Table 4. Summary of Evaluation and Comparison of Remedial Alternatives
Feasibility Study, OUCTP RI/FS, Former Fort Ord, California

Remedial Alternative	EPA CERCLA Evaluation Criteria									
	Overall Protection of Human Health and the Environment	**Compliance with ARARs**	**Short-Term Effectiveness**	**Long-Term Effectiveness and Permanence**	**Reduction of T, M, or V Through Treatment**	**Implementability**	**Capital Cost (millions)**	**O&M Cost (millions)**	**Total 30-Year NPV Cost (millions)**	**Regulatory and Community Acceptance**
Remedial Alternative 1 No Action With Monitored Natural Attenuation (MNA) (All Aquifers)	Would not provide significant protection because it takes no action to control potential exposures or sources of contamination other than MNA to monitor the status of the plumes and implement a contingency for wellhead treatment if COCs are detected in water supply wells in the Lower 180-Foot Aquifer.	Would not comply in the short term with chemical-specific and action-specific ARARs. However, it is assumed (1) the vertical conduits will be eliminated to prevent further migration of the source of COCs into the lower aquifers, (2) the COCs in groundwater would naturally attenuate over time to below ACLs, and (3) eventually comply with ARARs. However, a "non-attainment zone" may need to be established to comply with such ARARs in all three aquifers which rely on MNA.	Would not be effective in the short term at achieving RAOs, but would be effective in the short term regarding its implementability. It would take approximately 2 months to install new monitoring wells and establish the MNA program, with limited potential risks to workers or the community, as these procedures are frequently conducted according to approved SOPs.	Would have unknown long-term effectiveness and permanence because it would not actively remediate or contain the plume, and the residual risk for potential groundwater users would remain until natural attenuation of COCs occurs over a period of 30 or more years. This alternative employs reliable risk controls via wellhead treatment of water supply wells in the Lower 180-Foot Aquifer if COCs are detected in these wells.	Would not actively reduce T,M,V of COCs through treatment. Some reduction in these parameters would be achieved via natural attenuation processes over an extended period of time, and if COCs are detected in water supply wells in the Lower 180-Foot Aquifer and wellhead treatment is implemented.	Would be easy to implement from a technical perspective because it only involves monitoring well installation and long-term MNA and reporting, for which the required equipment, skilled labor resources, permits and approvals would be readily available. However, would be difficult to implement from an administrative perspective (gaining regulatory approval/ community acceptance) because it would not comply with ARARs nor actively remediate the plumes, which are migrating offsite.	$0.56	$2.19	$2.75	Acceptance will be determined in the Proposed Plan and ROD. Not likely to be acceptable because it does not take action to achieve ACLs in a timely manner, and would not comply with ARARs nor actively remediate the plumes (except through natural attenuation over an extended period of time), which are migrating offsite. However, if a "non-attainment zone" is established for the duration that MNA would take to achieve ACLs and the other alternatives are determined in the remedial design phase to be technically or economically infeasible, this alternative may be acceptable.

Acronyms
ACL = aquifer cleanup level
ARARs = applicable or relevant and appropriate requirements
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
COC = chemical of concern
EPA = US Environmental Protection Agency
GWET = groundwater extraction and treatment
MNA = monitored natural attenuation
OU2 GWTS = Operable Unit 2 Groundwater Extraction and Treatment System
PRB = permeable reactive barrier
RAOs = remedial action objectives
ROD = Record of Decision
SOPs = standard operating procedures
T,M,V = toxicity, mobility, volume

Checked: MS
Approved: CJS

Table 4. Summary of Evaluation and Comparison of Remedial Alternatives
Feasibility Study, OUCTP RI/FS, Former Fort Ord, California

