

**APPENDIX F – GREEN REMEDIAL EVALUATION**

**FINAL FEASIBILITY STUDY REPORT  
CASMALIA RESOURCES SUPERFUND SITE  
CASMALIA, CALIFORNIA**



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## 1.0 Green Remedial Evaluation for FS Area Remedial Alternatives

Green remedial evaluation is included in this FS consistent with United States Environmental Protection Agency (USEPA) Principles of Greener Cleanups (USEPA, 2009) and USEPA's Superfund Green Remediation Strategy (USEPA 2010). Sustainable or green remediation is the practice of weighing environmental, economic and social indicators so that an acceptable balance exists between the effects of undertaking remediation activities and the benefits that those activities deliver. Conducting remediation to render the land suitable for any purpose no matter how sensitive has major green and sustainability flaws and does not typically result in the greatest net environmental benefit. The solution proposed should be an approach that clearly emerges following an assessment of overall benefits, costs and all environmental impacts, value and circumstances of the property, community needs and views, and other relevant issues.

In April 2008, the USEPA issued a Technology Primer addressing the emerging practice of green remediation. In the Primer, green remediation is defined as “the practice of considering all environmental effects of remedy implementation and incorporating options to maximize net environmental benefit of cleanup actions” (USEPA, 2008b). The Primer also states that “green remediation strategies offer significant potential for increasing the net benefit of cleanup, saving project costs, and expanding the universe of long-term property use or reuse options without compromising cleanup goals.” Included in the Primer are a number of Best Management Practices and case studies. The Primer also identifies core elements of green remediation projects that are listed below.

- Energy requirements of the treatment system
- Air emissions
- Water requirements and impacts on water resources
- Land and ecosystem impacts
- Material consumption and waste generation

### 1.1 Green Remedial Evaluation and Criteria

Tables F-1 through F-7 present the green remedial evaluation for FS Areas 1 through 5. The tables list the remedial alternatives that are undergoing detailed analysis in Section 11 on the left side with individual columns that represent the green remedial criteria as listed below:

- Greenhouse gas emissions
- Energy usage
- Air emissions
- Collateral risk
- Community Impacts
- Resources Lost
- Water Usage

The evaluation is presented in a qualitative manner with resulting ratings for each of the above criterion. The ratings used range from “low” meaning low green assessment impacts to “high” or

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“very high” meaning high impacts. There are a total of six steps in the ratings: low, low to medium, medium, medium to high, high and very high. The resulting ratings from this table are used to input an average rating for green assessment in the detailed remedial alternative analysis (Tables 11-2 through 11-6C). Area 5 evaluation is divided into three parts: 1) Area 5 North; 2) Area 5 South; and, 3) Area 5 West.

Tables F-1 through F-7 also present “impact drivers” for each criterion. For example, for a capping alternative, the impact driver will relate to the area being capped and hence the area to be covered with geosynthetic liners. The impact drivers are also influenced by the cap design and thickness and hence the volume of soil cover needed. The location for borrow soil to construct the cap is also a potential impact driver. For excavation, the impact drivers would be the volume of soil, depth of excavation, the types of equipment needed, the amount of soil for disposal, and if offsite transportation of waste soils is needed. For groundwater or leachate extraction, the impact drivers would be the extraction flow rate, the specific treatment technologies, volumes of waste for offsite disposal, etc. These impact drivers help with obtaining a representative rating for each criterion.

## 1.2 References

- USEPA 2009 Principles for Greener Cleanups, Office of Solid Waste and Emergency Response (OSWER), US EPA, August 2009
- USEPA 2010 Superfund Green Remediation Strategy, US EPA, September 2010.
- USEPA 2008 Green Remediation: BMPs for Excavation and Surface Restoration, OSWER, US EPA, December 2008
- USEPA 2010 Green Remediation BMPs: Clean Fuel and Emission Technologies for Site Cleanup, OSWER, US EPA August 2010
- USEPA 2011 Green Remediation BMPs: Integrating Renewable Energy Into Site Cleanup, OSWER, US EPA April 2011
- USEPA 2012 Methodology for Understanding and Reducing a Project’s Environmental Footprint, US EPA, EPA 542-R-12-002, February 2012.

**Table F-1  
Green Remediation Evaluation  
FS Area 1 – PCB Landfill, Burial Trench Area (BTA), Central Drainage Area (CDA)**

Alt	Alternative Description	Impact Assessment	GHG Emissions	Energy Usage	Air Emissions	Collateral Risk	Community Impacts	Resources Lost	Water Usage
1	No Action	Relative Impact	None	None	None	None	None	None	None
		Impact Drivers	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2	RCRA-Equivalent Mono Soil Cap (BTA, CDA)(5') + RCRA Cap (PCB Landfill) + Stormwater Controls+ ICs + Monitoring	Relative Impact	Medium	Medium	Medium	Low to Medium	Low	Medium	High
		Impact Drivers	- Grading of 250,000 cy - Borrow soil/compaction for caps of 250,000 cy - Materials manufacture, transport, installation (4.4 acres HDPE, GCL liner)	- Fuel used in transportation of borrow soils and equipment - Fuel used in generators for electrical equipment - Temporary power for lighting or other equipment or instrumentation	-Grading of 250,000 cy -Borrow soil/compaction for caps of 250,000 cy -Materials manufacture, transport, installation (4.4 acres HDPE, GCL liner)	- Risk related to heavy earthmoving equipment work with dozers, compactors - Transportation of borrow soil from adjacent NW Borrow Area	- Limited impacts because no significant amount of export or import of soil transported from long distances - 4.4 acres of HDPE and GCL and earthmoving equipment would be trucked in	- Offsite borrow soil use, energy and water usage	- Because the clay moncap is 5' thick, will require more compaction and adequate moisture to achieve permeability performance standard - Onsite pond water will be used. Limited use of other municipal or well water for some applications
3	Evapotranspirative (ET) Cap (BTA, CDA)(5') + RCRA Cap (PCB Landfill) + Stormwater Controls+ ICs + Monitoring	Relative Impact	Medium	Medium	Medium	Low to Medium	Low	Medium	High
		Impact Drivers	- Grading of 250,000 cy - Borrow soil/compaction for caps of 250,000 cy - Materials manufacture, transport, installation (4.4 acres HDPE, GCL liner)	- Fuel used in transportation of borrow soils and equipment - Fuel used in generators for electrical equipment - Temporary power for lighting or other equipment or instrumentation	-Grading of 250,000 cy -Borrow soil/compaction for caps of 250,000 cy -Materials manufacture, transport, installation (4.4 acres HDPE, GCL liner)	- Risk related to heavy earthmoving equipment work with dozers, compactors - Transportation of borrow soil from adjacent NW Borrow Area	- Limited impacts because no significant amount of export or import of soil transported from long distances - 4.4 acres of HDPE and GCL and earthmoving equipment would be trucked in	- Offsite borrow soil use, energy and water usage	- Because the ET cap is 5' thick, will require more compaction and adequate moisture to achieve permeability performance standard - Onsite pond water will be used. Limited use of other municipal or well water for some applications
4	RCRA Cap (PCB Landfill, BTA, CDA) + Stormwater Controls + ICs + Monitoring	Relative Impact	Medium	Medium	Medium	Low to Medium	Low	Medium	Medium to High
		Impact Drivers	- Grading of 250,000 cy - Borrow soil/compaction for caps of 200,000 cy - Materials manufacture, transport, installation (28 acres HDPE, GCL liner)	- Fuel used in transportation of borrow soils and equipment - Fuel used in generators for electrical equipment - Temporary power for lighting or other equipment or instrumentation	-Grading of 250,000 cy -Borrow soil/compaction for caps of 200,000 cy -Materials manufacture, transport, installation (28 acres HDPE, GCL liner)	- Risk related to heavy earthmoving equipment work with dozers, compactors - Transportation of borrow soil from adjacent NW Borrow Area	- Limited impacts because no significant amount of export or import of soil transported from long distances -4.4 acres of HDPE and GCL and earthmoving equipment would be trucked in	- Offsite borrow soil, energy and water usage	- Onsite pond water will be used. Limited use of other municipal or well water for some applications - Slightly reduced water usage compared to RCRA equivalent 5-foot soil cap
5	Excavate (Entire BTA)(20') + Excavate (CDA remedial area)(5') + RCRA-Equivalent Mono Soil Cap (BTA, CDA)(5') + RCRA Cap (PCB Landfill) + Dispose Excavated Soil Offsite + Stormwater Controls+ ICs + Monitoring	Relative Impact	High	High	High	High	High	Moderate to High	High
		Impact Drivers	- Excavation of 230,000 cy, - Grading of 130,000 cy - Borrow soil/compaction for caps of 350,000 cy - Materials manufacture, transport, installation (4.4 acres HDPE, GCL liner)	- Fuel used in transportation of borrow soils and equipment - Fuel used in generators for electrical equipment - Temporary power for lighting or other equipment or instrumentation	-Excavation of 230,000 cy, -Grading of 130,000 cy -Borrow soil/compaction for caps of 350,000 cy - Materials manufacture, transport, installation (4.4 acres HDPE, GCL liner)	- Risks related to transportation of wastes to offsite landfill - Risks related to potential exposure to site workers from excavated trench wastes	- Disturbance due to high truck traffic with offsite disposal for some or all excavated wastes - Potential odors and contaminated run off from contaminated dirt in trucks	- Landfill space lost with offsite disposal - Offsite borrow soil, energy and water usage	- Because of the large excavation and the backfill would be a clay moncap that will require more compaction and adequate moisture to achieve permeability standard - Onsite pond water will be used.

