Kaiser Mead Groundwater Remediation Interim Action

Final (100%) Design Report for Extraction, Treatment, and Discharge

Final – Rev 1

June 2020

Kaiser Mead Custodial Trust

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Acronyms and Abbreviations

°F	degrees Fahrenheit
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
Avista	Avista Electric Service
BAFO	best and final offer
BCR	biochemical reactor
BOD	biochemical oxygen demand
CARA	Critical Aquifer Protection Area
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CMF	Change Management Form
CN	cyanide
COD	chemical oxygen demand
Custodial Trust	Kaiser Mead Custodial Trust
EC	electrocoagulation
Ecology	Washington Department of Ecology
EPA	U.S. Environmental Protection Agency
EQ	equalization
gpm	gallon(s) per minute
HMI	human-machine interface
HRT	hydraulic retention time
HVAC	heating, ventilation, and air conditioning
IAWP	*Interim Action Work Plan, Kaiser Mead NPL Site* (Hydrometrics, 2019)
IBC	International Building Code
IEC	International Electrical Code
IECC	International Energy Conservation Code
IFC	International Fire Code
IMC	International Mechanical Code
L&I	Labor and Industries
MERV	Minimum Efficiency Reporting Value
mg/L	milligram(s) per liter
N/A	not applicable
NFPA	National Fire Protection Association
NPL	National Priorities List
O&M	operation and maintenance
P&ID	process and instrumentation diagram
PID	Proportional Integral Derivative

PLC	programmable logic controller
RCRA	Resource Conservation and Recovery Act of 1976
RDWP	*Kaiser Mead Groundwater Remediation Interim Action Remedial Design Work Plan*
SCADA	supervisory control and data acquisition
SCFD	Spokane County Fire District No. 9
SEPA	State Environmental Policy Act
site	Kaiser Aluminum Chemical Corporation former National Priorities List smelter site
SRCAA	Spokane Regional Clean Air Agency
UPC	Uniform Plumbing Code
VFD	variable frequency drive
WAC	Washington Administrative Code
WSDOT	Washington Department of Transportation
wt%	percent by weight

1. Introduction

This introductory section presents the purpose, remedy refinements, and organization of the Final (100%) Design Report for the Kaiser Mead Custodial Trust (Custodial Trust) groundwater remediation interim action at the Kaiser Aluminum Chemical Corporation former National Priorities List (NPL) smelter site (site) in Mead, Washington. This Revision 1 updates the Final Design to reflect design changes enacted to improve cost-efficiency of construction.

1.1 Purpose

The purpose of this report is twofold: (1) to provide the Custodial Trust and the Washington Department of Ecology (Ecology) with sufficient information to determine that the Contractor is correctly interpreting the interim action goals and requirements into site-specific engineering parameters, and (2) to confirm that the conceptual design basis can be constructed and implemented.

1.2 Refinements to the Remedial Design Work Plan Remedy

This report describes refinements to the groundwater remedy proposed in *Kaiser Mead Groundwater Remediation Interim Action Remedial Design Work Plan* (RDWP) (Jacobs, 2019). The purpose of the refinements is to improve the functionality and performance of the interim action and support optimization of the treatment process and effectiveness of the groundwater remedy.

1.3 Organization

This design report is organized into the following sections:

- **Section 1: Introduction**.
- **Section 2: Summary and Justification of Technical and Final Design Parameters** describes the technical basis of design used to prepare the final (100%) design. The section is organized by design discipline, starting with a design overview.
- **Section 3: Design Flexibility, Adaptability, and Optimization** summarizes the features and functionality incorporated in the design to provide operational flexibility, adaptability, and optimization over time.
- **Section 4: Permitting** describes the regulatory permitting requirements for residuals disposal at the site, and other potentially required local, state, and federal permits, their need, and their applicability to the interim action.
- **Section 5: Confirmation of Siting and Location of Interim Action Elements** provides confirmation that the interim action elements are appropriately sited and located, proper easements are intact, and site access is reasonable.
- **Section 6: Significant Operation and Maintenance Provisions** identifies operation and maintenance (O&M) provisions that will have a substantial influence on the design approach (for example, unattended operation and remote instrumentation and communication).
- **Section 7: Implementation Schedule Update, Key Milestones, and Cost Estimate Update** outlines updates to the proposed implementation schedule, key milestones, and cost estimate first presented in the RDWP (Jacobs, 2019).
- **Section 8: Deliverables** identifies and summarizes updates to anticipated deliverables associated with the 100% engineering design of extraction, treatment, and discharge systems.
- **Section 9: References** contains a bibliography of documents cited in text.

