and notification procedures providing notification to the downstream water utilities.

USEPA Response to Comment #77: ***USEPA agrees that routine review and necessary updating of O&M procedures should occur.***

78. The RI/FS states that the air stripping process at ARGET has a design capacity of 3,800 gallons per minute (gpm). The flows at this GET have never been this high, so performance at this level has not been proven. For that reason, we request that EPA and Central Valley Regional Water Board (Regional Board) reconsider approval of treatment flows in excess of design capacity (as indicated under alternative Z1-3) or consider requiring a plan to ensure safe implementation and monitoring of the increased flows and resultant water quality in an incremental manner. We believe that the increased flows should be proven to be treatable prior to amending the NPDES permit, or consideration be given to allow a temporary increase in flow in the permit with such safety features, prior to a permanent amendment.

USEPA Response to Comment #78: ***USEPA will work with the Water Board to consider this request during the review of design and operation plans.***

79. GET A treated groundwater has been historically discharged to Rebel Hill Ditch. Under alternatives Z4-2 and Z4-3 there may be an expansion of GET A or construction of a new

GET facility. This new GET may discharge to Alder Creek under a new permit or discharges may be used onsite as non-potable water. This should be evaluated carefully to ensure that the beneficial uses of Alder Creek are not impaired any further and that this additional flow to the American River is included in the cumulative impact analysis.

USEPA Response to Comment #79: ***During the development of a design that includes alternative discharges to Alder Creek, USEPA and the State will review the adequacy of the current analysis of potential impacts.***

Constituents of Concern

80. The first Remedial Action Objective (RAO) is to protect public health and the environment. We agree that this is the intent of the remedy, but if drinking water Maximum Contaminant Levels (MCLs) are the basis for cleanup levels, then the remedy is actually only meeting acceptable levels of risk in drinking water as defined by EPA. Whenever feasible it is preferred to further reduce the risk to public health, and we support the use of California Public Health Goals (PHGs) and EPA Maximum Contaminant Level Goals (MCLGs) where appropriate for the Superfund cleanup.

    USEPA Response to Comment #80: ***Please see General Response #1 at the start of this Responsiveness Summary, as well as USEPA's responses to Comment #1 and #3.***

81. The fact sheet provides a table of the groundwater cleanup levels (Table 1). There are three trihalomethanes (THMs) listed on the table; bromodichloromethane, chloroform, and dibromochloromethane. Each of these has a cleanup level shown of 80 micrograms per liter (μg/L) based on the Federal MCL. We believe that this is inaccurate since the Federal MCL applies to Total THMs (TTHMs). The TTHM MCL includes the three THMs listed above as well as bromoform. The standard should be clarified in the table, and EPA should clarify if the proposed remedy continues to meet the combined standard.

    USEPA Response to Comment #81: ***The federal MCL does establish a limit of 80 µg/L for the sum of the concentrations of all four trihalomethanes.***

82. The RI/FS states that the American River Groundwater Extraction and Treatment (ARGET) facility utilizes an analytical method for 1,4-dioxane with a detection level of 10 µg/L. This level is above the cleanup level, 3 µg/L based on the Federal Public Health Advisory. The detection limit of 10 µg/L seems insufficient to evaluate compliance with cleanup goals and determine impact to public health. We request consideration of requiring the detection limit to be reduced to below the cleanup level.

    USEPA Response to Comment #82: ***USEPA will review quality assurance information for alternative analytical methods for 1,4-dioxane prior to approval of improved methods to attain an appropriate quantitation limits for 1,4-dioxane.***

83. The RI/FS states that GETs A and B have non-detectable NDMA, at 0.012 µg/L. This level is higher than the cleanup level, 0.003 µg/L based on the PHG, as well as the California Department of Public Health (DPH) Notification Level of 0.01 µg/L. The detection level of 0.012 µg/L seems insufficient to evaluate compliance with cleanup goals and determine impact to public health. We request consideration of requiring the detection limit to be reduced to below the cleanup level.

USEPA Response to Comment #83: ***USEPA is in the process of reviewing quality assurance information for alternative analytical methods for NDMA.***

84. The RI/FS states that both Zones 1 and 3 have tentatively identified compounds (TICs) as well as detected unknown compounds in the contaminated groundwater. These have not been identified as constituents of primary concern (COPCs) and are not being addressed in this Proposed Plan. These compounds should continue to be investigated in some manner to ensure that if harmful chemicals are identified at a later time, they can be addressed through review of the remedy and modifications to actions or treatment. Monitoring at some reasonable frequency also seems warranted during the long length of the clean-up, as analytical methods may improve and provide more information on these contaminants.

USEPA Response to Comment #84: ***An approach to identifying TICs will be incorporated into future monitoring plans.***

85. The selected alternatives should include contingency plans to address detects above the levels approved by the Regional Board or DPH. If additional chemicals of concern arise that were not previously identified, they should be addressed immediately and included in revisions to the remediation plan and associated implementation permits. Contingencies should be in place to cease discharge as appropriate until such issues are satisfactorily reviewed by the regulatory agencies and addressed.

USEPA Response to Comment #85: ***Specific contingencies to address exceedence of treatment requirements are incorporated into Operation and Maintenance Plans as well as monitoring requirements.***

86. In the RI/FS the EPA mentions several on-going studies or evaluations that are on-going as part of the interim solution. The City would like to request that EPA provide on their website information related to on-going research and evaluations at the Aerojet site, such as potential health impacts, groundwater seep investigations, and pilot testing of in-situ treatment technologies.

USEPA Response to Comment #86: ***USEPA notes this request for information access and will attempt to provide as much updated information though the webpage as feasible. The URL for the website is www.epa.gov/region09/aerojet.***

Monitoring and Reporting Program

87. The Monitoring Program needs to continue to include the receiving waters, including the American River upstream and downstream of Buffalo Creek. This monitoring should be timed to coordinate with GET effluent monitoring so that the results can be compared if there are detections in the treated groundwater. Also, if any discharges are planned for Alder Creek, Alder Creek should be added to the list of receiving waters.

USEPA Response to Comment #87: *USEPA will consider this advice during review of the monitoring plan.*

88. Detection limits, methods, constituents or other factors should be appropriate to ensure that collected data provides appropriate information to protect human health. These parameters should be adjusted to keep current with future water quality standards and guidelines and available laboratory technology. The monitoring program should include an expanded list of all potential chemicals of concern on a reasonable frequency to ensure that if present at levels of concern, additional chemicals of concern are identified and addressed.

USEPA Response to Comment #88: *Updated monitoring plans will consider the recommendations in this comment*

89. The City acknowledges the helpfulness and information provided by Aerojet Staff over the past several years in providing notification of NPDES permit exceedences for the Interim Groundwater Extraction and Treatment Systems. The Plan should continue to include notification procedures to contact downstream water purveyors when monitoring results exceed MCLs, detects are found in the American River, or there are any significant problems with the discharge or remediation activities that may affect American River water quality. The notification needs to occur in a timely manner to allow water diverters the ability to respond to changes in source water quality. The discharge should also be immediately ceased in cases of potential significant issues. This is essential to ensure protection of public health.

USEPA Response to Comment #89: *See response to comment #85.*

90. The Plan should include ongoing monitoring, inspections, and evaluation of site conditions, including the physical equipment utilized for the clean-up to ensure that it is functioning correctly.

USEPA Response to Comment #90: *The five year review process requires the inspection and evaluation of ongoing remedies. USEPA agrees with this comment and will consider the recommendation in the development of future monitoring programs for the site.*

Commenter: Mike Finnegan, US Department of the Interior

General Comments

91. The discharges of extracted or remediated water to the streams must be clarified by quantities and constituents, rather than generalized that discharges meet standards. Water quality parameters of concern include temperature as well as perchlorate, N-Nitrosodimethylamine NDMA, and trichloroethylene TCE.

    USEPA Response to Comment #91: The treatment standards for discharge to surface water onsite shall meet the substantive requirements of the NPDES permit or in the case of discharge off the Superfund site, shall require compliance with all applicable requirements of the NPDES permit. The values have been have been specified in the ROD.

92. The Bureau of Reclamation does not support discharges of remediated water to any tributaries to the American River upstream from Nimbus Dam or the American River Fish Hatchery including Alder Creek.

    USEPA Response to Comment #92: USEPA does not anticipate any changes in the current locations of discharge for remediated water in compliance with an NPDES permit. Treated groundwater from ARGET and GET E/F is discharged to Buffalo Creek and treated groundwater from GETs A and B, located in Zone 3, is discharged to the Rebel Hill Ditch, where it infiltrates into the ground along the southern boundary of the Aerojet Site.

93. Additional alternatives should be developed to provide discharge of extracted or remediated water to Morrison Creek and Laguna Creek to the south, rather than to the American River. In particular, opportunities of the proposed project for discharge and remediation of extracted groundwater may be improved by conveyance of the water in the channel of Morrison Creek and coordination with the Sacramento Regional County Sanitation District for use of the lands, water and facilities of the Sacramento Regional Wastewater Treatment Plant near Morrison Creek and the Sacramento National Wildlife Refuge. Although some water from Beach and Stone Lakes is pumped over the levee to the Sacramento River, floodwaters in the Morrison Creek basin will likely flush discharged water into the eastern Delta during the rainy seasons.

    USEPA Response to Comment #93: USEPA appreciates these suggestions and will consider specific alternatives in the design phase.

94. Remediated water may be used in landscaping for certain developments in the general area.

    USEPA Response to Comment #94: The ROD allows for such uses of treated water, provided the treatment meets the appropriate discharge requirements.

95. On page 2, Figure 2 shows that the OU-5 approximately underlies Reclamation's Nimbus Dam, headworks structure, and a portion of the Folsom South Canal. Does the EPA foresee any impacts from the proposed cleanup activities upon these structures? If EPA does foresee any impacts, what are they? These impacts need to be more fully understood.

USEPA Response to Comment #95: ***EPA does not foresee any impacts from the proposed cleanup activities upon these structures. The proposed groundwater extraction wells shown on Figure 2 are more than 1500 feet from these structures and the screened intervals for these extraction wells range from 50 feet to 228 feet below groundwater surface. Existing pipelines will be used to convey groundwater beneath the Folsom South Canal to the treatment system that will remove the contaminants prior to discharge.***

Specific Comments

96. Reclamation is concerned that given the fact that residence time in Lake Natoma is not well understood that there is the potential for contaminants, especially perchlorate and NDMA, to accumulate in recreation areas, the fish hatchery, or the Folsom South Canal. Reclamation is also concerned that unintended releases of contaminants could impact this larger and highly used lake for a long period of time and would result in expensive regulation and clean-up costs. Given the regulatory uncertainty of these contaminants and the length of the proposed clean up, such an accumulation would have serious and long-term impacts to Lake Natoma. Therefore, Reclamation requests that United States Environmental Protection Agency require a study of residence time and mixing dynamics related to use of an Alder Creek outfall prior to proposing use of this location, and allow Reclamation to better understand the risks of using Alder Creek as a discharge location. Such a study should consider the maximum cumulative use of the discharge location and should consider a variety of operational and hydrologic conditions in Lake Natoma.

USEPA Response to Comment #96: ***Potential impacts due to the discharge of treatment system effluent are fully evaluated as part of the NPDES permit process.***

97. The documents reviewed indicate that a bio-treatment system may be used to treat perchlorate in the water to be discharged into Alder Creek. The bacteria used in the process to remove perchlorate could be carried in the discharge water and negatively impact the habitats in Lake Natoma and the Fish Hatchery. It is not clear from the information received if there will be secondary treatment that would remove the bacteria. If non-native bacteria are carried in the water to the discharge point in Alder Creek, a Biological Assessment should be conducted to assess the ecological impact of introducing non-native bacteria (or increased concentrations of native bacteria) into Alder Creek which flow into Lake Natoma and subsequently the Fish Hatchery.

USEPA Response to Comment #97: ***Perchlorate-reducing bacteria are not generally exotic. Inefficient operation of biological treatment systems has the potential to***

discharge increased concentration of bacteria. Appropriate monitoring and contingency plans for treatment disruption should decrease the chances of release of bacteria. Potential impacts due to the discharge of treatment system effluent are fully evaluated as part of the NPDES permit process.

98. The impacts resulting from introducing warmer waters from the discharge into Lake Natoma must be evaluated. These impacts could reduce Reclamation's cold water storage and ultimately negatively affect the Fish Hatchery downstream.

    USEPA Response to Comment #98: *See response to comment #91. The NPDES permit requirement for off-site discharge does include a provision for temperature control.*

99. Many of the concentrations of contaminants that are proposed to be established for discharge limitations exceed Public Health goals. Examples of these are NDMA limits at 0.007 µg/L when the California Environmental Health Hazard level is 0.003 µg/L (and a Public Health Goal of 0.002 µg/L), trichloroethylene at 0.8 µg/L, and copper at 11 to 17 mg/L (based on their effluent limits and historic records at other discharge points) when the American River goal is 0.01 mg/L. Aerojet should provide Reclamation with a table that lists of all proposed discharge concentrations and compares them to all Public Health goals and/or policies that these concentrations will exceed. This would allow Reclamation to better evaluate the impact of allowing the discharge. A copper accumulation study may be required to determine the impacts of allowing copper to be discharged into Alder Creek above the American River goal.

    USEPA Response to Comment #99: *See response to comment #91 as well as General Response #1 at the start of this responsiveness summary regarding use of advisory values that have not been formally promulgated. Results of past and current monitoring data can be provided. The Water Board may be a convenient local source for the monitoring data.*

100. Since discharging into Alder Creek does have the potential to negatively impact a significant sensitive habitat managed by Reclamation and the Fish and Wildlife Service, the action should have been evaluated within the National Environmental Policy Act NEPA process. During this review we noticed references to California Environmental Quality Act CEQA, but has Aerojet completed a full Environmental Assessment (EA) and completed the NEPA process? If they have completed this process please provide it to Reclamation. If Aerojet has not completed the NEPA process, Reclamation request this NEPA process be undertaken before further decisions are made involving/impacting any of Reclamation's facilities or projects.

    USEPA Response to Comment #100: *OU-5 is intended to address the contamination beyond the Aerojet property boundary but still within the Superfund site, in a*

CERCLA process that is considered the functional equivalent of NEPA. Provisions of CERCLA require a review of the effectiveness and protectiveness of the remedy every five years, including potential ecological impacts.

101. Site background (Page 3-final paragraph). "The investigation also thoroughly.examined the potential risks due to Volatile Organic Compounds vapors from contaminated groundwater to residents and workers." Did investigations include harm to aquatic communities? If so, what measures are being recommended in the interim to protect aquatic life?

    USEPA Response to Comment #101: A Screening Level Ecological Risk Assessment (SLERA) was conducted to evaluate exposure of ecological receptors from groundwater discharge to Alder Creek, the only surface water feature that supports ecological receptors that could potentially receive discharge from OU-5 groundwater. The SLERA indicated that no significant ecological risk was associated with the positively detected COPCs in surface water.

102. Page 4 paragraph 3; Site characteristics. What did the remedial investigation find in terms of groundwater contamination in Buffalo Creek—if Buffalo Creek is not included in OU-5 please state why not.

    USEPA Response to Comment #102: The RI states that groundwater does not discharge to Buffalo Creek. This creek was not included because it is not located within OU-5, as shown in Figure 2 of the Proposed Plan.

103. Page 4 (Scope and role…). Chemicals of concern are confirmed in Zone 4. Why do you not include the landfill clean-up in the proposed actions for OU-5? Please explain why the landfill closure is not included in the proposed actions for OU-5.

    USEPA Response to Comment #103: The landfill cleanup is not included in the Proposed Plan because this area is expected to be cleaned up under State and local authority. USEPA had expected this process to be completed or underway prior to development of the ROD. USEPA has indicated that it will review the schedule for completion of the cleanup and will evaluate the protectiveness of the landfill cleanup. USEPA will consider an amendment of the ROD if the landfill cleanup is inadequate.

104. Page 4 (last paragraph). "Remedial investigations of five other Operable Units in the source areas must be completed before final remedies are selected for the entire Aerojet Superfund Site."

a. How are the remedial investigations of the five Operable Units being coordinated with the implementation of the Proposed Plan for OU-5?

USEPA Response to Comment #104a.: *Due to the size and complexity of the Aerojet Superfund Site, a phased approach is being implemented so that the groundwater extraction and treatment systems for the off-site groundwater contamination in OU-3 and OU-5 are constructed as soon as possible. USEPA, State and Aerojet staff are working together so the remedial investigations for the five other source area OUs obtain the information needed to integrate the remedies selected for each OU, and to effectively address the entire Site.*

b. Will they be requesting comments on the five Operable Unit investigations before implementing final remedies under the Proposed Plan for Operable Unit 5 (OU-5)? As the final remedies for the entire Aerojet site won't be selected until the completion of the investigations on the five other OUs, there is interdependency with what is selected under the Proposed Plan for OU-5.

USEPA Response to Comment #104b.: *The remedial design for the OU-5 GETS will commence following issuance of the OU-5 ROD. The proposed plans for any of the remaining OUs are not expected until after the OU-5 ROD is signed. The OU-5 GETs will be designed to provide hydraulic containment for groundwater plumes originating from the Aerojet property source areas. The design for the OU-5 GETs will not be dependent on development of remedial designs for the Source Area OUs.*

105. Page 5 (1st paragraph; "summary of site risk"). "Human health and ecological risk assessments were performed to identify and estimate potential risks to people and the environment from Aerojet's contamination of groundwater and soils, assuming current conditions and unrestricted future use of the land within OU-5." What was looked at to determine ecological risk? What risk management range was used in the ecological health assessment?

USEPA Response to Comment #105 *A Screening Level Ecological Risk Assessment (SLERA) was conducted consistent with USEPA's current guidance for performing Ecological Risk Assessments. The SLERA characterized potential risks to ecological receptors that may be exposed to chemicals present in groundwater and soil. The SLERA focused on exposure of ecological receptors from groundwater discharge to Alder Creek, the only surface water feature that supports ecological receptors that could potentially receive discharge from OU-5*

groundwater. Surface water and seep concentrations were compared to Agency criteria (e.g., promulgated surface water quality standards) and ecological benchmarks. Additional evaluation of potential risks to the aquatic community within Alder Creek was assessed based on the results of a bioassessment. Characterization of the potential for adverse effects to occur in ecological receptors as a result of exposure to constituents detected in soil was conducted by comparing reported constituent concentrations with ecotoxicity benchmarks (i.e., the hazard quotient method). Based on the HQs and the habitats, each site within OU-5 was evaluated for potential for constituents in soil to pose an adverse risk to ecological receptors.

106. Page 5 ("Groundwater"). "The on-property and off-property cancer risk for all four zones exceeds EPA's target risk range. The Hazard Indices are well over 1. Remedial action to prevent further contamination and cleanup of the drinking water aquifer is justified by the potential risks."

    a. What is the risk range that was used to gauge harm to aquatic species?

    USEPA Response to Comment #106a.: *See response to comment 105.*

    b. What remedial action is being recommended—if referenced in the document can they point to it (e.g., see preferred alternative on page "x")?

    USEPA Response to Comment #106b.: *As summarized on page 8, the preferred remedial action for groundwater is groundwater containment with mass removal. The existing and proposed groundwater extraction wells are shown on Figure 2.*

107. Page 6 (continued from Page 5- "surface soil and near-surface soil"). "The contaminants found in these areas include lead, zinc, cadmium, polychlorinated biphenyls (PCBs), dioxins, furans, chloroform and TCE. Table 2 shows the cleanup goals for each COC based on the lowest cancer or non-cancer risks for potential land uses (residential or commercial)."

    a. TCE is not listed in Table 2; what is the risk basis for this chemical in the soil?

    USEPA Response to Comment #107a.: *TCE poses a risk in soil due to soil vapor. It is not listed in Table 2 because it did not pose a direct contact risk (i.e., ingestion, outdoor inhalation, and dermal absorption). The ROD states that the Soil Vapor levels of TCE protective of residential inhalation cancer risk is 1.2 µg /m^3.*

b. Also, under Table 2, "The state has estimated that a soil perchlorate concentration of 0.6 mg/kg would protect the groundwater. Why is this COC listed as "non-cancer" on Table 2 under the "risk basis" column at a soil contamination concentration of 55 mg/kg (residential unrestricted use)?

USEPA Response to Comment #107b.: The risk-based cleanup goal of 55 mg/kg listed in Table 2 is based on protection of a residential receptor directly contacting this non-carcinogenic chemical in soil. Perchlorate toxicity levels are established to protect thyroid function. A cleanup number for perchlorate based on an additional exposure pathway, leaching from soil to groundwater, is provided in the footnote as corrected in the ROD.

c. Later on, on this same page (Page 6) there is a statement as follows, "The soil action levels (Table 2) are calculated to reduce human health risks to protective levels." Why not list 0.6 mg/kg in the soil concentration column of this table for perchlorate if this is the level that will reduce the risk to protective levels?

USEPA Response to Comment #107c.: See response to #107b. The two perchlorate values are presented separately because the exposure pathways differ (direct contact versus protection of groundwater).

108. Page 7 (Groundwater RAOs). "Complete cleanup of the entire Aerojet Superfund Site will require coordination of all seven groundwater and source operable units." Earlier the Proposed Plan indicated that there were five other Operable Unit investigations (besides OU-5) in the source areas that must be completed before final remedies are selected for the entire Aerojet Superfund Site (see Page 4 comments above). What is the seventh groundwater and source OU?

USEPA Response to Comment #108: Operable units currently associated with the Site include OU-3 through OU9. OU-3 is referred to as the Western OU which addressed groundwater plumes west of the Aerojet property. OU4 includes Area 41 (Cavitt Ranch) located east of the Aerojet property. OU6 through OU9 are source areas located on Aerojet property.

109. Figure 3—Soil contamination areas (page 7). How did they select the soil contamination sites that are shown on this figure—why aren't there any sites nearby proposed/existing extraction wells; in particular, proposed extraction wells in Zone 1 of OU-5 (see Figure 2)?

USEPA Response to Comment #109: The OU-5 soil areas were selected from potential source and contaminated soil sites that transect, border, or are surrounded by lands removed from the boundary of the Aerojet Superfund site ("carve-out lands"). The reason that the OU-5 soil areas are not adjacent to the OU-5 extraction wells is because the groundwater contaminant plumes that are

extracted by the existing and proposed Zone 1 wells are from source areas located within the Aerojet property boundary.

110. Surface water/ground water interaction. In a recent draft decision by the State Water Resources Control Board (SWRCB, 2003) regarding the American River, the SWRCB concluded that from Nimbus Dam to about 6,000 feet below the dam, groundwater elevations and surface water elevations were similar enough to each other that groundwater could be tributary to the American River. This statement was excerpted from the Sacramento Groundwater Authority Groundwater Management Plan, December 2003. How will the pumping under either the Groundwater Containment and Containment with Mass Removal alternatives account for this surface water/groundwater interaction in the area of Zone 1 remedial actions?

USEPA Response to Comment #110: *The results of ongoing groundwater modeling will be examined for indications of significant interaction between groundwater and the American River since this would potentially compromise the effectiveness of the containment remedy.*

111. On page 8, it states, "Many of the details, such as final well location and pumping rates, will be determined in the design phase of the project." Are they required to seek public review on the design phase of the Proposed Plan for OU-5?

USEPA Response to Comment #111: *USEPA is committed to continue open communication and to seek input from the public throughout the cleanup process. The Community Advisory Group provides regular feedback from stakeholders and these meetings are open to any interested community member or agency. EPA also publishes fact sheets and press releases that invite input from the community. During the design phase, landowners located adjacent to proposed extraction well locations will be able to provide additional input regarding the final extraction well locations. This has been the standard procedure for activities outside Aerojet's property boundary.*

112. Page 8 ("summary of groundwater alternatives). "The estimated 30-year cost for Groundwater Containment is $57 million...The estimated 30-year cost for Groundwater Containment with Mass Removal is over $61 million. How did they arrive at these costs for clean-up; what are the variables in the calculation that could change and will the true costs only be revealed during implementation phase?

USEPA Response to Comment #112: *The 30-year cleanup costs were estimated by summing the projected costs for installation of extraction wells, piping and treatment system installation, as well as operation, maintenance and monitoring costs for a 30 year period. Numerous variables were evaluated to estimate the project cost for the groundwater remedial alternatives including number of*

extraction wells needed, conveyance piping size, treatment system requirements. Detailed cost estimates are provided in Appendix C of the ROD. Although the true costs will only be developed during the implementation phase, the cost estimates in the RI/FS and the Proposed Plan are suitable for selecting the preferred remedial alternatives.

113. Page 8 ("summary of soil and soil vapor alternatives"). "More than 25 soil areas of potential concern in OU-5 were investigated (Figure 3 on page 7)."Reclamation didn't see 25 areas of potential concern noted on the Figure, unless the numbers that appear to indicate buildings (inset) are included. Therefore, are the "majority of the soil areas" meeting residential use requirements?

    USEPA Response to Comment #113: The building numbers do indicate soil areas that were investigated in OU5. Soil samples were collected adjacent to Buildings 49001, 49002, 49003, 49004, 49011, 49017, 49020, 49021, 49023, and 49026 to assess the presence of lead in soil resulting from the historical use of lead-based paint. Septic tanks associated with Buildings 49007, 49011 and 49022 were also investigated. By including the individual buildings, a total of 36 areas were investigated and 21 areas met residential use requirements.

114. Page 8 ("summary of soil and soil vapor alternatives"). "All options, including the No Action option, would require careful and thorough monitoring to ensure effectiveness and protectiveness." What are the requirements for monitoring (state/federal) and wouldn't they vary depending on the COC that's being remediated? Please provide more details on the monitoring plan so Reclamation can evaluate this further.

    USEPA Response to Comment #114: Monitoring requirements will vary depending on several factors including the COCs to be remediated, the location of the area to be monitored and the remedial method selected. Monitoring requirements will be specified in the Remedial Design/Remedial Action (RD/RA) Statement of Work to be prepared by USEPA following issuance of the ROD.

115. Page 8 ("summary of groundwater alternatives"). "The water will be piped to one of several treatment systems (see Figure 2) where a series of standard, reliable treatment systems remove the various contaminants." The treatment system that is in existence for Zone 3 (GET B) does not appear to capture the flow of the groundwater south of this Zone—the treatment system is north of the extraction wells.

    USEPA Response to Comment #115: The groundwater extraction pumps in each of the Zone 3 extraction wells are designed to capture the impacted groundwater and pump the water back to GET B for treatment. During the design phase, we will

assess the need for new extraction wells to capture the plume in addition to those shown on Figure 2.

116. Page 8 ("summary of soil and soil vapor alternatives"). "The Groundwater Containment with Mass Removal alternative includes additional extraction of more highly contaminated groundwater nearer the source areas to reduce the mass of contaminants more effectively." The statement above describes the Groundwater Containment with Mass Removal alternative as a viable alternative that will reduce the time the clean-up takes. What about the methods required for this more thorough extraction—is this more complicated, more costly, more time intensive (initially)? Should these differences be characterized under table 3 (page 10) "implementability"?

    USEPA Response to Comment #116: The primary difference between "Groundwater Containment" and "Groundwater Containment with Mass Removal" is that additional groundwater extraction wells located up-gradient of the toe of the plume would be utilized to contain the more highly contaminated groundwater. The Groundwater Containment with Mass Removal alternative uses the same technology as Groundwater Containment, and therefore is no more complicated. The alternative that includes mass removal is more costly in the first 30-year period because more groundwater is treated and more wells would need to be maintained. Because many of the existing extraction wells and pipelines would be utilized for mass removal, the mass removal alternative installation is not significantly more costly or time intensive to initially construct. Both alternatives are considered to meet the criteria for implementability.

117. Page 10 ("soil areas"). "Proven methods for treating perchlorate in the surface soils at area C41 pose the risk of flushing some of the contaminant into the groundwater and would not meet EPA's protectiveness criteria."

    a. What Zone is area C41 in? Can they overlay the Zones on top of the soil areas shown on Figure 3?

       USEPA Response to Comment #117a.: Soil area C41 is located within the Aerojet property boundary and is located east of Zone 1 and south of Zone 4.

    b. Later on, the sub-surface soil treatment in C41 is discussed and it is noted that some of the Perchlorate may get into the groundwater, but if it does they can treat it through the proposed groundwater remediation methods. See page 12: "If (new Vadose Zone) treatment methods do not prove viable for this location, the perchlorate could gradually move into the groundwater where it would be captured and treated with the groundwater remedial action." Is subsurface soil viewed differently under EPA's protectiveness criteria?

USEPA Response to Comment #117b.: *Cleanup goals that are protective of human health and the environment can vary depending on the intended use of the property. Perchlorate concentrations in soil at Area C41 are below residential and commercial cleanup goals but exceed cleanup goals that are protective of ground water. Because perchlorate concentrations extend below an excavation depth of 10 feet, impacted soil below this depth may represent an on-going source to groundwater unless treated in place. Since an effective subsurface treatment for perchlorate has not been demonstrated, perchlorate will be captured and treated once it has migrated into the groundwater with necessary monitoring.*

118. Page 11- Table 4 ("7D, 33D and FCS" column).

It was unclear from Table 4 that the preferred alternative only considers commercial restricted use in areas 7D, 33D, and FCS. See page 10: "The RI /FS indicated that SVE would not be effective for cleaning up the low concentrations of VOCs measured in soil vapor in areas 7D, FCS and 33D to meet the goals for unrestricted use."

Given the uncertainty regarding the ability to extract perchlorate in sub-surface (Vadose zone) soils within Area C41, Table 4's evaluation criteria should reflect this with regard to "long-term effectiveness" and "reduction of toxicity, mobility or volume by treatment"; i.e., suggest that these evaluation criteria be changed to "partially meets criterion." Perhaps this Area (C41) could be broken out separately.

USEPA Response to Comment #118: *The term "deed restriction" in the heading for areas 7D, 33D and FCS implies commercial use, as described under Soil and Vadose Zones on page 7 of the plan. The evaluation criteria presented in Table 4 are standard criteria used to evaluate all Superfund sites. The areas were grouped by remedial alternative. As discussed in "Soil Areas" on page 10 of the plan, vadose zone perchlorate cleanup methods are being considered separately for Area C41.*

119. Page 11 ("groundwater"). "Monitoring of the effectiveness and protectiveness of the remedy is required to ensure that the remedial action objectives are met." The effectiveness and protectiveness monitoring criteria should be described to ensure a full understanding of the alternatives being proposed.

USEPA Response to Comment #119: *Remedy effectiveness and protectiveness criteria are described in Figure 4 of the proposed plan under evaluation criteria 1, 3 and 5. The Remedial Action Objectives (RAOs), as provided on pages 6 and 7 of the proposed plan, describe what the remedy is expected to accomplish in order to effectively protect human health and the environment.*

120. Page 11 ("groundwater"). "The State of California supports the alternative for cleanup of groundwater, with the exception that the Regional Water Quality Control Board prefers lower cleanup goals for TCE and chloroform based on final or draft California Public Health Goals." As per an earlier comment, TCE levels don't appear in Table 2 (page 6).

USEPA Response to Comment #120: *See response to comment #107a.*

121. Top of Page 12 (continued from Page 11 "soil areas"). "Soil areas 32D, 34D, 35D and 38D, covering a total of approximately 11 acres in close proximity to each other...Contaminants in the vapors would be captured and treated by granulated carbon or destroyed using an existing catalytic oxidation system. If the cleanup does not attain unrestricted use levels, the land would be restricted to commercial use with a land use covenant." Which COCs are they trying to contain with this methodology? Also, the column in table 4 containing the preferred alternative does not include the deed restriction clause. The wording here is confusing as it indicates, "the land would be restricted to commercial use with a covenant".

USEPA Response to Comment #121: *Volatile organic compounds (VOCs) including TCE; PCE; chloroform; 1,1-DCA; 1,2-DCA; 1,1-DCE; cis/trans 1,2-DCE; vinyl chloride; and/or benzene have been detected in soil vapor samples at areas 32D, 34D, 35D and 38D. The preferred alternative would be to extract and treat the soil vapor to levels that would enable unrestricted use of the property. A land use covenant would only be required if operation of the soil vapor extraction system is unable to attain soil vapor cleanup levels that meet the requirements of unrestricted use.*

122. Page 12 (paragraph 2). "Perchlorate contamination in soil area C41 extends beneath the excavation depth and may represent an ongoing source to groundwater." Are effectiveness and protectiveness monitoring criteria going to be recommended to assuage this potential problem as the clean-up progresses?

USEPA Response to Comment #122: *Groundwater sampling will be conducted down-gradient of area C41 to monitor the potential impact of perchlorate concentrations in soil leaching to groundwater.*

123. Page 12 (paragraph 2). Vadose zone perchlorate cleanup methods are being developed and, if successful, may be used at area C41. If treatment methods do not prove viable for this location, the perchlorate could gradually move into the groundwater where it would be captured and treated with the groundwater remedial action." Is this vadose zone clean-up being proposed as part of the preferred alternative—it's not reflected in the table of alternatives (Table 4-page 11)? Does this mean it's not viable?

USEPA Response to Comment #123: *See response to comment 117b.*

124. Page 12- last paragraph ("soil areas") "The State of California supports the preferred alternatives for cleanup of the soil areas, with the exception that the Regional Water Quality Control Board prefers a lower cleanup goal for hexavalent chromium based on a draft California Public Health Goal."

a. According to Table 4 (page 11), the non-preferred alternative for soil areas 32D, 34D 35D and 38D are not in compliance with State and Federal requirements. All other alternatives listed in the table are in compliance, with the exception of "no-action" alternatives. Does this means that the hexavalent chromium clean-up goal is in compliance with the HHA at the various soil sites?

USEPA Response to Comment #124a.: *The non-preferred alternative for soil areas 32D, 34D, 35D, and 38D not being in compliance relates to trichloroethene (TCE), not hexavalent chromium. In regards to the hexavalent chromium cleanup level, this metal was found in soil areas 10D, 11D and C4 and the cleanup goal is in compliance with the HHA.*

b. How will this State-specified level be factored in, given that there are Federal MCL levels specified for hexavalent chromium (See Table 1—groundwater clean-up levels) but no State of CA MCLs specified. See discussion on page 6 regarding clean-up levels; i.e., state MCL levels to be used if specifying a lower concentration.

USEPA Response to Comment #124b.: *Hexavalent chromium is not a COC in groundwater at OU-5.*

125. Definitions

a. What is a multiple completion well—listed in the legend of Figure 2 "proposed extraction well/multiple completion well"?

USEPA Response to Comment #125a.: *A multiple completion well is two or more wells that are installed adjacent to each other that are screened (with openings to allow groundwater to enter) at different depth often using a single drilling operation.*

b. What is "soil vapor extraction"—see page 10 "soil areas"?

USEPA Response to Comment #125b.: *Soil vapor extraction (SVE) is a soil remediation method that physically separates contaminants from soil in a vapor form by exerting a vacuum through the soil formation. SVE removes volatile organic compounds (VOCs) from soil, which is then typically treated at the surface using activated carbon or thermal treatment.*

c. What is "RAO"– see page 10 "soil areas"?

USEPA Response to Comment #125c.: *RAO is an acronym for Remedial Action Objective.*

d. What do the risk-based thresholds "non-cancer" and "cancer" mean when applied to the two categories of use (residential restricted and commercial non-restricted) on Table 2?

USEPA Response to Comment #125d.: *Exposure to chemicals can result in either cancer or non-cancer health effects. The term "non-cancer" is used to indicate a cleanup goal based on non-cancer health threats while "cancer" is used to indicate a cleanup goal based on cancer risk. These categories are provided because not all chemicals are carcinogenic. In some cases, the non-cancer health threat of a chemical is greater than its cancer risk.*

Commenter: Angel and Greg Ball, residents

126. I would like to see your plans implemented ASAP. I find special interests such as water companies are not concerned about the best interest of the community of Rancho Cordova just "their water and money".

USEPA Response to Comment #126: *USEPA is grateful for the thoughtful participation and support from community members.*

Commenter: Lisbet Gullone, resident

127. I generally support the preferred cleanup alternative (including Groundwater Containment and Mass Removal). However, I believe that in order to meet one of the long term goals of EPA (to allow beneficial uses of the contaminated areas), the contaminants should be reduced to the levels identified in the Public Health Goals for the State of California. Is it possible to form a partnership with the State that will allow for more extensive cleanup of TCE and chloroform (as recommended by the Regional Water Quality Control Board)?

USEPA Response to Comment #127: *Please see General Response #1 on Page 1 of this Responsiveness Summary and the responses to the Water Board comments, particularly #1, #2 and #3. USEPA has great respect for the Water Board and other State agencies, and the agencies work together collaboratively on the Aerojet cleanup, including review of cleanup objectives during the final Sitewide remedy selection process. Differences in specific authority and policy determination can usually be bridged.*

128. Regarding the removal of contaminated soil, I believe that the excavated soil should be treated to remove contaminants before it is replaced/relocated (this option will prevent future health concerns and inflated cleanup costs). I am also concerned about the portion of OU-5 that has been excluded from the proposed actions (Zone 4). Will the State of California/County of Sacramento be required to coordinate the landfill closure process for this part of the Superfund Site with EPA?