**NOTES**

- Equipment operating onsite for cap construction include Caterpillar 14G Blade motor grader (fine grading), Caterpillar D6 Dozer with 84" drum sheeps foot roller, 824 compactor (combined dozer and compactor), 3 water trucks 4,000 gallons each and for excavation Caterpillar D10 dozer with rippers and puddle scrapers.



**Table F-2  
Green Remediation Evaluation  
FS Area 2 – RCRA Canyon, West Canyon Spray Area (WCSA)**

Alternative Number	Alternative Description	Impact Assessment	GHG Emissions	Energy Usage	Air Emissions	Collateral Risk	Community Impacts	Resources Lost	Water Usage
1	No Action	Relative Impact	None	None	None	None	None	None	None
		Impact Drivers	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2	Eco-cap (Westslope RCRA Canyon, WCSA remedial area)(2') + Grading/BMPs (Uncapped Areas) + Stormwater Controls + ICs + Monitoring	Relative Impact	Low to Medium	Low to Medium	Low to Medium	Low to Medium	Low	Medium	Medium
		Impact Drivers	- Grading of 130,000 cy - Borrow soil/compaction for caps of 49,000 cy - Materials manufacture, transport, installation (biotic barrier, jute mesh, TRMs) - Grading/BMPs for 19 acres	- Fuel used in transportation of borrow soils and equipment - Fuel used in generators for electrical equipment - Temporary power for lighting or other equipment or instrumentation	-Grading of 130,000 cy -Borrow soil/compaction for caps of 49,000 cy - Materials manufacture, transport, installation (biotic barrier, jute mesh, TRMs) for 13.7 acres - Grading/BMPs for 19 acres	- Risk related to heavy earthmoving equipment work with dozers, compactors - Transportation of borrow soil from adjacent NW Borrow Area	- Limited impacts because no significant amount of export or import of soil transported from long distances - Biotic barrier, jute mesh, and TRMs would be trucked in	- Offsite borrow soil use, energy and water usage	- Onsite pond water will be used. Limited use of other municipal or well water for some applications
3	RCRA-Equivalent Mono Soil Cap (Westslope RCRA Canyon)(5') + Excavation (WCSA remedial area)(5') + Grading/BMPs (Uncapped Areas) + Stormwater Controls + ICs + Monitoring	Relative Impact	Medium	Medium	Medium	Medium	Medium	Medium	Medium to High
		Impact Drivers	- Grading of 100,000 cy - Excavation of 44,000 cy - Borrow soil/compaction for caps of 123,000 cy - Materials manufacture, transport, installation (jute mesh, TRMs) - Grading/BMPs for 19 acres	- Fuel used in transportation of borrow soils and equipment - Fuel used in generators for electrical equipment - Temporary power for lighting or other equipment or instrumentation	- Grading of 100,000 cy - Excavation of 44,000 cy - Borrow soil/compaction for caps of 123,000 cy - Materials manufacture, transport, installation (jute mesh, TRMs) - Grading/BMPs for 19 acres	- Risk related to heavy earthmoving equipment work with dozers, compactors - Transportation of borrow soil from adjacent - Risks related to potential exposure to site workers from excavated trench wastes	- Disturbance due to truck traffic with borrow soil for caps and backfill - Potential odors and contaminated run off from contaminated dirt in trucks - Jute mesh, TRMs would be trucked in	- Landfill space lost with offsite disposal - Offsite borrow soil, energy and water usage	- Because the clay monocab is 5' thick, will require more compaction and adequate moisture to achieve permeability performance standard - Construction of larger evaporation pond (+ 3 acres)
4	RCRA-Equivalent Mono Soil Cap (Westslope RCRA Canyon, WCSA remedial area)(5') + Grading/BMPs (Uncapped Areas) + Stormwater Controls + ICs + Monitoring	Relative Impact	Medium	Medium	Medium	Medium	Medium	Medium	Medium to High
		Impact Drivers	- Grading of 130,000 cy - Borrow soil/compaction for caps of 123,000 cy - Materials manufacture, transport, installation (TRMs) - Grading/BMPs for 19 acres	- Fuel used in transportation of borrow soils and equipment - Fuel used in generators for electrical equipment - Temporary power for lighting or other equipment or instrumentation	- Grading of 130,000 cy - Borrow soil/compaction for caps of 123,000 cy - Materials manufacture, transport, installation (biotic barrier, TRMs) - Grading/BMPs for 19 acres	- Risk related to heavy earthmoving equipment work with dozers, compactors - Transportation of borrow soil from adjacent NW Borrow Area	- Disturbance due to truck traffic with borrow soil for caps - Jute mesh, TRMs would also be trucked in	- Offsite borrow soil use, energy and water usage	- Because the clay monocab is 5' thick, will require more compaction and adequate moisture to achieve permeability performance standard - Onsite pond water will be used. Limited use of other municipal or well water for some applications - Construction of larger evaporation pond (+ 3 acres)
5	RCRA-Equivalent Mono Soil Cap (Westslope RCRA Canyon)(5') + Excavation (WCSA remedial	Relative Impact	Medium to High	Medium to High	Medium to High	Medium to High	Medium	Medium to High	Medium to High