Figures are located at the end of text, followed by Appendixes A through E.

2. Summary and Justification of Technical and Final Design Parameters

This section describes the technical basis of design used to prepare the final (100%) design. The section is organized by design discipline. The design drawings are in Appendix A, the technical specifications are in Appendix B, and the United Rentals final design vendor package is in Appendix C.

2.1 Design Overview

The overall site plan is shown on Drawing Sheet 001-C-001 in Appendix A. An enlarged plan of the extraction well and infiltration basin area is shown on Sheet 001-C-012, and an enlarged plan of the treatment area is shown on Sheet 002-E-003. A process flow diagram of the complete system is on Sheet 001-G-007. Sheet 001-G-008 shows the hydraulic profile. Calculations for individual disciplines are in Appendix D. The State Environmental Policy Act (SEPA) checklist completed by the Custodial Trust as part of the *Interim Action Work Plan, Kaiser Mead NPL Site* (IAWP) (Hydrometrics, 2019) is in Appendix E.

2.2 Process

2.2.1 Extraction Wells

The wellfield consists of five groundwater extraction wells. Four of the wells have been installed as part of this remedial action (TW-2B, 3B, 4B, and 5B) and one well is existing (TW-1B). Submersible, multistage, centrifugal well pumps will be installed within the saturated zone of each well (approximately 160 to 170 feet below ground surface). Extraction well water will be pumped from individual wells to a flow metering vault with sampling stations located in each well line before entering the vault. The extraction well pumping will be controlled by a panel above ground with flowmeters and controls located within the vault, located near the south side of the wellfield. This configuration will allow for individual well monitoring and control and for consolidated pump controls in a central secured location for operations and optimization. Pumping controls and flow measurement readouts for each well are located above ground in a secured panel with display. Flowmeters, lines including manifold to a 3-inch force main to the wetlands, and a pneumatic pressure tank will be located in the vault. Extraction well pump water will be manifolded to a common force main for conveyance to the wetlands/electrocoagulation (EC) treatment system. There are no booster pumps. The extraction well submersible pumps provide the motive force to transfer groundwater to the treatment system, allowing each well to operate independently. Additional information on the extraction system is found in the RDWP (Jacobs, 2019).

2.2.2 Groundwater Force Main

Groundwater will be conveyed from the flow metering vault through the groundwater force main. The routing of the force main is shown on Drawing Sheet 001-C-002 in Appendix A. The groundwater force main comes up through the floor of the EC Building in the southeast corner through an actuated valve that will automatically close if the EC system shuts down, including upon loss of power. The resulting back pressure will automatically shut down flow from the extraction well pumps. The groundwater force main will have provisions for automatic flow measurement, recording, and manual sampling before being routed back down through the floor to Wetland Cell 1. If there are any system faults resulting in flow in the force main to stop, the EC system will coordinate its operation appropriately. A tee and valving on the force main in the EC Building provides the option of bypassing the wetland system and sending the groundwater directly into the EC system. Similarly, a tee and valving in the EC Building provides the option of directing EC system effluent back to Cell 1. These optional flow paths will not normally be used, but provide operational flexibility, particularly during startup and commissioning.