Remedial Alternative	EPA CERCLA Evaluation Criteria									
	Overall Protection of Human Health and the Environment	Compliance with ARARs	Short-Term Effectiveness	Long-Term Effectiveness and Permanence	Reduction of T, M, or V Through Treatment	Implementability	Capital Cost (millions)	O&M Cost (millions)	Total 30-Year NPV Cost (millions)	Regulatory and Community Acceptance
Remedial Alternative 2 In Situ Enhanced Biodegradation (A-Aquifer); Groundwater Extraction and Treatment Within OU2 GWTS (Upper 180-Foot Aquifer); Monitored Natural Attenuation with Wellhead Treatment Contingency (Lower 180-Foot Aquifer)	Would provide the greatest protection because it is expected to reduce groundwater COCs throughout the entire A-Aquifer plume to below ACLs within 15 years and the Upper 180-Foot Aquifer in a similar timeframe. Long-term monitoring would also be conducted with wellhead treatment contingency as under Alternative 1.	Would comply with chemical-specific and action-specific ARARs within the A-Aquifer and Upper 180-Foot Aquifer because ACLs could be achieved within 15 years. In the shorter term, however, a "non-attainment zone" may need to be established to comply with such ARARs in the Lower 180-Foot Aquifer which would rely on MNA.	Would be effective in the short term at achieving RAOs, and would be effective in the short term regarding its implementability. It would take approximately 6 months to install the lactate injection/ recirculation wells and implement the first injection within the A-Aquifer, and install an extraction well and tie-in to the OU2 GWTS within the Upper 180-Foot Aquifer. There would be potential risks to workers or the community; however, these procedures are frequently conducted according to approved SOPs.	Would have significant long-term effectiveness and permanence because it would actively remediate and contain the A-Aquifer and Upper 180-Foot Aquifer plumes. This alternative employs reliable risk controls throughout these plumes and wellhead treatment of water supply wells in the Lower 180-Foot Aquifer if COCs are detected in these wells.	Would actively reduce T,M,V of COCs and achieve reduction to below ACLs throughout the entire plume via in situ enhanced biodegradation treatment in the A-Aquifer, GWET in the Upper 180-Foot Aquifer, and natural attenuation processes throughout OUCTP and specifically in the Lower 180-Foot Aquifer, with additional reduction in this aquifer if COCs are detected in water supply wells and wellhead treatment is implemented.	Would require a moderate level of effort to implement from a technical perspective because it involves installation of several hundred injection points/recirculation wells and equipment, extraction wells, piping, and monitoring wells, as well as long-term treatment system operations and maintenance, and long-term MNA and reporting over a period of 30 years. However, the required equipment, skilled labor resources, permits and approvals would be readily available. Would be moderately easy to implement from an administrative perspective (gaining regulatory approval/ community acceptance) because it would provide the most protection and comply with ARARs through active remediation of the A-Aquifer and Upper 180-Foot Aquifer plumes using proven technologies, and would also include long-term MNA over a period of 30 years to assess the status of the all three aquifer plumes, as well as a contingency for wellhead treatment in the Lower 180-Foot Aquifer if COCs are detected in water supply wells.	$4.63	$4.91	$9.54	Acceptance will be determined in the Proposed Plan and ROD. Likely to be acceptable because it would protect human health and the environment; would comply with ARARs; and takes action both in the short and long term to achieve ACLs in both the A-Aquifer and Upper 180-Foot Aquifers, while including contingent wellhead treatment of water supply wells in the Lower 180-Foot Aquifer if COCs are detected in these wells.

Table 4. Summary of Evaluation and Comparison of Remedial Alternatives
Feasibility Study, OUCTP RI/FS, Former Fort Ord, California