**Table F-2  
Green Remediation Evaluation  
FS Area 2 – RCRA Canyon, West Canyon Spray Area (WCSA)**

Alternative Number	Alternative Description	Impact Assessment	GHG Emissions	Energy Usage	Air Emissions	Collateral Risk	Community Impacts	Resources Lost	Water Usage
	area)(5') + Clean Soil Cover (Uncapped Areas)(2') + Stormwater Controls + ICs + Monitoring	Impact Drivers	<ul style="list-style-type: none"> <li>- Grading of 100,000 cy</li> <li>- Excavation of 44,000 cy</li> <li>- Borrow soil/compaction for caps of 210,000 cy</li> <li>- Materials manufacture, transport, installation (jute mesh, TRMs)</li> </ul>	<ul style="list-style-type: none"> <li>- Fuel used in transportation of borrow soils and equipment</li> <li>- Fuel used in generators for electrical equipment</li> <li>- Temporary power for lighting or other equipment or instrumentation</li> </ul>	<ul style="list-style-type: none"> <li>- Grading of 100,000 cy</li> <li>- Excavation of 44,000 cy</li> <li>- Borrow soil/compaction for caps of 210,000 cy</li> <li>- Materials manufacture, transport, installation (jute mesh, TRMs)</li> </ul>	<ul style="list-style-type: none"> <li>- Risk related to heavy earthmoving equipment work with dozers, compactors</li> <li>- Transportation of borrow soil from adjacent NW Borrow Area</li> <li>- Risks related to transportation of wastes to offsite landfill</li> <li>- Risks related to potential exposure to site workers from excavated trench wastes</li> </ul>	<ul style="list-style-type: none"> <li>- Disturbance due to high truck traffic with offsite borrow soil transport</li> <li>- Potential odors and contaminated run off from contaminated dirt in trucks –</li> <li>- TRMs would be trucked in</li> </ul>	<ul style="list-style-type: none"> <li>- Offsite borrow soil, energy and water usage</li> </ul>	<ul style="list-style-type: none"> <li>- Because the clay monocab is 5' thick, will require more compaction and adequate moisture to achieve permeability performance standard</li> <li>- Water also needed for clean soil cover for uncapped areas</li> <li>- Onsite pond water will be used. Limited use of other municipal or well water for some applications</li> </ul>
6	RCRA-Equivalent Hybrid Cap (Westslope RCRA Canyon) + Excavation (WCSA remedial area) + Clean Soil Cover (Uncapped Areas)(2') + Stormwater Controls + ICs + Monitoring	Relative Impact	Medium to High	Medium to High	Medium to High	Medium	Medium	Medium	Medium to High
		Impact Drivers	<ul style="list-style-type: none"> <li>- Grading of 275,000 cy</li> <li>- Borrow soil/compaction for caps of 140,000 cy</li> <li>- Materials manufacture, transport, installation (HDPE liner, geocomposite drainage layer, jute mesh, TRMs) for 13.8 acres</li> <li>- Grading/BMPs for 19 acres</li> </ul>	<ul style="list-style-type: none"> <li>- Fuel used in transportation of borrow soils and equipment</li> <li>- Fuel used in generators for electrical equipment</li> <li>- Temporary power for lighting or other equipment or instrumentation</li> </ul>	<ul style="list-style-type: none"> <li>- Grading of 275,000 cy</li> <li>- Borrow soil/compaction for caps of 140,000 cy</li> <li>- Materials manufacture, transport, installation (HDPE liner, geocomposite drainage layer, jute mesh, TRMs) for 13.8 acres</li> <li>- Grading/BMPs for 19 acres</li> </ul>	<ul style="list-style-type: none"> <li>- Risk related to heavy earthmoving equipment work with dozers, compactors</li> <li>- Transportation of borrow soil from adjacent NW Borrow Area</li> </ul>	<ul style="list-style-type: none"> <li>- Limited impacts because no significant amount of export or import of soil transported from long distances</li> <li>- HDPE membrane, geocomposite liner, TRMs would also be trucked in</li> </ul>	<ul style="list-style-type: none"> <li>- Offsite borrow soil use, energy and water usage</li> </ul>	<ul style="list-style-type: none"> <li>- Because the vegetative soil layer covers a small area (13.8 acres)</li> <li>- Onsite pond water will be used. Limited use of other municipal or well water for some applications</li> <li>- Construction of larger evaporation pond (+ 3 acres)</li> </ul>
7	ET Cap (Westslope RCRA Canyon)(5') + Excavation (WCSA remedial area)(5') + Clean Soil Cover (Uncapped Areas)(2') + Stormwater Controls + ICs + Monitoring	Relative Impact	Medium to High	Medium to High	Medium to High	Medium to High	Medium	Medium to High	Medium to High
		Impact Drivers	<ul style="list-style-type: none"> <li>- Grading of 250,000 cy</li> <li>- Excavation of 44,000 cy</li> <li>- Borrow soil/compaction for caps of 210,000 cy</li> <li>- Materials manufacture, transport, installation (jute mesh, TRMs) for 19 acres</li> </ul>	<ul style="list-style-type: none"> <li>- Fuel used in transportation of borrow soils and equipment</li> <li>- Fuel used in generators for electrical equipment</li> <li>- Temporary power for lighting or other equipment or instrumentation</li> </ul>	<ul style="list-style-type: none"> <li>- Grading of 100,000 cy</li> <li>- Excavation of 44,000 cy</li> <li>- Borrow soil/compaction for caps of 210,000 cy</li> <li>- Materials manufacture, transport, installation (jute mesh, TRMs) for 19 acres</li> </ul>	<ul style="list-style-type: none"> <li>- Risk related to heavy earthmoving equipment work with dozers, compactors</li> <li>- Transportation of borrow soil from adjacent NW Borrow Area</li> <li>- Risks related to transportation of wastes to offsite landfill</li> <li>- Risks related to potential exposure to site workers from excavated trench wastes</li> </ul>	<ul style="list-style-type: none"> <li>- Disturbance due to high truck traffic with offsite borrow soil transport</li> <li>- Potential odors and contaminated run off from contaminated dirt in trucks –</li> <li>- TRMs would be trucked in</li> </ul>	<ul style="list-style-type: none"> <li>- Offsite borrow soil, energy and water usage</li> </ul>	<ul style="list-style-type: none"> <li>- Because the ET cap is 1' compacted clay and 4' vegetative layer with clay. More compaction for clay layer and significant amount of amendments needed for vegetative layer.</li> <li>- Water also needed for clean soil cover for uncapped areas</li> <li>- Onsite pond water will be used. Limited use of other municipal or well water for some applications</li> </ul>
8	RCRA-Equivalent Hybrid Cap (entire RCRA Canyon, WCSA remedial area) + Storm water Controls + ICs + Monitoring	Relative Impact	High	High	High	High	High	Medium to High	High
		Impact Drivers	<ul style="list-style-type: none"> <li>- Grading of 400,000 cy</li> <li>- Borrow soil/compaction for caps of 120,000 cy</li> <li>- Materials manufacture, transport, installation (HDPE liner, geocomposite drainage layer) for 33 acres</li> </ul>	<ul style="list-style-type: none"> <li>- Fuel used in transportation of borrow soils and equipment</li> <li>- Fuel used in generators for electrical equipment</li> <li>- Temporary power for lighting or other equipment or</li> </ul>	<ul style="list-style-type: none"> <li>- Grading of 400,000 cy</li> <li>- Borrow soil/compaction for caps of 120,000 cy</li> <li>- Materials manufacture, transport, installation (HDPE liner, geocomposite drainage layer) for 33 acres</li> </ul>	<ul style="list-style-type: none"> <li>- Risk related to heavy earthmoving equipment work with dozers, compactors</li> <li>- Transportation of borrow soil from adjacent NW Borrow Area</li> </ul>	<ul style="list-style-type: none"> <li>- Limited impacts because no significant amount of export or import of soil transported from long distances</li> <li>- HDPE membrane, geotextile composite, and TRMs would be trucked in</li> </ul>	<ul style="list-style-type: none"> <li>- Offsite borrow soil use, energy and water usage</li> </ul>	<ul style="list-style-type: none"> <li>- Because the cap covers the entire RCRA Canyon and WCSA (33 acres) and would require a large amount of water</li> <li>- Onsite pond water will be used. Limited use of other municipal or well water for</li> </ul>

**Table F-2  
Green Remediation Evaluation  
FS Area 2 – RCRA Canyon, West Canyon Spray Area (WCSA)**

Alternative Number	Alternative Description	Impact Assessment	GHG Emissions	Energy Usage	Air Emissions	Collateral Risk	Community Impacts	Resources Lost	Water Usage
			- 16,000 feet of surface drains	instrumentation					some applications
9	ET Cap (entire RCRA Canyon, WCSA remedial area) + Storm water Controls + ICs + Monitoring	Relative Impact	High	High	High	High	High	Medium to High	High
		Impact Drivers	- Grading of 280,000 cy - Borrow soil/compaction for caps of 300,000 cy - Materials manufacture, transport, installation (TRMs) for 33 acres - 16,000 feet of surface drains	- Fuel used in transportation of borrow soils and equipment - Fuel used in generators for electrical equipment - Temporary power for lighting or other equipment or instrumentation	- Grading of 280,000 cy - Borrow soil/compaction for caps of 300,000 cy - Materials manufacture, transport, installation (HDPE liner, geocomposite drainage layer) for 33 acres - 16,000 feet of surface drains	- Risk related to heavy earthmoving equipment work with dozers, compactors - Transportation of borrow soil from adjacent NW Borrow Area	- Limited impacts because no significant amount of export or import of soil transported from long distances - HDPE membrane, geotextile composite, and TRMs would be trucked in	- Offsite borrow soil use, energy and water usage	- Because the cap covers the entire RCRA Canyon and WCSA (33 acres) and would require a large amount of water for compacted clay layer and vegetative layer - Onsite pond water will be used. Limited use of other municipal or well water for some applications

**NOTES**

1. Equipment operating onsite for cap construction include Caterpillar 14G Blade motor grader (fine grading), Caterpillar D6 Dozer with 84" drum sheeps foot roller, 824 compactor (combined dozer and compactor), 3 water trucks 4,000 gallons each and for excavation Caterpillar D10 dozer with rippers and puddle scrapers.