2.2.3 Enhanced Wetland Process

After passing through the EC Building, the groundwater is piped underground to Cell 1 of the wetlands system. The Enhanced Wetland Process system consists of a subsurface flow-based, three-cell system comprising an anaerobic biochemical reactor (BCR) (Cell 1), a two-part, fill-and-drain, aerobic gravel media bed (Cell 2A/2B), and a horizontal subsurface flow wetland (Cells 3A and 3B). The three separate lined pond areas comprise Cell 1, Cell 2A, and Cells 2B/3A/3B. The capacity to recirculate treated wetland effluent water through the wetland up to an amount equal to the volume being pumped from the wells is included to return any residual nitrogen dioxide and nitrate formed in the aerobic cells back to the anaerobic BCR to be removed via denitrification. Drawing Sheets 002-C-001, 002-C-006 through 002-C-010, and 002-ME-001 through 002-ME-003 in Appendix A provide details on the Enhanced Wetland Process.

Wetland Cell 1 has a water surface area of about 0.37 acre, Cell 2A has a water surface area of about 0.12 acre, and Cell 2B/3A/3B has a combined water surface area of about 1.02 acre. The water surface steps down in elevation through the process train with gravity flow. Water from the extraction wells is pumped to distribution piping on the media surface in Cell 1 and flows vertically down through the media before it is collected from under Cell 1 treatment media in a drainage rock layer with slotted agricultural drain piping and infiltrator slotted arches that form the primary drainage conveyance channel on the wetland cell bottom liner.

Cell 1 is an anaerobic BCR consisting of a layer of saturated organic matter (65 percent wood chips, 9 percent grass hay, 25 percent sawdust, and 1 percent horse manure) overlaying a 1-inch-diameter round river gravel filter layer and a 1.5-inch-diameter round river rock drainage layer (see Drawing Sheet 002-C-006 in Appendix A). The surface of the organic media is covered by a geotextile separation layer and 1.5 feet of wood chips for insulation. Extraction well water and up to an equal amount of effluent water recycled from the wetlands blend together in the piping supplying Cell 1. The nearly constant year-round level of natural heat in the groundwater will be conserved with the insulation layer of wood chips to reduce the potential for freezing in winter and to increase temperature sensitive biological activity throughout the wetlands. As water moves through the wetlands, it will gain heat in summer and lose heat in the winter. Therefore, the recycled water will cool the wetlands in winter and heat the wetlands in summer.

A single water distribution and collection piping system is provided in Cell 1. The influent to Cell 1 combines extracted groundwater from the well network with recirculation flows and distributes the combined water in pipe network located at the surface of the organic media layer just under the insulating woodchip layer. The effluent from Cell 1 is collected at the base of the wetland just above the bottom liner system. Free, weak acid dissociable, and total cyanide (CN) will be removed through volatilization of hydrogen cyanide and passive biological pH reduction; sorption of metals and CN to organic surfaces; and anaerobic degradation. Oxidized nitrogen (i.e., NO_2-N, NO_3-N) will be removed through biological denitrification to innocuous nitrogen gas. Incidental fluoride removal is anticipated in the early stages of BCR operation through physical adsorption to organic matter surfaces. The independent fill and drain piping networks allow adjustment of contact time and biochemical reactions. The hydraulic residence time in Cell 1 can be varied with water surface elevation and recycle flow rate from about 60 to 160 hours. Water discharges from Cell 1 through a 12-inch-diameter pipe and inline water level control structure (agri-drain) with a weir for a high-water level setting and an automated slide valve 2 feet below the high-level setting for dosing Cell 2A with surges of water at greater than the flow rate into Cell 1. Water is conveyed by piping to Cell 2 by gravity, and infiltrates through a gravel layer for aerobic treatment of the nitrogen, carbon, and sulfur compounds from Cell 1.