Remedial Alternative	EPA CERCLA Evaluation Criteria									
	Overall Protection of Human Health and the Environment	Compliance with ARARs	Short-Term Effectiveness	Long-Term Effectiveness and Permanence	Reduction of T, M, or V Through Treatment	Implementability	Capital Cost (millions)	O&M Cost (millions)	Total 30-Year NPV Cost (millions)	Regulatory and Community Acceptance
Remedial Alternative 3 In Situ Permeable Reactive Barrier (PRB) (A-Aquifer); Groundwater Extraction and Treatment Within OU2 GWTS (Upper 180-Foot Aquifer); Monitored Natural Attenuation with Wellhead Treatment Contingency (Lower 180-Foot Aquifer)	Would provide protection over the long term because it is expected to reduce groundwater COCs throughout the majority of the A-Aquifer plume to below ACLs within 50 years and the Upper 180-Foot Aquifer within a shorter timeframe. Long-term monitoring would also be conducted with wellhead treatment contingency as under Alternative 1.	Would only comply with chemical-specific and action-specific ARARs within the A-Aquifer immediately downgradient of PRB in the short term, but would eventually comply over a period of 50 years. Would comply in the Upper 180-Foot Aquifer because plume capture could be achieved. In the shorter term, however, a "non-attainment zone" may need to be established to comply with such ARARs in the A-Aquifer and the Lower 180-Foot Aquifer which would rely on MNA.	Would not be effective in the short term at achieving RAOs, and would not be effective in the short term regarding its implementability. It would take approximately 2 years to conduct a pilot study to verify effectiveness and then install the PRB within the A-Aquifer. Would be effective in the short term to install an extraction well and tie-in to the OU2 GWTS within the Upper 180-Foot Aquifer. There would be potential risks to workers or the community; however, these procedures are frequently conducted according to approved SOPs.	A pilot study would be needed to verify effectiveness, injection techniques and barrier alignment. Would be somewhat effective in the long term because the PRB would actively remediate and contain the downgradient portion of A-Aquifer plume for a period of approximately 20 years. However, it is not anticipated to provide permanence because (1) the reactive materials only have an expected effective duration of 20 years compared to the 50 years anticipated to be required to achieve ACLs, and (2) it relies on natural attenuation processes to reduce COCs below ACLs in the majority of the plume that occurs upgradient of the PRB location.	Would actively reduce T,M,V of COCs within the downgradient portion of the A-Aquifer plume for a period of approximately 20 years (the expected effective lifespan of the PRB), and could achieve reduction to below ACLs within 50 years through in situ PRB treatment and natural attenuation processes. Would actively reduce T,M,V of COCs via GWET in the Upper 180-Foot Aquifer, and natural attenuation processes throughout OUCTP and specifically in the Lower 180-Foot Aquifer, with additional reduction in this aquifer if COCs are detected in water supply wells and wellhead treatment is implemented.	Would require a high level of effort to implement from a technical perspective because it involves conducting a field-scale pilot study to ascertain its site-specific effectiveness, followed by a full-scale installation of a deep barrier that must be tied into the underlying FO-SVA using specialized techniques and placement of iron materials using innovative slurry injection techniques. It also includes installation of an extraction wells and GWET for the Upper 180-Foot Aquifer, as well as long-term treatment system operations and maintenance, and long-term MNA and reporting for a period of 30 years. However, the required equipment, skilled labor resources, permits and approvals to implement this alternative are assumed to be available. This alternative is anticipated to be moderately difficult to implement from an administrative perspective (gaining regulatory approval/ community acceptance) because it (1) would only remediate groundwater and comply with ARARs in the portion of the plume immediately downgradient of the PRB in the short term, and (2) would not have long-term effectiveness and permanence due to the limited lifespan of the treatment media (approximately 20 years as compared to the 50 years estimated to be required to achieve ACLs based on groundwater modeling).	$8.73	$4.42	$13.15	Acceptance will be determined in the Proposed Plan and ROD. Unknown whether this alternative would be acceptable because it would only protect human health and comply with ARARs immediately downgradient of the PRB in the A-Aquifer in the short term. A pilot study would be required to verify its effectiveness. However, if a "non-attainment zone" is established for the duration of the period it would take to achieve ACLs in the A-Aquifer and the other A-Aquifer alternatives are determined in the remedial design phase to be technically or economically infeasible, this alternative may be acceptable. Would achieve ACLs in the Upper 180-Foot Aquifer via GWET, with wellhead treatment of water supply wells in the Lower 180-Foot Aquifer if COCs are detected in these wells.