USEPA Response to Comment #128: *See response to comments #6 regarding the treatment of excavated soil, and the response to comment # 103 about the coordination of the landfill closure in Zone 4.*

129. I would like to know more about the groundwater extraction and treatment (GET) system that was installed in the mid 1980s. Based on the continued northerly expansion of the groundwater contamination plume, it appears that this effort has not been effective. If the future cleanup efforts include the pumping of contaminated groundwater to the same treatment systems, how could the removal of contaminants be improved?

USEPA Response to Comment #129: *The GET systems installed in the mid 1980's were interim systems that were designed by Aerojet prior to its signing the Partial Consent Degree which required Aerojet to perform a RI/FS for the site. Data obtained during the RI/FS for OU-3 and OU-5 has significantly improved the understanding of site conditions (i.e., groundwater plume extent, hydrogeology of contaminated aquifers) which enables the construction of effective extraction and treatment systems to contain the plume. Groundwater modeling techniques have also improved over that last 20 years which has enhanced the ability to design more effective extraction systems. Methods for monitoring extraction system effectiveness have also improved so that once the proposed systems are installed, system revisions that may be needed can be more readily identified.*

130. Finally, I am also curious about the public notification requirements for this type of project.

USEPA Response to Comment #130: *See response to comment #111.*

Commenter: Rick Bettis, CAG member

131. Generally I think it appears comprehensive, reasonable and sufficient. However I do concur with the SWQCP regarding the use of the California Public health goals for TCE. I believe that while the study results for the PHG are not final and may be conservative that we should utilize the "precautionary principle" for TCE since it is so prevalent in the project area. I also agree with the SWQCB concerning the use of PHG for chromium. Hopefully these upgrades can be achieved in a reasonably economical manner. It is critical that we maintain the sustainable yield of the groundwater basin for water supply purposes.

Accordingly I urge that emphasis should be given monitoring and containment since we must prevent further spread of the plume.

USEPA Response to Comment #131: *Thank you for your thoughtful support. Please see the General Responses at the start of this Responsiveness Summary and responses to comments #1, #2, #3, #9 and #127 regarding use of State PHGs. Also see responses to comments #39, #40 and #41 regarding maintaining a sustainable yield from the aquifer.*

B. ORAL COMMENTS RECEIVED DURING 08/11/2009 PUBLIC MEETING

Comments from unidentified audience members

132. Will the Aerojet site be cleaned up to residential cleanup levels and how do we decide when to excavate the soil versus use soil vapor extraction?

    USEPA Response to Comment #132: *USEPA prefers that impacted soil is cleaned up to meet the risk-based cleanup goals for unrestricted use such as residential development. Soil vapor extraction can be effective in areas with contaminants that volatilize (i.e., TCE) but soil excavation proposed for other areas with non-volatile contaminants (i.e., elevated metals or perchlorate concentrations).*

133. In areas where additional pumping is required to clean up the groundwater before you can clean up the overlying soil, are there any estimates of how long that pumping might take?

    USEPA Response to Comment #133: *Because the time needed to clean up the soil in the source area OUs is still to be determined, the time needed to clean up the groundwater has not been estimated but could be over 100 years in some areas.*

134. Is Aerojet's process still producing contaminants? Aerojet is still operating.

    USEPA Response to Comment #134: *Aerojet is still operating and must comply with all applicable State and federal regulations.*

135. What is the estimated amount of acre feet that will be pumped per year?

    USEPA Response to Comment #135: *The total groundwater extraction rate from the four zones in OU-5 will updated during remedial design but assuming a total flow rate of 8,000 – 10000 gallons per minute, approximately 12000 – 16000 acre feet would be pumped per year.*

136. Because groundwater is a limited resource, has aquifer recharge been considered?

    USEPA Response to Comment #136: *The preferred alternative does not include direct recharge. USEPA and Aerojet recognize that there will be an impact on the groundwater table in every alternative. It is USEPA's assessment that extraction of groundwater in this complicated aquifer and discharged to surface water will be more effective than extraction and reinjection. If the groundwater were recharged on Aerojet's property, the size of the on-property containment system would have to be significantly increased and may not be economically viable.*

137. What soil cleanup levels are protective?

USEPA Response to Comment #137: *Risk-based soil cleanup goals are listed in Table 2 of the Proposed Plan.*

138. If Aerojet is no longer adding contaminants and the source of the contamination has been identified, is the contaminated area of soil continuing to seep in to the groundwater, or has that already taken place and we are cleaning up a reservoir of contaminated water?

USEPA Response to Comment #138: *Contaminated areas of soil that have not been remediated continue to have the potential to impact groundwater. Several factors can affect the potential for contaminated soil to impact groundwater, including rate of stormwater infiltration (i.e., area paved or unpaved) and the type and concentration of the contaminants present (i.e., high concentrations of solvents can migrate to groundwater without stormwater infiltration). Contaminants have reached the groundwater so groundwater containment and cleanup is needed in addition to remediation of contaminated soil.*

139. What is a deed restriction for commercial versus residential use?

USEPA Response to Comment #139: *A deed restriction is recorded in the property records to restrict the use of the property in certain ways. For example, it could restrict the property to commercial or industrial use and not permit residential use. Or it could require certain engineering controls (i.e., operation of soil vapor extraction system, maintain pavement in areas of impacted soil). These restrictions transfer with the land ownership, and cannot generally be removed by new owners.*

140. Who is paying for the cleanup and do we care how much it will cost?

USEPA Response to Comment #140: *Aerojet is paying for the cleanup. Controlling the cleanup costs are important so Aerojet can continue to afford to pay for the cleanup. USEPA regulations require consideration of cost in selecting a remedy.*

141. Why does a well get shut down? Is that when we were giving people water and we weren't checking and then we found out later? How does that happen that when you end up giving people water for a long period of time and then you find out you were giving them water that was hurting them?

USEPA Response to Comment #141: *A well is shut down when groundwater contaminants are detected that are not acceptable for the intended use such as drinking water. For some chemicals such as perchlorate, cleanup levels and adequate analytical testing methods were not available 10 years ago. Since that time groundwater analytical methods have significantly improved and cleanup*

levels have been established in order to effectively evaluate groundwater conditions.

142. In the 1970's there were chemicals in that water that we did not know about. Could there still something in the water today that we don't know about?

USEPA Response to Comment #142: *There will always be the potential that unknown chemicals could be present in water but in general the major chemicals that could potentially cause health problems can be identified. USEPA will continue to monitor for and investigate significant tentatively identified compounds (TICs).*

143. In the 1980's we were never told there was anything wrong with the water. We have lived here since then and raised our children. Families have thyroid issues and other health problems. Are any studies being conducted?

USEPA Response to Comment #143: *The primary objective of the OU-5 remedy is to protect public health now and in the long-term. USEPA cooperates with and has encouraged research to increase our understanding of the risks faced from the Aerojet site and similar situations. The Agency for Toxic Substances and Disease Registry (ATSDR) with California's Department of Public Health have performed a series of independent public health assessments at the Aerojet site beginning with reports in the late 1990's. These reports are part of the public record for the Aerojet site. Other specific studies have been conducted and more will be conducted in the future. For example, UC Davis and the US Centers for Disease Control and Prevention (CDC) conducted a study of 181 women from 20 to 50 years of age to assess potential exposure to perchlorate. These individuals resided in three communities west and northwest of the Aerojet facility.*

144. How many more people have to get sick before something is done?

USEPA Response to Comment #144: *USEPA's primary goal is to protect the public. The drinking water meets Department of Health Services (DHS) requirements. The contaminated wells have been shut down. The water purveyors routinely monitor all of the drinking water wells, under the supervision of the DHS.*

145. Why shouldn't we be doing something else to find out how much it's affecting us?

USEPA Response to Comment #145: *See response to comment 143.*

146. Why is Aerojet allowed to continue to operate or they are not moved out someplace else so they don't hurt anymore families?

USEPA Response to Comment #146: *Ongoing releases from Aerojet that would impact human health have not been identified. Even if Aerojet were to leave the facility, the contamination would still need to be cleaned up.*

Commenter: Andy Soule

147. Is there any soil contamination in Rancho Cordova outside of the Aerojet property or in Sailor Bar?

USEPA Response to Comment #147: *Soil contamination has not been identified in Sailor Bar. Areas outside of the Aerojet property boundary that are being addressed by other operating units include Areas 39, 40 and 41 located east of the Aerojet property.*

148. Why can't you focus on cleaning up the groundwater at the source so it would be simpler to clean up the groundwater downstream?

USEPA Response to Comment #148: *Groundwater extraction from the proposed extraction wells will help to contain and remediate the plume. The preferred groundwater remedial alternatives include "mass removal" which will extract groundwater that has higher contaminant concentrations within OU-5 as compared to concentrations at the down-gradient edge of the plume. Evaluation of the upgradient source areas located on the Aerojet property is ongoing but the first priority is to safeguard the public drinking water.*

Commenter: Connie Berry

149. I have family members with health issues. Has anybody done a survey of the people who have lived for a long period of time in these areas where these wells have been shut down?

USEPA Response to Comment #149: *See response to comment #143. USEPA also cooperates with State, federal and academic researchers interested in the relationship with past exposures and health issues.*

Commenter: David Berry

150. I've lived in Rancho Cordova for the vast majority of time since 1958. I have a twin sister who died of cancer. I have a daughter who has Grave's disease, which is hyperthyroid. I have a brother with prostate cancer. And the day after tomorrow, I go to see if I have thyroid cancer. You absolutely need to do that public health assessment by doing a survey to see how many people have already been affected.

    USEPA Response to Comment #150: *See response to comment #149. The Agency for Toxic Substances and Disease Registry (ATSDR)with California's Department of Public Health have performed a series of independent public health assessments at the Aerojet site beginning with reports in the late 1990's. These reports are part of the public record for the Aerojet site.*

151. Page 4 of the Proposed Plan indicates that Aerojet is in the process of applying for zoning modifications to its special planning area designation by Sacramento County ordinance for its land within OU-5 to allow for mixed residential and commercial use. My comment is that that is ludicrous. It's criminal; should not be allowed.

    USEPA Response to Comment #151: *This comment among others regarding land use decisions led USEPA to research the local procedures for land use planning and permitting and the current stages of the process regarding the Aerojet property. A firm of expert consultants interviewed Aerojet, Sacramento County, Rancho Cordova and Folsom officials and staff. The results were incorporated into the ROD and a presentation will be available at the USEPA website for Aerojet: www.epa.gov/region09/aerojet.*

152. The issue of liability and compensation needs to be address. The law that you're acting under is called Comprehensive Environmental Response Compensation and Liability Act. And I haven't heard a word about compensation and not much about liability. The damage already done to people medically and physically needs to be addressed.

    USEPA Response to Comment #152: *The CERCLA statute reference to compensation concerns payment and recovery of costs related to the cleanup response to a release of contamination and for the recovery of natural resource damages. Aerojet is paying for the cleanup costs including State and federal costs to oversee the cleanup. Aerojet's liability for the cleanup is defined in CERCLA and in the judicial and administrative enforcement documents related to this Site.*

Commenter: Larry Ladd

153. Comment was also submitted via email. See Mr. Ladd's comments above.

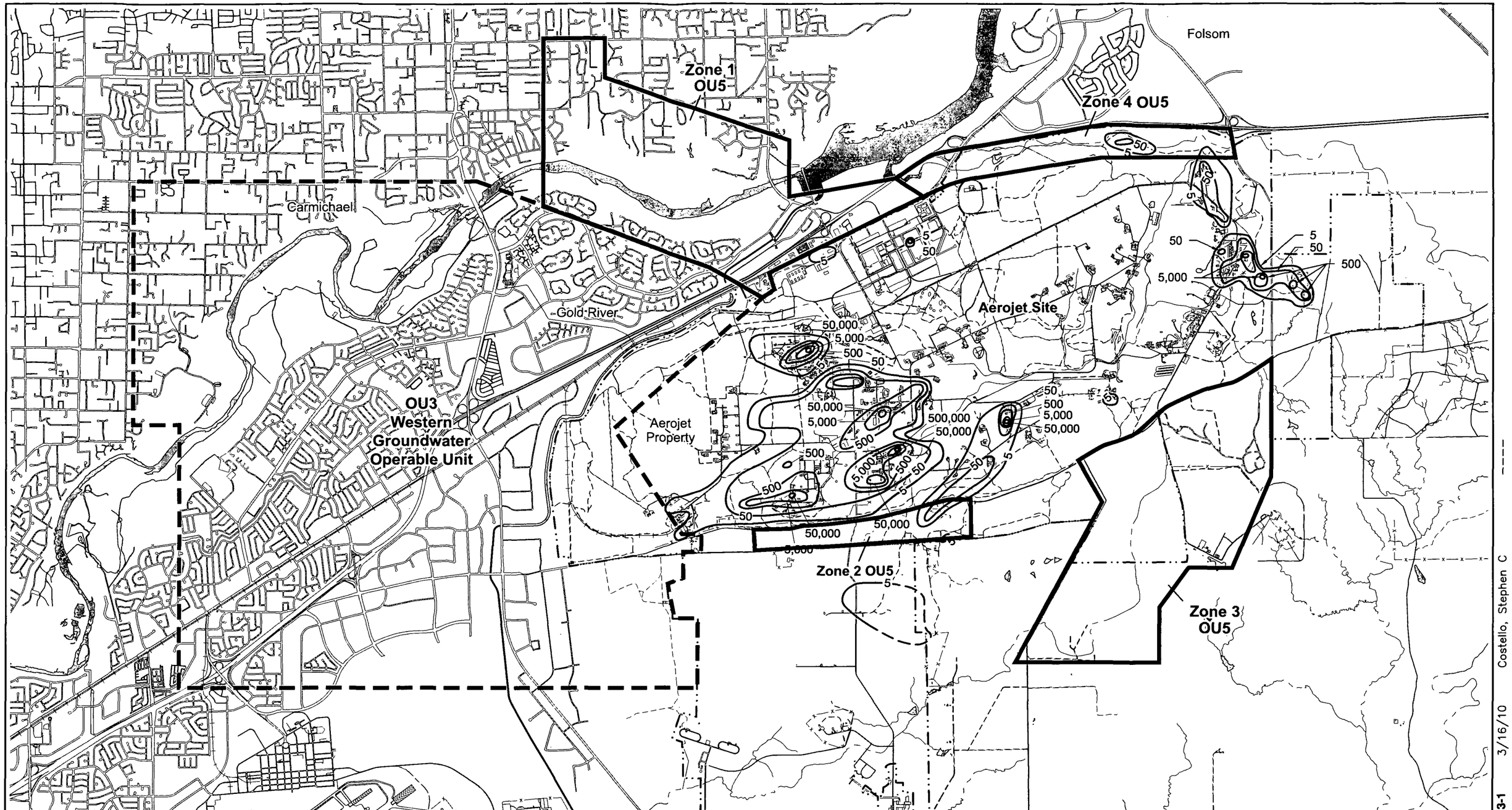
Commenter: Ellissa Callman

154. Will the remedial investigation and feasibility study and tonight's presentation be available electronically?

    USEPA Response to Comment #154: *Yes, the URL for the website with the Proposed Plan presentation is www.epa.gov/region09/aerojet.*

Appendix B of the Aerojet OU-5 Record of Decision

Major Aerojet Groundwater Plume Maps for TCE, Perchlorate and NDMA



EXPLANATION

— 5 — TCE Isoconcentration Contour in ppb

-·-·- Aerojet Property Boundary

Perimeter Groundwater Operable Unit Boundary-OU5

Western Groundwater Operable Unit Boundary-OU3

N

Scale: 1" = 4,000'

0 2,000 4,000

USEPA REGION IX
AEROJET OU5

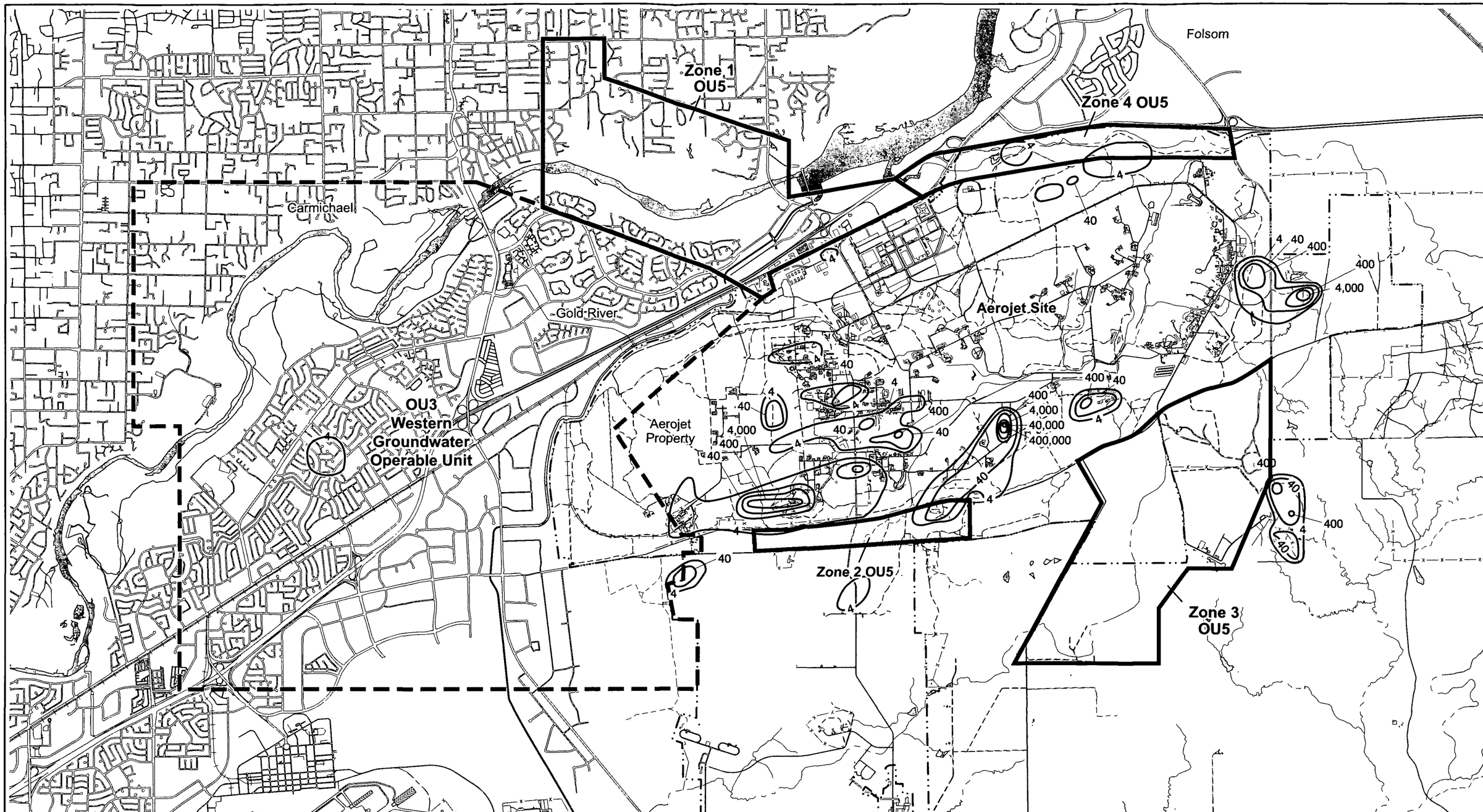
FIGURE 1

Layer A
TCE Iso-Concentration Contour
2007 - 2010

FIGURE 3-1

SR10130834

10-0022



EXPLANATION

— 4 — Perchlorate Isoconcentration Contour in ppb

-·-·- Aerojet Property Boundary

Perimeter Groundwater Operable Unit Boundary-OU5

Western Groundwater Operable Unit Boundary-OU3

USEPA REGION IX
AEROJET OU5

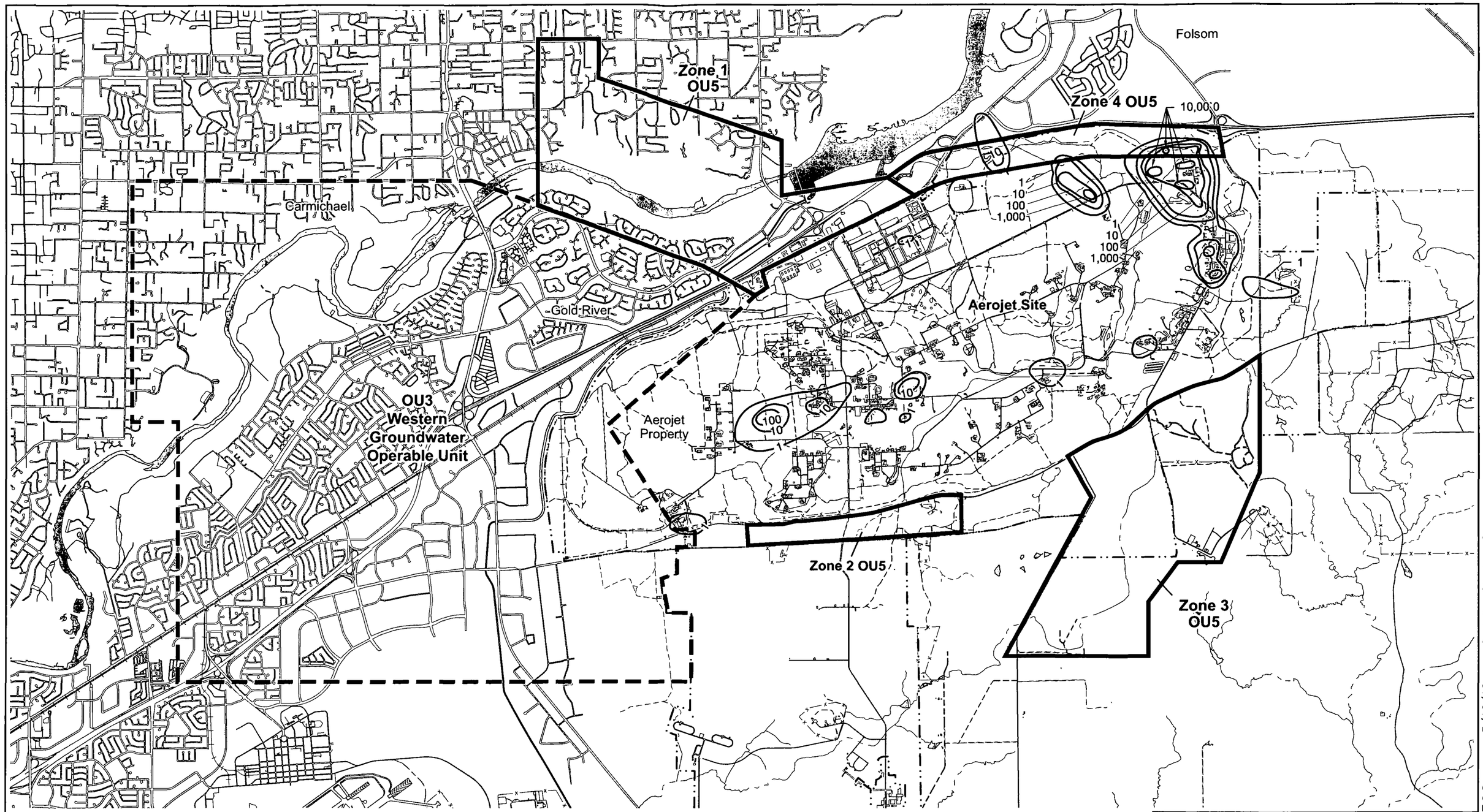
FIGURE 2

Layer A
Perchlorate Iso-Concentration Contour Map
2007 - 2010

FIGURE 3-2 3/16/10 Costello, Stephen C

SR10130840

10-0022



EXPLANATION

—1— NDMA Isoconcentration Contour in ppt

Aerojet Property Boundary

Perimeter Groundwater Operable Unit Boundary-OU5

Western Groundwater Operable Unit Boundary-OU3

N

Scale: 1" = 4,000'

0 2,000 4,000

USEPA REGION IX
AEROJET OU5

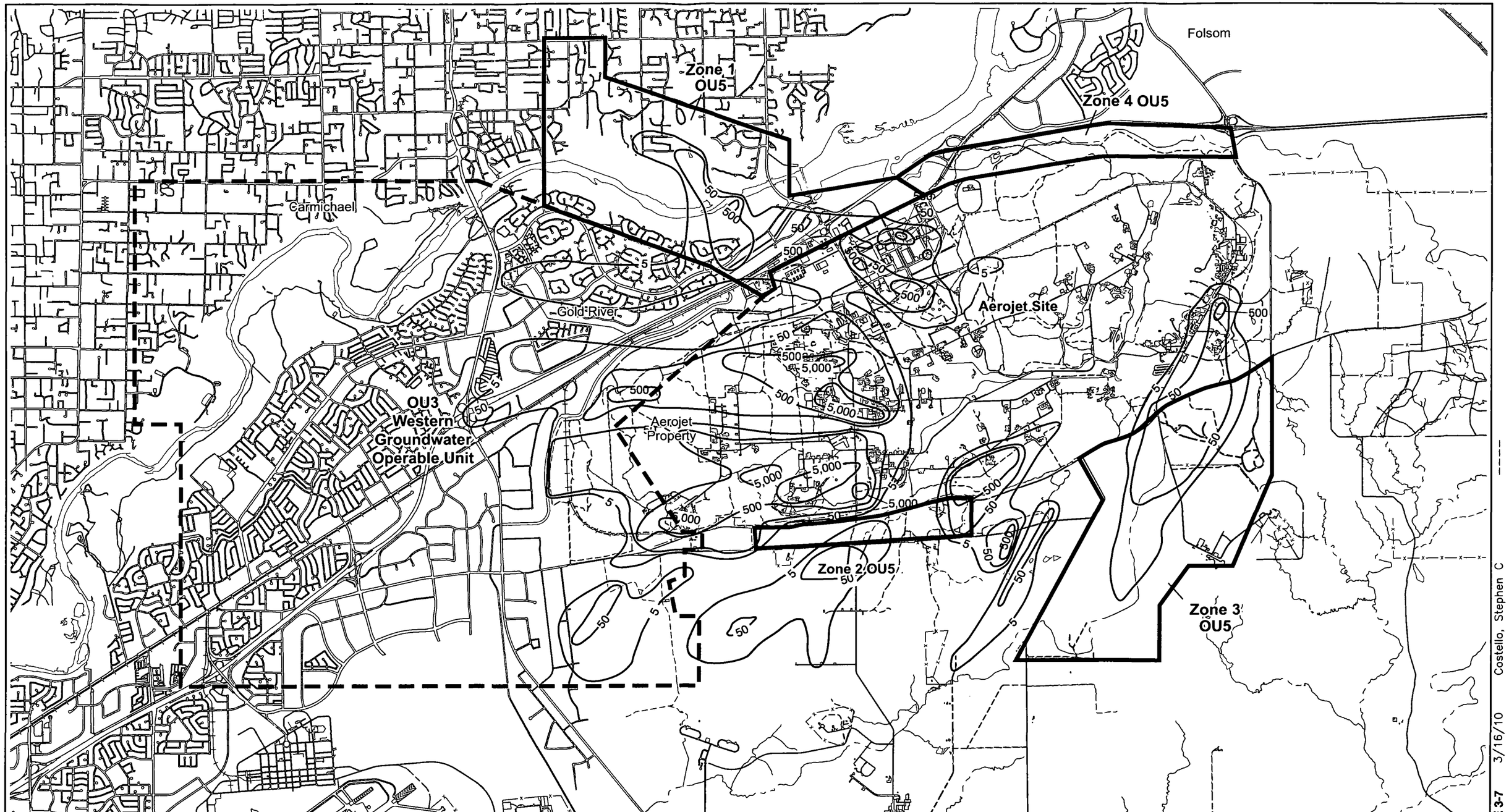
FIGURE 3

Layer A
NDMA Iso-Concentration Contour Map
2007 - 2010

FIGURE 3-3 3/16/10 Costello, Stephen C

SR10130845

10-0022



EXPLANATION

— 5 — TCE Iso-Concentration Contour in ppb

— · · — · · — Aerojet Property Boundary

Perimeter Groundwater Operable Unit Boundary-OU5

Western Groundwater Operable Unit Boundary-OU3

N

Scale: 1" = 4,000'

0 2,000 4,000

USEPA REGION IX
AEROJET OU5

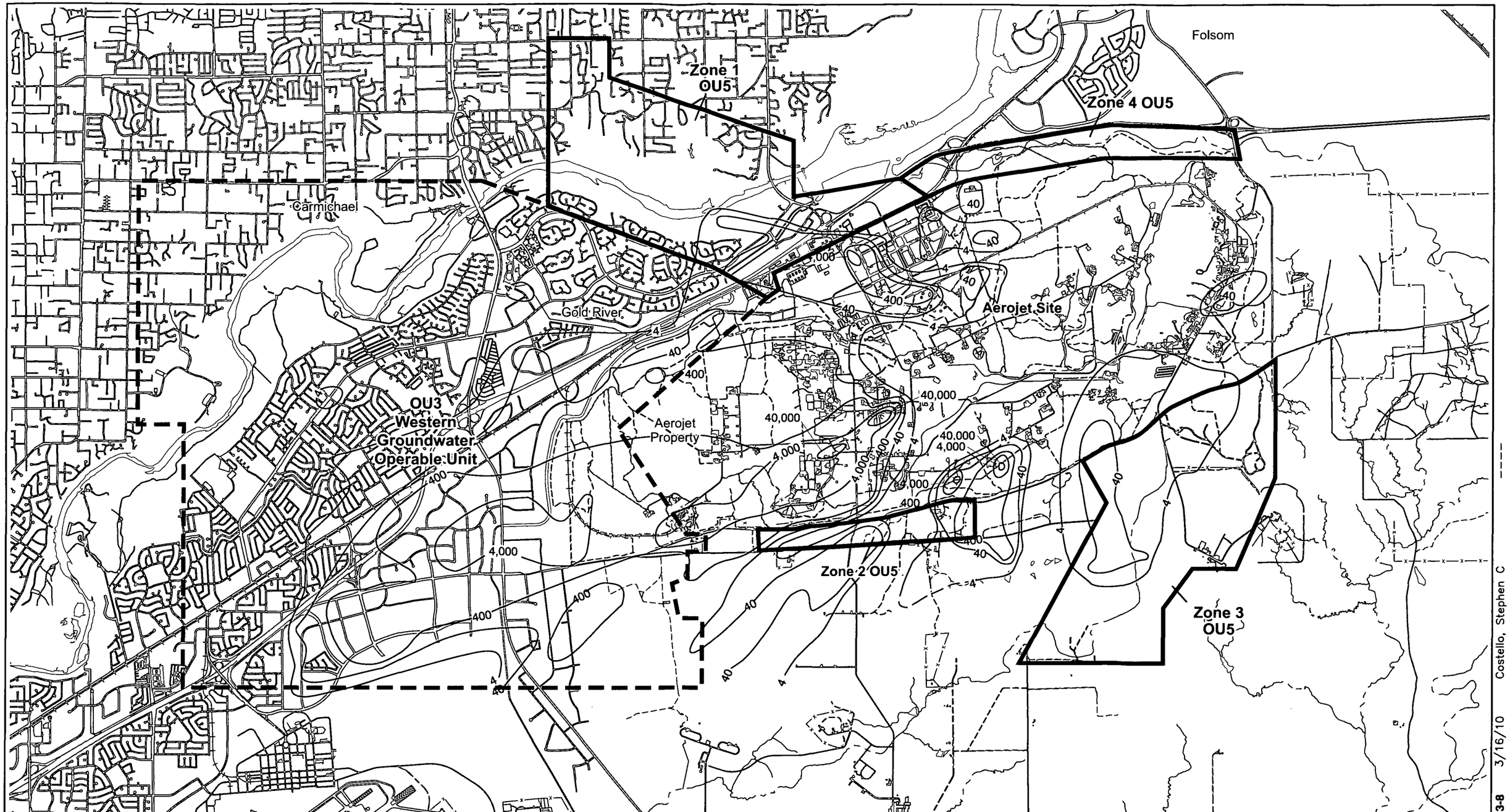
FIGURE 4

Layer C
TCE Iso-Concentration Contour Map
2007 - 2010

FIGURE 3-7 3/16/10 Costello, Stephen C

SR10130836

10-0022



EXPLANATION

— 4 — Perchlorate Iso-Concentration Contour in ppb

— · — · — Aerojet Property Boundary

Perimeter Groundwater Operable Unit Boundary-OU5

Western Groundwater Operable Unit Boundary-OU3

N

Scale: 1" = 4,000'

0 2,000 4,000

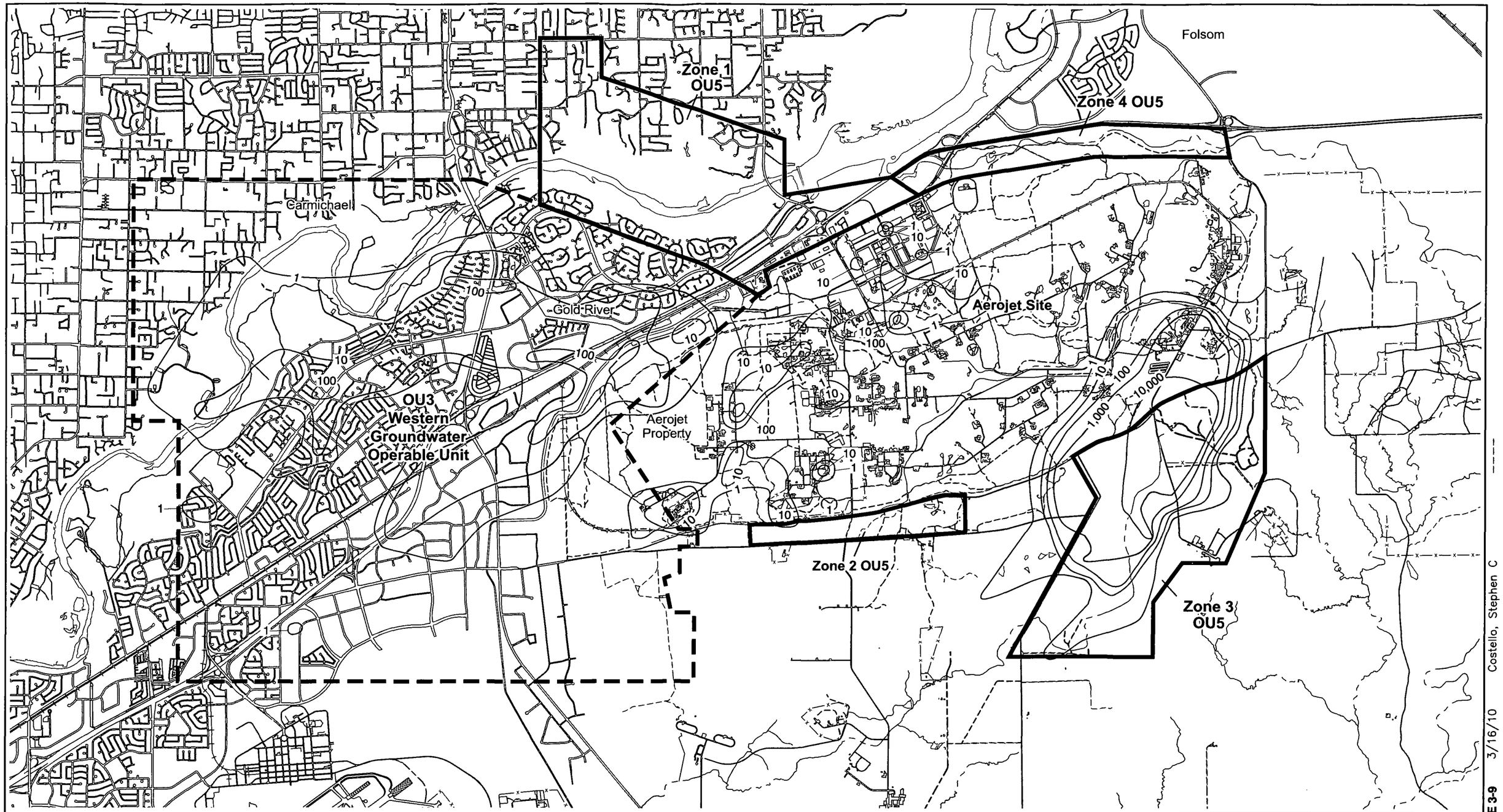
USEPA REGION IX
AEROJET OU5

FIGURE 5

Layer C
Perchlorate Iso-Concentration Contour Map
2007 - 2010

SR10130851 **FIGURE 3-8** 3/16/10 Costello, Stephen C

10-0022



EXPLANATION

— 1 — NDMA Iso-Concentration Contour in ppt

— · — · — Aerojet Property Boundary

Perimeter Groundwater Operable Unit Boundary-OU5

Western Groundwater Operable Unit Boundary-OU3

N

Scale: 1" = 4,000'

0 2,000 4,000

USEPA REGION IX
AEROJET OU5

FIGURE 6

Layer C
NDMA Iso-Concentration Contour Map
2007 - 2010

FIGURE 3-9 3/16/10 Costello, Stephen C

SR10130847

10-0022

Appendix C of the Aerojet OU-5 Record of Decision

Detailed Description and Cost Data for Groundwater Alternatives
(from the Aerojet Perimeter Groundwater OU Feasibility Study, February 2005)

Detailed capital, operation and maintenance (O&M), monitoring, and present worth cost estimates for each alternative are included in this Appendix. Capital cost details are provided for the years in which capital costs are projected to occur.