Cell 2A is an aerobic cell consisting of a pulsed flow, subsurface media reactor characterized by gravel 4 feet deep in two size gradations designed to receive water through a distribution system on the bottom liner. The cell is controlled by a weir and a solar-powered, automated slide gate valve to control the fill rate, drained duration, and frequency of fill and drain cycles (see Drawing Sheet 002-C-006 in Appendix A). Water levels will fluctuate multiple times during the day in response to draining by a second, 12-inch-diameter inline water level control structure with a weir for a high water level setting and an automated slide valve at the bottom of the structure at the outlet from Cell 2A. Water levels rise and fall in Cell 2A on a schedule controlled by the two solar-powered, automated valves with local control and adjustable riser weirs on the Cell 1 and Cell 2A outlets. Water discharges Cell 2A by gravity into an inlet splash zone in Cell 2B. The automated valves in the Cell 1 outlet and the Cell 2A outlet will operate in opposite cycles of open and close so when the Cell 1 valve is open, the Cell 2A valve is closed and Cell 2A will fill. When the Cell 2A outlet valve opens to drain Cell 2A, the Cell 1 valve is closed so that no short circuiting of flow occurs.

The 12-inch automated valves have capacity to fill or drain Cell 2A in about 1 hour and will be used to fill and drain Cell 2A from 4 to 8 times per day to provide flexibility in the amount of aeration provided. Flow in Cell 2A is both vertical and horizontal through rock media that will grow a bio-film. Cell 2A fills and drains through a single row of slotted infiltrators on the wetland bottom liner. Cell 2A is about twice as wide at the top as at the bottom so filling creates an upward flow that also expands horizontally as it flows over the aerated biofilm on the rock media, displacing air in the voids between rocks. Draining from the bottom creates flow vertically downward that is also contracting horizontally as the level drops. Air fills the voids as the water discharges. The automated valves can be adjusted to control the rate of filling and draining as well as the duration that the cell sits drained to allow thin film capillary drainage, or sits full to allow contact with the biofilm. Automated valves were selected over siphons for Cell 2A to increase the flexibility of control. The surface of the rock media in Cell 2A is covered by a geotextile separation layer and 1.5 feet of wood chips for insulation. The hydraulic residence time in Cell 2A can be varied with recycle flow rate and number of tidal cycles per day from about 1.8 to 3.8 hours.

Cell 2B is a vegetated, subsurface flow wetland for aerobic polishing with horizontal flow in gravel media 2 feet deep of two size gradations that improves removal of nitrogen and dampens the surge from the water release from Cell 2A. Ammonia produced by CN dissolution will be passively nitrified to nitrite and nitrate through enhanced oxygen transfer within the pulsed bed system. Further removal of CN is expected to occur through volatilization and aerobic biodegradation. Excess carbon, oxygen-demanding substances (e.g., biochemical oxygen demand [BOD] and chemical oxygen demand [COD]), and sulfur produced from Cell 1 will be subject to biological degradation and passive oxidation. The surface of the wetland will be planted in alternating bands of soft-stem bulrush and hard-stem bulrush with the top of the rootball placed at the water level so roots can extend completely through the rock media. A 6-inch-thick layer of wood chips will be placed over the rock media for insulation and the bulrush will be planted through the woodchips in small excavations. Over time, the bulrush will add organic detritus to the wetland surface to improve insulation. Rapid release of water from Cell 2A will cause both vertical and horizontal flow in the rock media near the inlet end of Cell 2B as the water enters Cell 2B at a rate faster than it can move through the media horizontally to the outlet weir. The inlet end of Cell 2B will have a near-surface layer that fills and drains and has aeration capability similar to cell 2A. The inlet pipe to Cell 2B has vertical risers that extend above the water surface to create a splash zone for increased aeration and solar exposure in the thin film of water spouting from the risers. The outer edge of the splash perimeter will form ice. The water contains enough heat that the risers will remain open and drain down to the Cell 2B water level, which is 6 to 12 inches below the rock surface after each fill cycle. The adjustments to reduce risk of ice in prolonged cold weather are to run more fill/drain cycles per day to move warm water through the splash zone more often each day and to reduce recycle since wetlands effluent will be colder than well water. The inlet risers have up to 4 feet of head at the beginning of a fill cycle. The hydraulic residence time in Cell 2B can be varied with recycle flow rate from about 6.8 to 13.7 hours. Water passes through the gravel root zone in Cell 2B and then flows by gravity through a transition zone (Cell 3A) to allow continuous flow to Cell 3B with pulsed flow to Cell 2B. The hydraulic residence time in Cell 3A can be varied with recycle flow rate from about 3.5 to 6.9 hours.