**Table F-3  
Green Remediation Evaluation  
FS Area 3 – Former Pond and Pads, Roadways, Remaining Onsite Areas, Maintenance Shed Area, Liquids Treatment Area  
Hotspot Locations 1, 2, 3, 4 and 10**

Alternative Number	Alternative Description	Impact Assessment	GHG Emissions	Energy Usage	Air Emissions	Collateral Risk	Community Impacts	Resources Lost	Water Usage
1	No Action	Relative Impact	None	None	None	None	None	None	None
		Impact Drivers	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2	RCRA Prescriptive Cap (Locations 2, 3 and 4) + Asphalt Cap(Location 1) + Groundwater Monitoring (Location 10) + Grading/BMPs (Uncapped Areas) + Storm water Controls + ICs + Monitoring	Relative Impact	Medium	Medium	Medium	Medium	Medium	Medium	Medium
		Impact Drivers	- Excavation of 8,000 cy, - Grading of 60,000 cy - Borrow soil/compaction for caps of 48,000 cy - Materials manufacture, transport, installation (6.6 acres HDPE, GCL liner)	- Fuel used in transportation of borrow soils and equipment - Fuel used in generators for electrical equipment - Temporary power for lighting or other equipment or instrumentation	- Excavation of 8,000 cy, - Grading of 60,000 cy - Borrow soil/compaction for caps of 48,000 cy - Materials manufacture, transport, installation (6.6 acres HDPE, GCL liner)	- Risk related to heavy earthmoving equipment work with dozers, compactors - Transportation of borrow soil from adjacent NW Borrow Area - Risks related to potential exposure to site workers from excavated trench wastes	- Disturbance due to moderate truck traffic from import of borrow soil - Potential odors and contaminated run off from contaminated dirt in trucks	- Offsite borrow soil, energy and water usage	- Onsite pond water will be used. Limited use of other municipal or well water for some applications
3	RCRA Cap (Location 2) + Excavate ((Location 3)(20'); (Location 4)(5')) + Excavate/New Asphalt Cap (Location 1)(5') + GW Monitoring (Location 10) + Grading/BMPs (Uncapped Areas) + Stormwater Controls + ICs + Monitoring	Relative Impact	Medium	Medium	Medium	Medium	Medium	Medium	Medium
		Impact Drivers	- Excavation of 92,000 cy, - Grading of 17,000 cy - Borrow soil/compaction for caps of 20,000 cy - Materials manufacture, transport, installation (2.8 acres HDPE, GCL liner)	- Fuel used in transportation of borrow soils and equipment - Fuel used in generators for electrical equipment - Temporary power for lighting or other equipment or instrumentation	- Excavation of 92,000 cy, - Grading of 17,000 cy - Borrow soil/compaction for caps of 20,000 cy - Materials manufacture, transport, installation (2.8 acres HDPE, GCL liner)	- Risk related to heavy earthmoving equipment work with dozers, compactors - Transportation of borrow soil from adjacent NW Borrow Area - Risks related to potential exposure to site workers from excavated trench wastes	- Disturbance due to moderate truck traffic from import of borrow soil - Potential odors and contaminated run off from contaminated dirt in trucks	- Offsite borrow soil, energy and water usage	- Onsite pond water will be used. Limited use of other municipal or well water for some applications
4	RCRA Cap (Location 2) + Excavate ((Location 3)(20'); (Location 4)(5'); (Location 10)(50'))/Place in PCB Landfill/Backfill + Excavate/New Asphalt Cap (Location 1)(5') + Grading/BMPs (Uncapped Areas) + Stormwater Controls + ICs + Monitoring	Relative Impact	Medium to High	Medium to High	Medium to High	Medium	Medium	Medium	Medium to High
		Impact Drivers	- Excavation of 157,000 cy, - Grading of 17,000 cy - Borrow soil/compaction for caps of 20,000 cy - Materials manufacture, transport, installation (2.8 acres HDPE, GCL liner)	- Fuel used in transportation of borrow soils and equipment - Fuel used in generators for electrical equipment - Temporary power for lighting or other equipment or instrumentation	- Excavation of 157,000 cy, - Grading of 17,000 cy - Borrow soil/compaction for caps of 20,000 cy - Materials manufacture, transport, installation (2.8 acres HDPE, GCL liner)	- Risk related to heavy earthmoving equipment work with dozers, compactors - Transportation of borrow soil from adjacent NW Borrow Area - Risks related to potential exposure to site workers from excavated trench wastes	- Disturbance due to moderate truck traffic from import of borrow soil - Potential odors and contaminated run off from contaminated dirt in trucks	- Offsite borrow soil, energy and water usage	- Onsite pond water will be used. Limited use of other municipal or well water for some applications

**Table F-3**  
**Green Remediation Evaluation**  
**FS Area 3 – Former Pond and Pads, Roadways, Remaining Onsite Areas, Maintenance Shed Area, Liquids Treatment Area**  
**Hotspot Locations 1, 2, 3, 4 and 10**

Alternative Number	Alternative Description	Impact Assessment	GHG Emissions	Energy Usage	Air Emissions	Collateral Risk	Community Impacts	Resources Lost	Water Usage
5	Excavate (Locations 1,2,4)( 5'); Location (3, 20'); (Location 10, 50')/offsite disposal + Backfill/Clean soil cap + Stormwater Controls + ICs + Monitoring	Relative Impact	High	High	High	High	High	High	High
		Impact Drivers	<ul style="list-style-type: none"> <li>- Excavation of 200,000 cy,</li> <li>- Grading of 130,000 cy</li> <li>- Borrow soil/compaction for caps of 220,000 cy</li> <li>- Transport of 190,000 tons of soils about 120 miles to Buttonwillow</li> </ul>	<ul style="list-style-type: none"> <li>- Fuel used in transportation of borrow soils and equipment</li> <li>- Fuel used in generators for electrical equipment</li> <li>- Temporary power for lighting or other equipment or instrumentation</li> </ul>	<ul style="list-style-type: none"> <li>- Excavation of 200,000 cy,</li> <li>- Grading of 130,000 cy</li> <li>- Borrow soil/compaction for caps of 220,000 cy</li> <li>- Transport of 190,000 tons of soils about 120 miles to Buttonwillow</li> </ul>	<ul style="list-style-type: none"> <li>- Risk related to heavy earthmoving equipment work with dozers, compactors</li> <li>- Transportation of borrow soil from adjacent NW Borrow Area</li> <li>- Risks related to transportation of wastes to offsite landfill</li> <li>- Risks related to potential exposure to site workers from excavated trench wastes</li> </ul>	<ul style="list-style-type: none"> <li>- Disturbance due to high truck traffic with offsite disposal for some or all excavated wastes</li> <li>- Potential odors and contaminated run off from contaminated dirt in trucks</li> </ul>	<ul style="list-style-type: none"> <li>- Landfill space lost with offsite disposal</li> <li>- Offsite borrow soil, energy and water usage</li> </ul>	<ul style="list-style-type: none"> <li>- Onsite pond water will be used. Limited use of other municipal or well water for some applications</li> </ul>

**NOTES**

1. Equipment operating onsite for cap construction include Caterpillar 14G Blade motor grader (fine grading), Caterpillar D6 Dozer with 84" drum sheeps foot roller, 824 compactor (combined dozer and compactor), 3 water trucks 4,000 gallons each and for excavation Caterpillar D10 dozer with rippers and puddle scrapers.

**Table F-4  
Green Remediation Evaluation  
FS Area 4 – Stormwater Ponds and Treated Liquid Impoundments - Ponds RCF, A-Series, 18, A-5, 13**