In accordance with EPA guidance, the cost estimates for each alternative are order-of magnitude estimates and are generally accurate within the +50%/-30% range specified in the guidance. The accuracy of the estimates is subject to substantial variation because details of the specific design will not be known until any remedy is implemented. For example, the actual site conditions, project scope and schedule, design details, competitive market conditions, changes during construction, labor and equipment rates, and other variables are not known.

Furthermore, the selection of technologies or process options is not intended to limit flexibility during remedial design. The selection provides a basis for estimating costs.
Remedial design efforts might reveal possible cost savings as a result of value engineering studies and reduce the cost of implementing the remedy. In addition treatment technologies for removal of NDMA and perchlorate that were in the developmental and full scale testing phases during preparation of this OU RI/FS may be substantially more proven at the time of design, incorporated into the remedy and provide significant cost savings.

Wherever possible, actual capital and O&M costs from construction and operation of existing monitor wells, extraction wells, conveyance piping, groundwater treatment facilities, and treated groundwater surface water discharge facilities for the GET systems at Aerojet were used for these cost estimates. Unit rates in the various cost estimates are based on a combination of Aerojet's past experience in actual construction and start-up of remediation facilities, EMSI's and its subcontractor's past experience in design and construction of remediation facilities and professional judgment, and vendor bids for costs that are not available from past experience.

Specific examples for various unit rates contained in the cost estimates include:

• Costs to secure site access to construct wells, permit wells, secure permits, and address CEQA issues are based on past experience in completing these activities.

• Surveying costs are based on an approximate going rate of $125/hr for a 2-person survey crew, including equipment and transportation costs.

- Extraction well drilling, downhole piping, pump and wellhead piping, aquifer pump testing and data reduction, extraction well sampling, wellhead site improvements and service road, and startup/troubleshooting are all based on Aerojet's experience in constructing numerous similar facilities at the Aerojet Sacramento Site.

- Unit costs for pumps, electrical cable, well vaults, flow meters, miscellaneous piping, fencing, and process piping and supports are based on past experience of EMSI and Aerojet engineering and construction staff and past quotes from vendors.

- Electrical disconnect switches, buried electrical cable, pull boxes, motor starters, controls, and instrumentation costs are based on the past experience of Mitchell Engineering, a subconsultant to both EMSI and Aerojet for electrical and instrumentation/controls engineering design and services during construction as well as Mitchell Engineering's review of the latest version of the Means Electrical Construction Cost Guide for verification of some electrical-related equipment unit rates.

- Conveyance piping costs were estimated on a per lineal foot basis based on actual groundwater and water piping project construction costs for piping associated with the Aerojet GETs E and F and ARGET facilities and piping projects in the Sacramento area. Specifically, unit costs shown in the following table were used. The source of these unit costs is Appendix E of the Western Groundwater Operable Unit Remedial Investigation/Feasibility Study (EMSI, Aerojet, and HSI Geotrans, 1999).

Pipe Diameter (inches)	Estimated Construction Cost ($/lineal foot)
6 and 8	100
10 and 12	140
16	175
20	225
24	260
30	300
Open field areas on Aerojet site	$8 per inch-diameter

- The unit rate for a packed-column air stripper is based on past unit rates for air strippers provided to Aerojet by DEI Systems of Salt Lake City, UT. Specifically, the most recent unit rate for an air stripper of similar size (9 ft diameter x 43 ft height) and capability, including blower and appurtenances, purchased by Aerojet in late 2002 for the White Rock North Dump (WRND) South-Central plume AKT-1 location was $88,000. Unit rates of $100,000 (at GET A) and $125,000 (at GET E/F and ARGET) were used for air stripper estimates to account for any

changes that might be specific to a packed column air stripper considered for a different location than WRND.

- Cost estimates for LPGAC equipment, specifically a pair of 12-foot diameter contactors operated in series, and associated bag pre-filters and backwashing facilities were obtained from USFilter. O&M costs for LPGAC are based on an influent TCE concentration of 5 ug/L, USFilter's GAC isotherm that predicts 0.0118 pounds of LPGAC usage per 1,000 gallons of groundwater treated, and a unit cost of $0.75 per pound of either virgin coal or reactivated coconut GAC.

- For ion exchange, capital cost estimates for ion exchange contactors were provided by USFilter. For flows less than 1,000 gpm, installed costs for a 10-foot diameter system (2 contactors in series) would be approximately $150,000. For flows between 1,000 and 2,500 gpm, a 12-foot diameter system would be required ($175,000 installed). Ion exchange resin replacement costs for Aerojet are currently $167 per acre foot of groundwater treated.

- Capital costs for expansion of the biological reduction process at GET E/F to accommodate flow from Zone 2 were derived by escalating the 1999 costs ($5.5M) to construct the current 5,300 gpm system using Engineering News Records' Construction Cost Index and then proportioning the costs based on flowrate. O&M costs for the biological reduction process at GET E/F are currently $87 per acre foot.

- Capital and O&M cost estimates for new UV/oxidation equipment were based on recent quotes received by Aerojet by Wedeco for addition of UV/oxidation equipment at the GET A, B, and ARGET treatment facilities.

- General contractor installation, electrical/instrumentation & control, and startup/troubleshooting unit rates are all based on Aerojet's recent experience with general contractor, electrical/instrumentation & control, and startup/troubleshooting costs associated with the expansion of the GET E/F 5,300 gpm groundwater treatment facility expansion, adjusted to account for the respective estimated flowrate associated with any potential smaller new or expansion of existing groundwater treatment facility, using the professional judgment of EMSI.

  Because of Aerojet's history of contracting directly with equipment manufacturers and various general civil/sitework, concrete, mechanical, and electrical/I&C contractors as compared to contracting to a general contractor who would then contract for and markup the cost of equipment and subcontractors, the 10 percent "Contractor Markup, Mob/demob, Insurance" indirect cost at the bottom of the Capital Cost estimates was only multiplied by the estimated cost of equipment and materials that would be supplied by a contractor (i.e., not contracted directly by Aerojet).

- Extraction and recharge well maintenance costs are based on Aerojet experience with rehabilitating the current wells on the Sacramento Site.

- Electrical utilities unit rate is the current rate per kilowatt-hour (kwh) paid by Aerojet to the Sacramento Municipal Utility District (SMUD). Electrical use costs are derived by taking the running horsepower or kilowatt use for a piece of equipment, multiplying by the number of hours per year and multiplying by the rate per kilowatt-hour. For most of the extraction wells and GET treatment facilities, Aerojet has actual electrical use records. Where available, actual use was included in the cost estimates.

- Equipment maintenance and equipment replacement unit rates of 3 percent of equipment capital costs are average industry-wide standards that are used in operation and maintenance costs estimates and budgeting. The capital costs for equipment (and associated installation) that is expected to have a life of approximately 10 years (such as extraction well, booster, and transfer pumps; and flow meters at extraction wellheads) were used as the basis.

- Monitoring costs are based on Aerojet's actual costs for analysis of environmental samples at their in-house laboratory. The unit rate for monitoring varies depending on the analyses being performed by the laboratory. Specifically, costs for monitoring are based on current Aerojet-Sacramento facility costs for the PCD Exhibit IV and VI requirements for groundwater monitoring on a per-sample basis for labor and equipment. Following are per sample analytical costs: VOCs ($50 each), SVOCs ($225 each), perchlorate ($50 each), and NDMA ($60 each).

Detailed Cost Estimates

Alternative Z1-2

Capital Cost Estimate
Alternative Z1-2: Contain and Remediate Zone 1 Groundwater

PGOU FS

Description		Quantity	Units	Unit Rate	Estimated Cost
Estimated Capital Costs:					
Demolition of Existing GET D					
Demo GET D treatment facility and above ground piping		1	LS	50,000	50,000
Subtotal - Demo GET D					50,000
Extraction Wells **[4 new wells, 3 locations]**					
Surveying		2.0	day	1,000	2,000
Secure well permit		4	ea	1,000	4,000
Secure permanent easement		4	LS	1,000	4,000
Extraction wells - drilling and development	No. Wells				
Layer C	2	200	ft	250	100,000
Layer D	2	250	ft	250	125,000
Aquifer pumping test and data reduction		4	LS	6,000	24,000
Well pump discharge piping, 3" SS threaded		900	lin ft	40	36,000
Pumps, incl. elec. cable		4	ea	25,000	100,000
Wellhead vault: H-20 traffic rated		4	ea	5,000	20,000
Flow meter		4	ea	1,500	6,000
Misc. wellhead piping and valves		4	ea	400	1,600
Electrical disconnect switch at well vault		4	ea	500	2,000
Installation (pump, wellhead piping/valves)		4	LS	2,000	8,000
One-time initial extraction well sampling		4	ea	650	2,600
Power service drop		2	ea	5,000	10,000
Buried electrical power (480v, 3-phase)		2,600	lin ft	15	39,000
Buried instrumentation and control wiring		6,300	lin ft	7	44,100
Electrical pull boxes every 400'		23	ea	500	11,500
Motor starters for wells		4	ea	1,500	6,000
Controls for well pumps		4	ea	500	2,000
Service road to extraction wells		2,350	lin ft	10	23,500
Subtotal - Extraction Wells					571,000
Piping					
Secure easements		1	LS	5,000	5,000
Surveying		3	day	1,000	3,000
Single-walled piping system (open field)					
8"		5,150	lin ft	64	329,600
10"		1,700	lin ft	80	136,000
Single-walled piping system (in street)					
8"		1,200	lin ft	120	144,000
Connections to exist 10" and 20" pipelines		2	LS	2,000	4,000
Subtotal - Untreated Groundwater Piping		8,050			622,000
Treatment at Modified ARGET Treatment Facility: approximately 3,560 gpm total flow					
Approximately 1,120 gpm from extraction wells 4325, 4330, 4335 and GET D extraction wells conveyed via 10" secondary contained pipeline. This flow would be "pretreated" for perchlorate removal and UV/ox or HiPOx for VOCs reduction and 1,4-dioxane removal.					
Approximately 2,440 gpm from extraction wells North and Southwest of the American River conveyed via 20" pipe to ARGET. This flow would be combined with the "pretreated" flow and treated via air stripping for VOCs removal.					
Slab on grade for ion exchange system (48'x30'x1.5')		1,440	sq ft	20	28,800
Transfer pumping w/ variable frequency drive		1	ea	25,000	25,000
Bag pre-filters		2	ea	13,000	26,000
Ion exchange contactors and valving (12' dia system) up to 2,500 gpm capacity		1	ea	175,000	175,000
In-plant piping, valving		1	LS	10,000	10,000
Instrumentation and control/telemetry		1	LS	20,000	20,000
Electrical		1	LS	10,000	10,000
General contractor installation (interconnecting piping, valving only)		1	LS	20,000	20,000
Startup/troubleshooting		1	LS	5,000	5,000
Subtotal - Treatment					320,000
Estimated Construction Costs - Subtotal					1,563,000
General Contractor Markup, Mob/demob, Insurance		% of equipment		10	50,000
Engineering, Permitting and Construction Management			%	15	234,000
Regulatory Oversight			%	2.5	39,000
Estimated Project Capital Costs - Subtotal					1,886,000
Contingency			%	15	283,000
Estimated Project Capital Costs - Total					**2,170,000**

Estimated Annual Operation, Maintenance, and Monitoring Costs
Alternative Z1-2: Contain and Remediate Zone 1 Groundwater

PGOU FS

Description	Number	Quantity	Units	Unit Rate	Estimated O&M Cost ($/yr)
Estimated O&M Costs					
New perchlorate treatment via ion exchange at approximately 1,120 gpm					
Existing UV/oxidation treatment for 1,4-dioxane removal and VOCs pretreatment at approximately 1,120 gpm					
Removal/polishing of VOCs via existing air stripping process at approximately 3,560 gpm					
Extraction well maintenance		15	ea	200	3,000
Electric utilities:					
Existing containment extraction wells	8	1,289,651	kwh	0.075	96,700
4580 estimate	1	98,002	kwh	0.075	7,400
New C1 extraction well:	1	73,501	kwh	0.075	5,500
New C2 extraction well:	1	147,002	kwh	0.075	11,000
New D1 extraction well:	1	214,378	kwh	0.075	16,100
New D2 extraction well:	1	153,127	kwh	0.075	11,500
New 5020:	1	64,681	kwh	0.075	4,900
New 5105:	1	54,391	kwh	0.075	4,100
Transfer pump from influent tank (assume 34 running hp)	1	219,524	kwh	0.075	16,500
UV/oxidation pretreatment (1,120 gpm)	55 kw	481,800	kwh	0.075	36,100
Air stripper blower, effluent transfer pump, misc. power	52 kw	455,520	kwh	0.075	34,200
Ion exchange resin replacement (1,120 gpm)		1,807	acre-ft	167	301,700
UV lamp replacement		157	ea	125	19,600
Hydrogen peroxide use (assume 12 mg/L, 35% solution)		5,952	gal	3	17,900
Materials and expendables (assume same as 2003 ARGET actuals)		1	LS	45,000	45,000
Equip Maintenance (@ % of new equipment capital)		139,000	%	3	4,200
Equipment Replacement (@ % of new equipment capital)		139,000	%	3	4,200
Labor (incl. fringe benefits):					
Operator labor (assume same as 2003 ARGET actuals)		1	year	17,000	17,000
Subtotal - Operation and Maintenance					657,000
Contingency (scope)			%	10	65,700
Estimated O&M Costs - Total					**723,000**
Estimated Monitoring Costs					
Monitoring:					
Monitoring and extraction wells		1	LS	147,000	147,000
ARGET treatment		1	LS	30,000	30,000
Estimated Monitoring Costs - Total					177,000
Estimated Operation, Maintenance and Monitoring Costs - Total					**900,000**

Non-Discounted Constant Dollar Cost Estimate
Alternative Z1-2: Contain and Remediate Zone 1 Groundwater

Time until RAOs achieved = 151 years (reduce TCE to less than 5 ug/L)

Year	*n*	Capital Costs ($)	O&M and Monitoring Costs ($/yr)	Subtotal Non-Discounted Costs ($)	Cumulative Non-Discounted Costs ($)
2135	130	220,000	900,000	1,120,000	126,460,000
2136	131		900,000	900,000	127,360,000
2137	132		900,000	900,000	128,260,000
2138	133		900,000	900,000	129,160,000
2139	134		900,000	900,000	130,060,000
2140	135		900,000	900,000	130,960,000
2141	136		900,000	900,000	131,860,000
2142	137		900,000	900,000	132,760,000
2143	138		900,000	900,000	133,660,000
2144	139		900,000	900,000	134,560,000
2145	140	610,000	900,000	1,510,000	136,070,000
2146	141		900,000	900,000	136,970,000
2147	142		900,000	900,000	137,870,000
2148	143		900,000	900,000	138,770,000
2149	144		900,000	900,000	139,670,000
2150	145		900,000	900,000	140,570,000
2151	146		900,000	900,000	141,470,000
2152	147		900,000	900,000	142,370,000
2153	148		900,000	900,000	143,270,000
2154	149		900,000	900,000	144,170,000
2155	150	730,000	900,000	1,630,000	145,800,000
2156	151		900,000	900,000	146,700,000

Capital Cost Estimate
Alternative Z1-3: Contain, Remediate, and Remove Additional Mass from Zone 1 Groundwater

PGOU FS

Description		Quantity	Units	Unit Rate	Estimated Cost
Estimated Capital Costs:					
Demolition of Existing GET D					
Demo GET D treatment facility and above ground piping		1	LS	50,000	50,000
Subtotal - Demo GET D					50,000
Extraction Wells [4 wells, 3 locations]					
Surveying		2.0	day	1,000	2,000
Secure well permit		4	ea	1,000	4,000
Secure permanent easement		4	LS	1,000	4,000
Extraction wells - drilling and development	No. Wells				
Layer C	2	200	ft	250	100,000
Layer D	2	250	ft	250	125,000
Aquifer pumping test and data reduction		4	LS	6,000	24,000
Well pump discharge piping, 3" SS threaded		900	lin ft	40	36,000
Pumps, incl. elec. cable		4	ea	25,000	100,000
Wellhead vault, H-20 traffic rated		4	ea	5,000	20,000
Flow meter		4	ea	1,500	6,000
Misc. wellhead piping and valves		4	ea	400	1,600
Electrical disconnect switch at well vault		4	ea	500	2,000
Installation (pump, wellhead piping/valves)		4	LS	2,000	8,000
One-time initial extraction well sampling		4	ea	650	2,600
Power service drop		2	ea	5,000	10,000
Buried electrical power (460v, 3-phase)		2,600	lin ft	15	39,000
Buried instrumentation and control wiring		6,200	lin ft	7	44,100
Electrical pull boxes every 400'		25	ea	500	11,500
Motor starters for wells (for MCC, incl. disconnect, see line)		4	ea	1,500	6,000
Controls for well pumps (to new MCC - see below)		4	ea	500	2,000
Service road to extraction wells		2,250	lin ft	10	22,500
Subtotal - Extraction Wells					571,000
Piping					
Secure easements		1	LS	5,000	5,000
Surveying		3	day	1,000	3,000
Single-walled piping system (open field)					
8"		5,150	lin ft	64	329,600
5"		2,400	lin ft	64	153,600
10"		1,700	lin ft	80	136,000
Single-walled piping system (in street)					
8"		1,200	lin ft	120	144,000
Connect 10" pipeline from GET D wells to existing ARGET 10" PE piping		2	LS	2,000	4,000
Subtotal - Untreated Groundwater Piping		9,250			775,000
Treatment at Modified ARGET Treatment Facility; approximately 2,900 gpm total flow					
Approximately 1,260 gpm from extraction wells 4325, 4330, 4336 and GET D extraction and mass removal wells conveyed via 10" secondary contained pipeline. Also, approx 500 gpm from wells Z1-C2 and -D2. This combined flow would be "pretreated" for perchlorate removal and UV/ox or HiPOx for VOCs reduction and 1,4-dioxane removal					
Approximately 1,640 gpm from extraction wells North and Southwest of the American River conveyed via 20" pipe to ARGET. This flow would be combined with the "pretreated" flow and treated via air stripping for VOCs removal					
Slab on grade for ion exchange system (46'x30'x1.5')		1,440	sq ft	20	28,800
Transfer pumping w/ variable frequency drive		1	ea	25,000	25,000
Bag prefilters		2	ea	10,000	20,000
Ion exchange contactors and valving (12' dia system) up to 2,500 gpm capacity		1	ea	175,000	175,000
In-plant piping, valving		1	LS	10,000	10,000
Instrumentation and control/telemetry		1	LS	20,000	20,000
Electrical		1	LS	10,000	10,000
General contractor installation (interconnecting piping, valving only)		1	LS	20,000	20,000
Startup/troubleshooting		1	LS	5,000	5,000
Subtotal - Treatment					320,000
Estimated Construction Costs - Subtotal					1,716,000
Contractor Markup, Mob/demob, Insurance		% of equipment		10	56,000
Engineering, Permitting and Construction Management			%	15	257,000
Regulatory Oversight			%	2.5	43,000
Estimated Project Capital Costs - Subtotal					2,074,000
Contingency			%	15	311,000
Estimated Project Capital Costs - Total					2,390,000

Estimated Annual Operation, Maintenance, and Monitoring Costs
Alternative Z1-3: Contain, Remediate, and Remove Additional Mass from Zone 1 Groundwater

PGOU FS

Description	Number	Quantity	Units	Unit Rate	Estimated O&M Cost ($/yr)
Estimated O&M Costs					
New perchlorate treatment via ion exchange at approximately 1,960 gpm					
Existing UV/oxidation treatment for 1,4-dioxane removal and VOCs pretreatment at approximately 1,460 gpm					
Removal/polishing of VOCs via existing air stripping process at approximately 3,900 gpm					
Extraction well maintenance		17	ea	200	3,400
Electric utilities:					
Existing containment and mass removal extraction wells	10	1,500,215	kwh	0.075	112,500
4550 estimate	1	98,002	kwh	0.075	7,400
New C1 extraction well:	1	73,501	kwh	0.075	5,500
New C2 extraction well:	1	147,002	kwh	0.075	11,000
New D1 extraction well:	1	214,378	kwh	0.075	16,100
New D2 extraction well:	1	153,127	kwh	0.075	11,500
New 5020:	1	64,681	kwh	0.075	4,900
New 5105:	1	54,391	kwh	0.075	4,100
Transfer pump from influent tank (assume 44 running hp)	1	285,969	kwh	0.075	21,400
UV/oxidation pretreatment (1,460 gpm)	72 kw	630,720	kwh	0.075	47,300
Air stripper blower, effluent transfer pump, misc. power	52 kw	455,520	kwh	0.075	34,200
Ion exchange resin replacement (1,960 gpm)		3,162	acre-ft	167	528,000
UV lamp replacement		205	ea	125	25,600
Hydrogen peroxide use (assume 12 mg/L, 35% solution)		7,759	gal	3	23,300
Materials and expendables (assume same as 2003 ARGET actuals)		1	LS	45,000	45,000
Equip Maintenance (@ % of new equipment capital)		139,000	%	3	4,200
Equipment Replacement (@ % of new equipment capital)		139,000	%	3	4,200
Labor (incl. fringe benefits):					
Operator labor (assume same as 2003 ARGET actuals)		1	year	17,000	17,000
Subtotal - Operation and Maintenance					927,000
Contingency (scope)			%	10	92,700
Estimated O&M Costs - Total					1,020,000
Estimated Monitoring Costs					
Monitoring:					
Monitoring and extraction wells		1	LS	147,000	147,000
ARGET treatment		1	LS	54,000	54,000
Estimated Monitoring Costs - Total					201,000
Estimated Operation, Maintenance and Monitoring Costs - Total					1,221,000

Non-Discounted Constant Dollar Cost Estimate
Alternative Z1-3: Contain, Remediate, and Remove Additional Mass from Zone 1 Groundwater

Time until RAOs achieved = 151 years (reduce TCE to less than 5 ug/L)

Year	n	Capital Costs ($)	O&M and Monitoring Costs ($/yr)	Subtotal Non-Discounted Costs ($)	Cumulative Non-Discounted Costs ($)
2070	65		1,221,000	1,221,000	84,755,000
2071	66		1,221,000	1,221,000	85,976,000
2072	67		1,221,000	1,221,000	87,197,000
2073	68		1,221,000	1,221,000	88,418,000
2074	69		1,221,000	1,221,000	89,639,000
2075	70	220,000	1,221,000	1,441,000	91,080,000
2076	71		1,221,000	1,221,000	92,301,000
2077	72		1,221,000	1,221,000	93,522,000
2078	73		1,221,000	1,221,000	94,743,000
2079	74		1,221,000	1,221,000	95,964,000
2080	75		1,221,000	1,221,000	97,185,000
2081	76		1,221,000	1,221,000	98,406,000
2082	77		1,221,000	1,221,000	99,627,000
2083	78		1,221,000	1,221,000	100,848,000
2084	79		1,221,000	1,221,000	102,069,000
2085	80	610,000	1,221,000	1,831,000	103,900,000
2086	81		1,221,000	1,221,000	105,121,000
2087	82		1,221,000	1,221,000	106,342,000
2088	83		1,221,000	1,221,000	107,563,000
2089	84		1,221,000	1,221,000	108,784,000
2090	85		1,221,000	1,221,000	110,005,000
2091	86		1,221,000	1,221,000	111,226,000
2092	87		1,221,000	1,221,000	112,447,000
2093	88		1,221,000	1,221,000	113,668,000
2094	89		1,221,000	1,221,000	114,889,000
2095	90	220,000	1,221,000	1,441,000	116,330,000
2096	91		1,221,000	1,221,000	117,551,000
2097	92		1,221,000	1,221,000	118,772,000
2098	93		1,221,000	1,221,000	119,993,000
2099	94		1,221,000	1,221,000	121,214,000
2100	95		1,221,000	1,221,000	122,435,000
2101	96		1,221,000	1,221,000	123,656,000
2102	97		1,221,000	1,221,000	124,877,000
2103	98		1,221,000	1,221,000	126,098,000
2104	99		1,221,000	1,221,000	127,319,000
2105	100	1,810,000	1,221,000	3,031,000	130,350,000
2106	101		1,221,000	1,221,000	131,571,000
2107	102		1,221,000	1,221,000	132,792,000
2108	103		1,221,000	1,221,000	134,013,000
2109	104		1,221,000	1,221,000	135,234,000
2110	105		1,221,000	1,221,000	136,455,000
2111	106		1,221,000	1,221,000	137,676,000
2112	107		1,221,000	1,221,000	138,897,000
2113	108		1,221,000	1,221,000	140,118,000
2114	109		1,221,000	1,221,000	141,339,000
2115	110	220,000	1,221,000	1,441,000	142,780,000
2116	111		1,221,000	1,221,000	144,001,000
2117	112		1,221,000	1,221,000	145,222,000
2118	113		1,221,000	1,221,000	146,443,000
2119	114		1,221,000	1,221,000	147,664,000
2120	115		1,221,000	1,221,000	148,885,000
2121	116		1,221,000	1,221,000	150,106,000
2122	117		1,221,000	1,221,000	151,327,000
2123	118		1,221,000	1,221,000	152,548,000
2124	119		1,221,000	1,221,000	153,769,000
2125	120	610,000	1,221,000	1,831,000	155,600,000
2126	121		1,221,000	1,221,000	156,821,000
2127	122		1,221,000	1,221,000	158,042,000
2128	123		1,221,000	1,221,000	159,263,000
2129	124		1,221,000	1,221,000	160,484,000

Detailed Cost Estimates

Alternative Z2-2

Capital Cost Estimate
Alternative Z2-2: Contain Zone 2 Groundwater
PGOU FS

Description		Quantity	Units	Unit Rate	Estimated Cost
Estimated Capital Costs:					
Extraction Wells **[3 locations]**					
Surveying		3.0	day	1,000	3,000
Secure well permit		3	ea	1,000	3,000
Secure permanent easement		3	LS	1,000	3,000
Extraction wells - drilling and development	No. Wells				
Layer C	3	200	ft	250	150,000
Layer D	0	250	ft	250	0
Aquifer pumping test and data reduction		3	LS	6,000	18,000
Well pump discharge piping, 3" SS threaded		600	lin ft	40	24,000
Pumps, incl. elec. cable		3	ea	25,000	75,000
Wellhead vault: H-20 traffic rated		3	ea	5,000	15,000
Flow meter		3	ea	1,500	4,500
Misc. wellhead piping and valves		3	ea	400	1,200
Electrical disconnect switch at well vault		3	ea	500	1,500
Installation (pump, wellhead piping/valves)		3	LS	2,000	6,000
One-time initial extraction well sampling		3	ea	650	2,000
Power service drop		1	ea	5,000	5,000
Buried electrical power (480v, 3-phase)		4,600	lin ft	15	69,000
Buried instrumentation and control wiring		9,000	lin ft	7	63,000
Electrical pull boxes every 400'		34	ea	500	17,000
Motor starters for wells		3	ea	1,500	4,500
Controls for well pumps		3	ea	500	1,500
Service road to extraction wells		4,600	lin ft	10	46,000
Subtotal - Extraction Wells					512,000
Piping					
Secure easements		1	LS	5,000	5,000
Surveying		2	day	1,000	2,000
Single-walled piping system (open field)					
6"		1,700	lin ft	48	81,600
8"		1,400	lin ft	64	89,600
10"		2,200	lin ft	80	176,000
Single-walled untreated groundwater piping system (in street)					
10"		3,800	lin ft	140	532,000
Subtotal - Untreated Groundwater Piping		9,100			886,000
Treatment at GET E/F (additional 1,400 gpm)					
Sitework		1	LS	2,000	2,000
Additonal equalization tank capacity		20,000	gal	1	20,000
Booster pump		1	ea	20,000	20,000
Expand fluidized bed reactor (FBR) system		1	ea	1,571,962	1,572,000
Rehab spare 480 kv UV/oxidation equip. for add'l 1,400 gpm, incl. controls, piping, a		1	ea	150,000	150,000
Additonal air stripper for add'l 1,400 gpm; including transfer pumps		1	LS	125,000	125,000
In-plant piping, valving		1	LS	20,000	20,000
Instrumentation and control/telemetry		1	LS	5,000	20,000
Electrical		1	LS	10,000	20,000
General contractor installation (tanks, pumps, piping, valving only)		1	LS	10,000	10,000
Startup/troubleshooting		1	LS	5,000	5,000
Subtotal - Treatment					1,964,000
Estimated Construction Costs - Subtotal					**3,362,000**
Contractor Markup, Mob/demob, Insurance		% of equip/mat'ls		10	76,000
Engineering, Permitting and Construction Management			%	15	504,000
Regulatory Oversight			%	2.5	84,000
Estimated Project Capital Costs - Subtotal					4,026,000
Contingency			%	15	604,000
Estimated Project Capital Costs - Total					**4,630,000**

Estimated Annual Operation, Maintenance, and Monitoring Costs
Alternative Z2-2: Contain Zone 2 Groundwater
PGOU FS

Description	Number	Quantity	Units	Unit Rate	Estimated O&M Cost ($/yr)
Extraction well maintenance		3	ea	200	600
Electric utilities:					
New extraction wells:					
Z2-C1 and -C3	2	220,504	kwh	0.075	16,500
Z2-C2	1	122,502	kwh	0.075	9,200
Proposed booster pumping (assume 100' TDH, 52 running hp)	1	343,005	kwh	0.075	25,700
Air stripper blower, effluent transfer pump	50 kw	438,000	kwh	0.075	32,900
UV/oxidation (additional 1,400 gpm)	144 kw	1,261,440	kwh	0.075	94,600
UV lamp replacement (additional 1,400 gpm)		392	ea	125	49,100
Hydrogen peroxide use (assume 10 mg/L, 35% solution)		9,300	gal	3	27,900
Proposed new FBR O&M costs at 1,400 gpm		2,258	acre-ft	80	180,700
Equip Maintenance (@ % of new equipment capital)		105,500	%	3	3,200
Equipment Replacement (@ % of new equipment capital)		105,500	%	3	3,200
Labor (incl. fringe benefits):					
Existing GET E/F operator labor (incl. w/ GET E/F O&M costs)		1	year	0	0
Subtotal Operation and Maintenance					444,000
Contingency (scope)			%	10	44,400
Estimated O&M Costs - Total					**488,000**
Monitoring:					
Monitoring and extraction wells		1	LS	36,000	36,000
GET E/F treatment		1	LS	4,000	4,000
Subtotal Monitoring					**40,000**
Estimated Operation, Maintenance and Monitoring Costs - Total					**528,000**

Non-Discounted Constant Dollar Cost Estimate
Alternative Z2-2: Contain Zone 2 Groundwater

Time until RAOs achieved = 232 years (reduce TCE to less than 5 ug/L)

Year	*n*	Capital Costs ($)	O&M and Monitoring Costs ($/yr)	Subtotal Non-Discounted Costs ($)	Cumulative Non-Discounted Costs ($)
2188	183		528,000	528,000	132,456,000
2189	184		528,000	528,000	132,984,000
2190	185		528,000	528,000	133,512,000
2191	186		528,000	528,000	134,040,000
2192	187		528,000	528,000	134,568,000
2193	188		528,000	528,000	135,096,000
2194	189		528,000	528,000	135,624,000
2195	190	156,000	528,000	684,000	136,308,000
2196	191		528,000	528,000	136,836,000
2197	192		528,000	528,000	137,364,000
2198	193		528,000	528,000	137,892,000
2199	194		528,000	528,000	138,420,000
2200	195		528,000	528,000	138,948,000
2201	196		528,000	528,000	139,476,000
2202	197		528,000	528,000	140,004,000
2203	198		528,000	528,000	140,532,000
2204	199		528,000	528,000	141,060,000
2205	200	4,910,000	528,000	5,438,000	146,498,000
2206	201		528,000	528,000	147,026,000
2207	202		528,000	528,000	147,554,000
2208	203		528,000	528,000	148,082,000
2209	204		528,000	528,000	148,610,000
2210	205		528,000	528,000	149,138,000
2211	206		528,000	528,000	149,666,000
2212	207		528,000	528,000	150,194,000
2213	208		528,000	528,000	150,722,000
2214	209		528,000	528,000	151,250,000
2215	210	156,000	528,000	684,000	151,934,000
2216	211		528,000	528,000	152,462,000
2217	212		528,000	528,000	152,990,000
2218	213		528,000	528,000	153,518,000
2219	214		528,000	528,000	154,046,000
2220	215		528,000	528,000	154,574,000
2221	216		528,000	528,000	155,102,000
2222	217		528,000	528,000	155,630,000
2223	218		528,000	528,000	156,158,000
2224	219		528,000	528,000	156,686,000
2225	220	3,014,000	528,000	3,542,000	160,228,000
2226	221		528,000	528,000	160,756,000
2227	222		528,000	528,000	161,284,000
2228	223		528,000	528,000	161,812,000
2229	224		528,000	528,000	162,340,000
2230	225		528,000	528,000	162,868,000
2231	226		528,000	528,000	163,396,000
2232	227		528,000	528,000	163,924,000
2233	228		528,000	528,000	164,452,000
2234	229		528,000	528,000	164,980,000
2235	230	156,000	528,000	684,000	165,664,000
2236	231		528,000	528,000	166,192,000
2237	232		528,000	528,000	166,720,000

Detailed Cost Estimates

Alternative Z2-3

Capital Cost Estimate
Alternative Z2-3: Contain, Remediate, and Remove Additional Mass from Zone 2 Groundwater
PGOU FS

Description		Quantity	Units	Unit Rate	Estimated Cost
Estimated Capital Costs:					
Extraction Wells **[3 locations]**					
Surveying		3.0	day	1,000	3,000
Secure well permit		3	ea	1,000	3,000
Secure permanent easement		4	LS	1,000	4,000
Extraction wells - drilling and development	No. Wells				
Layer C	3	200	ft	250	150,000
Layer D	0	250	ft	250	0
Aquifer pumping test and data reduction		4	LS	6,000	24,000
Well pump discharge piping, 3" SS threaded		600	lin ft	40	24,000
Pumps, incl. elec. cable		4	ea	25,000	100,000
Wellhead vault: H-20 traffic rated		4	ea	5,000	20,000
Flow meter		4	ea	1,500	6,000
Misc. wellhead piping and valves		4	ea	400	1,600
Electrical disconnect switch at well vault		4	ea	500	2,000
Installation (pump, wellhead piping/valves)		4	LS	2,000	8,000
One-time initial extraction well sampling		4	ea	650	2,600
Power service drop		2	ea	5,000	10,000
Buried electrical power (480v, 3-phase)		4,600	lin ft	15	69,000
Buried instrumentation and control wiring		13,600	lin ft	7	95,200
Electrical pull boxes every 400'		46	ea	500	23,000
Motor starters for wells		4	ea	1,500	6,000
Controls for well pumps		4	ea	500	2,000
Service road to extraction wells		4,600	lin ft	10	46,000
	Subtotal - Extraction Wells				599,000
Piping					
Secure easements		1	LS	5,000	5,000
Surveying		2	day	1,000	2,000
Single-walled piping system (open field) - 3 new wells					
6"		1,700	lin ft	48	81,600
8"		1,400	lin ft	64	89,600
10"		2,200	lin ft	80	176,000
Single-walled untreated groundwater piping system (in street) - 3 new wells					
10"		3,800	lin ft	140	532,000
Single-walled untreated groundwater piping system (open field) - Well 4420 to GET B					
6"		4,600	lin ft	48	220,800
	Subtotal - Untreated Groundwater Piping	13,700			1,107,000
Treatment at GET E/F (additional 1,400 gpm)					
Sitework		1	LS	2,000	2,000
Additonal equalization tank capacity		20,000	gal	1	20,000
Booster pump		1	ea	20,000	20,000
Expand fluidized bed reactor (FBR) system		1	ea	1,571,962	1,572,000
Rehab spare 480 kv UV/oxidation equip. for add'l 1,400 gpm, incl. controls, piping, appurten., ins		1	ea	150,000	150,000
Additonal air stripper for add'l 1,400 gpm; including transfer pumps		1	LS	125,000	125,000
In-plant piping, valving		1	LS	20,000	20,000
Instrumentation and control/telemetry		1	LS	5,000	20,000
Electrical		1	LS	10,000	20,000
General contractor installation (tanks, pumps, piping, valving only)		1	LS	10,000	10,000
Startup/troubleshooting		1	LS	5,000	5,000
	Subtotal - Treatment at GET E/F				1,964,000
Treatment at GET B (expand 150 gpm for Well 4420)					
Existing ion exchange contactors at GET B can accommodate add'l 150 gpm		0	ea	150,000	0
Add'l UV/oxidation equip. at 150 gpm, incl. controls, piping, appurten., install'n		1	ea	130,000	130,000
In-plant piping, valving		1	LS	5,000	5,000
Instrumentation and control/telemetry		1	LS	5,000	5,000
Electrical		1	LS	5,000	5,000
General contractor installation (tanks, pumps, piping, valving only)		1	LS	5,000	5,000
Startup/troubleshooting		1	LS	1,000	1,000
	Subtotal - Treatment				151,000
	Estimated Construction Costs - Subtotal				**3,821,000**
	Contractor Markup, Mob/demob, Insurance	% of equip/mat'ls		10	92,000
	Engineering, Permitting and Construction Management		%	15	573,000
	Regulatory Oversight		%	2.5	96,000
	Estimated Project Capital Costs - Subtotal				4,582,000
	Contingency		%	15	687,000
	Estimated Project Capital Costs - Total				**5,270,000**