Cell 3B is a vegetated horizontal subsurface flow wetland for final polishing before discharge through an adjustable riser weir to a sump, for pumping to the EC system, or recirculation to Cell 1. Nitrite and nitrate produced in Cell 2 will be removed through coupled nitrification and denitrification in the biologically active media. Any residual CN will be further subject to biological degradation, volatilization, and sorption to mineral and organic surfaces. Excess carbon, BOD and COD, and sulfur produced from Cell 2 will receive additional polishing. Water from Cell 3B will be recirculated in part to Cell 1 for passive denitrification and to conserve biological carbon and nutrients supplied by the BCR media. Cell 3B has a single, 20-inch-thick layer of ¾-inch angular basalt as media. The surface of the wetland will be planted in alternating bands of soft-stem bulrush and hard-stem bulrush with the top of the rootball placed at the water level so roots can extend completely through the rock media. A 6-inch-thick layer of wood chips will be placed over the rock media for insulation and the bulrush will be planted through the woodchips in small excavations. Over time, the bulrush will add organic detritus to the wetland surface to improve insulation. The hydraulic residence time in Cell 3B is about 13.5 to 27 hours. Flow through Cell 3B is uniformly distributed and steady so the flow through the root-filled media will have time for chemical and biological reactions to provide final polishing of the water before it is discharged to the wetland effluent pump station.

The preliminary operational inputs for the subsurface biological treatment wetlands are summarized in Table 2.2-1. Operational inflow concentrations are assumed and based on existing data; the final basis of design will be confirmed following installation of well pumping systems and startup of the system.

Table 2.2-1. Enhanced Treatment Wetland Preliminary Operational Inputs

Key Design Factors	Details
Operational Inputs	Groundwater Inflow = 50 gpm nominal, 75 gpm maximum Recirculation flow = 50 gpm nominal, 75 gpm maximum Free CNin up to = 5 mg/L Total CNin up to = 30 mg/L Fin up to = 20 mg/L NOx-Nin up to = 40 mg/L Total Dissolved Solids up to = 1,500 mg/L
Major Materials/Components	Wood chips, sawdust, and grass hay (locally supplied) for reactive media and surface insulation, and horse manure (as an inoculant). Media gravel, 3/4-inch-diameter, regionally supplied angular basalt, for treatment media. Drainage gravel, 1- and 1.5-inch-diameter rounded river rock for flow collection, biofilm growth, and conveyance. Liner will be geocomposite

Notes:

Free CN_{in} = influent free CN; F_{in} = influent fluoride; NO_x-N_{in} = sum of influent nitrite and nitrate, expressed as nitrogen (NO_2-N + NO_3-N)

gpm = gallon(s) per minute

mg/L = milligram(s) per liter

2.2.4 Wetland Effluent Pump Station

Cell 3B discharges by gravity through an adjustable weir into subsurface piping designed to convey the water to the wetland effluent pump station. The wetland effluent pump station contains two submersible pumps, the wetland recirculation pump (PMP-201) used for wetland effluent recirculation back to Cell 1, and the wetland effluent pump (PMP-202) used to convey wetland effluent through buried piping to the EC system. Drawing Sheet 002-ME-001 in Appendix A shows the location of piping and the pump station, Sheet 002-I-001 provides a process and instrumentation diagram (P&ID), and Sheet 002-M-003 shows mechanical details.