Table 4. Summary of Evaluation and Comparison of Remedial Alternatives
Feasibility Study, OUCTP RI/FS, Former Fort Ord, California

Remedial Alternative	EPA CERCLA Evaluation Criteria									
	Overall Protection of Human Health and the Environment	**Compliance with ARARs**	**Short-Term Effectiveness**	**Long-Term Effectiveness and Permanence**	**Reduction of T, M, or V Through Treatment**	**Implementability**	**Capital Cost (millions)**	**O&M Cost (millions)**	**Total 30-Year NPV Cost (millions)**	**Regulatory and Community Acceptance**
Remedial Alternative 4 Groundwater Extraction and Treatment (A-Aquifer); Groundwater Extraction and Treatment Within OU 2 GWTS (Upper 180-Foot Aquifer); Monitored Natural Attenuation with Wellhead Treatment Contingency (Lower 180-Foot Aquifer)	Would provide significant protection because it is expected to reduce groundwater COCs throughout the majority of the A-Aquifer plume to below ACLs within 30 years and the Upper 180-Foot Aquifer in a similar timeframe. Long-term monitoring would also be conducted with wellhead treatment contingency as under Alternative 1.	Would comply with chemical-specific and action-specific ARARs within the majority of the A-Aquifer and entire Upper 180-Foot Aquifer because ACLs could be achieved within 30 years. In the shorter term, however, a "non-attainment zone" may need to be established to comply with such ARARs in the downgradient uncaptured portion of the A-Aquifer plume and the Lower 180-Foot Aquifer which would rely on MNA.	Would be effective in the short term at achieving RAOs except in the downgradient portion of the A-Aquifer plume, and would be effective in the short term regarding its implementability. It would take approximately 4 months to install the extraction wells and treatment system in the A-Aquifer, and install an extraction well and tie-in to the OU2 GWTS within the Upper 180-Foot Aquifer. There would be potential risks to workers or the community; however, these procedures are frequently conducted according to approved SOPs.	Would have significant long-term effectiveness and permanence because it would actively remediate and contain the A-Aquifer and Upper 180-Foot Aquifer plumes. This alternative employs reliable risk controls throughout these plumes and wellhead treatment of water supply wells in the Lower 180-Foot Aquifer if COCs are detected in these wells.	Would actively reduce T,M,V of COCs and achieve reduction to below ACLs throughout the entire plume via GWET in the A-Aquifer and Upper 180-Foot Aquifer, and natural attenuation processes in the Lower 180-Foot Aquifer, with additional reduction in this aquifer if COCs are detected in water supply wells and wellhead treatment is implemented.	Would require a moderate level of effort to implement from a technical perspective because it involves installation of horizontal extraction wells piped beneath a road, and construction of treatment system, piping, and monitoring wells, as well as long-term treatment system operations and maintenance, and long-term MNA and reporting over a period of 30 years. However, the required equipment, skilled labor resources, permits and approvals would be readily available. Would be moderately easy to implement from an administrative perspective (gaining regulatory approval/ community acceptance) because it would provide protection and comply with ARARs throughout the majority of the A-Aquifer active and entire Upper 180-Foot Aquifer plumes using proven technologies, and would also include long-term MNA over a period of 30 years to assess the status of the all three aquifer plumes, as well as a contingency for wellhead treatment in the Lower 180-Foot Aquifer if COCs are detected in water supply wells.	$2.38—$2.46	$11.07—$17.47	$13.45—$19.93	Acceptance will be determined in the Proposed Plan and ROD. Likely to be acceptable because it would protect human health and the environment; would comply with ARARs; and takes action both in the short and long term to achieve ACLs in both the majority of the A-Aquifer and entire Upper 180-Foot Aquifer, while including contingent wellhead treatment of water supply wells in the Lower 180-Foot Aquifer if COCs are detected in these wells.