Estimated Annual Operation, Maintenance, and Monitoring Costs
Alternative Z2-3: Contain, Remediate, and Remove Additional Mass from Zone 2 Groundwater
PGOU FS

Description	Number	Quantity	Units	Unit Rate	Estimated O&M Cost ($/yr)
Extraction well maintenance		5	ea	200	1,000
Electric utilities:					
Extraction wells:					
Z2-C1 and -C3	2	220,504	kwh	0.075	16,500
Z2-C2	1	122,502	kwh	0.075	9,200
4420	1	36,751	kwh	0.075	2,800
GET E/F					
Electric utilities:					
Proposed booster pumping (assume 100' TDH, 52 run hp)	1	343,005	kwh	0.075	25,700
UV/oxidation (additional 1,400 gpm)	144 kw	1,261,440	kwh	0.075	94,600
Air stripper blower, effluent transfer pump	50 kw	438,000	kwh	0.075	32,900
UV lamp replacement (additional 1,400 gpm)		392	ea	125	49,100
Hydrogen peroxide use (assume 10 mg/L, 35% solution)		9,300	gal	3	27,900
Proposed new FBR O&M costs at 1,400 gpm		2,258	acre-ft	80	180,700
GET B					
Electric utilities:					
UV/oxidation (additional 150 gpm)	15 kw	131,400	kwh	0.075	9,900
UV lamp replacement (additional 150 gpm)		42	ea	125	5,300
Hydrogen peroxide use (assume 10 mg/L, 35% solution)		996	gal	3	3,000
Ion exchange resin replacement (150 gpm)		242	acre-ft	167	40,400
Equip Maintenance (@ % of new equipment capital)		134,000	%	3	4,000
Equipment Replacement (@ % of new equipment capital)		134,000	%	3	4,000
Labor (incl. fringe benefits):					
Existing GET E/F and GET B operator labor (incl. w/ exist O&M costs)		1	year	0	0
Subtotal Operation and Maintenance					507,000
Contingency (scope)			%	10	50,700
Estimated O&M Costs - Total					**558,000**
Monitoring:					
Monitoring and extraction wells		1	LS	36,000	36,000
GET B treatment		1	LS	4,000	4,000
GET E/F treatment		1	LS	4,000	4,000
Subtotal Monitoring					**44,000**
Estimated Operation, Maintenance and Monitoring Costs - Total					**602,000**

Non-Discounted Constant Dollar Cost Estimate
Alternative Z2-3: Contain, Remediate, and Remove Additional Mass from Zone 2 Groundwater

Time until RAOs achieved = 131 years (reduce TCE to less than 5 ug/L)

Year	*n*	Capital Costs ($)	O&M and Monitoring Costs ($/yr)	Subtotal Non-Discounted Costs ($)	Cumulative Non-Discounted Costs ($)
2133	128		602,000	602,000	103,276,000
2134	129		602,000	602,000	103,878,000
2135	130	90,000	602,000	692,000	104,570,000
2136	131		602,000	602,000	105,172,000

Detailed Cost Estimates

Alternative Z3-2

Capital Cost Estimate
Alternative Z3-2 Contain and Remediate Zone 3 Groundwater
(*Ion Exchange for perchlorate removal*)
PGOU FS

Description		Quantity	Units	Unit Rate	Estimated Cost
Estimated Capital Costs:					
Extraction Wells	**[12 new wells, 6 locations]**				
Surveying		4.0	day	1,000	4,000
Secure well permit		12	ea	1,000	12,000
Secure permanent easement		12	LS	1,000	12,000
Extraction wells - drilling and development	No. Wells				
Layer C	3	200	ft	250	150,000
Layer D	3	250	ft	250	187,500
Layers E/F	6	300	ft	250	450,000
Aquifer pumping test and data reduction		12	LS	6,000	72,000
Well pump discharge piping, 3" SS threaded		3,150	lin ft	40	126,000
Pumps, incl. elec. Cable: 15 hp or less		3	ea	15,000	45,000
Pumps, incl. elec. Cable: greater than 15 hp		9	ea	35,000	315,000
Wellhead vault: H-20 traffic rated		12	ea	5,000	60,000
Flow meter		12	ea	1,500	18,000
Misc. wellhead piping and valves		12	ea	400	4,800
Electrical disconnect switch at well vault		12	ea	500	6,000
Installation (pump, wellhead piping/valves)		12	LS	2,000	24,000
One-time initial extraction well sampling		12	ea	650	7,800
Power service drop (at Grant Line Rd)		1	ea	5,000	5,000
Buried electrical power (480v, 3-phase)		9,200	lin ft	15	138,000
Buried instrumentation and control wiring		0	lin ft	7	0
Electrical pull boxes every 400'		26	ea	500	13,000
Motor starters for wells (for MCC, main disconnect, see trmt)		12	ea	1,500	18,000
Controls for well pumps (in new MCC - see below)		12	ea	500	6,000
Radio repeaters for new wells (control from GET B GWTF)		1	ea	20,000	20,000
Service road to extraction wells		9,200	lin ft	10	92,000
Subtotal - Extraction Wells					1,786,000
Piping					
Secure easements		1	LS	5,000	5,000
Surveying		2	day	1,000	2,000
Single-walled piping system (open field)					
6"		5,100	lin ft	48	244,800
8"		4,100	lin ft	64	262,400
Subtotal - Untreated Groundwater Piping		9,200			514,000
Treatment at GET B (approximately 1,900 gpm)					
Sitework		1	LS	5,000	5,000
Expand existing pre-engineered metal building: 20'x40'		800	sq ft	50	40,000
Add'l UV/oxidation equip. at 400 gpm, incl. controls, piping, appurten., install'n		1	ea	346,000	346,000
In-plant piping, valving		1	LS	20,000	20,000
Instrumentation and control/telemetry		1	LS	30,000	30,000
Electrical MCC, main disconnect (exists)		0	LS	10,000	0
Electrical		1	LS	40,000	40,000
General contractor installation (tanks, pumps, piping, valving only)		1	LS	50,000	50,000
Startup/troubleshooting		1	LS	10,000	10,000
Subtotal - Treatment					541,000
Estimated Construction Costs - Subtotal					2,841,000
Contractor Markup, Mob/demob, Insurance		% of equipment		10	60,000
Engineering, Permitting and Construction Management			%	15	426,000
Regulatory Oversight			%	2.5	71,000
Estimated Project Capital Costs - Subtotal					3,398,000
Contingency			%	15	510,000
Estimated Project Capital Costs - Total					**3,910,000**

Estimated Annual Operation, Maintenance, and Monitoring Costs
Alternative Z3-2 Contain and Remediate Zone 3 Groundwater
(Ion Exchange for perchlorate removal)
PGOU FS

Description	Number	Quantity	Units	Unit Rate	Estimated O&M Cost ($/yr)
Operation and Maintenance:					
Extraction well maintenance		18	ea	200	3,600
Electric utilities:					
Existing extraction wells:					
4570 (flow increased from 60 to 400 gpm)	1	196,003	kwh	0.075	14,700
4505, -10, -15, -20-, -25 (52 gpm)	1	112,398	kwh	0.075	8,400
New extraction wells:					
Z3-C1 and -2 (100 gpm, est. 7.5 running hp)	2	98,002	kwh	0.075	7,400
Z3-C3 (50 gpm, est. 3.7 running hp)	1	24,500	kwh	0.075	1,800
Z3-D1 (100 gpm, est. 7.5 running hp)	1	49,001	kwh	0.075	3,700
Z3-D2 and -3 (250 gpm, est. 18.7 running hp)	2	245,004	kwh	0.075	18,400
Z3-E1 (150 gpm, est. 11.2 running hp)	1	73,501	kwh	0.075	5,500
Z3-E2 (75 gpm, est. 5.6 running hp)	1	36,751	kwh	0.075	2,800
Z3-E3 (80 gpm, est. 6 running hp)	1	39,201	kwh	0.075	2,900
Z3-F1 (125 gpm, est. 9.4 running hp)	1	61,251	kwh	0.075	4,600
Z3-F2 (50 gpm, est. 3.7 running hp)	1	24,500	kwh	0.075	1,800
Z3-F3 (120 gpm, est. 9 running hp)	1	58,801	kwh	0.075	4,400
UV/oxidation (2 systems: 1 existing, 1 new) 1,900 gpm	190 kw	1,664,400	kwh	0.075	124,800
Air stripper blowers (20 hp)	2	261,749	kwh	0.075	39,000
Ion exchange resin replacement (1,900 gpm)		3,065	acre-ft	167	511,800
UV lamp replacement		533	ea	125	66,600
Hydrogen peroxide use (assume 5 mg/L, 35% solution)		12,622	gal	3	37,900
Equip Maintenance (@ % of new equipment capital)		402,000	%	3	12,100
Equipment Replacement (@ % of new equipment capital)		402,000	%	3	12,100
Labor (incl. fringe benefits):					
Operator labor (assume same as 2003 GET B)		1	year	17,000	17,000
Subtotal Operation and Maintenance					901,300
Contingency (scope)			%	10	90,100
Estimated O&M Costs - Total					**991,000**
Monitoring:					
Monitoring and extraction wells		1	LS	157,000	157,000
GET B treatment		1	LS	15,000	15,000
Subtotal Monitoring					**172,000**
Estimated Operation, Maintenance and Monitoring Costs - Total					**1,163,000**

Non-Discounted Constant Dollar Cost Estimate
Alternative Z3-2 Contain and Remediate Zone 3 Groundwater
(Ion Exchange for perchlorate removal)
PGOU FS

Time until RAOs achieved = 327 years (reduce NDMA to less than 0.0017 ug/L)

Year	*n*	Capital Costs ($)	O&M and Monitoring Costs ($/yr)	Subtotal Non-Discounted Costs ($)	Cumulative Non-Discounted Costs ($)
2305	300	4,120,000	1,163,000	5,283,000	396,520,000
2306	301		1,163,000	1,163,000	397,683,000
2307	302		1,163,000	1,163,000	398,846,000
2308	303		1,163,000	1,163,000	400,009,000
2309	304		1,163,000	1,163,000	401,172,000
2310	305		1,163,000	1,163,000	402,335,000
2311	306		1,163,000	1,163,000	403,498,000
2312	307		1,163,000	1,163,000	404,661,000
2313	308		1,163,000	1,163,000	405,824,000
2314	309		1,163,000	1,163,000	406,987,000
2315	310	590,000	1,163,000	1,753,000	408,740,000
2316	311		1,163,000	1,163,000	409,903,000
2317	312		1,163,000	1,163,000	411,066,000
2318	313		1,163,000	1,163,000	412,229,000
2319	314		1,163,000	1,163,000	413,392,000
2320	315		1,163,000	1,163,000	414,555,000
2321	316		1,163,000	1,163,000	415,718,000
2322	317		1,163,000	1,163,000	416,881,000
2323	318		1,163,000	1,163,000	418,044,000
2324	319		1,163,000	1,163,000	419,207,000
2325	320	1,450,000	1,163,000	2,613,000	421,820,000
2326	321		1,163,000	1,163,000	422,983,000
2327	322		1,163,000	1,163,000	424,146,000
2328	323		1,163,000	1,163,000	425,309,000
2329	324		1,163,000	1,163,000	426,472,000
2330	325		1,163,000	1,163,000	427,635,000
2331	326		1,163,000	1,163,000	428,798,000
2332	327		1,163,000	1,163,000	429,961,000

Detailed Cost Estimates

Alternative Z3-3

Capital Cost Estimate
Alternative Z3-3: Contain, Remediate, and Remove Additional Mass from Zone 3 Groundwater
(Ion Exchange for perchlorate removal)
PGOU FS

Description		Quantity	Units	Unit Rate	Estimated Cost
Estimated Capital Costs:					
Extraction Wells **[12 new wells, 6 locations]**					
Surveying		4.0	day	1,000	4,000
Secure well permit		12	ea	1,000	12,000
Secure permanent easement		12	LS	1,000	12,000
Extraction wells - drilling and development	No. Wells				
Layer C	3	200	ft	250	150,000
Layer D	3	250	ft	250	187,500
Layers E/F	6	300	ft	250	450,000
Aquifer pumping test and data reduction		12	LS	6,000	72,000
Well pump discharge piping, 3" SS threaded		3,150	lin ft	40	126,000
Pumps, incl. elec. Cable: 15 hp or less		3	ea	15,000	45,000
Pumps, incl. elec. Cable: greater than 15 hp		9	ea	35,000	315,000
Wellhead vault: H-20 traffic rated		12	ea	5,000	60,000
Flow meter		12	ea	1,500	18,000
Misc. wellhead piping and valves		12	ea	400	4,800
Electrical disconnect switch at well vault		12	ea	500	6,000
Installation (pump, wellhead piping/valves)		12	LS	2,000	24,000
One-time initial extraction well sampling		12	ea	650	7,800
Power service drop (at Grant Line Rd)		1	ea	5,000	5,000
Buried electrical power (480v, 3-phase)		9,200	lin ft	15	138,000
Buried instrumentation and control wiring		0	lin ft	7	0
Electrical pull boxes every 400'		26	ea	500	13,000
Motor starters for wells (for MCC, main disconnect, see trmt)		12	ea	1,500	18,000
Controls for well pumps (in new MCC - see below)		12	ea	500	6,000
Radio repeater for new wells (control from GET B GWTF)		1	ea	20,000	20,000
Service road to extraction wells		9,200	lin ft	10	92,000
Subtotal - Extraction Wells					1,786,000
Piping					
Secure easements		1	LS	5,000	5,000
Surveying		2	day	1,000	2,000
Single-walled piping system (open field)					
6"		5,100	lin ft	48	244,800
8"		4,100	lin ft	64	262,400
Subtotal - Untreated Groundwater Piping		9,200			514,000
Treatment at GET B (approximately 2,550 gpm)					
Sitework		1	LS	5,000	5,000
Expand existing pre-engineered metal building: 20'x40'		800	sq ft	50	40,000
Add'l ion exchange capacity (12' dia system, 1,000 gpm) includes install'n		1	ea	150,000	150,000
Add'l UV/oxidation equip. at 1,050 gpm, incl. controls, piping, appurten., install'n		1	ea	908,000	908,000
In-plant piping, valving		1	LS	20,000	20,000
Instrumentation and control/telemetry		1	LS	30,000	30,000
Electrical MCC, main disconnect (exists)		0	LS	10,000	0
Electrical		1	LS	40,000	40,000
General contractor installation (tanks, pumps, piping, valving only)		1	LS	50,000	50,000
Startup/troubleshooting		1	LS	10,000	10,000
Subtotal - Treatment					1,253,000
Estimated Construction Costs - Subtotal					3,553,000
Contractor Markup, Mob/demob, Insurance		% of equipment		10	60,000
Engineering, Permitting and Construction Management			%	15	533,000
Regulatory Oversight			%	2.5	89,000
Estimated Project Capital Costs - Subtotal					4,235,000
Contingency			%	15	635,000
Estimated Project Capital Costs - Total					**4,870,000**

Estimated Annual Operation, Maintenance, and Monitoring Costs
Alternative Z3-3: Contain, Remediate, and Remove Additional Mass from Zone 3 Groundwater
(Ion Exchange for perchlorate removal)
PGOU FS

Description	Number	Quantity	Units	Unit Rate	Estimated O&M Cost ($/yr)
Operation and Maintenance:					
Extraction well maintenance		24	ea	200	4,800
Electric utilities:					
Existing extraction wells:					
4570 (flow increased from 60 to 400 gpm)	1	196,003	kwh	0.075	14,700
4303, 4405, 4450	1	495,326	kwh	0.075	37,100
4011	1	12,250	kwh	0.075	900
4475	1	49,001	kwh	0.075	3,700
4480	1	122,502	kwh	0.075	9,200
4505, -10, -15, -20-, -25 (52 gpm)	1	112,398	kwh	0.075	8,400
New extraction wells:					
Z3-C1 and -2 (100 gpm, est. 7.5 running hp)	2	98,002	kwh	0.075	7,400
Z3-C3 (50 gpm, est. 3.7 running hp)	1	24,500	kwh	0.075	1,800
Z3-D1 (100 gpm, est. 7.5 running hp)	1	49,001	kwh	0.075	3,700
Z3-D2 and -3 (250 gpm, est. 18.7 running hp)	2	245,004	kwh	0.075	18,400
Z3-E1 (150 gpm, est. 11.2 running hp)	1	73,501	kwh	0.075	5,500
Z3-E2 (75 gpm, est. 5.6 running hp)	1	36,751	kwh	0.075	2,800
Z3-E3 (80 gpm, est. 6 running hp)	1	39,201	kwh	0.075	2,900
Z3-F1 (125 gpm, est. 9.4 running hp)	1	61,251	kwh	0.075	4,600
Z3-F2 (50 gpm, est. 3.7 running hp)	1	24,500	kwh	0.075	1,800
Z3-F3 (120 gpm, est. 9 running hp)	1	58,801	kwh	0.075	4,400
Transfer pumps (assume 40' TDH, 29 run hp)	2	500,788	kwh	0.075	37,600
UV/oxidation (2 systems: 1 existing, 1 new) 2,550 gpm	250 kw	2,190,000	kwh	0.075	164,300
Air stripper blowers (20 hp)	2	261,749	kwh	0.075	39,000
Ion exchange resin replacement (2,550 gpm)		4,113	acre-ft	167	686,900
UV lamp replacement		716	ea	125	89,500
Hydrogen peroxide use (assume 5 mg/L, 35% solution)		16,940	gal	3	50,800
Equip Maintenance (@ % of new equipment capital)		402,000	%	3	12,100
Equipment Replacement (@ % of new equipment capital)		402,000	%	3	12,100
Labor (incl. fringe benefits):					
Operator labor (assume same as 2003 GET B)		1	year	17,000	17,000
Subtotal Operation and Maintenance					1,241,400
Contingency (scope)			%	10	124,100
Estimated O&M Costs - Total					**1,366,000**
Monitoring:					
Monitoring and extraction wells		1	LS	157,000	157,000
GET B treatment		1	LS	15,000	15,000
Subtotal Monitoring					172,000
Estimated Operation, Maintenance and Monitoring Costs - Total					**1,538,000**

Non-Discounted Constant Dollar Cost Estimate
Alternative Z3-3: Contain, Remediate, and Remove Additional Mass from Zone 3 Groundwater (Ion Exchange for perchlorate removal)
PGOU FS

Time until RAOs achieved = 263 years (reduce NDMA to less than 0.0017 ug/L)

Year	*n*	Capital Costs ($)	O&M and Monitoring Costs ($/yr)	Subtotal Non-Discounted Costs ($)	Cumulative Non-Discounted Costs ($)
2215	210	590,000	1,538,000	2,128,000	367,620,000
2216	211		1,538,000	1,538,000	369,158,000
2217	212		1,538,000	1,538,000	370,696,000
2218	213		1,538,000	1,538,000	372,234,000
2219	214		1,538,000	1,538,000	373,772,000
2220	215		1,538,000	1,538,000	375,310,000
2221	216		1,538,000	1,538,000	376,848,000
2222	217		1,538,000	1,538,000	378,386,000
2223	218		1,538,000	1,538,000	379,924,000
2224	219		1,538,000	1,538,000	381,462,000
2225	220	2,430,000	1,538,000	3,968,000	385,430,000
2226	221		1,538,000	1,538,000	386,968,000
2227	222		1,538,000	1,538,000	388,506,000
2228	223		1,538,000	1,538,000	390,044,000
2229	224		1,538,000	1,538,000	391,582,000
2230	225		1,538,000	1,538,000	393,120,000
2231	226		1,538,000	1,538,000	394,658,000
2232	227		1,538,000	1,538,000	396,196,000
2233	228		1,538,000	1,538,000	397,734,000
2234	229		1,538,000	1,538,000	399,272,000
2235	230	590,000	1,538,000	2,128,000	401,400,000
2236	231		1,538,000	1,538,000	402,938,000
2237	232		1,538,000	1,538,000	404,476,000
2238	233		1,538,000	1,538,000	406,014,000
2239	234		1,538,000	1,538,000	407,552,000
2240	235		1,538,000	1,538,000	409,090,000
2241	236		1,538,000	1,538,000	410,628,000
2242	237		1,538,000	1,538,000	412,166,000
2243	238		1,538,000	1,538,000	413,704,000
2244	239		1,538,000	1,538,000	415,242,000
2245	240	2,430,000	1,538,000	3,968,000	419,210,000
2246	241		1,538,000	1,538,000	420,748,000
2247	242		1,538,000	1,538,000	422,286,000
2248	243		1,538,000	1,538,000	423,824,000
2249	244		1,538,000	1,538,000	425,362,000
2250	245		1,538,000	1,538,000	426,900,000
2251	246		1,538,000	1,538,000	428,438,000
2252	247		1,538,000	1,538,000	429,976,000
2253	248		1,538,000	1,538,000	431,514,000
2254	249		1,538,000	1,538,000	433,052,000
2255	250	2,350,000	1,538,000	3,888,000	436,940,000
2256	251		1,538,000	1,538,000	438,478,000
2257	252		1,538,000	1,538,000	440,016,000
2258	253		1,538,000	1,538,000	441,554,000
2259	254		1,538,000	1,538,000	443,092,000
2260	255		1,538,000	1,538,000	444,630,000
2261	256		1,538,000	1,538,000	446,168,000
2262	257		1,538,000	1,538,000	447,706,000
2263	258		1,538,000	1,538,000	449,244,000
2264	259		1,538,000	1,538,000	450,782,000
2265	260	2,430,000	1,538,000	3,968,000	454,750,000
2266	261		1,538,000	1,538,000	456,288,000
2267	262		1,538,000	1,538,000	457,826,000
2268	263		1,538,000	1,538,000	459,364,000

Detailed Cost Estimates

Alternative Z4-2

Capital Cost Estimate
Alternative Z4-2: Contain and Remediate Zone 4 Groundwater (expand GET A)
PGOU FS

Description		Quantity	Units	Unit Rate	Estimated Cost
Estimated Capital Costs:					
Extraction Wells **[7 locations]**					
Surveying		4	day	1,000	4,000
Secure well permit		7	ea	1,000	7,000
Secure permanent easement (owned by Aerojet)		0	LS	1,000	0
Extraction wells - drilling and development	No. Wells				
Layer A	6	100	ft	200	120,000
Layer B	1	150	ft	200	30,000
Aquifer pumping test and data reduction		7	LS	6,000	42,000
Well pump discharge piping, 3" SS threaded		750	lin ft	40	30,000
Pumps, incl. elec. cable		7	ea	10,000	70,000
Wellhead vault: H-20 traffic rated		7	ea	5,000	35,000
Flow meter		7	ea	1,500	10,500
Misc. wellhead piping and valves		7	ea	400	2,800
Electrical disconnect switch at well vault		7	ea	500	3,500
Installation (pump, wellhead piping/valves)		7	LS	2,000	14,000
One-time initial extraction well sampling		7	ea	650	4,600
Power service drop		1	ea	5,000	5,000
Buried electrical power (480v, 3-phase)		8,200	lin ft	15	123,000
Buried instrumentation and control wiring		11,600	lin ft	7	81,200
Electrical pull boxes every 400'		50	ea	500	25,000
Motor starters for wells (for MCC, main disconnect, see trmt)		7	ea	1,500	10,500
Controls for well pumps (in new MCC - see below)		7	ea	500	3,500
Service road to extraction wells		1,800	lin ft	10	18,000
Subtotal - Extraction Wells					640,000
Piping					
Secure easements (owned by Aerojet)		0	LS	5,000	0
Surveying		3	day	1,000	3,000
Single-walled piping system (open field)					
6"		5,200	lin ft	48	249,600
8"		6,400	lin ft	64	409,600
Subtotal - Untreated Groundwater Piping		11,600			662,000
Expand Existing GET A Groundwater Treatment Facility					
New wells 430 gpm (ion exchange for perchlorate removal)					
Total flow 640 gpm (NDMA and VOCs removal)					
Slab-on-grade for air stripper and transfer pump (assume 40'x40'x1.5')		1,600	sq ft	20	32,000
Bag filter housing		1	ea	13,000	13,000
Ion exchange equipment (430 gpm from proposed Sector C wells)		1	ea	150,000	150,000
Low watt UV/oxidation equipment (add'l 240 gpm above exist. 400 gpm)		1	ea	381,000	381,000
Air stripper and blower (replace existing)		1	ea	100,000	100,000
Effluent transfer pumping		1	ea	6,000	6,000
Misc process piping, supports, appurtenances		1	LS	10,000	10,000
Instrumentation and control/telemetry		1	LS	10,000	10,000
MCC and main disconnect exists, combo motor starter for blower, pump		2	LS	1,500	3,000
Electrical		1	LS	10,000	10,000
General contractor installation		1	LS	15,000	15,000
Startup/troubleshooting		1	LS	5,000	5,000
Subtotal - Treatment					735,000
Estimated Construction Costs - Subtotal					2,037,000
Contractor Markup, Mob/demob, Insurance			% of materials	10	57,000
Engineering, Permitting and Construction Management			%	15	306,000
Regulatory Oversight			%	2.5	51,000
Estimated Project Capital Costs - Subtotal					2,451,000
Contingency			%	15	368,000
Estimated Project Capital Costs - Total					**2,820,000**

Alternative Z4-2: Contain and Remediate Zone 4 Groundwater (expand GET A)
PGOU FS

Description	Number	Quantity	Units	Unit Rate	Estimated O&M Cost ($/yr)
Extraction well maintenance		14	ea	200	2,800
Electric utilities:					
Existing 7 containment extraction wells		270,500	kwh	0.075	20,300
New extraction wells:					
Z4-A1 (15 gpm, est. 1.1 running hp)	1	7,350	kwh	0.075	600
Z4-A2 (25 gpm, est. 1.9 running hp)	1	12,250	kwh	0.075	900
Z4-A3 (100 gpm, est. 7.5 running hp)	1	49,001	kwh	0.075	3,700
Z4-A4 (50 gpm, est. 3.7 running hp)	1	24,500	kwh	0.075	1,800
Z4-A5 (75 gpm, est. 5.6 running hp)	1	36,751	kwh	0.075	2,800
Z4-A6 (40 gpm, est. 3.0 running hp)	1	19,600	kwh	0.075	1,500
Z4-B1 (125 gpm, est. 9.4 running hp)	1	61,251	kwh	0.075	4,600
UV/oxidation (640 gpm)	95 kw	832,200	kwh	0.075	62,400
Air stripper blower	10 hp	65,437	kwh	0.075	4,900
Site area lighting	2 kw	17,520	kwh	0.075	1,300
UV lamp replacement		269	ea	125	33,600
Hydrogen peroxide use (assume 7 mg/L, 35% solution)		5,952	gal	3	17,900
Ion exchange resin replacement (430 gpm)		694	acre-ft	167	115,800
Equip Maintenance (@ % of new equipment capital)		100,500	%	3	3,000
Equipment Replacement (@ % of new equipment capital)		100,500	%	3	3,000
Labor (incl. fringe benefits):					
Operator labor (assume same as 2003 GET A)		1	year	6,000	6,000
Subtotal Operation and Maintenance					287,000
Contingency (scope)			%	10	28,700
Estimated O&M Costs - Total					**316,000**
Monitoring:					
Monitoring and extraction wells		1	LS	51,000	51,000
GET A treatment		1	LS	10,000	10,000
Subtotal Monitoring					**61,000**
Estimated Operation, Maintenance and Monitoring Costs - Total					**377,000**

Non-Discounted Constant Dollar Cost Estimate
Alternative Z4-2: Contain and Remediate Zone 4 Groundwater (expand GET A)

Time until RAOs achieved = 347 years (reduce NDMA to less than 0.0017 ug/L)

Year	*n*	Capital Costs ($)	O&M and Monitoring Costs ($/yr)	Subtotal Non-Discounted Costs ($)	Cumulative Non-Discounted Costs ($)
2305	300	2,970,000	377,000	3,347,000	142,440,000
2306	301		377,000	377,000	142,817,000
2307	302		377,000	377,000	143,194,000
2308	303		377,000	377,000	143,571,000
2309	304		377,000	377,000	143,948,000
2310	305		377,000	377,000	144,325,000
2311	306		377,000	377,000	144,702,000
2312	307		377,000	377,000	145,079,000
2313	308		377,000	377,000	145,456,000
2314	309		377,000	377,000	145,833,000
2315	310	120,000	377,000	497,000	146,330,000
2316	311		377,000	377,000	146,707,000
2317	312		377,000	377,000	147,084,000
2318	313		377,000	377,000	147,461,000
2319	314		377,000	377,000	147,838,000
2320	315		377,000	377,000	148,215,000
2321	316		377,000	377,000	148,592,000
2322	317		377,000	377,000	148,969,000
2323	318		377,000	377,000	149,346,000
2324	319		377,000	377,000	149,723,000
2325	320	1,200,000	377,000	1,577,000	151,300,000
2326	321		377,000	377,000	151,677,000
2327	322		377,000	377,000	152,054,000
2328	323		377,000	377,000	152,431,000
2329	324		377,000	377,000	152,808,000
2330	325		377,000	377,000	153,185,000
2331	326		377,000	377,000	153,562,000
2332	327		377,000	377,000	153,939,000
2333	328		377,000	377,000	154,316,000
2334	329		377,000	377,000	154,693,000
2335	330	120,000	377,000	497,000	155,190,000
2336	331		377,000	377,000	155,567,000
2337	332		377,000	377,000	155,944,000
2338	333		377,000	377,000	156,321,000
2339	334		377,000	377,000	156,698,000
2340	335		377,000	377,000	157,075,000
2341	336		377,000	377,000	157,452,000
2342	337		377,000	377,000	157,829,000
2343	338		377,000	377,000	158,206,000
2344	339		377,000	377,000	158,583,000
2345	340	1,200,000	377,000	1,577,000	160,160,000
2346	341		377,000	377,000	160,537,000
2347	342		377,000	377,000	160,914,000
2348	343		377,000	377,000	161,291,000
2349	344		377,000	377,000	161,668,000
2350	345		377,000	377,000	162,045,000
2351	346		377,000	377,000	162,422,000
2352	347		377,000	377,000	162,799,000

Detailed Cost Estimates

Alternative Z4-3

Capital Cost Estimate
Alternative Z4-3: Contain, Remediate, and Remove Additional Mass from Zone 4 Groundwater (expand GET A)
PGOU FS

Description		Quantity	Units	Unit Rate	Estimated Cost
Estimated Capital Costs:					
Extraction Wells **[7 locations]**					
Surveying		4	day	1,000	4,000
Secure well permit		7	ea	1,000	7,000
Secure permanent easement (owned by Aerojet)		0	LS	1,000	0
Extraction wells - drilling and development	No. Wells				
Layer A	6	100	ft	200	120,000
Layer B	1	150	ft	200	30,000
Aquifer pumping test and data reduction		7	LS	6,000	42,000
Well pump discharge piping, 3" SS threaded		750	lin ft	40	30,000
Pumps, incl. elec. cable		7	ea	10,000	70,000
Wellhead vault: H-20 traffic rated		7	ea	5,000	35,000
Flow meter		7	ea	1,500	10,500
Misc. wellhead piping and valves		7	ea	400	2,800
Electrical disconnect switch at well vault		7	ea	500	3,500
Installation (pump, wellhead piping/valves)		7	LS	2,000	14,000
One-time initial extraction well sampling		7	ea	650	4,600
Power service drop		1	ea	5,000	5,000
Buried electrical power (480v, 3-phase)		8,200	lin ft	15	123,000
Buried instrumentation and control wiring		11,600	lin ft	7	81,200
Electrical pull boxes every 400'		50	ea	500	25,000
Motor starters for wells (for MCC, main disconnect, see trmt)		7	ea	1,500	10,500
Controls for well pumps (in new MCC - see below)		7	ea	500	3,500
Service road to extraction wells		1,800	lin ft	10	18,000
Subtotal - Extraction Wells					640,000
Piping					
Secure easements (owned by Aerojet)		0	LS	5,000	0
Surveying		3	day	1,000	3,000
Single-walled piping system (open field)					
6"		5,200	lin ft	48	249,600
8"		6,400	lin ft	64	409,600
Subtotal - Untreated Groundwater Piping		11,600			662,000
Expand Existing GET A Groundwater Treatment Facility					
New wells + mass removal wells 450 gpm (ion exchange for perchlorate removal)					
Total flow 670 gpm (NDMA and VOCs removal)					
Slab-on-grade for air stripper and transfer pump (assume 40'x40'x1.5')		1,600	sq ft	20	32,000
Bag filter housing		1	ea	13,000	13,000
Ion exchange equipment (450 gpm from Sector C + mass removal wells)		1	ea	150,000	150,000
Low watt UV/oxidation equipment (add'l 270 gpm above exist. 400 gpm)		1	ea	428,000	428,000
Air stripper and blower (replace existing)		1	ea	100,000	100,000
Effluent transfer pumping		1	ea	6,000	6,000
Misc process piping, supports, appurtenances		1	LS	15,000	15,000
Instrumentation and control/telemetry		1	LS	10,000	10,000
MCC and main disconnect exists, combo motor starter for blower, pump		2	LS	1,500	3,000
Electrical		1	LS	10,000	10,000
General contractor installation		1	LS	15,000	15,000
Startup/troubleshooting		1	LS	5,000	5,000
Subtotal - Treatment					787,000
Estimated Construction Costs - Subtotal					2,089,000
Contractor Markup, Mob/demob, Insurance			% of materials	10	58,000
Engineering, Permitting and Construction Management			%	15	313,000
Regulatory Oversight			%	2.5	52,000
Estimated Project Capital Costs - Subtotal					2,512,000
Contingency			%	15	377,000
Estimated Project Capital Costs - Total					**2,890,000**

Alternative Z4-3: Contain, Remediate, and Remove Additional Mass from Zone 4 Groundwater (expand GET A) PGOU FS

Description	Number	Quantity	Units	Unit Rate	Estimated O&M Cost ($/yr)
Extraction well maintenance		17	ea	200	3,400
Electric utilities:					
Existing 7 containment extraction wells		270,500	kwh	0.075	20,300
Existing 3 mass removal extraction wells		65,944	kwh	0.075	4,900
New extraction wells:					
Z4-A1 (15 gpm, est. 1.1 running hp)	1	7,350	kwh	0.075	600
Z4-A2 (25 gpm, est. 1.9 running hp)	1	12,250	kwh	0.075	900
Z4-A3 (100 gpm, est. 7.5 running hp)	1	49,001	kwh	0.075	3,700
Z4-A4 (50 gpm, est. 3.7 running hp)	1	24,500	kwh	0.075	1,800
Z4-A5 (75 gpm, est. 5.6 running hp)	1	36,751	kwh	0.075	2,800
Z4-A6 (40 gpm, est. 3.0 running hp)	1	19,600	kwh	0.075	1,500
Z4-B1 (125 gpm, est. 9.4 running hp)	1	61,251	kwh	0.075	4,600
UV/oxidation (670 gpm)	100 kw	876,000	kwh	0.075	65,700
Air stripper blower	10 hp	65,437	kwh	0.075	4,900
Site area lighting	2 kw	17,520	kwh	0.075	1,300
UV lamp replacement		282	ea	125	35,200
Hydrogen peroxide use (assume 7 mg/L, 35% solution)		6,231	gal	3	18,700
Ion exchange resin replacement (450 gpm)		726	acre-ft	167	121,200
Equip Maintenance (@ % of new equipment capital)		100,500	%	3	3,000
Equipment Replacement (@ % of new equipment capital)		100,500	%	3	3,000
Labor (incl. fringe benefits):					
Operator labor (assume same as 2003 GET A)		1	year	6,000	6,000
Subtotal Operation and Maintenance					304,000
Contingency (scope)			%	10	30,400
Estimated O&M Costs - Total					**334,000**
Monitoring:					
Monitoring and extraction wells		1	LS	51,000	51,000
GET A treatment		1	LS	10,000	10,000
Subtotal Monitoring					**61,000**
Estimated Operation, Maintenance and Monitoring Costs - Total					**395,000**

Non-Discounted Constant Dollar Cost Estimate
Alternative Z4-3: Contain, Remediate, and Remove Additional Mass from Zone 4 Groundwater (expand GET A)

Time until RAOs achieved = 208 years (reduce NDMA to less than 0.0017 ug/L)

Year	*n*	Capital Costs ($)	O&M and Monitoring Costs ($/yr)	Subtotal Non-Discounted Costs ($)	Cumulative Non-Discounted Costs ($)
2143	138		395,000	395,000	67,500,000
2144	139		395,000	395,000	67,895,000
2145	140	1,150,000	395,000	1,545,000	69,440,000
2146	141		395,000	395,000	69,835,000
2147	142		395,000	395,000	70,230,000
2148	143		395,000	395,000	70,625,000
2149	144		395,000	395,000	71,020,000
2150	145		395,000	395,000	71,415,000
2151	146		395,000	395,000	71,810,000
2152	147		395,000	395,000	72,205,000
2153	148		395,000	395,000	72,600,000
2154	149		395,000	395,000	72,995,000
2155	150	590,000	395,000	985,000	73,980,000
2156	151		395,000	395,000	74,375,000
2157	152		395,000	395,000	74,770,000
2158	153		395,000	395,000	75,165,000
2159	154		395,000	395,000	75,560,000
2160	155		395,000	395,000	75,955,000
2161	156		395,000	395,000	76,350,000
2162	157		395,000	395,000	76,745,000
2163	158		395,000	395,000	77,140,000
2164	159		395,000	395,000	77,535,000
2165	160	1,150,000	395,000	1,545,000	79,080,000
2166	161		395,000	395,000	79,475,000
2167	162		395,000	395,000	79,870,000
2168	163		395,000	395,000	80,265,000
2169	164		395,000	395,000	80,660,000
2170	165		395,000	395,000	81,055,000
2171	166		395,000	395,000	81,450,000
2172	167		395,000	395,000	81,845,000
2173	168		395,000	395,000	82,240,000
2174	169		395,000	395,000	82,635,000
2175	170	120,000	395,000	515,000	83,150,000
2176	171		395,000	395,000	83,545,000
2177	172		395,000	395,000	83,940,000
2178	173		395,000	395,000	84,335,000
2179	174		395,000	395,000	84,730,000
2180	175		395,000	395,000	85,125,000
2181	176		395,000	395,000	85,520,000
2182	177		395,000	395,000	85,915,000
2183	178		395,000	395,000	86,310,000
2184	179		395,000	395,000	86,705,000
2185	180	1,150,000	395,000	1,545,000	88,250,000
2186	181		395,000	395,000	88,645,000
2187	182		395,000	395,000	89,040,000
2188	183		395,000	395,000	89,435,000
2189	184		395,000	395,000	89,830,000
2190	185		395,000	395,000	90,225,000
2191	186		395,000	395,000	90,620,000
2192	187		395,000	395,000	91,015,000
2193	188		395,000	395,000	91,410,000
2194	189		395,000	395,000	91,805,000
2195	190	120,000	395,000	515,000	92,320,000
2196	191		395,000	395,000	92,715,000
2197	192		395,000	395,000	93,110,000
2198	193		395,000	395,000	93,505,000
2199	194		395,000	395,000	93,900,000
2200	195		395,000	395,000	94,295,000
2201	196		395,000	395,000	94,690,000
2202	197		395,000	395,000	95,085,000
2203	198		395,000	395,000	95,480,000
2204	199		395,000	395,000	95,875,000
2205	200	3,040,000	395,000	3,435,000	99,310,000
2206	201		395,000	395,000	99,705,000
2207	202		395,000	395,000	100,100,000
2208	203		395,000	395,000	100,495,000
2209	204		395,000	395,000	100,890,000
2210	205		395,000	395,000	101,285,000
2211	206		395,000	395,000	101,680,000

Non-Discounted Constant Dollar Cost Estimate
Alternative Z4-3: Contain, Remediate, and Remove Additional Mass from Zone 4 Groundwater (expand GET A)

Time until RAOs achieved = 208 years (reduce NDMA to less than 0.0017 ug/L)

Year	*n*	Capital Costs ($)	O&M and Monitoring Costs ($/yr)	Subtotal Non-Discounted Costs ($)	Cumulative Non-Discounted Costs ($)
2212	207		395,000	395,000	102,075,000
2213	208		395,000	395,000	102,470,000

Appendix D of the Aerojet OU-5 Record of Decision

Detailed Description and Cost Data for Soil Area Alternatives
from the Aerojet Perimeter Groundwater OU Feasibility Study, August 2008

See Appendix C - Description and Cost Data for Groundwater Alternatives for discussion of methodology.