Both pumps have variable frequency drives (VFDs) for flow modulation. A water level instrument in the sump will be used to automatically vary the speed of the wetland effluent pump (PMP-202) in order to maintain the water level setpoint in the sump. A magnetic flowmeter will be used to automatically vary the speed of the wetland recirculation pump (PMP-201) in order to maintain the flow setpoint as set at the local control panel. The run status of each pump is monitored by the EC system programmable logic controller (PLC). If the EC system shuts down, the wetland effluent pump station will be automatically stopped. If the wetland effluent pump station goes into alarm, the EC system will automatically close the groundwater force main valve in the EC Building that triggers a shutdown of the wellfield. The EC system will continue to operate until the EQ tank water level reaches the low-level shutoff setpoint. If the wetland effluent pump fails, the pump station general alarm signal will trigger the EC system to close the groundwater force main valve, wetland influent flow will stop, and the wetland recirculation pump will continue to recycle flow to Cell 1 until the EQ tank level reaches the low-level shutoff setpoint and the pump station is entirely stopped on the permissive interlock. Water levels in the wetlands will then equilibrate based on outlet weir elevations. If the wetland recirculation pump fails, the pump station general alarm signal will trigger the EC system to close the groundwater force main valve, wetland influent flow will stop, and the wetland effluent pump will continue to convey treated wetland flows to the EC system. The wetland effluent pump will continue to pump until the wet well level reaches the pump shutoff setpoint and the EC system will eventually shut off when the EQ tank reaches its low-level shutoff setpoint. Water levels in the wetlands will equilibrate based on outlet weir elevations.

Valving and controls switching will allow the wetland recirculation pump to serve as backup for the wetland effluent pump. The top elevation of the wetland effluent pump station is higher than that of the Cell 3B liner, so water will cease to flow to the pump station once the water level equilibrates in the wet well. There is enough freeboard within Cells 2B and 3A/3B to contain all the drain-down from Cells 1 and 2A. If the water level in the wetland effluent pump station reaches the high-level alarm setpoint, the general alarm signal will trigger the EC System to close the groundwater force main valve and wetland influent flow will stop. Wetland effluent pumps will continue to run until the wet well level is pumped down to the pump shutoff setpoint. Water levels in the wetlands will then equilibrate based on outlet weir elevations. The EC system will eventually shut off when the EQ tank reaches its low-level shutoff setpoint.

2.2.5 Electrocoagulation Process

Wetland effluent from the wetland effluent pump station is conveyed in underground piping to the equalization (EQ) tank in the EC Building. The EQ tank is the beginning of the EC treatment process. United Rentals will supply the EC treatment system. An equipment layout, process flow diagram, P&IDs, and specifications for the EC system, prepared by United Rentals, are in Appendix C. The EC process is designed for a nominal flow of 50 gpm and a maximum flow of 75 gpm.

The system adds calcium chloride to the EQ tank, adjusts the pH to an expected target of about 7.2 with sulfuric acid, and provides aeration by bubbling air. A level system tracks water level and controls two variable-speed pumps, which in turn pump to two EC reactors configured in series. The EC overflow flows by gravity to a post-EC tank for level control of two variable-speed pumps, which pump to a mixed and aerated defoam tank in which pH is adjusted using sulfuric acid. The defoam tank overflows by gravity through the floc tank, in which polymer is added to enhance flocculation of solids. The overflow from the floc tank flows by gravity into an inclined plate clarifier to separate solids from the overflow. The overflow then passes by gravity into a post-treatment tank that uses level monitoring to control two variable-speed post-treatment pumps, which in turn pump through a set of four multimedia filters, a set of two bag filters, and finally through the effluent conveyance pipeline to the infiltration basin. Valving can be used to recycle treated effluent to Cell 1 of the Enhanced Treatment Wetland. The settled solids in the clarifier are pumped into a cone-bottomed sludge thickener. From there, the supernatant is returned by gravity to the defoam tank for retreatment, and the thickened sludge is pumped to a recessed chamber filter press located on an elevated stand for dewatering. The dewatered sludge drops into a roll-off bin, and the filtrate is returned by gravity to the EQ tank. When full the roll-off bin is covered and trucked away for disposal. The filter press has a pressurized air system to enhance dewatering and reduce sludge weight. Filter backwash is returned to the EQ tank. Spent bag filter bags are disposed of with the sludge.