Alternative Number	Alternative Description	Impact Assessment	GHG Emissions	Energy Usage	Air Emissions	Collateral Risk	Community Impacts	Resources Lost	Water Usage
1	No Action	Relative Impact	None	None	None	None	None	None	None
		Impact Drivers	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2	Eco-cap (RCF Pond, A-Series Pond) (2') + New 11-acre Evaporation Pond (North of RCF Pond) + RCRA Prescriptive Cap (Pond 18) + Lined Retention Basins (Pond A-5, Pond 13) + Stormwater Controls + ICs + Monitoring	Relative Impact	Medium to High	Medium to High	Medium to High	Medium	Medium to High	Medium	Medium to High
		Impact Drivers	- Grading or excavation of 120,000 cy - Borrow soil/compaction for caps of 300,000 cy - Materials manufacture, transport, installation (43 acres HDPE, GCL liner, biotic barrier)	- Fuel used in transportation of borrow soils and equipment - Fuel used in generators for electrical equipment - Temporary power for lighting or other equipment or instrumentation	- Grading or excavation of 120,000 cy - Borrow soil/compaction for caps of 300,000 cy - Materials manufacture, transport, installation (43 acres HDPE, GCL liner, biotic barrier)	- Risk related to heavy earthmoving equipment work with dozers, compactors - Transportation of borrow soil from adjacent NW Borrow Area - Risks related to transportation of wastes to offsite landfill - Risks related to potential exposure to site workers from excavated trench wastes	- Disturbance due to high truck traffic with offsite disposal for some or all excavated wastes - Potential odors and contaminated run off from contaminated dirt in trucks - Biotic barrier, TRMs would be trucked in	- Offsite borrow soil, energy and water usage	- Onsite pond water will be used. Limited use of other municipal or well water for some applications
3	Eco-cap (RCF Pond, Segregate East RCF)(2') + Lined Evaporation Pond (A-Series Pond) + RCRA Cap (Pond 18) + Lined Retention Basins (Pond A-5, 13) + Stormwater controls + ICs + Monitoring	Relative Impact	Medium	Medium	Medium	Medium	Medium	Medium	Medium
		Impact Drivers	- Grading or excavation of 43,000 cy - Borrow soil/compaction for caps of 175,000 cy - Materials manufacture, transport, installation (34 acres HDPE, GCL liner, biotic barrier)	- Fuel used in transportation of borrow soils and equipment - Fuel used in generators for electrical equipment - Temporary power for lighting or other equipment or instrumentation	- Grading or excavation of 43,000 cy - Borrow soil/compaction for caps of 175,000 cy - Materials manufacture, transport, installation (34 acres HDPE, GCL liner, biotic barrier)	- Risk related to heavy earthmoving equipment work with dozers, compactors - Transportation of borrow soil from adjacent NW Borrow Area - Risks related to transportation of wastes to offsite landfill - Risks related to potential exposure to site workers from excavated trench wastes	- Disturbance due to high truck traffic with offsite disposal for some or all excavated wastes - Potential odors and contaminated run off from contaminated dirt in trucks - Biotic barrier, TRMs would be trucked in	- Offsite borrow soil, energy and water usage	- Onsite pond water will be used. Limited use of other municipal or well water for some applications
4	Eco-Cap (RCF Pond)(2') + Construct 11-Acre Lined Evaporation Pond (A-Series Pond) + RCRA Cap (Pond 18) + Lined Retention Basins (Pond A-5, Pond 13) + Stormwater Controls + ICs + Monitoring	Relative Impact	Medium	Medium	Medium	Medium	Medium	Medium	Medium to High
		Impact Drivers	- Grading or excavation of 56,000 cy - Borrow soil/compaction for caps of 200,000 cy - Some pre-processing of soils prior to placement and compaction - Materials manufacture,	- Fuel used in transportation of borrow soils and equipment - Fuel used in generators for electrical equipment - Temporary power for lighting or other equipment or	- Grading or excavation of 56,000 cy - Borrow soil/compaction for caps of 200,000 cy - Some pre-processing of soils prior to placement and compaction - Materials manufacture,	- Risk related to heavy earthmoving equipment work with dozers, compactors - Transportation of borrow soil from adjacent NW Borrow Area - Risks related to	- Disturbance due to high truck traffic with offsite disposal for some or all excavated wastes - Potential odors and contaminated run off from contaminated dirt in trucks - Biotic barrier, TRMs would be trucked in	- Offsite borrow soil, energy and water usage	- Onsite pond water will be used. Limited use of other municipal or well water for some applications

**Table F-4  
Green Remediation Evaluation  
FS Area 4 – Stormwater Ponds and Treated Liquid Impoundments - Ponds RCF, A-Series, 18, A-5, 13**

Alternative Number	Alternative Description	Impact Assessment	GHG Emissions	Energy Usage	Air Emissions	Collateral Risk	Community Impacts	Resources Lost	Water Usage
			transport, installation (34 acres HDPE, GCL, biotic barrier)	instrumentation	transport, installation (34 acres HDPE, GCL line)	transportation of wastes to offsite landfill - Risks related to potential exposure to site workers from excavated trench wastes			
5	Eco-Cap (RCF Pond, Portion of A-Series Pond) + Construct 6-Acre Lined Evaporation Pond (A-Series Pond) + RCRA Cap (Pond 18) + Lined Retention Basins (Pond A-5, Pond 13) + Stormwater Controls + ICs + Monitoring	Relative Impact	Medium	Medium	Medium	Medium	Medium	Medium	Medium to High
		Impact Drivers	- Grading or excavation of 56,000 cy - Borrow soil/compaction for caps of 250,000 cy - Some pre-processing of soils prior to placement and compaction - Materials manufacture, transport, installation (34 acres HDPE, GCL line)	- Fuel used in transportation of borrow soils and equipment - Fuel used in generators for electrical equipment - Temporary power for lighting or other equipment or instrumentation	- Grading or excavation of 56,000 cy - Borrow soil/compaction for caps of 250,000 cy - Some pre-processing of soils prior to placement and compaction - Materials manufacture, transport, installation (34 acres HDPE, GCL line)	- Risk related to heavy earthmoving equipment work with dozers, compactors - Transportation of borrow soil from adjacent NW Borrow Area - Risks related to transportation of wastes to offsite landfill - Risks related to potential exposure to site workers from excavated trench wastes	- Disturbance due to high truck traffic with offsite disposal for some or all excavated wastes - Potential odors and contaminated run off from contaminated dirt in trucks - Biotic barrier, TRMs would be trucked in	- Offsite borrow soil, energy and water usage	- Onsite pond water will be used. Limited use of other municipal or well water for some applications
6	Eco-Cap (RCF Pond, A-Series Pond)(2') + RCRA Cap (Pond 18) + Lined Retention Basins (Pond A-5, Pond 13) + Stormwater Controls + ICs + Monitoring [No evaporation pond]	Relative Impact	Medium	Medium	Medium	Medium	Medium	Medium	Medium to High
		Impact Drivers	- Grading or excavation of 56,000 cy - Borrow soil/compaction for caps of 200,000 cy - Some pre-processing of soils prior to placement and compaction - Materials manufacture, transport, installation (34 acres HDPE, GCL line)	- Fuel used in transportation of borrow soils and equipment - Fuel used in generators for electrical equipment - Temporary power for lighting or other equipment or instrumentation	- Grading or excavation of 56,000 cy - Borrow soil/compaction for caps of 200,000 cy - Some pre-processing of soils prior to placement and compaction - Materials manufacture, transport, installation (34 acres HDPE, GCL line)	- Risk related to heavy earthmoving equipment work with dozers, compactors - Transportation of borrow soil from adjacent NW Borrow Area - Risks related to transportation of wastes to offsite landfill - Risks related to potential exposure to site workers from excavated trench wastes	- Disturbance due to high truck traffic with offsite disposal for some or all excavated wastes - Potential odors and contaminated run off from contaminated dirt in trucks - Biotic barrier, TRMs would be trucked in	- Offsite borrow soil, energy and water usage	- Onsite pond water will be used. Limited use of other municipal or well water for some applications
7	ET Cap (RCF Pond, Portion of A-Series Pond) + Construct 6-Acre Lined Evaporation Pond (A-Series Pond) + RCRA Cap (Pond 18) + Lined Retention Basins (Pond A-5, Pond 13) + Stormwater Controls + ICs + Monitoring	Relative Impact	Medium to High	Medium to High	Medium to High	Medium to High	Medium to High	Medium to High	High
		Impact Drivers	- Grading or excavation of 56,000 cy - Borrow soil/compaction for caps of 300,000 cy - Some pre-processing of soils prior to placement and compaction - Materials manufacture, transport, installation (34 acres HDPE, GCL line).	- Fuel used in transportation of borrow soils and equipment - Fuel used in generators for electrical equipment - Temporary power for lighting or other equipment or instrumentation	- Grading or excavation of 43,000 cy - Borrow soil/compaction for caps of 260,000 cy - Some pre-processing of soils prior to placement and compaction - Materials manufacture, transport, installation (16 acres HDPE, GCL line)	- Risk related to heavy earthmoving equipment work with dozers, compactors - Transportation of borrow soil from adjacent NW Borrow Area - Risks related to transportation of wastes to offsite landfill - Risks related to potential exposure to site workers from excavated	- Disturbance due to high truck traffic with offsite disposal for some or all excavated wastes - Potential odors and contaminated run off from contaminated dirt in trucks - Biotic barrier, TRMs would be trucked in	- Offsite borrow soil, energy and water usage	- Because the ET soil cap is 5' thick, will require more compaction and amendments to achieve performance standard - Onsite pond water will be used. Limited use of other municipal or well water for some applications

**Table F-4  
Green Remediation Evaluation  
FS Area 4 – Stormwater Ponds and Treated Liquid Impoundments - Ponds RCF, A-Series, 18, A-5, 13**