Table A20-1a *Summary of Estimated Cost of Remedial Alternatives*
FS Group A20-1
Sites 7D, 10D, 11D, and FCS
Perimeter Groundwater Operable Unit RI/FS
Aerojet Superfund Site
Sacramento County, California

Alternative		No Action	Institutional Controls	Total Cost of Alternative
A20-1A	No Action	$0	$0	**$0**
A20-1B	Institutional Controls	$0	$207,000	**$207,000**

Notes and Key:

Table A20-1b *Estimated Cost of Institutional Controls*
FS Group A20-1
Sites 7D, 10D, 11D, and FCS
Perimeter Groundwater Operable Unit RI/FS
Aerojet Superfund Site
Sacramento County, California

DESCRIPTION	QUANTITY NUMBER	QUANTITY UNIT	COST UNIT COST	COST TOTAL COST
DIRECT CAPITAL COST				
Institutional Contols				
Institutional Controls Plan	1	LS	$20,000	$20,000
Land Use Restriction/Covenant Drafting and Implementation	1	LS	$40,000	$40,000
5 Year Review and Reporting for 30 years	6	EA	$20,000	$120,000
			Subtotal - Institutional Controls	$180,000
			General Contingency (15% of Capital Costs)	$27,000
			Total Estimated Cost for Institutional Controls	**$207,000**

Notes and Key:
EA = Each
LS = Lump sum

Table A20-2a *Summary of Estimated Cost of Remedial Alternatives*
FS Group A20-2
Sites 7D and FCS
Perimeter Groundwater Operable Unit RI/FS
Aerojet Superfund Site
Sacramento County, California

Alternative		No Action	Institutional Controls	Vapor Barriers		Total Cost of Alternative
		Both Sites	Both Sites	7D	FCS	
A20-2A	No Action	$0	$0	$0	$0	$0
A20-2B	Vapor Barriers with Institutional Controls	$0	(1)	$62,000	$433,000	$495,000

Notes and Key:

Table A20-2b *Estimated Cost for Vapor Barriers*
FS Group A20-2
Sites 7D and FCS
Perimeter Groundwater Operable Unit RI/FS
Aerojet Superfund Site
Sacramento County, California

DESCRIPTION	QUANTITY NUMBER	QUANTITY UNIT	COST UNIT COST	COST TOTAL COST
DIRECT CAPITAL COST				
Passive Vapor Barriers[1]				
Site 7D				
Vapor Barrier - Residential Development	18,900	sq. ft.	$3.0	$56,700
Vapor Barrier - Commercial Development		sq. ft.	$2.5	$0
General Contingency (10% of Capital Costs)				$5,700
TOTAL ESTIMATED CAPITAL COST FOR VAPOR BARRIERS				**$62,000**
Site FCS				
Vapor Barrier - Residential Development		sq. ft.	$3.0	$0
Vapor Barrier - Commercial Development	157,500	sq. ft.	$2.5	$393,750
General Contingency (10% of Capital Costs)				$39,375
TOTAL ESTIMATED CAPITAL COST FOR VAPOR BARRIERS				**$433,000**

Notes and Key:
EA = Each
LS = Lump sum
[1]Assumptions for vapor barriers
Assumes vapor barriers required for area encompassed by site.
Residential Development - Assumes 60% building and 40% green belt/streets/parking
Commercial Development - Assumes 70% building and 30% green belt/streets/parking
7D Area: 31,500
FCS Area 225,000

Table A20-4a *Summary of Estimated Cost of Remedial Alternatives*
FS Group A20-4
Site C41
Perimeter Groundwater Operable Unit RI/FS
Aerojet Superfund Site
Sacramento County, California

Alternative		No Action	Excavation and Disposal	Total Cost of Alternative
A20-4A	No Action	$0	$0	**$0**
A20-4B	Excavation and Landfill Disposal	$0	$1,054,000	**$1,054,000**

Notes and Key:

Table A20-4b *Estimated Cost of Soil Excavation and Landfill Disposal*
FS Group A20-4
Site C41
Perimeter Groundwater Operable Unit RI/FS
Aerojet Superfund Site
Sacramento County, California

DESCRIPTION	QUANTITY NUMBER	QUANTITY UNIT	ESTIMATED COST UNIT COST ($)	ESTIMATED COST TOTAL COST ($)
DIRECT CAPITAL COST				
Reporting				
RD/RA Workplan	1	LS	$20,000	$10,000
Remedial Action Summary (Construction Completion Report)	1	LS	$20,000	$10,000
			SUBTOTAL - REPORTING	**$20,000**
Excavation and Disposal				
Surveying (pre- and post-excavation)	2	DAY	$1,500	$3,000
Equipment mobilization/demobilization	1	LS	$6,000	$6,000
Excavate and stockpile soil for Class II Landfill	15,825	TON	$6	$95,000
Soil transportation and disposal (Class II Landfill)	15,825	TON	$40	$633,000
Excavate and stockpile soil for Class I Landfill	0	TON	$36	$0
Soil transportation and disposal (Class I Landfill)	0	TON	$91	$0
Backfill excavations with clean fill and compact fill	0	TON	$10	$0
Water truck	2	DAY	$500	$1,000
Regulatory Oversight	1	LS	$10,000	$10,000
			SUBTOTAL - EXCAVATION AND DISPOSAL	**$748,000**
Confirmation and Stockpile Sample Analyses				
Stockpile sampling - Title 22 metals (1 sample/100 CY)	2	EA	$130	$300
Excavation floor confirmatory sampling	2	EA	$130	$300
Excavation sidewall sampling	8	EA	$130	$1,000
			SUBTOTAL - SAMPLING	**$1,600**
			SUBTOTAL - DIRECT CAPITAL COST	**$769,600**
INDIRECT CAPITAL COST				
Engineering Design, Procurement, Administrative, and Legal Costs (% of Direct Capital Costs)	1	%	6	$46,200
Construction Management (% of Direct Capital Costs)	1	%	4	$30,800
Project Management (% of Direct Capital Costs)	1	%	4	$30,800
Contractor's General Requirements (assume monthly rental of job trailer, storage box, and portable toilet; and administration support)	1	Week	$1,000	$1,000
			SUBTOTAL - INDIRECT CAPITAL COST	**$108,800**
			SUBTOTAL - CAPITAL COST (DIRECT AND INDIRECT)	**$878,000**
			Capital Cost Contingency (scope and cost) 20%	$176,000
			TOTAL ESTIMATED CAPITAL COST	**$1,054,000**

Notes and Key:
Excavation Floor Confirmation Samples assumes 1 sample per 1,000 square feet or 1 sample from excavation less than 1,000 square feet.
Excavation Sidewall Samples - Assumes 1 sample every 25 liner foot or 1 sample from each sidewall for excavation.
LS = Lump Sum
% = Percent
EA = Each
Ton = 2,000 pounds

Table A49-1a *Summary of Estimated Cost of Remedial Alternatives*
FS Group A49-1A
Sites 32D, 34D, 35D, and 38D
Perimeter Groundwater Operable Unit RI/FS
Aerojet Superfund Site
Sacramento County, California

Alternative		No Action	Institutional Controls	Capping	Soil Vapor Extraction and Cap	Total Cost Alternativ
A49-1A	No Action	$0	$0	$0	$0	$0
A49-1B	Capping with Institutional Controls	$0	$207,000	$366,000	$0	$573,000
A49-1C	SVE with Capping and Institutional Controls	$0	$207,000	$0	$1,241,000	$1,448,000

Notes and Key:
SVE = Soil vapor extraction
Area 49 - Includes Sites 32D, 34D, 35D, and 38D

Table A49-1b *Estimated Cost of Institutional Controls*
FS Group A49-1A
Sites 32D, 34D, 35D, and 38D
Perimeter Groundwater Operable Unit RI/FS
Aerojet Superfund Site
Sacramento County, California

DESCRIPTION	QUANTITY NUMBER	QUANTITY UNIT	COST UNIT COST	COST TOTAL COST
DIRECT CAPITAL COST				
Institutional Contols				
Institutional Controls Plan	1	LS	$20,000	$20,000
Land Use Restriction/Covenant Drafting and Implementation	1	LS	$40,000	$40,000
5 Year Review and Reporting for 30 years	6	EA	$20,000	$120,000
			Subtotal - Institutional Controls	$180,000
			General Contingency (15% of Capital Costs)	$27,000
			Total Estimated Cost for Institutional Controls	**$207,000**

Notes and Key:
EA = Each
LS = Lump sum

Table A49-1c *Estimated Cost of Capping*
FS Group A49-1A
Sites 32D, 34D, 35D, and 38D
Perimeter Groundwater Operable Unit RI/FS
Aerojet Superfund Site
Sacramento County, California

DESCRIPTION	QUANTITY NUMBER	QUANTITY UNIT	COST UNIT COST	COST TOTAL COST	SOURCE
DIRECT CAPITAL COST					
- Surveying/Site Layout	1	DAY	$1,500	$1,500	
- Purchase and Placement of Baserock for Asphalt Surface (2 inches over approximately 8.1 acres)	2,175	CY	$22.00	$47,850	
- Placement of Asphalt-Concrete Surface over Baserock (2 inches)	35,000	SY	$6.83	$239,085	
	TOTAL DIRECT CAPITAL COSTS			$288,435	
INDIRECT CAPITAL COST					
Engineering Design, Procurement, Administrative, and Legal Costs (% of Direct Capital Costs)	1	ls	10%	$28,844	ERM, 2006
Construction Management (% of Direct Capital Costs)	1	ls	15%	$43,265	ERM, 2006
Health and Safety Contingency (2% of Direct Capital Costs)	1	ls	2%	$5,769	ERM, 2006
	INDIRECT CAPITAL COST			$77,900	
TOTAL CAPITAL COST (DIRECT AND INDIRECT)				$366,000	

Notes and Key:
All total costs rounded to the nearest $100.

References:
ERM, 2006: ERM-West Incorporated, Internal Quote, 2006.
Means 2002: RS Means Site Work and Landscape Cost Data, 18th Annual Edition, 2004.
Means 2004: RS Means Heavy Construction Cost Data, 18th Annual Edition, 2004.
Means ECHOS 2004: RS Means Environmental Cost Data, 10th Annual Edition, 2004.

Table A49-1d *Estimated Cost of Soil Vapor Extraction at Sites 32D, 34D, 35D, and 38D*
FS Group A49-1A
Sites 32D, 34D, 35D, and 38D
Perimeter Groundwater Operable Unit RI/FS
Aerojet Superfund Site
Sacramento County, California

DESCRIPTION	QUANTITY NUMBER	QUANTITY UNIT	COST UNIT COST	COST TOTAL COST
DIRECT CAPITAL COST				
System Construction				
- Pilot Testing	1	LS	$100,000	$100,000
- Surveying/Site Layout	1	DAY	$1,500	$1,500
- Purchase and Placement of Baserock for Asphalt Surface (2 inches over approximately 8.1 acres)	2,175	CY	$22.00	$47,850
- Placement of Asphalt-Concrete Surface over Baserock (2 inches)	35,000	SY	$6.83	$239,085
- Construct Treatment Pad	1	LS	$15,000	$15,000
- Install Aboveground Conveyance Piping from Well Field to Treatment Pad	900	FT	$12.00	$10,800
- Purchase and Install Vacuum Blower and Moisture Knockout Vessel	1	LS	$10,000	$10,000
- Purchase and Install Thermal Oxidizer (500 cfm capacity unit)	1	LS	$80,000	$80,000
- Electrical and Controls Connection	1	LS	$15,000	$15,000
- Fencing Around Remediation Equipment	200	FT	$15.00	$3,000
			SUBTOTAL	**$522,235**
Miscellaneous Costs				
- AQMD Permit-to-Construct	1	LS	$5,000	$5,000
- Baseline Soil Vapor Sample Analysis from each SVE Well	6	EA	$265	$1,590
- Regulatory Oversight	1	LS	$10,000	$10,000
			SUBTOTAL	**$16,590**
			ESTIMATED TOTAL DIRECT CAPITAL COST	**$538,825**
INDIRECT CAPITAL COST				
- Engineering Design, Procurement, Administrative, and Legal Costs (10% of Direct Capital Costs)	1	LS	$53,883	$53,883
- Construction Management (7% of Direct Capital Costs)	1	LS	$37,718	$37,718
- Health and Safety Contingency (2% of Direct Capital Costs)	1	LS	$10,777	$10,777
			INDIRECT CAPITAL COST	**$102,377**
			TOTAL CAPITAL COST (DIRECT AND INDIRECT)	**$641,202**
ANNUAL COST (5-YEAR O&M PROGRAM)				
- Engineering and Technician Labor (12.5% FTE for Engineer-level and 20% FTE for Technician-level) - Includes Progress Reporting to Agencies	1	LS	$58,500	$58,500
- Annual AQMD Permit-to-Operate	1	LS	$2,500	$2,500
- Monthly System Sampling (for compliance with AQMD permit - system influent and effluent samples each month)	24	EA	$265	$6,360
- Annual Soil Vapor Sample Analysis from each SVE Well	6	EA	$265	$1,590
- Repair and Replacement of Miscellaneous Equipment and Materials	1	LS	$5,000	$5,000
- Electrical Power (assumes 400 kwhr/day at 90% operation time)	131,400	KWHR	$0.13	$17,082
- Natural Gas (assumes 100 cf/hr at 90% operation time)	8,097	CF	$0.77	$6,235
			TOTAL ANNUAL COST	**$97,267**
			TOTAL O&M PROGRAM COST (5 years)	**$486,333**
			TOTAL CAPITAL AND ANNUAL COSTS	$1,128,000
			General Contingency (10% of Capital and Annual Costs)	$113,000
			TOTAL COST OF ALTERNATIVE	**$1,241,000**

Notes and Key:

AQMD = Air Quality Management District
CF = Cubic feet
CFM = Cubic feet per minute
CY = Cubic Yard
EA = Each
FTE = Full Time Employee
KWHR = Kilowatt hour
LS = Lump sum
MO = Month
O&M = Operations and Maintenance

Table A49-2a *Summary of Estimated Cost of Remedial Alternatives*
FS Group A49-2
Site 33D and Buildings 49007 and 49011 Septic Tanks
Perimeter Groundwater Operable Unit RI/FS
Aerojet Superfund Site
Sacramento County, California

Alternative		No Action	Institutional Controls	Total Cost of Alternative
A49-2A	No Action	$0	$0	$0
A49-2B	Institutional Controls	$0	(1)	$0

Notes and Key:
(1) = Assumes cost of institutional control provided in FS Group A49-1 applies to all sites in Area 49.

Table A49-3a *Summary of Estimated Cost of Remedial Alternatives*
FS Group A49-3
Site 33D and Buildings 49007 and 49011 Septic Tanks
Perimeter Groundwater Operable Unit RI/FS
Aerojet Superfund Site
Sacramento County, California

Alternative		No Action	Institutional Controls	Total Cost of Alternative
A49-3A	No Action	$0	$0	$0
A49-3B	Institutional Controls	$0	(1)	$0

Notes and Key:
(1) = Assumes cost of institutional control provided in FS Group A49-1 applies to all sites in Area 49.

Table A49-4a *Summary of Estimated Cost of Remedial Alternatives*
FS Group A49-4
Septic Tank at Building 49022
Perimeter Groundwater Operable Unit RI/FS
Aerojet Superfund Site
Sacramento County, California

Alternative		No Action	Institutional Controls	Total Cost of Alternative
A49-4A	No Action	$0	$0	$0
A49-4B	Institutional Controls	$0	(1)	$0

Notes and Key:
(1) = Assumes cost of institutional control provided in FS Group A49-1 applies to all sites in Area 49.

Table A49-5a *Summary of Estimated Cost of Remedial Alternatives*
FS Group A49-5
Site C4
Perimeter Groundwater Operable Unit RI/FS
Aerojet Superfund Site
Sacramento County, California

Alternative		No Action	Excavation and Disposal	Total Cost of Alternative
A20-5A	No Action	$0	$0	$0
A20-5B	Excavation and Landfill Disposal	$0	$64,000	$64,000

Notes and Key:

Table A49-5b *Estimated Cost of Soil Excavation and Landfill Disposal*
FS Group A49-5
Site C4
Perimeter Groundwater Operable Unit RI/FS
Aerojet Superfund Site
Sacramento County, California

DESCRIPTION	QUANTITY NUMBER	QUANTITY UNIT	ESTIMATED COST UNIT COST ($)	ESTIMATED COST TOTAL COST ($)
DIRECT CAPITAL COST				
Reporting				
RD/RA Workplan	1	LS	$2,000	$10,000
Remedial Action Summary (Construction Completion Report)	1	LS	$2,000	$10,000
			SUBTOTAL - REPORTING	**$20,000**
Excavation and Disposal				
Surveying (pre- and post-excavation)	2	DAY	$1,500	$3,000
Equipment mobilization/demobilization	1	LS	$6,000	$3,000
Excavate and stockpile soil for Class II Landfill	270	TON	$6	$1,600
Soil transportation and disposal (Class II Landfill)	270	TON	$40	$10,800
Excavate and stockpile soil for Class I Landfill	0	TON	$36	$0
Soil transportation and disposal (Class I Landfill)	0	TON	$91	$0
Backfill excavations with clean fill and compact fill	0	TON	$10	$0
Water truck	1	DAY	$500	$500
Regulatory Oversight	0.25	LS	$10,000	$2,500
			SUBTOTAL - EXCAVATION AND DISPOSAL	**$21,400**
Confirmation and Stockpile Sample Analyses				
Stockpile sampling - Title 22 metals (1 sample/100 CY)	1	EA	$130	$100
Excavation floor confirmatory sampling	1	EA	$130	$100
Excavation sidewall sampling	1	EA	$130	$100
			SUBTOTAL - SAMPLING	**$300**
			SUBTOTAL - DIRECT CAPITAL COST	**$41,700**
INDIRECT CAPITAL COST				
Engineering Design, Procurement, Administrative, and Legal Costs (% of Direct Capital Costs)	1	%	10	$4,200
Construction Management (% of Direct Capital Costs)	1	%	10	$4,200
Project Management (% of Direct Capital Costs)	1	%	6	$2,500
Contractor's General Requirements (assume monthly rental of job trailer, storage box, and portable toilet; and administration support)	0.2	Week	$1,000	$200
			SUBTOTAL - INDIRECT CAPITAL COST	**$11,100**
			SUBTOTAL - CAPITAL COST (DIRECT AND INDIRECT)	**$53,000**
			Capital Cost Contingency (scope and cost) 20%	$11,000
			TOTAL ESTIMATED CAPITAL COST	**$64,000**

Notes and Key:
Excavation Floor Confirmation Samples assumes 1 sample per 1,000 square feet or 1 sample from excavation less than 1,000 square feet.
Excavation Sidewall Samples - Assumes 1 sample every 25 liner foot or 1 sample from each sidewall for excavation.
LS = Lump Sum
% = Percent
EA = Each
Ton = 2,000 pounds

Appendix B of the Aerojet OU-5 Record of Decision

Major Aerojet Groundwater Plume Maps for TCE, Perchlorate and NDMA

Attachment 2

STATEMENT OF WORK
FOR
REMEDIAL DESIGN AND
REMEDIAL ACTION (RD/RA)

for Groundwater of the
Perimeter Groundwater Operable Unit (OU-5)

AEROJET SUPERFUND SITE
SACRAMENTO COUNTY, CALIFORNIA

September 15, 2011

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A Approximate Extent of Contamination as of 2006-2008 and Approximate Remediation Well Locations

B Chemicals of Concern with Containment Levels

C Effluent Discharge Limitations

D Applicable or Relevant and Appropriate Requirements from the OU-5 Record of Decision

E OU-5 Project Work Plan

F Template for Groundwater Declaration of Covenants

ATTACHMENT 2

STATEMENT OF WORK FOR REMEDIAL DESIGN AND REMEDIAL ACTION

for Groundwater of the
Perimeter Groundwater Operable Unit (OU-5)
Aerojet Superfund Site, Sacramento County, California

I. Introduction

This Statement of Work (SOW) describes the activities the Respondents must perform in order to design, construct, operate, maintain, monitor, and evaluate the Groundwater Remedial Action (RA) for the Perimeter Groundwater Operable Unit (OU)-5 (hereafter referred to as OU-5), as described in the *Perimeter Groundwater Operable Unit OU-5 Record of Decision* (hereafter referred to as the ROD), dated February 15, 2011. This SOW is Attachment 2 to the *Unilateral Administrative Order for the Performance of Remedial Design and Interim Remedial Action for Groundwater* (hereafter referred to as the "Administrative Order") of the Perimeter Groundwater Operable Unit (OU-5), Aerojet Superfund Site (Site), Sacramento County, California.

OU-5 encompasses both soil and groundwater at the Aerojet Property (property) and beneath portions of the cities of Fair Oaks, Rancho Cordova, and Folsom as well as unincorporated areas of Sacramento County, California (Attachment A of this SOW [Approximate Extent of Contamination as of 2006-2008]). The soil areas comprise the following sites on the property: C4, C41, 7D, 10D, 11D, 32D, 33D, 34D, 35D, 38D, and the Former Company Store location (see Map of Soil Areas in Attachment A to this SOW). The groundwater included in OU-5 lies beneath four areas known as Zones 1 to 4 that lie to the north and south of the source operable units on the property (see Composite Plume Map in Attachment A to this SOW). The Contaminants of Concern (COC) in the soil and groundwater include the seventeen chemicals set forth in Attachment B (Chemicals of Concern with Containment Levels) of this SOW. The Remedial Action for the Soil areas of OU-5 is addressed in a separate Administrative Order and SOW.

The United States Environmental Protection Agency (EPA) is the lead Agency for the Administrative Order. The California Department of Toxic Substances Control (DTSC) and the California Regional Water Quality Control Board for the Central Valley Region (CVRWQCB) will represent the State of California in providing state review. Comments on submitted documents or data will be provided to Respondents by EPA. As lead Agency, EPA will resolve any differences in Agencies' responses to Respondents. The term "Agencies" shall mean EPA, DTSC, and CVRWQCB.

The Agencies intend to review deliverables to assess whether or not the RA will achieve the Remedial Action Objectives (RAO) set forth in Section II (Remedial Action Objectives) of this

SOW. Reviews by the Agencies or EPA's approval of a task or deliverable shall not, however, be construed as a guarantee of the adequacy of such task or deliverable.

The definitions set forth in the Definitions section of the Administrative Order shall apply to this SOW unless expressly provided otherwise herein.

II. Remedial Action Objectives

As specified in the Administrative Order, Respondents shall conduct an RA to meet all RAOs, discussed below, and other Performance Standards.

The RA for OU-5 is an interim remedy for the groundwater areas in OU-5, since the groundwater remedy is dependent on control of source areas in other OUs still in the Remedial Investigation/Feasibility Study (RI/FS) phase. The OU-5 groundwater remedy does not establish final cleanup levels for restoration of the contaminated aquifer, which will be selected in the final Site-wide Record of Decision document. Complete cleanup of the entire Site will require coordination of all seven groundwater and source operable units.

The interim groundwater RAOs for OU-5 are specified in the ROD as follows:

- Protect human health and the environment by preventing exposure to contaminated groundwater through restricting withdrawal of the water within the containment area on the current Aerojet property for purposes other than remediation;
- Achieve containment of the contaminated groundwater that exceeds the groundwater containment standards (listed in Attachment B) to prevent future migration of contaminants until cleanup levels are achieved to protect long-term beneficial uses of the groundwater; and
- Remove contaminant mass from the aquifer through extraction and treatment of highly contaminated groundwater at or near the upgradient portions of the OU-5 groundwater zones. This action will improve the efficiency and effectiveness of contaminant containment of OU-5 groundwater.

III. Summary of the OU-5 Remedial Action for Groundwater

The groundwater portion of the OU-5 remedy will complete the containment of groundwater contamination around the boundary of the Site, in conjunction with the remedy for Western Groundwater Operable Unit (OU-3). The containment provided by Groundwater Extraction and Treatment (GET) systems will prevent the contamination of additional drinking water supplies in a populated area dependent on groundwater supplies. This RA is an interim remedy for the containment of groundwater contamination in OU-5, and does not set numerical cleanup goals for the groundwater in the aquifer. Groundwater restoration in OU-5 is dependent on control of primary

source areas for the groundwater contamination and potential Non-Aqueous Phase Liquids upgradient of OU-5 in other operable units still in the RI/FS phase.

This RA is an interim remedy for containment of Contaminated Groundwater in OU-5, incorporates active measures to contain COCs within the groundwater that exceed risk-based limits, and includes the following actions:

- Contain groundwater that is contaminated above the containment levels in Attachment B to prevent further contamination of the aquifer. The contaminated groundwater will be contained using groundwater extraction and treatment;
- Remove additional contaminant mass from the contaminated groundwater on-property which is migrating off-property into OU-5 Groundwater Zones, through groundwater extraction and treatment at or near the property boundary in all contaminated layers of the aquifer;
- Treat extracted groundwater using reliable, proven treatment methods including biological treatment or resin adsorption for perchlorate, ultraviolet (UV) oxidation for N-Nitrosodimethylamine (NDMA), carbon adsorption or air stripping for residual volatile organic compounds (VOC), and oxidative destruction for less soluble VOCs and 1,4-Dioxane. EPA may approve alternative treatment methods in the future provided that they are demonstrated to be capable of meeting effluent limitations;
- Coordinate water replacement contingency planning and implementation at OU-5 with the contingency plans for OU-3;
- Implement Institutional Controls (IC), including Sacramento County review of new well drilling permits, and prohibitions on access to groundwater on the land overlaying the contaminated groundwater to restrict use of untreated groundwater within the contaminated portions of the aquifer until the final water quality objectives have been attained;
- Monitor groundwater at selected monitoring wells, drinking water wells, irrigation wells, and upgradient sentinel wells to verify and evaluate plume control and effectiveness of the remedy; and
- Manage groundwater within the hydraulic influence of the OU-5 groundwater remedy to maintain optimum water levels, to prevent adverse impact on the remedy, and to mitigate impacts on downgradient beneficial uses.

IV. Remedial Design Work Completed to Date

Since 1983, when the Site was placed on the National Priorities List, Aerojet has installed and operated numerous interim and final remedial action GETs (GETs A, B, D, E, F, F-south, E/F, Interim H, H-A, J, Interim K, K-A, L-A, L-B, and the American River Groundwater Extraction and Treatment [ARGET] system, as well as the Sailor Bar Park and Chettenham wellhead treatment systems) under directives from the Partial Consent Decree and under federal and state orders. Many

of these systems are located in OU-3, and a number of them have been superseded by newer systems and are no longer in operation. The GETs are treatment systems with an array of extraction wells designed to remove VOCs, NDMA, and/or perchlorate as necessary from groundwater beneath the Site. The treatment systems at each GET vary, but generally include combinations of air-stripping for VOC removal; UV light/chemical oxidation for removal of NDMA, most VOCs, and 1,4-dioxane; and ion exchange or biological reduction for perchlorate removal.

A number of these GETs (A, B, D, E/F, and ARGET) contained contamination that is part of OU-5. These interim remedial actions included GET D and ARGET in Zone 1, GET E/F in Zone 2 (included in OU-3), GET B in Zone 3, and GET A in Zone 4. The locations of these interim remedial actions are shown on the Composite Plume Map in Attachment A. The GET A and GET B treatment facilities are now co-located at the GET B location (Building 37110).

The well array and pumping rates of these GETs may be reconfigured or expanded to improve effectiveness of the capture system in all zones of OU-5. It may not be necessary to add additional treatment systems, although improvements in treatment may be considered.

V. Remedial Design and Remedial Action for Groundwater

A. Compliance with Performance Standards

The ROD states that the expected outcomes of the Selected Interim Groundwater Remedy include the containment of groundwater contamination at the current extent of the plumes to protect uncontaminated drinking water sources, reliable long-term operation of the containment through mass removal of highly contaminated groundwater within OU-5, and reducing the time and cost to restore the aquifer to beneficial use (drinking water source) once the final Site-wide remedy is selected and assuming control of contaminant sources. Existing GET components are expected to be utilized where effective and practicable. The RAOs specified in the ROD are listed in Section II (Remedial Action Objectives) of this SOW.

Performance standards for containment of groundwater are the Containment Levels listed in Table B-1 of Attachment B to this SOW. Respondents shall ensure that the locations of groundwater containment actions and compliance monitoring wells shall provide a sufficient buffer zone to allow additional actions to be taken, if necessary, to ensure compliance with the Performance Standards of this SOW. The OU-5 remedy shall operate together with current and pending groundwater remedies for OU-3 and other OUs as well as state enforcement actions (Inactive Rancho Cordova Test Site [IRCTS] and White Rock North Dump) to contain Contaminated Groundwater in all layers of the aquifer as an integral part of the remedy. The OU-5 remedy must integrate with remedies in adjacent parcels. Respondents shall provide adequate monitoring compliance and evaluation data to the Agencies at a sufficient number of monitoring wells within OU-5 to demonstrate that the

remedies west and south of OU-5 are working collectively with the OU-5 remedy to meet the Performance Standards of this SOW.

Performance standards for treatment of extracted groundwater prior to discharge to on-Site surface water or non-potable uses are the substantive requirements of the National Pollution Discharge Elimination System (NPDES) permit in effect at the Site when the ROD was signed on February 15, 2011 (see Attachment C of this SOW). Any discharge to ground on-Site shall also meet substantive requirements contained in Waste Discharge Requirements (WDR) issued by the CVRWQCB in effect at the Site when the ROD was signed or alternative WDRs that allow for the operational limits of specific GET facilities. Disposal/discharge of the treated groundwater must comply with the Applicable or Relevant and Appropriate Requirements (ARAR) contained in Attachment D of this SOW. Discharge of treated water to off-Site surface water, or other off-Site use of extracted groundwater, shall comply with all applicable federal and state water standards, including permits, in effect at the time of discharge. Discharges of treated water on-Site prior to each treatment system for the remedy selected in the ROD becoming operational and functional shall continue to comply with the discharge standards for that particular treatment system as provided in the Aerojet Partial Consent Decree in effect at the Site when the ROD was signed. If treated water is placed into a conveyance system on-Site for delivery as potable supply, Maximum Contaminant Levels (MCL) are ARARs (Attachment D) for treatment of the water on-Site. The treated groundwater shall not be injected into the subsurface unless it has been approved in writing by EPA and the CVRWQCB.

Other requirements, limits, and/or criteria for the RA related to Contaminated Groundwater are specified in the following items:

- Attachment B to this SOW (Chemicals of Concern with Containment Levels).
- Attachment C to this SOW (Effluent Discharge Limitations) and other discharge limits as described in Section V(A) Compliance with Performance Standards and Section V(E) Remedial Action.
- Attachment D to this SOW (Applicable or Relevant and Appropriate Requirements from the OU-5 Record of Decision). Note that this list of ARARs is taken directly from the ROD and applies to both Groundwater and Soil Remedial Actions.
- Groundwater Management Zone Plan (GMZP).
- Specified ICs of this SOW (Section V(L) Institutional Controls).
- Any additional Performance Standards developed in Section VI (Schedule for Major Deliverables and Other Tasks) of this SOW.

B. Supporting Plans and Deliverables

Respondents shall submit plans, specifications, and other deliverables for the Agencies' reviews, as specified in this SOW. One copy of each final document deliverable shall be

provided to the Site Repositories in an unbound format suitable for reproduction; one copy each shall be provided to EPA, DTSC, and CVRWQCB Project Coordinators, and EPA's contractor; additional copies, if required, shall be provided. In addition, for any deliverable specified in this SOW or determined during the course of the Work (as defined in the Administrative Order) to require review or input of a water purveyor or another federal, state, or local agency, Respondents shall provide additional electronic Portable Document Format (PDF) copies at no charge. Information presented in color must be legible and interpretable when reproduced in non-color. Final deliverables shall also be provided to the Agencies in electronic PDF unless otherwise directed by the Agencies. If requested by the Agencies, Respondents shall supply portions of final documents in modifiable electronic format. The Agencies shall be provided upon their request electronic files for any computer modeling simulations used by Respondents to generate deliverables along with any necessary software to run the applications, which is not in the public domain.

Respondents shall implement quality control procedures to ensure the quality of all reports and documents submitted to the Agencies for review. These procedures shall include but are not limited to internal technical and editorial review; independent verification of calculations; and documentation of all reviews, problems identified, and corrective actions taken.

As described in the EPA Review of Submissions section of the Administrative Order, EPA may approve, disapprove, or require modification of each deliverable under this SOW. Major deliverables described below shall be submitted according to the schedule in Section VI (Schedule for Major Deliverables and Other Tasks) of this SOW.

The following existing plans prepared for OU-3 shall be updated and revised to include OU-5. The requirements stipulated in the SOW for OU-3 (Section V(A) Supporting Plans) shall also apply to OU-5. The updated and revised plans shall be submitted for review by the Agencies and EPA's approval in accordance with the schedule contained in Section VI (Schedule for Major Deliverables and Other Tasks) of this SOW.

1. Sampling and Analysis Plans

In accordance with the Quality Assurance, Sampling, and Data Analysis section of the Administrative Order, Respondents shall prepare Sampling and Analysis Plans (SAP) for a) Remedial Design (RD) sampling, b) remedial construction sampling, and c) the long-term Operation and Maintenance (O&M) sampling for review by the Agencies and EPA's approval.

2. Construction Quality Assurance Plan

The Construction Quality Assurance Plan (CQAP) to be developed and implemented by Respondents shall ensure, with a reasonable degree of certainty, that the

completed RA construction meets or exceeds all design criteria, plans and specifications, and Performance Standards of this SOW.

3. Health and Safety Plans

Respondents shall prepare and implement Health and Safety Plans (HSP) to cover the following: a) remedy design and associated design phase field activity, b) remedy construction and associated field activities, and c) field activities after remedy construction during the long-term O&M period to ensure protection of on-site personnel and area residents from hazards posed by the RA.

4. Contingency Plans

In accordance with the RD and RA sections of the Administrative Order, Respondents shall submit a Construction Contingency Plan and an O&M Contingency Plan for actions to be taken in the event any action or occurrence during the performance of the Work causes a release or threatens to cause a release of hazardous substances or waste material from the Site creating an emergency situation that may present an immediate threat to public health or welfare or the environment. The O&M Contingency Plan shall specifically address actions to be taken if any portion of the remedy malfunctions or fails, causing a threat of release or release of COCs or Waste Materials from the Site that constitutes an emergency situation or presents an immediate threat to public health or welfare or the environment.

C. OU-5 Project Work Plan

Respondents shall submit a Project Work Plan to the Agencies for review in accordance with the schedule contained in Section VI (Schedule for Major Deliverables and Other Tasks) contained in this SOW. The Project Work Plan shall describe the management strategy, and shall also include a step-by-step plan for completing the design and construction of the RA and for attaining and maintaining all requirements, including Performance Standards, identified in the ROD. The Project Work Plan must be approved by EPA and submitted in accordance with the schedule contained in the Work to Be Performed section of the Administrative Order.

As detailed in Attachment E, the Project Work Plan shall include:

- Updated project description
- Description of the responsibility and authority of all organizations and key personnel involved with the RA
- Updated schedule and meetings
- Contracting strategy

- Plans for satisfying all permitting requirements
- Roles for design, construction, sampling, and operation of the RA
- Identification of any concerns about the quantity, quality, completeness, or usability of data upon which the design will be based
- Description of planned community relations activities to be conducted during RD or RA
- Updates to the Project Work Plan and periodic reporting to the agencies

The Project Work Plan shall address communication with interested parties, schedule, and coordination necessary to ensure achievement of the remedy Performance Standards.

D. Remedial Design

Respondents shall prepare an RD consisting of a series of GETs to extract and treat groundwater to meet all Performance Standards set forth in the ROD and this SOW. The RD shall assess the number of, and siting for, existing and proposed treatment facilities and the separation of treatment streams. Additional mass removal shall be conducted using groundwater extraction and treatment of the aquifer close to the main sources of the contamination upgradient of the OU-5 zones, together with service connections and any needed additional treatment capacity.

The groundwater treatment process shall meet the federal and state air regulations identified as Applicable or Relevant and Appropriate in the ROD (Attachment D of this SOW). If after the treatment systems are constructed, Respondents develop, sell, or lease their property which is within or directly adjacent to OU-5 (including the IRCTS), and within the area for which current federal and state air regulations require risk assessment, Respondents shall make any necessary modifications to the on-property treatment components to comply with the current air emission regulations regarding risk (such as modifications necessary due to increased population density and proximity).

RD activities shall include the preparation of clear and comprehensive design documents, construction plans and specifications, and other design activities needed to implement the Work and satisfy Performance Standards set forth in the ROD and this SOW. Plans for each specific groundwater zone may be submitted as they are completed. If individual zone plans are submitted, they shall subsequently be integrated into a complete OU-5 design document. All plans and specifications shall be developed in accordance with relevant portions of the latest revision of EPA's Superfund Remedial Design/Remedial Action Handbook (EPA 540/R-95/059), and in accordance with the schedule set forth in Section VI (Schedule for Major Deliverables and Other Tasks) of this SOW.

1. Preliminary Remedial Design

In accordance with the Remedial Design section of the Administrative Order, Respondents shall submit a Preliminary RD for review by the Agencies in accordance with the schedule contained in Section VI (Schedule for Major Deliverables and Other Tasks) of this SOW. EPA's approval is required before proceeding with further design work, unless EPA agrees otherwise. Unless modified by EPA, the Preliminary Design submittal shall include, at a minimum, the following:

- Results of treatability studies, if conducted
- Results of additional field sampling, if conducted
- Methodology and results of the effectiveness evaluation conducted on existing system components
- A detailed Design Basis Report that presents and justifies the concepts, assumptions, standards, and preliminary interpretations and calculations used in the design. The Design Basis Report shall include:
  - Volume or flow rate of water, brine, air, sludge, and other media requiring treatment or disposal;
  - A summary of water-quality or other data to be used during design, along with an analysis of whether the data confirm assumptions, recommendations, or conclusions made to date for OU-5;
  - Assumed influent quality over the design life of the treatment systems, with a description of the methodology used to develop the influent quality estimate (including discussion of the likelihood and magnitude of short-term and long-term changes in influent concentrations);
  - An explanation of how Performance Standards of this SOW for each layer of the aquifer will be met;
  - Discussion of any proposed or anticipated federal or state drinking water or ambient water quality standards that would impact the design;
  - Filtration, disinfection, corrosion control, or other treatment requirements in addition to removal of COCs;
  - Treatment technologies and/or treatment trains (for all media and by-products) and initial treatment process flow diagrams;
  - Preliminary sizing of treatment systems and other RA components;
  - Expected removal capacity of the treatment facilities for all groundwater COCs;
  - Delivery locations, rates, and pressures for the treated groundwater, and other conveyance system assumptions for discharging treated groundwater for water supplies, including siting of systems;

- Assessment of impact of the remedy on groundwater levels and measures for minimization of impact;
- The degree of automation, planned level of operator oversight and emergency notification;
- System control strategy, including the level of reliability (analysis of life cycle service and main component replacement times), redundancy, or specific damage prevention features needed in each major component of the RA to respond to seismic events, power outages, equipment failure, system maintenance, operator error, or deviations from design assumptions;
- Listing and discussion of siting criteria for new extraction wells, treatment facilities, pipelines, and other facilities, along with preliminary locations and alignments; and
- Estimate of the distance from each proposed extraction location to the location assumed in computer model simulations that were completed in support of the OU-5 containment RA. Outline computer modeling activities to achieve model calibration after monitoring wells are installed and to verify the effectiveness of the actual extraction well locations.

- Preliminary plans, drawings and sketches, and specifications of groundwater extraction, treatment, conveyance, and monitoring systems.
- Project delivery strategy
- A preliminary construction schedule for construction and implementation of the RA which identifies timing for initiation and completion of all critical path tasks.
- An updated list and copies of permits, any regulatory Agency's approval in addition to those of EPA, Memoranda of Understanding, access or use agreements, easements, leases, and properties developed or acquired to date; copies of permits, approvals, and agreements not previously supplied to the Agencies; and activities and schedules for obtaining outstanding items required before start of construction (e.g., for use of existing facilities or disposition of the treated water).
- SAPs in accordance with the Quality Assurance, Sampling, and Data Analysis section of the Administrative Order, and Section V(B)(1) (Sampling and Analysis Plans) of this SOW.
- CQAP in accordance with the Remedial Design section of the Administrative Order and Section V(B)(2) (Construction Quality Assurance Plan) of this SOW.
- HSPs in accordance with the Remedial Design and Remedial Action sections of the Administrative Order, and Section V(B)(3) (Health and Safety Plans) of this SOW.
- Contingency Plans in accordance with Section V(B)(4) (Contingency Plans) of this SOW.

2. Intermediate/Final Remedial Design

In accordance with the Remedial Design section of the Administrative Order, Respondents shall submit the Intermediate RD when the design effort is complete in accordance with the approved schedule contained in Section VI (Schedule for Major Deliverables and Other Tasks) of this SOW. The Intermediate Design shall fully address all Agencies' comments provided by EPA on the Preliminary Design, and if not previously addressed, be accompanied by a memorandum indicating how the comments were incorporated into the Intermediate Design. The Intermediate Design documents shall be certified by a Professional Engineer registered in the State of California.

The Intermediate RD shall serve as the Final RD if the Agencies have no further comments and EPA provides its approval. The Intermediate RD submittals shall include a capital and O&M cost estimate; reproducible drawings and specifications; and a complete set of construction drawings in full and one-half size reduction. The Final Design submittal shall include, at a minimum, the following: (1) final plans and specifications; (2) an O&M Plan; (3) the Field Sampling Plan (directed at measuring progress towards meeting performance standards and implemented in accordance with the approved RD Quality Assurance Project Plan (QAPP); and the (4) CQAP and (5) Construction Contingency Plan as described in Section V(B). The Final RD should also include a schedule for completion of construction, including inspection certifications to confirm that the Construction Criteria of this SOW are met.

E. Remedial Action

As approved by EPA, Respondents shall install, operate, maintain, and augment as necessary the GETs, which shall be a network of wells designed to completely contain Contaminated Groundwater and to remove COCs from the Contaminated Groundwater plume in all layers of the aquifer in the four zones of OU-5. The extraction, treatment, operation, and maintenance of groundwater treatment systems shall comply with the additional requirements listed below.

- Under all anticipated operating conditions, the GETs and their components shall be designed, operated, and maintained to reduce the concentrations of COC in the aquifer to below the containment levels set forth in Attachment B of this SOW. The groundwater extracted to achieve containment shall be remediated to the standards necessary for its reuse. On-Site surface water discharge shall meet the most stringent condition set forth in either Attachment B or Attachment C of this SOW as described in Section V(A) (Compliance with Performance Standards) of this SOW.
- The GETs shall comply with Attachment D of this SOW.

- Extraction, treatment, and monitoring systems shall not cause the discharge of material that is odorous or causes injury, nuisance, or annoyance to the public. GETs shall also comply with applicable noise ordinances.
- Respondents shall install and operate a monitoring program approved by EPA to evaluate and ensure that construction and implementation of the RD complies with approved plans, design documents, and Performance Standards set forth in this SOW.
- Design, construction, and destruction of extraction and monitoring wells after the effective date of this order shall comply with the substantive portions of the State Water Well Standards contained in Bulletin 74-90 and any subsequent revision thereto.
- The GETs shall be maintained in accordance with good engineering practices with adequate spare parts to ensure minimal service outages. Wellhead treatment or portable units shall have a provision for system replacement to prevent outages exceeding one week unless otherwise agreed to in writing by EPA.
- Respondents shall design the extraction wells and GETs to be capable of pumping and treating sufficient quantities of groundwater to adequately contain and extract the entire Contaminated Groundwater in all layers of the aquifer.

Respondents may submit a request for review by the Agencies and EPA's approval to terminate the pumping of extraction wells. Permanent or temporary termination of any portion of the GETs, including extraction wells designed for mass removal, can occur only at the written direction of EPA. The demonstration that data quality objectives have been achieved shall consist of at least three years of consecutive semi-annual monitoring during which none of the COCs exceed any Performance Standards of this SOW in any of the wells in the monitoring network. Monitoring shall be conducted pursuant to the SAP developed for OU-5.

Respondents shall demonstrate performance compliance through the deliverable documents acceptable to EPA as specified in Section VI (Schedule for Major Deliverables and Other Tasks) of this SOW. The RA shall provide sufficient vertical and horizontal hydraulic control in all layers of the aquifer to contain the groundwater with concentrations of COCs greater than the containment levels set forth in Attachment B of this SOW, as determined using the analytical methods approved by EPA. Respondents shall also provide documentation acceptable to the Agencies that the extraction wells will operate in a manner that ensures compliance with the Performance Standards.

In accordance with Section V(B) (Supporting Plans and Deliverables) and Section VI (Schedule for Major Deliverables and Other Tasks) of this SOW, Respondents shall submit to the Agencies for review a Construction SAP with Field Sampling Plan and QAPP; CQAP; Remedial Action HSP; and Construction Contingency Plan.

Unless otherwise approved by EPA, Respondents shall not begin any phase of the construction until after EPA has approved their Final RD, Construction Contingency Plan, and Construction SAP. Field changes to the RA, as set forth in the Project Work Plan (Attachment E) and the Final RD, shall not be undertaken without review by the Agencies and EPA's approval. All Work on the RA shall be documented in enough detail to produce as-built construction drawings after the RA is complete. Review by the Agencies and/or EPA's approval of submittals does not guarantee that the RA, when constructed, will meet the Performance Standards of this SOW.

1. Remedial Action Work Plan

Respondents shall submit a Remedial Action Work Plan to implement the approved sections of RD. The RA Work Plan shall include methodologies, plans and schedules for completion of at least the following: (1) selection of the remedial action contractor; (2) implementation of the CQAP; (3) development and submission of the groundwater monitoring plan (GMP); (4) identification of and satisfactory compliance with applicable permitting requirements; (5) implementation of the O&M Plan; (6) implementation of the Contingency Plan; and (7) development and submission of the Performance Standards assessment plan. The RA Work Plan shall also include a schedule for implementing all remedial action tasks identified in the SOW and shall identify the initial formulation of Remedial Action Project Team (including the Supervising Contractor). If further design is required for any portion of the groundwater Remedy, EPA may specifically request an addendum to the RA Work Plan.

2. Remedial Action Construction

Respondents shall implement the RA as detailed in the approved Project Work Plan, RA Work Plan (as updated), and approved Final Design. Respondents shall notify EPA within ten (10) days after Respondents conclude that the Remedial Action (or a discrete portion of the RA) has been fully performed and construction is complete.

3. Pre-Certification Inspection

A Pre-Certification Inspection shall be conducted by Respondents and EPA in accordance with the schedule contained in Section VI (Schedule for Major Deliverables and Other Tasks) of this SOW after Respondents complete construction and have commenced operation of the RA, or a discrete portion of the RA. If a Pre-Certification Inspection is held for a portion of the RA, one or more additional inspections shall be conducted so that the entire RA shall have been inspected. The objective of the inspection is to allow EPA to determine whether construction is complete and the RA (or inspected portion) is operational and functional.

4. Remedial Action Construction Completion Report

The pre-certification inspection shall be followed by a written report submitted within thirty (30) days of the inspection by a registered professional engineer and the Respondents' Project Coordinator certifying that the Remedial Action construction has been completed in full satisfaction of the requirements of the Administrative Order. The report shall include the following:

1. A statement by a registered Professional Engineer and the Aerojet Project Coordinator that the construction of the Remedial Action has been completed in accordance with the RA Work Plan submitted under the SOW.

2. Synopsis of the work defined in the SOW (a listing of the groundwater treatment systems and extraction wells for OU-5).

3. A brief summary of the results of operational and performance monitoring completed to date.

4. The following statement by the Aerojet Project Coordinator Certifying that the submission is true, accurate and complete:

"To the best of our knowledge, after thorough investigation, we certify that the information contained in or accompanying this submission is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

5. EPA Construction Inspection

Within 60 days of submittal of the Remedial Action Construction Completion Report, EPA and Respondents shall conduct a pre-final construction inspection of the RA, or a portion of the RA. Respondents shall provide final record drawings to EPA at least ten (10) days prior to this inspection/s.

The objective of the inspection/s is to determine whether construction is complete and the RA (or the inspected portion) is operational and functional. Any outstanding construction items discovered during the inspection shall be identified and noted on a punch list. Respondents shall certify that the equipment is effectively meeting the purpose and intent of the specifications. Respondents shall retest where deficiencies are revealed. EPA will prepare a Pre-final Construction Inspection Report which outlines the outstanding construction items, actions required to resolve the items, completion date for the items, and an anticipated date for a Final Construction Inspection. The Pre-final Construction Inspection Report can be in the form of a punch list or letter.

If required by EPA, a Final Construction Inspection shall be conducted after completion of any work identified in the Pre-final Construction Inspection Report in

accordance with the schedule contained in Section VI (Schedule for Major Deliverables and Other Tasks) of this SOW. Respondents shall coordinate with EPA to schedule any Final Construction Inspection. The Final Construction Inspection shall consist of a walk-through inspection by EPA and Respondents. The Pre-final Construction Inspection Report shall be used as a checklist, with the Final Construction Inspection focusing on the outstanding construction items identified in the Pre-final Construction Inspection. Respondents shall confirm that outstanding items have been resolved for all items, including any items which may be found after the checklist has been developed.

Any outstanding construction items discovered by Respondents or EPA during the Final Construction Inspection to still require correction, whether or not identified on the Pre-final Construction Inspection, shall be identified and noted on a punch list. If any items are still unresolved, the inspection shall be considered to be a Pre-final Construction Inspection that may necessitate a subsequent Final Construction Inspection.

6. Interim Remedial Action Report

As specified in the approved schedule included in Section VI (Schedule for Major Deliverables and Other Tasks) of this SOW, after EPA determines that construction is completed on the entire RA and the systems are operational and functional as intended, Respondents shall submit an Interim Remedial Action Report. In the Report, a registered Professional Engineer and Respondents' Project Coordinator shall state that the construction of the RA has been completed in accordance with the RA Work Plan submitted under this SOW. The written Report shall provide a synopsis of the Work defined in this SOW, describe deviations from the RA Work Plan, include reproducible and PDF electronic file versions of as-built drawings signed and stamped by a Professional Engineer, provide actual costs of the RA, O&M to date, and a summary of the results of operational and performance monitoring completed to date. The Report shall contain the following statement, signed by a responsible corporate official of Respondents or Respondents' Project Coordinator:

"To the best of our knowledge, after thorough investigation, we certify that the information contained in or accompanying this submission is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

F. Groundwater Monitoring

The Site-wide GMP shall be updated and revised to include information for OU-5. Respondents will include sections in the updated Site-wide GMP that discuss content

appropriate for a Compliance and Sentinel Well Network Plan, Compliance and Sentinel Well Installation Complete Report, Compliance Monitoring Plan, and General Monitoring Plan for OU-5, as these individual plans and reports are not required for OU-5. In addition, the updated plan will include groundwater monitoring related to Contaminated Soil Areas with waste left in place (i.e., Area C41 and Areas 32D, 34D, 35D, and 38D, as described in the *Unilateral Administrative Order for the Performance of Remedial Design and Final Remedial Action for Soil* of the Perimeter Groundwater Operable Unit (OU-5), Aerojet Superfund Site, Sacramento County, California. The requirements for the Compliance and Sentinel Well Network Plan, Compliance and Sentinel Well Installation Complete Report, Compliance Monitoring Plan, and General Monitoring Plan stipulated in the SOW for OU-3 (Section V(A), Section V(C), Section V(H), and Section V(J), respectively) shall also apply to OU-5 and be included in the Site-wide GMP. The GMP shall include the rationale for selecting the monitoring wells to be included in the sampling events. The updated and revised plan shall be submitted for review by the Agencies and EPA's approval in accordance with the schedule contained in Section VI (Schedule for Major Deliverables and Other Tasks) of this SOW.

Respondents shall conduct sampling at the compliance monitoring wells in accordance with the approved GMP to ensure compliance with the applicable Performance Standards. Results shall be reported in the Quarterly Compliance Monitoring Reports as discussed in Section V(J) (Quarterly Compliance Monitoring Reports) of this SOW. Contaminant concentrations at the compliance monitoring wells and potentiometric measurements from appropriate monitoring well pairs that help to demonstrate capture will be the primary criteria for evaluating compliance.

In addition to the installation of compliance and sentinel monitoring wells, Respondents shall also install additional wells as needed to:

- further define the hydrostratigraphy, hydraulic conductivities, and to define lateral and vertical hydraulic gradients;
- further define the degree of hydraulic connection between layers of the aquifer; and
- further define the extent of contamination that requires control or capture to meet the Performance Standards of the ROD.

Additional extraction and monitoring wells may be necessary based on the OU-5 effectiveness evaluation. Respondents shall prepare and submit drilling permits for new wells to Sacramento County for review and approval prior to drilling.

G. Operation and Maintenance

O&M shall be performed in accordance with the approved O&M Plan and Manual.

1. Operation and Maintenance Plan

An O&M Plan is required for the groundwater remedy, in accordance with the Remedial Design and Remedial Action sections of the Administrative Order. Respondents shall submit the plan to EPA for review and approval in accordance with the schedule contained in Section VI (Schedule for Major Deliverables and Other Tasks) of this SOW. The O&M Plan shall include, at a minimum, a schedule for activities and information regarding assignment of duties.

2. Operation and Maintenance Manual

Respondents shall prepare a draft O&M Manual for the entire OU-5 groundwater remedy, or for each GET included in the remedy, during the design period. A final O&M Manual shall be prepared after the final construction inspection to incorporate manufacturer/vendor information and any design modifications implemented during the RA in accordance with the schedule contained in Section VI (Schedule for Major Deliverables and Other Tasks) of this SOW. The O&M Manual shall be submitted for Agencies' reviews and EPA's approval. The O&M Manual shall include all necessary O&M information for the operating personnel, and shall provide for the following:

- System description;
- Startup and shutdown procedures;
- Description and schedule of normal O&M tasks, including equipment and material requirements, anticipated equipment replacement for significant components, availability of spare parts, provisions for remote monitoring and control, operator training and certification requirements, staffing needs, and related requirements;
- Indicators of system performance and/or maintenance (e.g., parameters to be monitored to determine timing for replacement of any items consumed during the remediation process);
- Any planned variation in groundwater extraction rate, including whether each extraction well is to be operated at a constant or variable flow rate, and a description of the magnitude and timing of any expected variation;
- Record keeping and reporting requirements, including operating and inspection logs, maintenance records, and periodic reports; and

- Description and analysis of potential operating problems (e.g., equipment failure, higher than expected contaminant concentrations), including emergency operating and response activities (noncompliance diversion or shutdown), failure notification procedures and relevant health and safety information.

H. Obligation to Perform Further Response Actions and Submission of Plans

As outlined in the Failure to Obtain Performance Standards and Additional Response Action sections of the Administrative Order, if EPA determines that Performance Standards have not been met or that further response actions are required to protect human health and the environment, Respondents shall submit a work plan within thirty (30) days after receiving EPA's notice that additional action is required. Respondents shall implement the plan approved by EPA in accordance with the provisions of the Administrative Order.

I. Remedial Performance Effectiveness Evaluation

As described in the Work To Be Performed section of the Administrative Order, "EPA may review the Site to assure that the Work performed pursuant to this Order adequately protects human health and the environment. Until such time as EPA certifies completion of the Work, Respondent(s) shall conduct the requisite studies, investigations, or other response actions as determined necessary by EPA in order to permit EPA to conduct the review under Section 121(c) of CERCLA. As a result of any review performed under this paragraph, Respondent(s) may be required to perform additional work or to modify work previously performed."

The Respondents shall conduct effectiveness evaluations of the interim groundwater remedy for OU-5 to ensure that the remedy is implemented in the most effective and efficient manner and compliant with the RAOs outlined in Section II (Remedial Action Objectives). The effectiveness evaluations shall include a thorough review of the containment of COCs by the OU-5 remedy and shall encompass the topics covered in both the EPA Capture Zone Guidance (EPA 2008) and the U.S. Army Corps of Engineers Remedial Systems Evaluation worksheets appropriate to the RD implemented (USACE 2011). After the data have been collated and reviewed, and a preliminary analysis performed, a meeting shall be held with the Agencies to discuss the findings of the effectiveness evaluation and recommendations for improvements to the implementation of the remedy.

These evaluations shall be conducted on an annual basis for the first four years after the RD is approved by EPA, because a number of GETs in OU-5 have been operating for several years, so portions of the probable RD have already been implemented. After this time, the frequency of the effectiveness evaluations shall be determined by EPA based on the quality of the remedial performance. The Respondents may expand the scope of the OU-3 effectiveness evaluation, described in the Findings of Fact section of the OU-3 Administrative Order, to include the evaluation of OU-5, or may conduct a separate evaluation for each operable unit, with EPA approval.

Remedial Performance Evaluation Reports shall be provided in accordance with the schedule contained in Section VI (Schedule for Major Deliverables and Other Tasks) of this SOW, and shall be coordinated with the schedule for the performance evaluation reports for OU-3. The annual Performance Evaluation Reports shall be comprehensive and contain sufficient information for an assessment of whether the containment is effective or if changes, such as alteration of pumping rates or additional wells, should be made to improve performance of the remedy.

Each report shall include summaries of compliance monitoring activities from the previous reporting period including summaries from Section V(J) (Quarterly Compliance Monitoring Reports) of this SOW; updated potentiometric maps with postings of measured hydraulic heads; field data used to demonstrate hydraulic containment; contaminant trend plots for monitoring and sentinel wells; estimates of plume containment using log-linear kriging methods; maps illustrating contaminant plume isocontours and the interpreted extent of contamination; appropriate groundwater modeling results required to demonstrate compliance with this SOW, including a detailed description and explanation of improvements made to the groundwater flow model in the preceding year such as geologic framework and model calibration; summaries of relevant operating and field data, including mass removal for groundwater; any preliminary calculations and supporting data used to evaluate compliance; descriptions of the nature of, duration of, and response to any noncompliance; and any other requirements outlined in Section V(F) (Groundwater Monitoring) of this SOW.

Initially, at a minimum, individual contaminant contour maps shall be prepared indicating the concentrations and extent of perchlorate, NDMA, and trichloroethylene (TCE) in each layer of the aquifer. Contaminant mass removal shall be presented in tables. Additional contaminant isocontour maps shall be prepared if requested by the Agencies to indicate the extent of migration and concentration levels of any or all of the other seventeen (17) COCs. Assumptions made in averaging, excluding, truncating, or otherwise selecting or manipulating the data to be used in preparing the contour maps shall be clearly stated.

J. Quarterly Compliance Monitoring Reports

The Quarterly Compliance Monitoring Reports that are required for OU-3 may be modified to include the information for OU-5 rather than producing two separate documents. Electronic submittal of these reports is required. The Quarterly Compliance Monitoring Reports shall include: measured contaminant concentrations at compliance monitoring wells; charts showing contaminant concentrations *versus* time at compliance monitoring wells; assessments and statements as to whether Performance Standards of this SOW are being satisfied at compliance monitoring wells; predictions, if appropriate, of possible future occurrences of noncompliance; relevant preliminary calculations and supporting data used to evaluate compliance; and any other relevant requirements outlined in the GMP.

The Quarterly Compliance Monitoring Reports shall be in accordance with the schedule contained in Section VI (Schedule for Major Deliverables and Other Tasks) of this SOW. The reports shall be based on data obtained using the O&M SAP for OU-3 and OU-5. The fourth quarter report shall provide a yearly summary with trends for groundwater remediation progress and provide recommendations for system modifications/adjustments. The Quarterly Compliance Monitoring Reports shall include analyses for all the COCs contained in Attachment B of this SOW, unless EPA directs the addition or deletion of COCs. The Quarterly Compliance Monitoring Reports are to include plots, in each layer of the aquifer, for perchlorate, NDMA, TCE, and any other COC(s) requested by EPA. At a minimum, until concentrations are within an order of magnitude of the containment levels, contaminant plots shall show at least four concentration contours for each contaminant agreed to by EPA, one of which will be the containment level set forth in Attachment B of this SOW.

K. Groundwater Management Zone Plan

Respondents shall create a GMZP for OU-5 to minimize adverse effect on groundwater levels and prevent interference with the remedy. The GMZP shall be submitted for review by the Agencies and EPA's approval in accordance with the schedule contained in Section VI (Schedule for Major Deliverables and Other Tasks) of this SOW. The GMZP shall be retained or integrated with another document, depending on the results of effectiveness evaluations. Relevant information for OU-5 may be integrated into the existing GMZP prepared for OU-3, or a separate plan may be prepared with EPA approval.

The GMZP shall model and assess in each affected aquifer layer any operational restrictions on existing water supply wells which may be required to prevent any adverse effect on the sphere of influence of the remedy extraction wells and to minimize adverse effects to groundwater levels. The GMZP shall also establish the areas (by aquifer layer) where new water supply wells shall not be installed to prevent adverse effect on the remedy. The GMZP shall be developed as part of the RA Work Plan and implemented as part of the Work Plan. Respondents shall coordinate with water purveyors and local regulatory Agencies to develop an assessment of total use impact on the aquifer when generating the GMZP.

L. Institutional Controls

Respondents shall execute the following ICs for OU-5 groundwater as further defined and described below:

- Respondents shall record with the County Recorder and implement a Declaration of Covenants and Environmental Restrictions Related to Groundwater, restricting access to Contaminated Groundwater from land within OU-5 for those parcels owned by the Respondents.
- Respondents shall provide annual public notification of OU-5 Contaminated Groundwater.

1. Declaration of Covenants

Within thirty (30) days of a written request from EPA or thirty (30) days prior to the transfer of property within OU-5 that is not subject to existing EPA-approved Institutional Controls, whichever is the earlier date, Respondents shall submit for review by the Agencies and then record after obtaining EPA's approval a Declaration of Covenants and Environmental Restrictions Related to Groundwater for land to be developed within OU-5. The Declaration of Covenants and Environmental Restrictions will include the following restrictions: a) No extraction of groundwater unless required by the RA; b) No recharge of groundwater or operation of injection wells unless and until permitted in writing by EPA and CVRWQCB; c) No extraction of groundwater that is encountered during excavation or construction for more than 24 hours, unless there is a sustained rain event or an extended period of groundwater extraction is expressly permitted in writing by the CVRWQCB; and d) Agencies' rights of access. The Declaration of Covenants Related to Groundwater shall be substantially in the form of the covenant attached to this SOW as Attachment F, subject to review, approval, and further modification by EPA.

These restrictions shall be implemented pursuant to California Civil Code Section 1471(c) whereby Respondents covenant to impose these restrictions. The Declaration of Covenants will be binding on the Respondents' successors and assigns as covenants running with the land. The Declaration of Covenants shall include a designation that the State of California is a "covenantee" and, that EPA is a "covenantee" or, alternatively, subject to EPA's discretion, a "third party beneficiary," allowing EPA, without acquiring an interest in real property, to maintain the right to enforce the Institutional Controls or obtain access pursuant to the Institutional Control. Respondents shall record with the County Recorder the Declaration of Covenants. Respondents shall give written notice of the contaminated groundwater to each buyer, lessee, renter and mortgagee of any of these lands and every lease, deed, mortgage or instrument conveying any part of these lands shall expressly provide that it is subject to this Declaration of Covenants.

Respondents shall duly execute this IC for OU-5 groundwater and submit it in accordance with the schedule contained in Section VI (Schedule for Major Deliverables and Other Tasks) of this SOW. Respondents shall provide the Agencies each year with an Annual ICs Status Report detailing the status of all ICs for OU-5. Relevant information for OU-5 may be integrated into the Annual IC Status Report prepared for OU-3 or a separate report may be prepared at the discretion of Respondents.

2. Public Notification

Respondents shall publish an annual Public Notification of Extent of OU-5 Contaminated Groundwater in two local newspapers that provides the location of

information on the OU-5 area of Contaminated Groundwater above the containment levels, the requirement for a permit for any well within OU-5, and the point of contact for a permit. Respondents shall obtain EPA approval of the format. If approved by EPA, Respondents may provide notification to the local community using an electronic information format acceptable to the EPA. This notification may be combined with the notification currently required for OU-3.

M. Certification of All Work Complete Report

As specified in the Remedial Action section in the Administrative Order and the schedule included in Section VI (Schedule for Major Deliverables and Other Tasks) of this SOW, Respondents shall submit a Certification of All Work Complete Report after all phases of the Work (including O&M) under the Administrative Order have been performed for review by the Agencies and EPA's approval. In the Certification of All Work Complete Report, a registered Professional Engineer and Respondents' Project Coordinator shall state that the Work has been completed in full satisfaction of requirements of the Remedial Action section of the Administrative Order. The written report shall provide a synopsis of the Work defined in this SOW, describe deviations from the RA Work Plan, provide actual costs of the RA (and O&M), and provide a summary of the results of operational and performance monitoring that have been completed. The report shall contain the following statement, signed by a responsible corporate official of Respondents or Respondents' Project Coordinator:

"To the best of our knowledge, after thorough investigation, we certify that the information contained in or accompanying this submission is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

The Certification of All Work Complete Report may be combined with that required for OU-3, or may be for OU-5 only, at the discretion of the Respondents and depending on the respective dates of completion of work for the two OUs.

N. Replacement Water Supply

Respondents have been ordered to prepare water replacement contingency plans under the Administrative Order for OU-3. Respondents shall prepare plans for water replacement contingencies in OU-5 consistent with the requirements for OU-3, and shall implement the plans as necessary. The scope of existing plans for OU-3 may be extended to OU-5 groundwater zones as appropriate and necessary.

O. Site Security

Respondents shall fence and otherwise secure all Site remedy components to prevent access by the public to these components and to minimize potential vandalism during the

performance of the RA. Warning signs with a telephone number to call for further information shall be posted along fencing protecting OU-5 components. Security components (fences, signs, locks, etc.) shall be maintained in good condition to perform their function until EPA agrees they are no longer required. Security components shall be installed as construction progresses.

P. Dust Control

Respondents shall ensure that no visible air emissions occur at or beyond facility fence lines at all times during the performance of the RA. Respondents shall implement dust control measures which are submitted for review by the Agencies and approved by EPA. Respondents shall take corrective measures to comply with local ordinances and regulations.

Q. Off-Site Rule Disposal Notification

Any groundwater discharged to a sewer shall meet the requirements of the Public-Owned Treatment Works (POTW). If wastes from OU-5 treatment facilities are disposed of to other than a POTW, Respondents shall comply with the Off-Site Rule contained in Section 300.440 of the National Contingency Plan for the disposal of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)-generated waste.

In accordance with the Remedial Action section of the Administrative Order, six months prior to disposal of wastes generated by Respondents' CERCLA activities to any off-site facility for disposal, Respondents shall provide EPA and the receiving state, in accordance with federal and state law and California Title 27, disposal notification containing the following: 1) the name of the Site/facility to receive the waste, with address and phone number, 2) quantity and description of the waste, 3) Resource Conservation and Recovery Act classification of the waste with basis for the classification, 4) expected date for shipment off-Site, 5) the regulatory status of the receiving site (i.e., Subtitle C or D permitted), 6) method of transportation, 7) confirmation that the site is approved under the Off-Site Rule, and 8) the date of the last EPA inspection.

R. Modification of SOW or Related Work Plans

If EPA determines that it is necessary to modify the work specified in the SOW and/or in work plans developed pursuant to the SOW to achieve and maintain the Performance Standards or to carry out and maintain the effectiveness of the remedy set forth in the ROD, and such modification is consistent with the scope of the remedy set forth in the ROD, then EPA may issue such modification in writing and shall notify Settling Defendants of such modification. If Settling Defendants object to the modification they may, within 30 days after EPA's notification, seek dispute resolution under the Record Review paragraph in the Administrative Order.

S. Remedy Review

As required by the EPA Periodic Review section of the Administrative Order, over the remedy period Respondents shall support EPA by providing technical and documentation support for periodic remedy reviews in accordance with Comprehensive Five-Year Review Guidance, EPA OSWER 9355.7-03B-P (June 2001 or latest revision). Respondents shall perform any necessary studies and investigations required by EPA to assess remedy protectiveness. The remedy will be reviewed at least every five years or earlier, if deemed appropriate by EPA.