Alternative Number	Alternative Description	Impact Assessment	GHG Emissions	Energy Usage	Air Emissions	Collateral Risk	Community Impacts	Resources Lost	Water Usage
						trench wastes			
8	Excavate (RCF Pond, A-Series Pond) (5') + Construct new 11-acre Lined Evaporation Pond (North of RCF Pond) + RCRA Prescriptive cap (Pond 18) + Lined Retention Basins (Pond A-5, Pond 13) + ICs + Monitoring	Relative Impact	High	High	High	High	High	Medium to High	Medium to High
		Impact Drivers	<ul style="list-style-type: none"> <li>- Excavation of 170,000 cy</li> <li>- Borrow soil/compaction for caps of 200,000 cy</li> <li>- Transport 140,000 tons of soils about 120 miles to Buttonwillow</li> <li>- Materials manufacture, transport, installation (24 acres HDPE, GCL liner)</li> </ul>	<ul style="list-style-type: none"> <li>- Fuel used in transportation of borrow soils and equipment</li> <li>- Fuel used in generators for electrical equipment</li> <li>- Temporary power for lighting or other equipment or instrumentation</li> </ul>	<ul style="list-style-type: none"> <li>- Excavation of 170,000 cy</li> <li>- Borrow soil/compaction for caps of 200,000 cy</li> <li>- Transport 140,000 tons of soils about 120 miles to Buttonwillow</li> <li>- Materials manufacture, transport, installation (24 acres HDPE, GCL liner)</li> </ul>	<ul style="list-style-type: none"> <li>- Risk related to heavy earthmoving equipment work with dozers, compactors</li> <li>- Transportation of borrow soil from adjacent NW Borrow Area</li> <li>- Risks related to transportation of wastes to offsite landfill</li> <li>- Risks related to potential exposure to site workers from excavated trench wastes</li> </ul>	<ul style="list-style-type: none"> <li>- Disturbance due to high truck traffic with offsite disposal for some or all excavated wastes</li> <li>- Potential odors and contaminated run off from contaminated dirt in trucks - Biotic barrier, TRMs would be trucked in</li> </ul>	<ul style="list-style-type: none"> <li>- Landfill space lost with offsite disposal</li> <li>- Offsite borrow soil, energy and water usage</li> </ul>	<ul style="list-style-type: none"> <li>- Because the backfill soil will need to be compacted and will require water</li> <li>- Onsite pond water will be used. Limited use of other municipal or well water for some applications</li> </ul>

**NOTES**

1. Equipment operating onsite for cap construction include Caterpillar 14G Blade motor grader (fine grading), Caterpillar D6 Dozer with 84" drum sheeps foot roller, 824 compactor (combined dozer and compactor), 3 water trucks 4,000 gallons each and for excavation Caterpillar D10 dozer with rippers and puddle scrapers.



**Table F-5  
Green Remediation Evaluation  
FS Area 5 North – Groundwater**

Alternative Number	Alternative Description	Impact Assessment	GHG Emissions	Energy Usage	Air Emissions	Collateral Risk	Community Impacts	Resources Lost	Water Usage
1	No Action	Relative Impact	None	None	None	None	None	None	None
		Impact Drivers	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2	Extraction (PSCT, Gallery Well) + Treat and Discharge PSCT Groundwater to Onsite Evaporation Pond + ICs + Monitoring	Relative Impact	Medium	Medium	Medium	Medium	Medium	Low to Medium	Medium
		Impact Drivers	<ul style="list-style-type: none"> <li>- PSCT and Gallery Well extraction</li> <li>- GWTS treatment of PSCT groundwater</li> <li>- Consumption of materials such as LPGAC and VPGAC associated with the GWTS</li> <li>- Emissions during transport and offsite disposal of Gallery Well liquids</li> </ul>	<ul style="list-style-type: none"> <li>- Fuel used in equipment</li> <li>- Fuel used in generators for electrical equipment</li> <li>- Temporary power for lighting or other equipment or instrumentation</li> </ul>	<ul style="list-style-type: none"> <li>- Emissions during transport and offsite disposal of Gallery Well liquids</li> </ul>	<ul style="list-style-type: none"> <li>- Risk related to heavy equipment work</li> <li>- Offsite liquids transport and disposal</li> </ul>	<ul style="list-style-type: none"> <li>- Limited impacts with extraction of groundwater and treatment</li> <li>- Some impacts with trucking Gallery Well liquids and NAPL by trucks for offsite disposal</li> </ul>	<ul style="list-style-type: none"> <li>- Offsite liquids disposal</li> </ul>	<ul style="list-style-type: none"> <li>- PSCT and Gallery Well extraction</li> <li>- GWTS treatment of PSCT groundwater</li> </ul>
3	Extraction (PSCT, Gallery Well) + Extraction (NAPL-only in P/S Landfill) + Monitoring (4 New LHSU Wells) + Treat and Discharge PSCT Groundwater to Onsite Evaporation Pond + ICs + Monitoring	Relative Impact	Medium	Medium	Medium to High	Medium to High	Medium	Medium	Medium
		Impact Drivers	<ul style="list-style-type: none"> <li>-PSCT, Gallery well and NAPL-only skimmer extraction</li> <li>-GWTS treatment of PSCT groundwater</li> <li>-Consumption of materials such as LPGAC and VPGAC associated with the GWTS</li> <li>-The addition of NAPL-only extraction would result in relatively small increase in energy use and GHG emissions due to periodic operation and low energy footprint of skimmer pumps.</li> <li>-Emissions during transport and offsite disposal of Gallery Well liquids</li> </ul>	<ul style="list-style-type: none"> <li>- Fuel used in equipment</li> <li>- Fuel used in generators for electrical equipment</li> <li>- Temporary power for lighting or other equipment or instrumentation</li> </ul>	<ul style="list-style-type: none"> <li>-Emissions during transport and offsite disposal of Gallery Well and NAPL-only liquids</li> <li>- Installation of up to 16 NAPL-only wells in NAPL area</li> </ul>	<ul style="list-style-type: none"> <li>- Risk related to installation of NAPL-only wells through waste drums in the P/S Landfill</li> <li>- Risk related to heavy equipment work</li> <li>- Offsite liquids and NAPL transport and disposal</li> </ul>	<ul style="list-style-type: none"> <li>- Limited impacts with extraction of groundwater and treatment</li> <li>- Some impacts with trucking Gallery Well liquids and NAPL by trucks for offsite disposal</li> </ul>	<ul style="list-style-type: none"> <li>- Offsite liquids disposal</li> <li>- Offsite NAPL disposal</li> </ul>	<ul style="list-style-type: none"> <li>-PSCT and Gallery well extraction</li> <li>-GWTS treatment of PSCT groundwater</li> </ul>
4	Extraction (PSCT, Gallery Well) + Extraction (NAPL-only in P/S Landfill) + Monitoring (4 New LHSU Wells) + Treat and Discharge PSCT Groundwater Offsite (No Evaporation Pond) + ICs + Monitoring	Relative Impact	High	High	Medium to High	Medium to High	Medium to High	Medium	Medium to High
		Impact Drivers	<ul style="list-style-type: none"> <li>- PSCT and Gallery Well extraction</li> <li>- GWTS treatment of PSCT groundwater to treat organics and inorganics. Reverse osmosis is a very energy intensive process</li> <li>- Includes consumption of materials such as LPGAC, RO membranes and VPGAC associated with the GWTS.</li> <li>- Emissions during transport and offside disposal of Gallery Well and NAPL-only liquids.</li> </ul>	<ul style="list-style-type: none"> <li>- Fuel used in equipment</li> <li>- Fuel used in generators for electrical equipment</li> <li>- Electricity to operate extraction and treatment system. RO is an energy intensive system.</li> <li>- Temporary power for lighting or other equipment or instrumentation</li> </ul>	<ul style="list-style-type: none"> <li>- Emissions during transport and offside disposal of Gallery Well and DNAPL-only liquids</li> <li>- Installation of up to 16 NAPL-only wells in NAPL area</li> </ul>	<ul style="list-style-type: none"> <li>- Risk related to installation of NAPL-only wells through waste drums in the P/S Landfill</li> <li>- Risk related to heavy equipment work</li> <li>- Offsite liquids and NAPL transport and disposal</li> </ul>	<ul style="list-style-type: none"> <li>- Limited impacts with extraction of groundwater and DNAPL and treatment</li> <li>- Some impacts with trucking Gallery Well liquids and NAPL by trucks for offsite disposal</li> <li>- Also large quantities of waste filters and inorganic wastes as sludge for offsite disposal</li> </ul>	<ul style="list-style-type: none"> <li>- Offsite waste disposal</li> <li>- Offsite NAPL disposal</li> </ul>	<ul style="list-style-type: none"> <li>-PSCT and Gallery Well extraction</li> <li>- GWTS treatment of PSCT groundwater for organics and inorganics</li> </ul>

**Table F-5  
Green Remediation Evaluation  
FS Area 5 North – Groundwater**

Alternative Number	Alternative Description	Impact Assessment	GHG Emissions	Energy Usage	Air Emissions	Collateral Risk	Community Impacts	Resources Lost	Water Usage
5	Extraction (PSCT, Gallery Well) + Extraction (Aggressive, 16 Large NAPL wells) + Extraction (NAPL-only in CDA, 4 existing wells) + Monitoring (4 new LHSU Wells) + Treat and Discharge to Onsite Evaporation Pond + ICs + Monitoring	Relative Impact	Very High	Very High	Very High	High	High	High	High
		Impact Drivers	<ul style="list-style-type: none"> <li>- PSCT and Gallery well extraction</li> <li>- GWTS treatment of PSCT and leachate groundwater that treats 5.2 million gallons per year.</li> <li>- Includes consumption of materials such as LPGAC and VPGAC associated with the GWTS</li> <li>- Installation of up to 16 large diameter wells in NAPL area in P/S Landfill</li> <li>- Emissions during transport and offsite disposal of Gallery Well and NAPL-only liquids</li> </ul>	<ul style="list-style-type: none"> <li>- Fuel used in equipment</li> <li>- Fuel used in generators for electrical equipment</li> <li>- Electricity to operate extraction and treatment system</li> <li>- Temporary power for lighting or other equipment or instrumentation</li> </ul>	<ul style="list-style-type: none"> <li>- Emissions during transport and offsite disposal of Gallery Well and NAPL liquids</li> <li>- Installation of up to 16 aggressive NAPL wells in NAPL area in P/S Landfill</li> <li>- Emissions from treatment of 5.2 million gallons of leachate liquids and NAPL</li> </ul>	<ul style="list-style-type: none"> <li>- Risk related to installation of large diameter aggressive NAPL extraction wells through waste drums in the P/S Landfill</li> <li>- Risk related to heavy equipment work</li> <li>- Offsite liquids and NAPL transport and disposal</li> </ul>	<ul style="list-style-type: none"> <li>- Limited impacts with well installation and groundwater extraction and treatment</li> <li>- Some impacts with trucking Gallery Well liquids and NAPL by trucks for offsite disposal</li> <li>- Potential impacts with groundwater extraction and treatment and emissions or releases from treatment system</li> </ul>	<ul style="list-style-type: none"> <li>- Offsite waste disposal</li> <li>- Offsite NAPL disposal</li> <li>- Evaporation of treated groundwater in onsite evaporation pond</li> </ul>	<ul style="list-style-type: none"> <li>- PSCT and Gallery well extraction</li> <li>- GWTS treatment of PSCT groundwater for organics and inorganics</li> </ul>
6	Extraction (PSCT, Gallery Well) + Dewater P/S Landfill (10 Horizontal Wells)/ Dispose Offsite + Extraction (NAPL-only in CDA, 4 existing wells) + Monitoring (4 new LHSU Wells) + Treat and Discharge to Onsite Evaporation Pond + ICs + Monitoring	Relative Impact	Very High	High	Very High	High	High	High	High
		Impact Drivers	<ul style="list-style-type: none"> <li>- PSCT and Gallery Well extraction</li> <li>- 10 Horizontal well extraction</li> <li>-GWTS treatment of PSCT groundwater and consumption of materials including RO that is energy intensive</li> <li>- Large volume (5.2 million gallons) of leachate liquids collected in tanks for offsite disposal</li> <li>- Emissions during transport and offsite disposal of Gallery Well and dewater liquids.</li> <li>- NAPL-only skimmers have low GHG emissions</li> </ul>	<ul style="list-style-type: none"> <li>- Fuel used in drill rigs and other equipment</li> <li>- Fuel used in generators for electrical equipment</li> <li>- Electricity to operate extraction pumps, transfer equipment especially RO which is energy intensive</li> <li>- Temporary power for lighting or other equipment or instrumentation</li> <li>- NAPL-only extraction from 4 wells in CDA is relatively low</li> </ul>	<ul style="list-style-type: none"> <li>- Installation of up to 10 800-foot long horizontal wells in P/S Landfill</li> <li>- Emissions during transport and offsite disposal of Gallery Well and dewater liquids</li> <li>- Emissions from transporting 5.2 million gallons of leachate liquid by truck</li> <li>- NAPL-only extraction from 4 wells in CDA from VOCs in NAPL</li> </ul>	<ul style="list-style-type: none"> <li>- Risk related to horizontal drilling under the P/S Landfill</li> <li>- Risk related to potential release of leachate liquids through horizontal wells</li> <li>- Risk related to heavy equipment work</li> </ul>	<ul style="list-style-type: none"> <li>- Significant impacts due to installation of complex horizontal wells under P/S Landfill</li> <li>- Significant impacts due to trucking large volumes of dewater liquids for offsite disposal</li> <li>- Some impacts with trucking Gallery Well liquids and NAPL by trucks for offsite disposal</li> </ul>	<ul style="list-style-type: none"> <li>- Offsite waste disposal of extracted NAPL and other waste liquids</li> <li>- Offsite leachate and groundwater disposal</li> </ul>	<ul style="list-style-type: none"> <li>- PSCT and Gallery Well extraction</li> <li>- 10 horizontal well continuous extraction</li> <li>- 4 NAPL-only skimmer wells</li> </ul>
7	Extraction (PSCT, Gallery Well) + Dewater P/S Landfill (10 Horizontal Wells)/Dispose Offsite + Extraction (NAPL-only in CDA, 12 new wells) + Extraction (4 new LHSU Wells) + Treat PSCT GW and Discharge Offsite + ICs + Monitoring	Relative Impact	Very High	High	Very High	High	High	High	High
		Impact Drivers	<ul style="list-style-type: none"> <li>- PSCT and Gallery Well extraction</li> <li>- 10 Horizontal well extraction</li> <li>-GWTS treatment of PSCT groundwater for organics and inorganics including RO that is energy intensive</li> <li>- Large volume (5.2 million gallons) of leachate liquids collected in tanks for offsite disposal</li> <li>- Emissions during transport and offsite disposal of Gallery Well and dewater liquids.</li> <li>- NAPL-only skimmers have low GHG emissions</li> <li>- LHSU extraction flow rates are very low and hence low GHG.</li> </ul>	<ul style="list-style-type: none"> <li>- Fuel used in drill rigs and other equipment</li> <li>- Fuel used in generators for electrical equipment</li> <li>- Electricity to operate extraction pumps, transfer equipment especially RO which is energy intensive</li> <li>- Temporary power for lighting or other equipment or instrumentation</li> <li>- NAPL-only extraction from 12 wells in CDA and LHSU extraction is relatively low</li> </ul>	<ul style="list-style-type: none"> <li>- Installation of up to 10 800-foot long horizontal wells in P/S Landfill</li> <li>- Emissions during transport and offsite disposal of Gallery Well and dewater liquids</li> <li>- Emissions from transporting 5.2 million gallons of leachate liquid by truck</li> <li>- NAPL-only extraction from 12 wells in CDA from VOCs in NAPL</li> </ul>	<ul style="list-style-type: none"> <li>- Risk related to horizontal drilling under the P/S Landfill</li> <li>- Risk related to potential release of leachate liquids through horizontal wells</li> <li>- Risk related to heavy equipment work</li> </ul>	<ul style="list-style-type: none"> <li>- Significant impacts due to installation of complex horizontal wells under P/S Landfill</li> <li>- Significant impacts due to trucking large volumes of dewater liquids for offsite disposal</li> <li>- Some impacts with trucking Gallery Well liquids and NAPL by trucks for offsite disposal</li> </ul>	<ul style="list-style-type: none"> <li>- Offsite waste disposal of extracted NAPL and other waste liquids</li> <li>- Offsite leachate and groundwater disposal</li> <li>- Offsite discharge of treated groundwater</li> </ul>	<ul style="list-style-type: none"> <li>- PSCT and Gallery Well extraction</li> <li>- 10 horizontal well continuous extraction</li> <li>- 12 NAPL-only skimmer wells</li> <li>- 4 LHSU extraction wells</li> </ul>