VI. Schedule for Major Deliverables and Other Tasks

ACTIVITY[1]	DUE DATE (Unless Otherwise Approved by EPA)
Unilateral Administrative Order for OU-5 Groundwater Effective Date	
PLANNING DOCUMENTS/COORDINATION	
Notice of Intent to Comply	On or before September 26, 2011.
Notification of Project Manager/ Qualifications	Ten (10) days after Effective Date of the Unilateral Administrative Order for OU-5 Groundwater If candidate disapproved by EPA, within thirty (30) days of EPA's notification of disapproval submit list of candidates/qualifications Twenty-one (21) days after EPA's letter regarding acceptable candidates, notify EPA of the Project Manger selected from EPA's approved candidates on list
Site-wide Groundwater Monitoring Plan	No later than one year after Effective Date of the Unilateral Administrative Order for OU-5 Groundwater. Updated annually. If required, a revised plan is due fourteen (14) days after receipt of EPA's comments
OU-5 Project Work Plan	Thirty (30) days after Effective Date of the Unilateral Administrative Order for OU-5 Groundwater If required, a revised plan is due fourteen (14) days after receipt of EPA's comments
Monthly Progress Report/s required by Section XV of the Unilateral Administrative Order for OU-5 Soil and Attachment E (Project Work Plan Section 1. Updated Project Description) to this SOW	On or before the Fifteenth (15th) day of each month following Effective Date of the Unilateral Administrative Order for OU-5 Groundwater until EPA notifies Respondents of Certification of Completion
Groundwater Management Zone Plan	One-hundred-eighty (180) days after Effective Date of the Unilateral Administrative Order for OU-5 Groundwater If required, a revised plan is due fourteen (14) days after receipt of EPA's comments
Annual IC Status Report	By end of January each year until EPA approves removal of ICs

ACTIVITY[1]	DUE DATE (Unless Otherwise Approved by EPA)
Failure to Attain Performance Standards Work Plan required by Paragraph 76 of the Unilateral Administrative Order for OU-5 Soil	Thirty (30) days after notification letter by EPA
Additional Response Actions Work Plan required by Section XII of the Unilateral Administrative Order for OU-5 Soil and Section V(H) (Obligation to Perform Further Response Actions and Submission of Plans) of this SOW	Thirty (30) days after notification letter by EPA
REMEDIAL DESIGN	
Notification of Supervising Contractor Selection for EPA's review and revised Quality Management Plan (QMP) submission – revise existing QMP to include OU-5	Ten (10) days after Effective Date of the Unilateral Administrative Order for OU-5 Groundwater If required, a revised contractor list is due thirty (30) days after receipt of EPA's comments
REMEDIAL DESIGN (Continued)	
Preliminary Remedial Design Submittal with Design Basis Report and Construction Contingency Plan (required by order)	Within ninety (90) days of EPA's approval of Project Work Plan if a phased approach to the remedy is used; otherwise, within one-hundred-eighty (180) days If required, a revised plan is due fourteen (14) days after receipt of EPA's comments
Intermediate Remedial Design Submittal – addresses agency comments on Remedial Design	Ninety (90) days after EPA's approval of Preliminary Design Submittal
Remedial Action Work Plan	Within 30 days after EPA approval of the Final Design. Update, as required
Final Design Submittal (if needed)	If required by EPA, thirty (30) days after EPA's comments on the Intermediate Design Submittal
REMEDIAL ACTION	
List of Remedial Action Contractors/Titles/Qualifications	Ten (10) days after EPA approves the Remedial Design (Intermediate or Final)
Contractor Solicitation Documents	Five (5) days after publishing solicitation documents
Pre-Certification Inspection for Completion of the Remedial Action	Thirty (30) days after Remedial Action construction is completed and operation has commenced
Remedial Action Construction Completion Report	Thirty (30) days after Pre-Certification Inspection
Interim Remedial Action Report (with certification)	Draft due two hundred seventy (270) days after Pre-Certification Inspection If required, a revised Report is due thirty (30) days after receipt of EPA's comments
Compliance Action Plan	Within fourteen (14) days of receipt of compliance monitoring data indicating noncompliance If required, a revised report is due fourteen (14) days after receipt of EPA's comments

ACTIVITY[1]	DUE DATE (Unless Otherwise Approved by EPA)
OPERATION AND MAINTENANCE	
Operation and Maintenance (O&M) Plan	Draft due sixty (60) days after construction of system. If required, a revised plan is due thirty (30) days after receipt of EPA's comments
O&M Manual	Draft manual must be completed ninety (90) days after EPA's approval of Preliminary Design Submittal but need not be submitted to the Agencies. Prefinal/final manual is due to the Agencies thirty (30) days after the Pre-Certification Inspection. If required by EPA, the final manual revision is due twenty-one (21) days after receipt of EPA's comments.
O&M Contingency Plan as required by Section V(B) (Supporting Plans and Deliverables) of this SOW	Draft plan ninety (90) days after EPA's approval of Preliminary Design Submittal and final plan thirty (30) days after Pre-Certification Inspection
Off-Site Rule Disposal Notification	One-hundred-eighty (180) days prior to any off-site disposal other than a POTW
PERFORMANCE EVALUATION	
Remedial Performance Evaluation Reports	Due annually, four-hundred-fifty (450) days after Remedial Design is approved, for first four years; frequency thereafter to be determined by EPA.
Quarterly Compliance Monitoring Reports	Due quarterly, beginning one-hundred-eighty (180) days after EPA's approval of the O&M SAP submitted as part of Final Design If required, revised plan due fourteen (14) days after receipt of EPA's comments
Direct Potable Reuse Supplemental Monitoring	Two (2) quarters prior to direct water supply discharge and then annually unless modified by EPA
NPDES Permit (Any Off-Aerojet Property Surface Discharge)	Application to CVRWQCB one-hundred-eighty (180) days prior to start of discharge
NPDES Monitoring and Reports	As specified in the National Pollution Discharge Elimination System Permit
Periodic Review (Remedy Protective)	At least every five (5) years unless required earlier by EPA, after submission of the Interim Remedial Action Report per Section 121(c) of CERCLA
INSTITUTIONAL CONTROLS	
Notice and Copy of Property Transfer Documents	Sixty (60) days prior to transfer of any real property, provide notice of transfer to EPA and copies of transfer documents; provide transferee with notice of the Unilateral Administrative Order for OU-5 Groundwater and any ICs, including Declaration of Covenants and Environmental Restrictions for the property to be transferred.
Record Declarations of Covenants and Environmental Restrictions	Record with Official Records of Sacramento County, State of California, within fifteen (15) days of EPA's approval.

ACTIVITY[1]	DUE DATE (Unless Otherwise Approved by EPA)
Public Notification of OU-5 Extent of Contaminated Groundwater	Ninety (90) days after Effective Date of the Unilateral Administrative Order for OU-5 Groundwater, then annually in combination with OU-3 information as a Site-wide notification in format approved by EPA until remedy completion.
SUPPORTING PLANS	
Remedial Design Health and Safety Plan; Sampling and Analysis Plan with Quality Assurance Project Plan and Field Sampling Plan	Remedial Design Health and Safety Plan within 30 days of selection of an approved Project Manager with remaining documents submitted within one-hundred-fifty (150) days of selection of an approved Project Manager
Laboratory protocols	At least thirty (30) days before beginning analysis
Remedial Action Health and Safety Plan; Sampling and Analysis Plan with Quality Assurance Project Plan and Field Sampling Plan; and Construction Quality Assurance Plan	Submit Health and Safety Plan within 30 days after EPA approval of the Final Design Submit other plans as a part of the Intermediate Design
O&M Health and Safety Plan; Sampling and Analysis Plan with Quality Assurance Project Plan and Field Sampling Plan	Submit as a part of the Intermediate Design
CERTIFICATIONS REQUIRED BY SECTIONS IX AND XXIII OF THE ADMINISTRATIVE ORDER	
Certification of All Work Complete Report	Thirty (30) days after the Respondents conclude that all phases of the Work have been fully performed, that the Performance Standards have been attained, and that all O&M activities have been completed
FINANCIAL SECURITY REQUIRED BY SECTION XXIII OF THE ADMINISTRATIVE ORDER	
Financial Security – Performance Guarantee	Within sixty (60) days after Effective Date of the Unilateral Administrative Order for OU-5 Groundwater
CERTIFICATES	
Certification of General Liability and Automobile Liability Insurance Coverage	At least seven (7) days prior to commencing any work at the Site

Notes:

1. Estimated time, in calendar days.

VII. References

The following list, although not comprehensive, provides citations for many of the regulations and guidance documents that apply to the RD/RA process. Respondents shall review these guidance documents (latest edition/revision) and shall use the information provided therein in performing the RD/RA and preparing all deliverables under this SOW.

"A Systematic Approach for Evaluation of Capture Zones at Pump and Treat Systems." U.S. Environmental Protection Agency (EPA), January 2008 (EPA/600/R-08/003).

"Close Out Procedures for National Priorities List Sites," EPA, Office of Emergency and Remedial Response, January 2000 (EPA 540-R-98-016).

"Comprehensive Five-Year Review Guidance," EPA, June 2001 (EPA 540-R-01-007).

"EPA NEIC Policies and Procedures Manual," EPA, May 1978, revised May 1986.

"EPA Requirements for Quality Assurance Project Plans," EPA, November 1999 (EPA QA/R-5, Interim Final).

"Guidance for the Data Quality Objectives Process," EPA, August 2000 (EPA QA/G-4, Final).

"Guidance for Quality Assurance Project Plans," EPA, February 1998 (EPA QA/G-5, Final).

"Guidance on Remedial Actions for Contaminated Ground Water at Superfund Sites," EPA, Office of Emergency and Remedial Response (Draft), OSWER Directive No. 9283.1-2.

"Interim Final Guidance on Oversight of Remedial Designs and Remedial Actions Performed by Potentially Responsible Parties," EPA, Office of Emergency and Remedial Response, OSWER Directive No. 9355.5-01. April 1990 (EPA 540/G-90/001).

"Methods for Monitoring Pump-and-Treat Performance," EPA, Office of Research and Development, June 1994 (EPA 600/R-94/123).

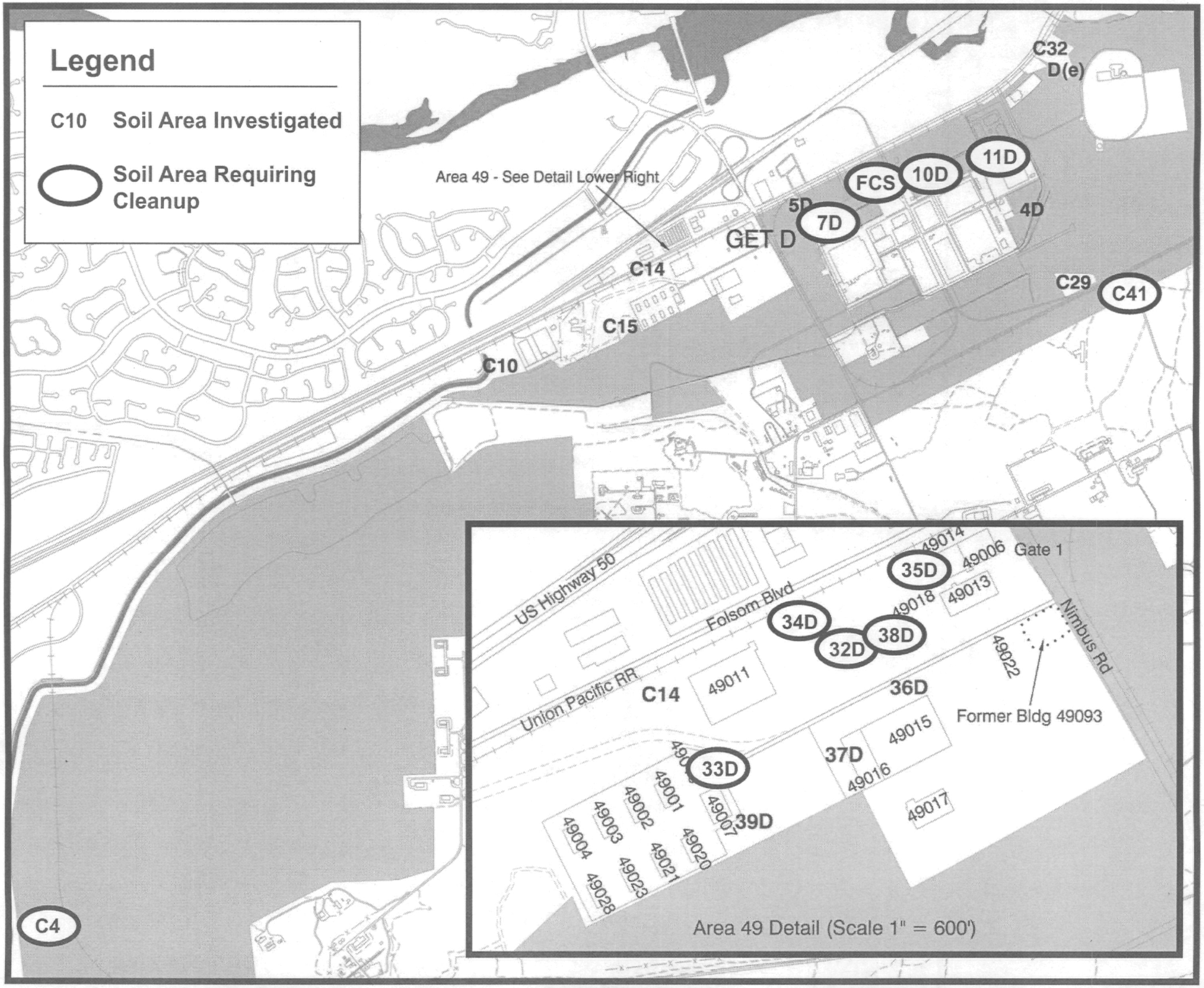
"National Oil and Hazardous Substances Pollution Contingency Plan, Final Rule," 40 CFR Part 300.

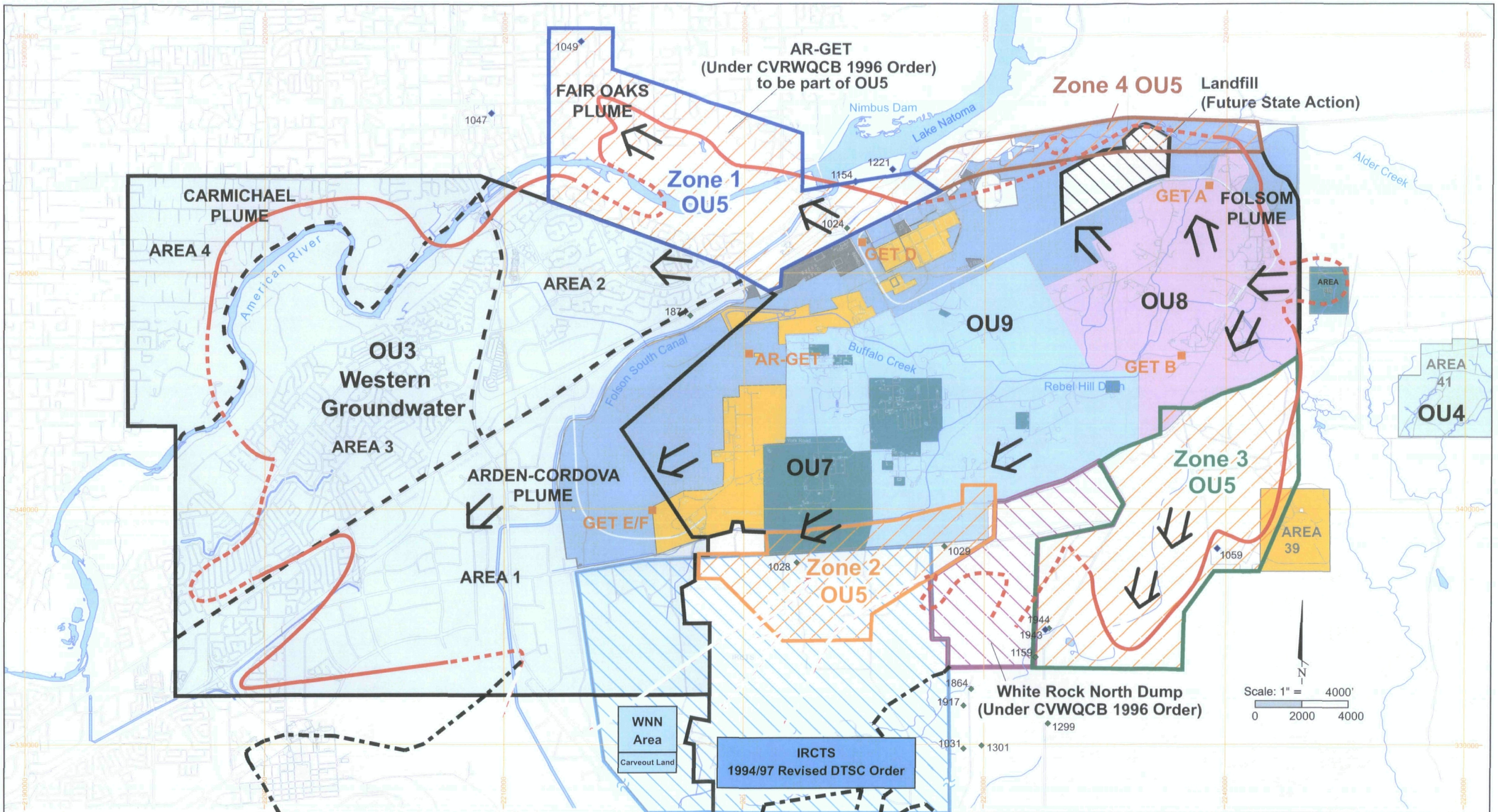
"Preparation of a U.S. EPA Region 9 Field Sampling Plan for Private and State-Lead Superfund Projects," EPA, April 1990 (No. 9QA-06-89).

"Superfund Remedial Design/Remedial Action Handbook," EPA, Office of Emergency and Remedial Response, June 1995 (EPA 540/R-95/059).

U.S. Army Corps of Engineers. 2011. USACE Remediation System Evaluation (RSE) Checklists (http://www.environmental.usace.army.mil/rse_checklist.htm)

ATTACHMENT A
APPROXIMATE EXTENT OF CONTAMINATION AS OF 2006-2008


Legend
C10 Soil Area Investigated
Soil Area Requiring Cleanup
Area 49 - See Detail Lower Right
C32
D(e)
11D
FCS
10D
5D
7D
4D
GET D
C14
C29
C41
C15
C10
C4
US Highway 50
Folsom Blvd
Union Pacific RR
Nimbus Rd
Gate 1
35D
34D
32D
38D
36D
37D
33D
39D
C14
49014
49006
49013
49018
49011
49022
49015
49016
49017
49001
49002
49003
49004
49007
49020
49021
49023
49028
Former Bldg 49093
Area 49 Detail (Scale 1" = 600')



Approximate Extent of Contaminants of Concern with Concentrations Greater than Cleanup Levels
Treatment System Location
General Groundwater Flow Direction
Domestic Well
Water Supply Well
OU3 Remediation Areas 1-4
Note: GET A, B, D and AR are part of OU5.

OU3 - in RD/RA
OU6 - Boundary OU
OU5 - Soil Medium
OU5 - Groundwater
Carveout Lands
IRCTS Composite Plume

Zone 1 - OU5
Zone 2 - OU5
Zone 3 - OU5
Zone 4 - OU5

Cavitt Ranch OU4
Island OU7
Central OU9
Eastern OU8

U.S. EPA REGION IX
AEROJET GENERAL CORP.
SUPERFUND SITE

Composite Plume Map

ATTACHMENT B
CHEMICALS OF CONCERN WITH CONTAINMENT LEVELS

TABLE B-1: GROUNDWATER CHEMICALS OF CONCERN WITH CONTAINMENT LEVELS FOR OU-5
Statement of Work for Remedial Design and Remedial Action, Attachment 2 to the Administrative Order, Perimeter Groundwater Operable Unit (OU-5), Aerojet Superfund Site, Sacramento County, California

Chemicals of Concern in Groundwater	Containment Level (µg/L or ppb)	
Non-Metal Anion		
Perchlorate	6	CA Drinking Water Standard (MCL)
SVOCs		
N-Nitrosodimethylamine	0.003	CA Public Health Goal
VOCs		
Trichloroethene	5	Federal MCL
1,1,2,2-Tetrachloroethane	1	CA MCL
1,1,2-Trichloroethane	5	Federal MCL
1,1-Dichloroethene	6	CA MCL
1,2-Dichloroethane	0.5	CA MCL
cis-1,2-Dichloroethene	6	CA MCL
trans-1,2-Dichloroethene	10	CA MCL
1,4-Dioxane	1	CDPH Notification Level
Bromodichloromethane*	80*	Federal MCL
Carbon tetrachloride	0.5	CA MCL
Chloroform*	80*	Federal MCL
Dibromochloromethane*	80*	Federal MCL
Methylene chloride	5	Federal MCL
Tetrachloroethene	5	Federal MCL
Vinyl chloride	0.5	CA MCL

Notes:

* The Federal MCL establishes a limit of 80 µg/L for the sum of the concentrations of all four major trihalomethanes: chloroform, bromodichloromethane, dibromochloromethane, and bromoform.

µg/L Microgram per liter
CA California
CDPH California Department of Public Health
MCL Maximum Contaminant Level
ppb Part per billion
SVOC Semivolatile organic compound
VOC Volatile organic compound

ATTACHMENT C
EFFLUENT DISCHARGE LIMITATIONS

TABLE C-1: SUBSTANTIVE REQUIREMENTS IN CURRENT (NOVEMBER 2010) NPDES EFFLUENT LIMITATIONS AT AEROJET SITE

Statement of Work for Remedial Design and Remedial Action, Attachment 2 to the Administrative Order, Perimeter Groundwater Operable Unit (OU-5), Aerojet Superfund Site, Sacramento County, California

	Effluent Discharge Limitations	
Constituents	**Daily Maximum in µg/L**	**Monthly Average in µg/L**
Volatile Organic Compounds[1]	0.7	0.50[2]
Perchlorate	6	4
1,4–Dioxane	6	3
N-Nitrosodimethylamine	0.010	0.002

Notes:

1 All volatile organic compounds listed in United States Environmental Protection Agency Methods 8010 and 8020.

2 The monthly average concentration of each constituent shall not exceed 0.5 µg/L.

µg/L Microgram per liter

ATTACHMENT D
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FROM THE OU-5 RECORD OF DECISION

TABLE D-1: DESCRIPTION OF ARARS FOR SELECTED REMEDY

Statement of Work for Remedial Design and Remedial Action, Attachment 2 to the Administrative Order, Perimeter Groundwater Operable Unit (OU-5), Aerojet Superfund Site, Sacramento County, California

Authority	Medium	Requirements	Status	Synopsis of Requirements	Action to be Taken to Attain Requirements
Chemical-Specific ARARs					
Federal Regulatory Requirement	Groundwater (GW)	Federal Safe Drinking Water Maximum Contaminant Levels (MCL); 42 U.S.C. § 300(f), et seq.; 40 C.F.R. Part 141 (2010)	Relevant & Appropriate (R&A)	MCLs have been adopted for a number of common organic and inorganic contaminants. These levels regulate the concentrations of contaminants in public drinking water supplies and may be relevant and appropriate for final RODs restoring groundwater aquifers potentially used for drinking water. MCLs are Relevant and Appropriate as performance standards for on-Site treatment of water delivered for potable end use.	MCLs are Relevant and Appropriate Standards for on-Site treatment of water placed into an on-Site conveyance system for potable end use. Where there are no federal MCLs for the contaminants, e.g., NDMA and 1,4-dioxane, the treatment standards are based on State MCLs or values developed by the State of California for drinking water. See Table 2.7 of the OU-5 ROD.
State Regulatory Requirement	GW	California Safe Drinking Water Act, Cal. Health & Safety Code § 116365; 22 CCR §§ 64431 & 64444	R&A	The State has promulgated MCLs for some of the COCs that are more stringent than federal MCLs.	More stringent State MCLs are Relevant and Appropriate Standards for on-Site treatment of water for potable end use. Where there are no State MCLs for the contaminants, such as NDMA and 1,4-dioxane, the treatment standards are based on CA PHG or Drinking Water Notification Levels. See Table 2.7 of the OU-5 ROD.

TABLE D-1: DESCRIPTION OF ARARS FOR SELECTED REMEDY (CONTINUED)
Statement of Work for Remedial Design and Remedial Action, Attachment 2 to the Administrative Order, Perimeter Groundwater Operable Unit (OU-5), Aerojet Superfund Site, Sacramento County, California

Authority	Medium	Requirements	Status	Synopsis of Requirements	Action to be Taken to Attain Requirements
Chemical-Specific ARARs (Continued)					
Federal Regulatory Requirement	Soil	EPA's Regional Screening Levels (RSL) (2010)	To Be Considered (TBC)	EPA has developed regional screening levels that are risk-based levels that are used to screen sites that may require additional investigation or possible remediation. RSLs may also be considered in setting soil cleanup levels or groundwater cleanup levels in the absence of promulgated MCLs for contaminants.	RSLs are considered in setting soil cleanup levels, including soil vapor levels, to be protective for residential, commercial or industrial land use scenarios. Groundwater cleanup values are based on MCLs, CA PHGs or CA Drinking Water Notification Levels as listed in Table 2.7 of the OU-5 ROD.
California PHGs, California Environmental Protection Agency, and OEHHA	GW	California Calderon-Sher SDWA of 1996, California Health and Safety Code § 116365	TBC	OEHHA has adopted PHGs for chemicals in drinking water. PHGs are levels of drinking water contaminants at or below which adverse health effects are not expected.	In the absence of MCLs for NDMA, the state PHGs adopted by OEHHA have been considered during selection of performance standards for groundwater containment.
CDPH Drinking Water Notification Levels	GW	California Health & Safety Code § 116455	TBC	CDPH has established drinking water notification levels (formerly known as action levels) based on health effects, but in some cases they are based on organoleptic (taste and odor) values for chemicals without MCLs.	In the absence of MCLs for 1,4-Dioxane, the drinking water notification levels established by CDPH have been considered during selection of performance standards for groundwater containment.

TABLE D-1: DESCRIPTION OF ARARS FOR SELECTED REMEDY (CONTINUED)
Statement of Work for Remedial Design and Remedial Action, Attachment 2 to the Administrative Order, Perimeter Groundwater Operable Unit (OU-5), Aerojet Superfund Site, Sacramento County, California

Authority	Medium	Requirements	Status	Synopsis of Requirements	Action to be Taken to Attain Requirements
Chemical-Specific ARARs (Continued)					
State Regulatory Requirement	GW	Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins (2009 revisions), adopted in accordance with CA Water Code, Division 7, Sections 13240 and 13050 (Porter-Cologne Act); Chapters II & III	Applicable	Those portions of the Basin Plan which set out the designated uses (i.e., beneficial uses) and the water quality objectives based upon such uses are applicable requirements.	The designated use for the aquifer at the Aerojet Site is municipal and aquatic water supply. The containment levels for the contaminated groundwater and surface water comply with the Basin Plan's water quality objectives based upon such use.
State Regulatory Requirement	GW	SWRCB Resolution No. 88-63 (Sources of Drinking Water Policy)	Applicable	Designates all ground and surface waters of the State as drinking water except where the Total Dissolved Solids (TDS) is greater than 3,000 ppm, the well yield is less than 200 gpd from a single well, the water is a geothermal resource or in a water conveyance facility, or the water cannot reasonably be treated for domestic use using either best management practices or best economically achievable treatment practices.	The aquifers under the Aerojet Site have been identified as sources of drinking water.

TABLE D-1: DESCRIPTION OF ARARS FOR SELECTED REMEDY (CONTINUED)
Statement of Work for Remedial Design and Remedial Action, Attachment 2 to the Administrative Order, Perimeter Groundwater Operable Unit (OU-5), Aerojet Superfund Site, Sacramento County, California

Authority	Medium	Requirements	Status	Synopsis of Requirements	Action to be Taken to Attain Requirements
Location-Specific ARARs					
Federal Regulatory Requirement	Floodplain and wetland protection	Executive Order Nos. 11990 & 11988	TBC	Require avoidance of adverse effects, minimization of potential harm, and restoration and preservation of natural and beneficial values of floodplains.	Constructing groundwater treatment facilities in a 100 year flood plain will be avoided. If it cannot be avoided, the potential harm to the flood plain shall be minimized.
Federal Regulatory Requirement	Within 100-year flood-plain	40 C.F.R. §264.18(b) (2010) and 22 CCR §66264.18(b)	Applicable	A RCRA facility located in a 100-year flood plain must be designated, constructed, operated and maintained to prevent washout of any hazardous waste by a 100-year flood	Because any new treatment facilities in OU-5 may generate hazardous waste, any such facility constructed within a 100 year flood plain must comply with this requirement.
Federal Regulatory Requirement	Sites on or eligible for inclusion on the National Register of Historic Places	National Historic Preservation Act (16 U.S.C. §§ 470, et seq.); 36 C.F.R. Part 800 (2010)	Applicable	Provides for protection of sites with historic places and structures. Federal agencies are required to take into account their undertakings on historic properties and afford the State Historic Preservation Office a reasonable time to comment.	Applicable if a federal undertaking (cleanup) could adversely affect historic properties which are included in or eligible for inclusion in the National Register of Historic Places. The proposed remedial alternatives are not expected to not alter or destroy any known prehistoric or historic archeological features in OU-5 of the Aerojet Site. However, because there is always a possibility that buried historic or prehistoric remains could be discovered during such actions, this requirement would require action to address such areas.

TABLE D-1: DESCRIPTION OF ARARS FOR SELECTED REMEDY (CONTINUED)
Statement of Work for Remedial Design and Remedial Action, Attachment 2 to the Administrative Order, Perimeter Groundwater Operable Unit (OU-5), Aerojet Superfund Site, Sacramento County, California

Authority	Medium	Requirements	Status	Synopsis of Requirements	Action to be Taken to Attain Requirements
Location-Specific ARARs (Continued)					
Federal Regulatory Requirement	Endangered species or threatened species	Substantive portions of the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.); 50 C.F.R. Part 200 and 50 C.F.R. Part 402 (2010)	Applicable	Federal agencies are required under Section 7 of the ESA to insure that their actions do not jeopardize the continued existence of a listed species or result in destruction of adverse modification of its critical habitat (16 U.S.C. ' 1536). If the proposed action may affect the listed species or its critical habitat, consultation with the USFWS may be required (50 C.F.R. ' 402.14). Additionally, Section 9 of the ESA prohibits the illegal taking of a listed species (16 U.S.C. ' 1538(a)(1).	Two endangered floral species are known to occur within Sacramento County: the Sacramento Orcutt grass (Orcuttia Viscinda) and the Boggs Lake hedge hyssop (Gratiola Heterospala). Four listed wildlife species are expected to occur within 25 miles of the Aerojet Site: Bald Eagle, Peregrine Falcon, Giant Garter Snake, and the Valley Elderberry Longhorn Beetle. The Aerojet Site may be a habitat for the Burrowing Owl, a species of concern in CA. Any action that may impact or threaten to impact an endangered species shall comply with this requirement.
State Regulatory Requirement		CA Endangered Species Act, Cal. Fish & Game Code § 2080	Applicable	Prohibits the illegal taking of plant and animal species designated as either threatened or endangered in the state of California	See Federal ESA above.
Federal Regulatory Requirement	Listed migratory birds	Migratory Bird Treaty Act; 16 U.S.C. §§ 703, et seq.	Applicable	Prohibits the illegal taking of migratory birds	The Aerojet Site may be a habitat for the Burrowing Owl, a species of concern in CA.
Federal Regulatory Requirement	Areas affecting stream or river	Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.) and 40 §302 (2010)	Applicable	Restrictions on diversion, channeling or other activity that modifies a stream or river and affects fish or wildlife.	Applicable if a water body will be controlled or modified by the action.

TABLE D-1: DESCRIPTION OF ARARS FOR SELECTED REMEDY (CONTINUED)
Statement of Work for Remedial Design and Remedial Action, Attachment 2 to the Administrative Order, Perimeter Groundwater Operable Unit (OU-5), Aerojet Superfund Site, Sacramento County, California

Authority	Medium	Requirements	Status	Synopsis of Requirements	Action to be Taken to Attain Requirements
Location-Specific ARARs (Continued)					
State Regulatory Requirement	Streambed or riverbed alterations	Substantive Requirements of Cal. Fish & Game Code § 1602	Applicable	Prohibits substantial diversion or obstruction of the natural flow of, or a substantial change of the bed or channel of a river, stream or lake. Prohibits the deposit or disposal of debris or waste where it may pass into any river, stream or lake.	Applies to grading and filling activity.
State Regulatory Requirement	Restrictions relating to land and groundwater	Cal. Civ. Code §1471; 22 CCR § 67391.1(a), (d) (2010)	R&A	Substantive requirements for placing an environmental restrictive covenant on contaminated land in the state of California.	Require Aerojet to record environmental restrictive covenants on contaminated land and to name EPA as a third party beneficiary in the covenants.
Action-Specific ARARs					
Federal Regulatory Requirement	Dredge and Fill	33 U.S.C. §§ 1251, et seq. and 40 C.F.R. Parts 230 & 231 (2010)	R&A	Regulates discharge of dredged or fill material into waters of the United States, including wetlands.	Substantive portions applicable. Permit is not required for on-Site activities.
Federal Regulatory Requirement	Generation of waste from construction and operation due to Remedial Action selected	40 C.F.R. Part 261(2010) and 22 CCR § 66261 (2010)	Applicable	Establishes procedures and numeric limits for identification and management of characteristic hazardous wastes, listed hazardous wastes, and State-only (non-RCRA) hazardous wastes.	These requirements are applicable to management of waste materials generated as a result of construction of the selected Remedial Action or operation of a groundwater treatment plant.

TABLE D-1: DESCRIPTION OF ARARS FOR SELECTED REMEDY (CONTINUED)
Statement of Work for Remedial Design and Remedial Action, Attachment 2 to the Administrative Order, Perimeter Groundwater Operable Unit (OU-5), Aerojet Superfund Site, Sacramento County, California

Authority	Medium	Requirements	Status	Synopsis of Requirements	Action to be Taken to Attain Requirements
Action-Specific ARARs (Continued)					
Federal Regulatory Requirement	Generation of waste from construction and operation due to Remedial Action selected	40 C.F.R. §262.11 (2010) and 22 CCR §66262.11 (2010)	Applicable	Requires waste generators to determine if wastes are hazardous wastes and establishes procedures for such determinations	These requirements are applicable to management of waste materials generated as a result of construction of the selected Remedial Action or operation of a groundwater treatment plant.
Federal Regulatory Requirement	Storage of hazardous wastes for treatment or disposal off-Site	40 C.F.R. §262.34 and 22 C.C.R. §66262.34 (2010)	Applicable	Specifies maximum amounts and maximum periods for accumulation of hazardous waste on-site under generator status	These requirements are potentially applicable to management of waste materials generated as a result of construction of the Remedial Action and operation of any groundwater treatment plant if these waste materials are hazardous wastes.
Federal Regulatory Requirement	Shipment of hazardous substances off-Site	42 U.S.C. § 9621(d)(3); 40 C.F.R § 300.440 (2010) ("Offsite Rule")	Applicable	Hazardous substances from a CERCLA response action that must be transferred off-Site for disposal or treatment must be transferred to a facility in compliance with RCRA, TSCA, and other applicable federal and state law.	Applicable to hazardous wastes from treatment facilities and to wastes from Remedial Actions that must be disposed of off-Site.

TABLE D-1: DESCRIPTION OF ARARS FOR SELECTED REMEDY (CONTINUED)
Statement of Work for Remedial Design and Remedial Action, Attachment 2 to the Administrative Order, Perimeter Groundwater Operable Unit (OU-5), Aerojet Superfund Site, Sacramento County, California

Authority	Medium	Requirements	Status	Synopsis of Requirements	Action to be Taken to Attain Requirements
Action-Specific ARARs (Continued)					
Federal Regulatory Requirement	Discharge to inland surface water	National Toxics Rule, 40 C.F.R. §§ 131.6 & 131.38 (2010) (CA Toxics Rule)	Applicable	Establishes the appropriate aquatic and human health criteria for priority toxic pollutants in inland surface waters and enclosed bays and estuaries. Included in the National Rule are EPA-promulgated specific criteria for certain water bodies in California the presence or discharge of which could reasonably be expected to interfere with maintaining designated uses.	May be applicable for off-Site discharge subject to NPDES permits and for on-Site discharge subject to substantive requirements of an NPDES permit.
State Regulatory Requirement	Discharge to surface water	Section IV-16 (Policy for Application of Water Quality Objectives) of the Basin Plan for Sacramento River and San Joaquin River Basins (2009 rev.)	TBC	Allows for the use of mixing zones as part of a determination of whether water quality is being maintained in the receiving water.	This requirement may be a performance standard if treated water is discharged to surface water.
Federal Regulatory Requirement	Discharge to surface water	National Pollutant Elimination Discharge System (NPDES) Permit 40 C.F.R. Parts 122 and 125 and 23 CCR 2235 et seq.	Applicable	Establishes treatment and monitoring requirements for discharges to surface water.	Discharge to surface water on-Site will comply with the substantive requirements of an NPDES Permit (See Table 2.15 of the OU-5 ROD); discharge to surface water off-Site will require a NPDES Permit.