**Table F-6  
Green Remediation Evaluation  
FS Area 5 South – Groundwater**

Alternative Number	Alternative Description	Impact Assessment	GHG Emissions	Energy Usage	Air Emissions	Collateral Risk	Community Impacts	Resources Lost	Water Usage
1	No Action	Relative Impact	None	None	None	None	None	None	None
		Impact Drivers	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2	Extraction (PCT-A, PCT-B) + Treat and Discharge to Onsite Evaporation Pond + MNA + ICs + Monitoring	Relative Impact	Medium	Medium	Medium	Low to Medium	Low to Medium	Medium	Low to Medium
		Impact Drivers	- PCT-A, PCT-B extraction - Replacement of PCT-B trench	- Fuel used in equipment - Fuel used in generators for electrical equipment - Electricity for extraction pumps - Temporary power for lighting or other equipment or instrumentation	- PCT-A, PCT-B extraction - Replacement of PCT-B trench	- Risk related to heavy equipment work and trench replacement	- Limited impacts with extraction and treatment system	- Electricity usage during PCT-A and PCT-B extraction	- PCT-A and PCT-B groundwater extraction and onsite evaporation
3	Extraction (PCT-A, PCT-B) + Treat and Discharge Offsite + MNA + ICs + Monitoring	Relative Impact	Medium to High	Medium to High	Medium to High	Medium	Medium	Medium to High	Medium
		Impact Drivers	- PCT-A, PCT-B extraction - Reverse Osmosis treatment to remove inorganics, an energy intensive process - Replacement of PCT-B trench	- Fuel used in equipment - Fuel used in generators for electrical equipment - Electricity for extraction pumps - Reverse Osmosis treatment to remove inorganics, an energy intensive process - Temporary power for lighting or other equipment or instrumentation	- PCT-A, PCT-B extraction - Replacement of PCT-B trench	- Risk related to heavy equipment work and trench replacement - Potential failure of RO system and discharge of high inorganics laden water offsite	- Medium impacts with treatment system - Transportation of RO wastes including brine and solid wastes	- Electricity usage during PCT-A, PCT-B extraction - Electricity usage with RO process for treating inorganics	- PCT-A and PCT-B groundwater extraction - RO system may need water for backflush and cleaning of filters
4	Extraction (PCT-A) + In-situ Reactive Wall (PCT-B) + MNA + ICs + Monitoring	Relative Impact	Low to Medium	Low to Medium	Low to Medium	Medium	Low	Moderate	Low
		Impact Drivers	- Extraction PCT-A - PCT-B reactive wall construction and periodic ZVI replacement	- Fuel used in equipment - Fuel used in generators for electrical equipment - Electricity for extraction pumps - Temporary power for lighting or other equipment or instrumentation	- PCT-B reactive wall construction and periodic ZVI replacement	- Risk related to heavy equipment work and ZVI reactive wall trench construction	- Limited impacts with passive in-situ reactive wall	- Electricity usage during PCT-B reactive wall construction and periodic ZVI replacement	- Limited groundwater extraction from PCT-A

**Table F-6  
Green Remediation Evaluation  
FS Area 5 South – Groundwater**

Alternative Number	Alternative Description	Impact Assessment	GHG Emissions	Energy Usage	Air Emissions	Collateral Risk	Community Impacts	Resources Lost	Water Usage
5	Aggressive Extraction (60 new wells, Area 5 South) + Extraction (PCT-A, PCT-B) + Treat and Discharge Offsite + ICs + Monitoring	Relative Impact	Very High	Very High	Very High	High	High	High	High
		Impact Drivers	<ul style="list-style-type: none"> <li>- PCT-A, PCT-B extraction</li> <li>- 30 gpm extraction and groundwater treatment system</li> <li>- Treatment technology including air stripping, UV/oxidation, reverse osmosis, thermal oxidizer, scrubber including electricity for transfer pumps, aeration blowers and LPGAC for polishing and VPGAC for vapor treatment.</li> <li>- RO treatment is very energy intensive</li> <li>- Emissions during transport and offsite disposal/ regeneration of carbon and filter wastes</li> </ul>	<ul style="list-style-type: none"> <li>- Fuel used in equipment</li> <li>- Fuel used in generators for electrical equipment</li> <li>- Electricity usage in extraction pumps</li> <li>- RO treatment is very energy intensive</li> <li>- Temporary power for lighting or other equipment or instrumentation</li> </ul>	<ul style="list-style-type: none"> <li>- PCT-A, PCT-B extraction</li> <li>- 30 gpm extraction and groundwater treatment system</li> <li>- Treatment technology including air stripping, UV/oxidation, reverse osmosis, thermal oxidizer, scrubber including electricity for transfer pumps, aeration blowers and LPGAC for polishing and VPGAC for vapor treatment.</li> <li>- Emissions during transport and offsite disposal of brine, spent carbon, filter wastes, etc.</li> </ul>	<ul style="list-style-type: none"> <li>- Risk related to heavy equipment work including drilling of 60 large diameter wells</li> <li>- Risk with potential for treatment system failure and discharge of high inorganics laden groundwater offsite.</li> </ul>	<ul style="list-style-type: none"> <li>- Significant impacts with drilling of 60 wells, installation of complex piping and treatment system</li> <li>- Offsite disposal of wastes, sludges and large quantities of brine</li> </ul>	<ul style="list-style-type: none"> <li>- Electricity usage during PCT-A, PCT-B and 60 well extraction and treatment</li> <li>- RO treatment is very energy intensive</li> <li>- Groundwater resource discharged offsite</li> </ul>	<ul style="list-style-type: none"> <li>- 30 gpm extraction and groundwater treatment system and offsite discharge</li> </ul>

**Table F-7  
Green Remediation Evaluation  
FS Area 5 West – Groundwater**

Alternative Number	Alternative Description	Impact Assessment	GHG Emissions	Energy Usage	Air Emissions	Collateral Risk	Community Impacts	Resources Lost	Water Usage
1	No Action	Relative Impact	None	None	None	None	None	None	None
		Impact Drivers	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2	Extraction (PCT-C) + MNA + ICs + Monitoring	Relative Impact	Medium	Medium	Medium	Low to Medium	Low to Medium	Medium	Low to Medium
		Impact Drivers	- PCT-C extraction - Replacement of PCT-C trench	- Fuel used in equipment - Fuel used in generators for electrical equipment - Electricity for extraction pumps - Temporary power for lighting or other equipment or instrumentation	- PCT-C extraction - Replacement of PCT-C trench	- Risk related to heavy equipment work and trench replacement	- Limited impacts with extraction and treatment system	- Electricity usage during PCT-C extraction	- PCT-C groundwater extraction and discharge to onsite evaporation pond
3	Extraction (PCT-C) + Treat and Discharge Offsite + MNA + ICs + Monitoring	Relative Impact	Medium to High	Medium to High	Medium to High	Medium	Medium	Medium	Medium
		Impact Drivers	- PCT-C extraction - GWTS with reverse osmosis is very energy intensive - Replacement of PCT-C trench	- Fuel used in equipment - Fuel used in generators for electrical equipment - Electricity for extraction pumps and RO system which is energy intensive - Temporary power for lighting or other equipment or instrumentation	- PCT-C extraction - GWTS emissions - Replacement of PCT-C trench	- Risk related to heavy equipment work and trench replacement - Risk with RO system failure and offsite discharge of inorganics laden groundwater	- Limited impacts with extraction and treatment system - Offsite transportation of large quantities of brine for disposal	- Electricity usage during PCT-C extraction - Groundwater resources lost by offsite discharge	- PCT-C groundwater extraction and discharge offsite
4	In-situ Reactive Wall (PCT-C) + MNA + ICs + Monitoring	Relative Impact	Low	Low	Low	Low to Medium	Low	Low to Medium	None
		Impact Drivers	- PCT-C reactive wall construction and periodic ZVI replacement	- Fuel used in equipment - Fuel used in generators for electrical equipment - Temporary power for lighting or other equipment or instrumentation	- PCT-C reactive wall construction and periodic ZVI replacement	- Risk related to heavy equipment work and ZVI replacement	- Limited impacts with passive in-situ reactive wall	- Electricity usage during PCT-C reactive wall construction and periodic ZVI replacement	- No extraction
5	Aggressive Extraction (40 new wells, Area 5 West) + Extraction (PCT-C) Treat and Discharge Offsite + ICs + Monitoring	Relative Impact	Very High	Very High	Very High	High	High	High	High
		Impact Drivers	- PCT-C extraction - 20 gpm extraction and groundwater treatment system - Treatment technology including air stripping, UV/oxidation, reverse osmosis, thermal oxidizer,	- Fuel used in equipment - Fuel used in generators for electrical equipment - Temporary power for lighting or other equipment or instrumentation	- PCT-C extraction - 20 gpm extraction and groundwater treatment system - Treatment technology including air stripping, UV/oxidation, reverse osmosis, thermal oxidizer,	- Risk related to heavy equipment work including drilling of 40 large diameter wells	- Significant impacts with drilling of 40 wells, installation of complex piping and treatment system - Offsite disposal of wastes, sludges and brine	- Electricity usage during PCT-C extraction and treatment	- 20 gpm extraction and groundwater treatment system and offsite discharge

**Table F-7  
Green Remediation Evaluation  
FS Area 5 West – Groundwater**

Alternative Number	Alternative Description	Impact Assessment	GHG Emissions	Energy Usage	Air Emissions	Collateral Risk	Community Impacts	Resources Lost	Water Usage
			scrubber including electricity for transfer pumps, aeration blowers and LPGAC for polishing and VPGAC for vapor treatment. - Emissions during transport and offsite disposal of waste brine, spent carbon and filter wastes		scrubber including electricity for transfer pumps, aeration blowers and LPGAC for polishing and VPGAC for vapor treatment. - Emissions during transport and offsite disposal of waste brine, spent carbon and filter wastes				