ATTACHMENT E
OU-5 PROJECT WORK PLAN

ATTACHMENT E
OU-5 PROJECT WORK PLAN

The Project Work Plan shall include:

1. Updated Project Description

The Project Work Plan shall include a description of the Work to be implemented by Respondents. The Work shall include a description of the location, installation, and monitoring of compliance and sentinel wells. The Project Work Plan shall also include, where applicable, information on extraction locations; treatment technologies; discharge of the treated water (i.e., recipients, delivery locations, delivery pressures, and delivery rates); locations of major project components; existing equipment and facilities to be used as part of the Remedial Action (RA); and other key aspects of the project. The Project Work Plan shall briefly discuss the condition, anticipated longevity, and any limitations in the use of each existing facility, and shall provide for written quarterly progress reports. The Remedial Design (RD)/RA monthly progress report/s shall comply with Progress Reports section of the Administrative Order and provide for the following: (a) describe the actions which have been taken toward achieving compliance with this Administrative Order during the previous quarter; (b) include all results of sampling and tests and all other data received or generated by Respondents or its contractors or agents and not previously submitted to the United States Environmental Protection Agency (EPA); (c) describe all work planned for the next quarter with schedules relating such work to the overall project schedule for RD/RA completion; and (d) describe all problems encountered and any anticipated problems, and actual or anticipated delays, and solutions developed and implemented to address any actual or anticipated problems or delays. If requested by EPA or the State Agencies, Respondents shall also provide briefings for EPA and the State Agencies to discuss progress. The reporting frequency may be revised by EPA. Respondents shall perform the necessary tasks including coordination efforts among regulatory Agencies, water purveyors, landowners and all other parties, public meetings, and presentations to achieve the Perimeter Groundwater Operable Unit (OU-5) remedy.

2. Description of the Responsibility and Authority of All Organizations and Key Personnel Involved With the Remedial Action

The Project Work Plan shall include a description of the responsibilities and qualifications of key personnel expected to direct or play a significant role in the RD, RA, or Operation and Maintenance of the OU-5 Remedy, including Respondents' Project Coordinator, Designer, Construction Contractor, Construction Quality Assurance personnel, and Resident Engineer. The Work Plan shall define lines of authority and provide brief description of duties.

3. Updated Schedule and Meetings

The Project Work Plan shall identify the initiation and completion dates for each required design activity, construction activity, inspections and deliverable required by the Administrative Order and this Statement of Work (SOW). The Project Work Plan at a minimum shall be consistent with the schedule included as Section VI (Schedule for Major Deliverables and Other Tasks) of this SOW or an expedited schedule for phased implementation to achieve cleanup sooner. The Work Plan shall also identify the approximate timing of meetings and other activities (not identified in Section VI [Schedule for Major Deliverables and Other Tasks] of this SOW), which may require participation by the Agencies.

The schedule shall provide for monthly coordination meetings that may be decreased in frequency as deemed appropriate by EPA after consultation among the Agencies. The coordination meetings shall address project status, problems, solutions, and schedule. Respondents shall prepare and distribute coordination meeting summary minutes to the Agencies in accordance with the schedule contained in Section VI (Schedule for Major Deliverables and Other Tasks) of this SOW after any meeting to document all decisions made, issues outstanding, schedule changes, planned follow up, and assignments.

4. Contracting Strategy

The Project Work Plan shall briefly describe the planned contracting strategy, including a brief description of the process for evaluation and approval of construction changes, for review by the Agencies and EPA's approval of significant changes.

5. Plans for Satisfying All Permitting Requirements and Acquiring Property, Leases, Easements, or Other Access

The Project Work Plan shall list all permits, approvals, Memoranda of Understanding (MOU), access or use agreements, property development or acquisition, leases, and easements required for implementation of the RA (extraction and monitoring wells, treatment facilities, distribution piping, and any surface water discharge point[s]).

Where normally required, permits must be obtained for all off-site activities, such as permits from the California Department of Public Health for domestic use of treated water. Respondents are not required to obtain permits for on-site remedial activities, but must comply with all substantive requirements, including local building codes. If permits will not be obtained for an on-site activity where a permit is normally required, Respondents shall describe all consultative or coordination activities planned to identify and satisfy the substantive requirements. Discharges to water

bodies off-site shall be subject to National Pollution Discharge Elimination System permitting.

6. Roles for Design, Construction, and Operation of the Remedial Action

The Project Work Plan shall describe the roles and responsibilities of Respondents, participating water producers and regulatory Agencies, and other parties expected to play a significant role in the design, construction, and operation of the RA. The Work Plan shall summarize and provide copies of MOUs and draft or final agreements between Respondents and water producers and any third parties expected to participate in implementation of the RA or to receive water that is, or contains, water extracted as part of the RA. If legally-binding agreements are not in place, the Work Plan shall describe commitments made to date and planned efforts to secure necessary commitments, including a schedule. If the participation of a third party is uncertain, the Work Plan shall describe alternatives to be implemented in the event that the party does not fulfill its planned role. Possible third party roles include agreeing to the use of existing equipment (e.g., groundwater extraction wells, water treatment facilities, pipelines, groundwater recharge facilities), treatment facilities operation, and acceptance of treated groundwater.

7. Identification of Any Concerns About the Quantity, Quality, Completeness, or Usability of Water Quality or Other Data Upon Which the Design Will Be Based

Respondents shall describe in the Project Work Plan additional data collection efforts, if any, required for completion of the RD. Respondents shall consider whether any data are needed to verify that critical design assumptions remain valid (e.g., the areas of Contaminated Groundwater requiring hydraulic containment). If additional data are required, Respondents shall propose a schedule amendment of the OU-5 Sampling and Analysis Plan (or Addendum) and implementation of the Plan. At a minimum, Respondents shall address the following: 1) interaction of OU-5 remedy with existing and pending groundwater remedies bordering OU-5 to the west and south to contain contamination in all layers of the aquifer; 2) ensuring that the containment boundary contains the Contaminated Groundwater in all layers of the aquifer; and 3) optimization of extraction well locations to prevent further degradation of the aquifer layers.

8. A Description of Planned Community Relations Activities to Be Conducted During Remedial Design or Remedial Action

In accordance with the Work to be Performed section of the Administrative Order, Respondents shall cooperate with the Agencies in providing to the public information regarding the remedial work. As requested by the Agencies, Respondents shall aid in the preparation of such information and dissemination to the public. Respondents

including any insurance requirements, assistance in mailing list updates, and public meeting support for any amendment of the proposed plan/ROD, including paying for a stenographer to prepare meeting transcripts, both draft for EPA review and comment and final of transcript (6 hardcopies and electronic version), and technical support as requested for response to public comment, etc.).

9. Updates to the Administration Work Plan and Periodic Reporting to the Agencies

The Administration Work Plan shall describe provisions for reporting progress to the Agencies consistent with the schedule included in Section VI (Schedule for Major Deliverables and Other Tasks) of this SOW or an expedited schedule for phased implementation to achieve cleanup sooner and the Compliance Monitoring Plan components of the GMP to be prepared in accordance with Section V(F) (Groundwater Monitoring) of this SOW. The Administration Work Plan shall also describe how the Work Plan will be updated as needed to document changes, provide for possible phased implementation, or provide information not available at the time the Work Plan and the quarterly progress report are submitted.

If any of the information required is not known at the time the Administration Work Plan must be submitted, and omitting the information from the Work Plan will not prevent compliance with any other requirements of this SOW, Respondents may submit the information at a later date. If any information is omitted, Respondents shall note in the Work Plan that the missing information was not available and specify when it will be submitted.

ATTACHMENT F
TEMPLATE FOR GROUNDWATER DECLARATION OF COVENANTS

DRAFT

Recording Requested By:

Aerojet-General Corporation

When Recorded, Mail To:

[_____] **[Groundwater only properties]**

[_____]

(Space above this line reserved for County Recorder's use.)

Assessor Parcel Number(s): Portion of

[_____]

DECLARATION OF COVENANTS AND ENVIRONMENTAL RESTRICTIONS RELATED TO GROUNDWATER

This Declaration of Covenants and Environmental Restrictions Related to Groundwater (this **"Declaration"**) is dated, for reference purposes, as of the ____ day of _____, _____, and is executed, on the dates set forth with the signatures below, by and among Aerojet-General Corporation (**"Covenantor"**), the California Regional Water Quality Control Board for the Central Valley Region (the **"Regional Board"**), and the United States of America and its assigns (the Regional Board and the United States of America, collectively, **"Covenantees"**) (Covenantor and Covenantees, collectively, the **"Parties"**).

WITNESSETH:

WHEREAS, Covenantor owns real property situated in Sacramento County (the **"County"**), California more fully described in **Exhibit "A"** attached hereto and incorporated herein by this reference (the **"Property"**); and

WHEREAS, the Property is part of the Aerojet Superfund Site (the **"Site"**), which the U.S. Environmental Protection Agency (the **"USEPA"**), pursuant to section 105 of the Comprehensive Environmental Response, Compensation and Liability Act (**"CERCLA"**), 42 U.S.C. section 9605, placed on the National Priorities List (the **"NPL"**), set forth at 40 C.F.R. Part 300, by publication in the Federal Register on September 8, 1983; and

WHEREAS, the Parties' Partial Consent Decree (the "**PCD**") was entered on June 23, 1989 in the consolidated actions No. CIVS 86-0063-EJG and No. CIVS 86-0064-EJG in the United States District Court for the Eastern District of California; and

WHEREAS, the groundwater and associated contaminated media beneath the surface of the Property contain "hazardous materials," as that term is defined in section 25260 of the California Health and Safety Code, "waste," as that term is defined in section 13050 of the California Water Code, and "hazardous substances," as that term is defined in section 9601(14) of CERCLA (the "**Groundwater Contamination**"); and

WHEREAS, the Property was investigated by Covenantor under oversight of, and accepted by, the USEPA, the Regional Board and the California Department of Toxic Substances Control ("DTSC") (collectively, the "**Regulatory Agencies**") under the PCD. As a result of that investigation, USEPA determined in its decision document entitled "Interim Record of Decision for Groundwater and Final Record of Decision for Soil for the Perimeter Groundwater Operable Unit (OU-5)" dated February 15, 2011 ("**PGOU ROD**") (which determination was concurred with by the Regional Board and DTSC) that (i) all continuing sources of Groundwater Contamination are outside the area of the Property and (ii) other than the restrictions described herein at section 1.3, no further remedial action is required for unrestricted use of the Property; and

WHEREAS, in order to protect present and future public health and safety and the environment, and in order to facilitate further investigation, monitoring, and remediation of the Groundwater Contamination, while maximizing the potential for development and use of the Property for all purposes, the Parties have agreed to impose upon the Property certain covenants and restrictions, including access rights, subject to various limitations and conditions designed to facilitate development and use of the Property, all as set forth in this Declaration, all of which covenants, restrictions, limitations, and conditions are intended to be, and shall be, binding on successors in title to the Property as covenants running with the land; and

WHEREAS, pursuant to California Civil Code section 1471, and under the circumstances described in the foregoing recitals, Covenantor has the right and power to impose upon its title to the Property, for the benefit of, and to be enforceable by, Covenantees and Covenantor, and to be binding upon Covenantor and its successors and assigns, covenants related to said Groundwater Contamination, including covenants to do, or refrain from doing, acts upon the Property as specified in this Declaration, and the Parties intend this Declaration to be executed, delivered, and recorded in the Official Records in compliance with the requirements of, and pursuant to, said section 1471.

NOW, THEREFORE:

ARTICLE I
DEVELOPMENT, USE, AND CONVEYANCE OF THE PROPERTY

1.1 Declaration. In reference to the facts and circumstances set forth in the foregoing "Whereas" clauses, Covenantor does hereby declare and covenant that:

(a) Subject to all of the terms and conditions set forth in this Declaration, the Property shall be subject to the Environmental Restrictions (defined below) and Covenantees' Right of Access (defined below), and Covenantor does give, grant, and convey to Covenantees and reserve unto itself the perpetual right to enforce said Environmental Restrictions and Covenantees' Right of Access as beneficiaries thereof; and

(b) The Property and every portion thereof shall be improved, held, used, occupied, leased, sold, hypothecated, encumbered, and/or conveyed subject to said Environmental Restrictions and Covenantees' Right of Access.

1.2 Necessity. The Parties agree that the Environmental Restrictions (defined below), Covenantees' Right of Access (defined below), and other provisions of this Declaration are reasonably necessary to protect present and future public health and safety and the environment; to reduce impediments to remediation of the Contaminated Groundwater; to allow remedial measures for the Groundwater Contamination to be studied and implemented; and to avoid potential harm to persons or property that may result from hazardous materials that are found in the Contaminated Groundwater.

1.3 Environmental Restrictions and Covenantees' Right of Access. The following covenants, conditions, and restrictions set forth in subparts (a) through (d) of this section 1.3 (collectively, the **"Environmental Restrictions"**) and the following access rights set forth in subpart (e) of this section 1.3 (collectively, the **"Covenantees' Right of Access"**) apply to the use of the Property, run with the land, and are binding upon Covenantor and its successors in interest who hold title to all or any portion of the Property (collectively, **"Owners"**) and upon those persons entitled by ownership, leasehold, or other legal relationship to the right to possession or occupancy of any portion of the Property (collectively, **"Occupants"**):

(a) No Extraction. No Owners or Occupants of the Property or any portion thereof shall drill, bore, otherwise construct, or use a well for the purpose of extracting water for any use, including, but not limited to, domestic, potable, or industrial uses, unless and until expressly permitted in writing by Covenantor and the Regional Board.

(b) No Recharge. No Owners or Occupants of the Property or any portion thereof shall install, operate, or maintain a recharge or sedimentation control basin that is designed to infiltrate water (a "**Recharge Activity**") unless and until expressly permitted in writing by Covenantor and the Regional Board as follows:

(1) Recharge Waiver Request. For purposes of this section 1.3(b) , the term "**Recharge Waiver Request**" means a written application signed by an Owner or Occupant or its authorized agent or contractor that sets forth (A) the legal description and, if available, street address of the affected portion of the Property; (B) the name, mailing address, telephone number, and other pertinent information about the Owner of that portion, all persons holding mortgages, deeds of trust, or other monetary encumbrances upon that portion, and the contractor or contractors, if any, expected to conduct the Recharge Activity; (C) a detailed description of the nature (including projected infiltration rate) and period of the proposed Recharge Activity; and (D) such other pertinent information as Covenantor and/or the Regional Board shall request; and

(2) Review of Requests. Upon receipt of a Recharge Waiver Request, Covenantor and the Regional Board shall consider such Recharge Waiver Request and issue their written approvals or denials thereof, which approvals, if issued, may include appropriate conditions subject to which the proposed Recharge Activity shall be conducted. Approval shall be granted for any Recharge Activity that does not interfere with, or adversely impact, remediation of the Groundwater Contamination and is otherwise undertaken in accordance with applicable law.

(c) No Injection. No Owners or Occupants of the Property or any portion thereof shall install, operate, or maintain any injection wells for any use unless and until expressly permitted in writing by Covenantor and the Regional Board.

(d) Excavations. No Owners or Occupants of any portion of the Property shall conduct sustained extraction of the groundwater that is encountered during excavations for the construction of buildings or other improvements (**"Construction Dewatering"**) unless and until expressly permitted in writing by Covenantor and the Regional Board as follows:

(1) Request for Approval of Construction Dewatering. For purposes of this section 1.3(d) , the term "**Request for Approval of Construction Dewatering**" means a written application signed by an Owner or Occupant or its authorized agent or contractor that sets forth (A) the legal description and, if available, street address of the affected portion of the Property; (B) the name, mailing address, telephone number, and other pertinent information about the Owner of that portion, all persons holding mortgages, deeds of trust, or other monetary encumbrances upon that portion, and the contractor or contractors, if any, expected to conduct the Construction Dewatering; (C) the plans and specifications for the proposed Construction Dewatering, including, but not limited to, the projected start and completion dates for the proposed Construction Dewatering; and (D) such other pertinent information as Covenantor and/or the Regional Board shall request; and

(2) Review of Requests. Upon receipt of a Request for Approval of Construction Dewatering, Covenantor and the Regional Board shall consider such Request for Approval of Construction Dewatering and issue their written approvals or denials therefor, which approvals, if issued, may include appropriate conditions subject to which the proposed Construction Dewatering shall be conducted. Approval shall be granted for any Construction Dewatering that does not interfere with, or adversely impact, remediation of the Groundwater Contamination and is otherwise undertaken in accordance with applicable law.

(e) Covenantees' Right of Access. Subject to future constriction to certain areas of the Property as set forth in section 4.3 of this Declaration, Covenantor hereby grants to Covenantees a right of access (**"Covenantees' Right of Access"**) to the Property, at all reasonable times, for the following purposes only:

(1) Implementing, or overseeing the implementation of, "response actions," as defined in CERCLA, in any "records of decision," as defined in CERCLA, or orders issued by either Covenantee respecting the Groundwater Contamination;

(2) Verifying any data or information respecting Groundwater Contamination submitted to Covenantees or either of them;

(3) Verifying that no action is being taken on the Property respecting the Groundwater Contamination in violation of any of the Environmental Restrictions or any of the other terms of this Declaration or of any federal or California environmental laws or regulations;

(4) Monitoring "response actions," as defined in CERCLA, on the Property respecting Groundwater Contamination and conducting investigations related to the Groundwater Contamination on or near the Property, including, without limitation, sampling of air, water, sediments, soils, and specifically, without limitation, obtaining split or duplicate samples; and

(5) Conducting periodic reviews of the remedial action respecting the Groundwater Contamination, including, but not limited to, reviews required by applicable statutes and/or regulations.

1.4 Reserved Rights of Covenantor. Subject to the rights of Covenantees hereunder, Covenantor hereby reserves unto itself all rights and privileges respecting ownership, use, and development of the Property.

1.5 Notice Requirement. Covenantor, in accordance with California Health and Safety Code section 25359.7, agrees to give written notice of the Groundwater Contamination to each buyer, lessee, renter, and mortgagee of all or any part of the Property. Additionally, every lease, deed, mortgage, or other instrument conveying any interest in all or any part of the Property shall expressly provide that it is subject to this Declaration.

ARTICLE II
ENFORCEMENT

2.1 Remedies Available. Covenantees and Covenantor shall be entitled to enforce the terms of this Declaration, including, but not limited to, the Environmental Restrictions and Covenantees' Right of Access, by resort to specific performance, injunction, and other appropriate legal process. Any forbearance, delay, or omission to exercise rights under this Declaration in the event of a breach of any term of this Declaration shall not be deemed to be a waiver by Covenantees or Covenantor of such term or of any subsequent breach of the same or any other term, or of any rights of Covenantees or Covenantor under this Declaration.

2.2 Removal of Offending Improvements. Failure of an Owner or Occupant to comply with any of the Environmental Restrictions, as set forth in section 1.3 of this Declaration, shall be grounds for either of the Covenantees and/or Covenantor, by reason of this Declaration, to have the authority to require that the Owner modify or remove the improvements constructed in violation of that section. Violations of this Declaration shall be grounds for Covenantor and/or either or both Covenantees to file civil actions against the Owner as provided by law.

2.3 Waiver of Certain Defenses. Covenantor hereby waives any defense of laches, estoppel, or prescription.

2.4 Covenantor's Title. Covenantor hereby covenants that Covenantor is lawfully seized of fee simple title to the Property, that Covenantor has a good and lawful right and power to sell and convey it or any interest therein, that the Property is free and clear of encumbrances, except encumbrances shown in the Official Records, and that Covenantor will forever warrant and defend Covenantor's title thereto and quiet possession thereof.

2.5 Administrative Jurisdiction. The federal agency having administrative jurisdiction over the interests acquired by the United States by this Declaration is the USEPA.

ARTICLE III
DURATION, TERMINATIONS, MODIFICATIONS, ASSIGNMENTS, AND TRANSFERS

3.1 Duration. Unless terminated in accordance with the provisions of this Article III, the Environmental Restrictions and Covenantees' Right of Access shall continue in perpetuity.

3.2 Terminations and Modifications. Any Owner or, with the Owners' written consent, any Occupant may apply in writing to Covenantor and to Covenantees for a termination or modification of all or some portion of the Environmental Restrictions and/or Covenantees' Right of Access as applied to that Owner's portion of the Property as follows:

(a) Any such application shall set forth reasons why the purposes of this Declaration can continue to be accomplished if and when such termination or modification is granted and shall have attached to it a copy of the instrument that the Owner or Occupant wants Covenantor and Covenantees to execute in order to effect such termination or modification;

(b) The decision whether or not to grant the termination or modification, what conditions may be attached thereto, and the exact language of the instrument effecting such termination or modification shall be in the discretion of both Covenantor and Covenantees, provided they shall not act arbitrarily or capriciously;

(c) Applications for a termination or modification may be granted only with the consent of both Covenantor and Covenantees, except that any amendment or modification done pursuant to section 4.3(b) of this Declaration may be made with the consent of Covenantor and the Regional Board only and without the consent of the USEPA;

(d) Whenever any such termination or modification is granted, Covenantor and Covenantees shall execute, acknowledge, and deliver an appropriate instrument to effect such termination or modification in form that is recordable in the Official Records, which instrument may be in the form provided by the applicant or in such other form as Covenantor and Covenantees shall determine;

(e) Any such termination or modification shall be effective upon recordation in the Official Records of said instrument as executed and acknowledged by Covenantor and Covenantees, with no other act or documentation required to effect such termination or modification; and

(f) No participation by, or consent from, any Owner or Occupant whose portion or portions of the Property are not directly affected by the termination or modification shall be necessary although Covenantor and/or Covenantees may, at their election, seek and receive information, opinions, or other participation about the proposed termination or modification from or by any or all other Owners or Occupants of the Property or any portion thereof.

3.3 Assignment to the Regional Board. Upon completion of "remedial action" (as that term is defined in CERCLA) respecting the Groundwater Contamination, the Regional Board agrees to accept an assignment of any covenant granted by this Declaration to the USEPA. Any such assignment and acceptance thereof shall be in writing and effective when it is recorded in the Official Records.

3.4 Successive Owners and Occupants. An Owner or Occupant's rights and obligations under this Declaration terminate upon transfer, expiration, or termination of the Owner or Occupant's interest in the Property, except that liability for acts or omissions occurring prior to transfer shall survive. The Owner or Occupant's successor in interest, if any, shall take that interest subject to this Declaration and be bound by the obligations hereunder applicable to Owners and Occupants until a later transfer, expiration, or termination of that interest occurs.

ARTICLE IV
SUBDIVISIONS AND BOUNDARY LINE ADJUSTMENTS

4.1 Subdivisions. Concerning subdivisions of all or any portion of the Property:

(a) Approval of Tentative Maps. Except as provided in subpart (e) of this section 4.1, prior to submission to the County of any substantial change to the tentative subdivision map, for the Property previously submitted to the County, such proposed change shall be presented to Covenantor and to the Regional Board for their review and written approval to the extent such change pertains to the location, configuration, and size of:

(1) Those portions of the Property shown on such map as designated to serve as permanent roadways to be offered for dedication to the County, including both areas for vehicular travel and contiguous areas, if any, for meridians and pedestrian sidewalks (collectively, the **"Permanent Roadways"**);

(2) Any lots or parcels shown on such map (collectively, **"Well Lots"**) on which any wells, pumping stations, equipment, pipelines, and related facilities, designed for the monitoring, extraction, removal, transport, injection, or recharge of groundwater (collectively, the **"Wells, Pipelines, and Related Facilities"**) are located; and

(3) All creeks, ditches, and other channels, whether natural or artificial, that drain, are used for the drainage of, or are designed to drain, surface waters (collectively, the **"Creeks and Ditches"**) shown on that tentative subdivision map; provided that:

(4) No other parts of any tentative subdivision map shall be subject to such review and approval by Covenantor or the Regional Board;

(b) Submittal to the County. No substantial change to such previously submitted tentative subdivision map for any portion of the Property shall be submitted to the County for approval unless and until it has been approved in writing by Covenantor and the Regional Board in the manner required by subpart (a) of this section 4.1;

(c) The County's Notice List. The Owner proposing any subdivision of any portion of the Property shall arrange for Covenantor and the Regional Board to be included on all lists maintained by the County of persons to whom the County shall send notices of hearings and other matters concerning the processing of subdivision maps for the Property or any portion thereof;

(d) No Variance on Final Maps. No final subdivision map for any portion of the Property shall be different than its precedent tentative subdivision map as approved by Covenantor and the Regional Board with respect to the location, configuration, or size of Permanent Roadways, Well Lots, if any, and Creeks and Ditches, if any, shown thereon (except for any difference(s) deemed by the County to be in substantial compliance with the precedent tentative subdivision map) unless Covenantor and the Regional Board have approved in writing such difference;

(e) Further Subdivision. If and when a final subdivision map with respect to any portion of the Property (a **"Subdivided Portion"**) is recorded in the Official Records, then, for any further subdivision of that Subdivided Portion, the Owner thereof shall not be required to comply with any of the provisions of this Article IV so long as such further subdivision does not alter (except for any alteration(s) deemed by the County to be in substantial compliance with the precedent subdivision map) the location, configuration, or size of any of the Permanent Roadways, Well Lots, if any, or Creeks and Ditches, if any, located within that Subdivided Portion; and

(f) No Waiver of Rights. Nothing in this section 4.1 or any other provision of this Declaration limits, or shall be construed to limit, in any way, the statutory, administrative, and constitutional rights of Covenantor and Covenantees to participate in any and all public hearings conducted by the County with respect to, and to provide to the County, whether at a hearing or otherwise, any comments or suggestions that Covenantor or the Regional Board may want to offer concerning, any subdivision map for the Property or any portion thereof.

4.2 Boundary Line Adjustments. Concerning boundary line adjustments affecting all or any portion of the Property:

(a) Application of the Subdivision Procedures. If any such boundary line adjustment would alter the location, size, or configuration of any Permanent Roadway, any Well Lot, or any Creeks and Ditches, then that boundary line adjustment shall be deemed to be a subdivision governed by the provisions of section 4.1 of this Declaration. Other boundary line adjustments are not governed by the provisions of said section 4.1 except that an Owner may, at its option, elect to have any boundary line adjustment governed by the provisions of said section 4.1, which election shall be done in the form of written notice from the Owner addressed to Covenantor and the Regional Board; and

(b) Treated as a Subdivision. Upon the giving of any such written notice, then, for all purposes of this Declaration, Covenantor and Covenantees shall enjoy the rights, powers, and benefits respecting such boundary line adjustment the same as would apply if subdivision maps were being used, including, but not limited to, the following results:

(1) Deemed Lots and Parcels. The reconfigured parcels, as set forth in the boundary line adjustment, shall be deemed Lots and Parcels under the provisions of this Declaration;

(2) Deemed Subdivided Portion. That portion of the Property affected by the boundary line adjustment shall be deemed a Subdivided Portion under the provisions of this Declaration; and

(3) Constriction of Covenantees' Right of Access. The area encumbered by Covenantees' Right of Access shall become constricted as set forth in section 4.3 of this Declaration.

4.3 Effect of Final Subdivision Maps. Notwithstanding the other provisions of this Article IV or any other provision of this Declaration, when and if a final subdivision map respecting any portion of the Property is recorded in the Official Records, then, and from and after such recordation, with respect to that Subdivided Portion:

(a) Constriction of Covenantees' Right of Access. Covenantees' Right of Access shall encumber only, and the burdens thereof shall be confined to, those portions of that Subdivided Portion designated on such final subdivision map as Permanent Roadways and those portions or all of any Well Lot or Well Lots or Creeks and Ditches designated on such final subdivision map, and shall no longer encumber any other part of that Subdivided Portion, including, but not limited to, the other Lots and Parcels located therein; and

(b) Automatic Effect. Such constriction of the areas encumbered by Covenantees' Right of Access shall happen automatically, without the need for any further instrument or document, for that Subdivided Portion, the moment the final subdivision map therefor is recorded in the Official Records. Nonetheless, Covenantor and the Regional Board shall, if requested to do so, confirm such constrictions by executing, acknowledging, and

delivering, in form recordable in the Official Records, such instruments and documents as may be reasonably requested to constitute such confirmation, including, but not limited to, an amendment to, or modification of, this Declaration; provided that such request is submitted by the Owner of the Subdivided Portion to Covenantor and the Regional Board either before, or within ninety (90) days after, such final subdivision map is recorded in the Official Records.

4.4 Roadway and Utility Uses. Covenantor and Covenantees agree that:

(a) Definition of Roadway and Utility Uses. Permanent Roadways will be used by and for vehicles and pedestrians to cross the Property and for ingress and egress to, from, and among the Lots and Parcels and public streets adjacent to the Property and for utility lines, including, but not limited to, sewer, telephone, cable television, natural gas, electricity, and water, as well as incidental uses related thereto, such as, but not limited to, traffic signals, manholes, vaults, signs, transformers, pipelines, valves, meters, switches, hydrants, sprinkler controls, conduits, coverings, berms, fences, lighting, landscaping, and related facilities (collectively, the **"Roadway and Utility Uses"**), regardless when or whether any offers of dedication thereof are accepted by the County; and

(b) Reasonable Accommodation. The Roadway and Utility Uses, whether public or private, shall reasonably accommodate and not unreasonably interfere with, hinder, or impede Covenantees' rights under Covenantees' Right of Access.

4.5 Flexibility Respecting Well and Pipeline Locations. Covenantor and Covenantees anticipate having flexibility in planning for, choosing, and approving sites for Wells, Pipelines, and Related Facilities, and therefore, Covenantor has determined, and Covenantees have approved the determination, that such sites, as well as access to and from such sites, can be confined generally, but not necessarily exclusively, to Permanent Roadways, given the quantity of area for Permanent Roadways expected by the Parties to be set forth on subdivision maps of portions of the Property; and that the Parties will be able to maximize the number of Wells, Pipelines, and Related Facilities positioned entirely within the Permanent Roadways, and to minimize (possibly to zero) the number of Wells, Pipelines, and Related Facilities that encumber any Lot or Parcel.

ARTICLE V
MISCELLANEOUS PROVISIONS

5.1 Recitals of Facts and Representations. Each of the Parties hereby represents and warrants that it knows of nothing indicating that any of the statements of fact set forth in the "Whereas" clauses at the beginning of this Declaration (which are incorporated herein by this reference) is false, incomplete, or misleading as written and believes that all of said statements of fact are accurate, complete, and not misleading as written.

5.2 Municipal Incorporation. If all or any portion of the Property is or becomes incorporated as a city or becomes annexed to a city, then, and from and after such date of incorporation or annexation, all references in this Declaration to "the County" with respect to Subdivision Maps, offers of dedication of Permanent Roadways, and other matters shall be deemed to be references to such city.

5.3 Covenants Running with the Land. The provisions of section 2.4 are personal covenants burdening Covenantor personally, and benefiting Covenantees personally, and are not intended, and shall not be, covenants running with the land. All of the other terms and

conditions set forth in this Declaration, including, but not limited to, the Environmental Restrictions and Covenantees' Right of Access:

(a) Are intended to be covenants running with the land that shall be binding upon the Owners and Occupants, as Covenantor's successors in title, pursuant to section 1471 of the California Civil Code; and

(b) Shall, pursuant to said section 1471, run with the land, pass with each and every portion of the Property, and apply to and bind the respective successors in interest thereof, for the benefit of Covenantees and Covenantor personally, and not as owners of any other land.

5.4 Concurrence of Owners and Occupants Presumed. All Owners and Occupants shall be deemed by their purchase, leasing, or possession of any portion of the Property to be in accord with all of the provisions of this Declaration and to agree that the terms and conditions of this Declaration, including, but not limited to, the Environmental Restrictions and Covenantees' Right of Access, must be adhered to, for the benefit of Covenantees and Covenantor, and that the interests of the Owners and Occupants shall be subject to all of the terms and conditions of this Declaration, including, but not limited to, the Environmental Restrictions and Covenantees' Right of Access contained herein, regardless whether a copy of this Declaration has been referenced in, or incorporated into, any given deed, lease, or other instrument of transfer or conveyance.

5.5 No Admission of Responsibility for Ground Water Contamination. Nothing in this Declaration shall be construed: (a) to impose upon Covenantor, or to constitute an assumption by Covenantor of, any responsibility for the characterization, analysis, monitoring, or clean-up of the Groundwater Contamination; or (b) as an admission or acknowledgment that Covenantor is a person responsible for such characterization, analysis, monitoring, or clean-up of the Groundwater Contamination.

5.6 No Waiver of Statutory Rights. Nothing in this Declaration shall be construed as a waiver of, or as imposing any limitation or condition upon exercise of, and the Parties do not intend hereby to waive, any rights of Covenantees or either of them under any federal, state, local, or common law, including, but not limited to, CERCLA, the California Health and Safety Code, and the California Water Code, which unwaived rights include, but are not limited to, rights of access to properties when and where the statutory and regulatory conditions to exercise thereof have been satisfied.

5.7 Severability of Provisions. If any provision of this Declaration is unenforceable, it shall be deemed not a part of this Declaration, and the other remaining provisions shall remain fully enforceable and shall be interpreted to accomplish, as closely as may be lawful, the intentions of the Parties as expressed by the entirety of this Declaration.

5.8 No Dedication Intended. No gift or public dedication or right of access or use by the general public of or to any portion of the Property is intended to be offered, conveyed, or declared by this Declaration, and this Declaration does not offer, convey, or declare any such gift or public dedication or right of access or use by the general public.

5.9 Notices. Whenever any person gives or serves any written notice, demand, or other communication with respect to this Declaration, each such notice, demand, or other communications shall be deemed effective (a) when delivered, if personally delivered to the person being served, whether or not that person is an official of a governmental agency; or (b) three (3) business days after deposit in the mail if mailed by the United States mail, postage paid certified, return receipt requested:

If to: "Covenantor"
Aerojet-General Corporation
Post Office Box 13222
Sacramento, California 95813
Attn: Director of Real Estate

If to: "Regional Board"
Aerojet Project Manager
Regional Water Quality Control Board
3443 Routier Road, Suite A
Sacramento, California 95827-3003

If to: "USEPA"
Aerojet Project Manager
United States Environmental Protection Agency
Region IX, Superfund
75 Hawthorne Street
San Francisco, California 94105

5.10 Recordation. This Declaration shall be recorded by Covenantor in the Official Records within ten (10) days of the date of execution hereof, and after such recordation, Covenantor shall deliver to each of the Covenantees a copy of this Declaration showing the recording information inserted by the County Recorder in the upper right-hand corner of the first page hereof.

5.11 Code References. All references to sections in any California or United States code or statute include successor provisions.

5.12 Interests of Covenantees. Notwithstanding any other provision of this Declaration, nothing in this Declaration shall be construed as granting or conveying, and the Parties do not intend to have any provision of this Declaration grant or convey, to Covenantees or either of them title to, or any real estate interest in, the Property or any portion thereof, except the benefit and burden, if any, of the Environmental Restrictions and the Covenantees' Right of Access, and the other covenants and provisions set forth in this Declaration that are applicable to Covenantees, all as covenants running with the land as set forth in this Declaration.

5.13 Controlling Law. The interpretation and performance of this Declaration shall be governed by applicable laws of the United States and of California.

5.14 Liberal Construction. Any general rule of construction to the contrary notwithstanding, this Declaration shall be liberally construed to accomplish the purposes of the Parties as set forth herein.

5.15 Entire Agreement. This Declaration sets forth the entire agreement of the Parties with respect to the rights and obligations created or set forth herein and supersedes all prior discussions, negotiations, understandings, and agreements relating thereto, all of which are merged herein.

5.16 No Forfeiture. Nothing contained in this Declaration shall be construed to result in a forfeiture or reversion of Covenantor's title to the Property in any respect.

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5.17 Captions and Headings. The captions and headings in this Declaration have been inserted solely for convenience of reference and are not part of this Declaration and shall have no effect upon construction or interpretations.

5.18 Counterparts. The Parties may execute this Declaration in two (2) or more counterparts, which shall, in the aggregate, be signed by all Parties; each counterpart shall be deemed an original of this Declaration as against any Party who has signed it. In the event of any disparity between counterparts produced, the counterpart recorded in the Official Records shall be controlling.

IN WITNESS WHEREOF, the Parties execute this Declaration as of the dates set forth with their signatures below, and this Declaration is effective as of the date it is recorded in the Official Records.

Covenantor: Aerojet-General Corporation

By: _____

Title: Authorized Agent

Date: _____

Covenantee: State of California
Regional Water Quality Control Board,
Central Valley Region

By: _____

Title: Executive Officer

Date: _____

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Covenantee: U.S. Environmental Protection Agency, on behalf of the United States of America

In accordance with Section 104(j) of CERCLA, 42 U.S.C. § 9604(j), as amended, the Regional Administrator, Region IX, of the United States Environmental Protection Agency agrees to and accepts this Declaration.

By: _____

Title:

Date: _____