Three chemicals will be used during EC treatment: sulfuric acid, calcium chloride, and polymer. Sulfuric acid will be used to lower water pH, calcium chloride will be used to enhance treatment, and polymer will be used to flocculate precipitates for clarification. Sulfuric acid will be used as a 93 percent by weight (wt%) solution, calcium chloride as a 35 wt% solution, and polymer as a dry powder mixed into a solution from 50 pound bags.

A “mini-bulk” system will be used for sulfuric acid and calcium chloride. Mini-bulk consists of a tank-based system filled by delivery truck on an as-needed basis. It is called mini-bulk because the tanks and delivery volumes are smaller than those used in larger operations in which full tanker loads are delivered. The mini-bulk system consists of two tanks located outside against the south wall of the EC Building within a fenced area with locked-gate access. Each tank will be made of high-density plastic resin with double walls and top-mounted connections and openings. The tanks will have a mechanical fill-level indicator visible from the front, and the capability to be equipped with telemetry for remote tracking of levels by the operator and delivery company. The chemical feed pumps will be located inside the building and will pull chemical from the top of the tanks through the building wall via double-wall piping. The concrete slab under the tanks will have curbs on the west and east sides and will slope toward the building into a drain that is piped through the foundation and into the interior building sump to collect any spills during tank filling. Stormwater will also be collected, and although the flow is not expected to be higher than the sump pump capacity, a valve will be provided inside the building to temporarily constrain or stop this flow if ever needed. A heat-traced combination eyewash and chemical shower will be outside adjacent to the tanks, as will a hose bib and hose for housekeeping. The calcium chloride will need freeze protection because 35 wt% calcium chloride begins to crystallize at 20 degrees Fahrenheit (°F). An in-tank submersible heater will be installed in the tank and turned on seasonally.

A pair of sulfuric acid feed pumps will be inside the building and pump to the EQ tank based on automatic pH feedback through double-wall hose or pipe. Calcium chloride solution will also be pumped to the EQ tank using redundant chemical feed pumps. The third chemical to be used is anionic polymer. This will be delivered in bags and made up into solution by the operator on an as-needed basis because the usage rate is low.

The floor of the building will be sloped to provide containment and direct water to a sump containing an automatic pump which will pump to the EQ tank for treatment. Air will be collected from the interior apex of the building and vented at the exterior ridgeline.

Potable water will be needed for polymer solution makeup, eyewash/safety shower systems, and washdown for the EC Building. The Final Design includes provisions to have potable water delivered to the site via truck on a routine basis (anticipated monthly). A 2,000-gallon tank will be located within the EC Building accessed by rollup door for access by delivery truck. An option for potable water from the Whitworth Water District was considered to supply a fire hydrant (required for the EC Building as discussed in Section 7) that could be used for this water supply. The water supply from the hydrant would be transported via a 2-inch connection to the new fire hydrant located near the EC Building. The EC Building connection would incorporate isolation valves and a double-check backflow preventer in accordance with Whitworth Water District requirements. An adjustable pressure reducing valve would be installed before the double-check backflow preventer. A water meter would be installed where the fire hydrant main connects to the existing Whitworth Water District pipeline. Currently this option is on hold and is not shown in the Final Design. If this option is executed, the hydrant water supply would connect to the 2,000-gallon tank located inside the EC Building.

A floor drain and 65-gpm sump pump is located in the middle of the EC Building to collect washwater and spills. The sump pump operates automatically via low- and high-level switches, and pumps to the EQ tank. The sump also has a high-high-level switch which if activated will trigger an alarm, shut down the EC process and the wetland effluent pump station, and close the valve on the inflow from the extraction wells. This in turn will trigger the automatic shutdown of all wells. It will also provide remote notification to an operator via telemetry.

Manual valving is provided in the EC Building to allow recirculation of EC treated water to either the EQ tank or to Wetland Cell 1. This provides ability to retreat off-spec effluent if necessary. Manual valving is also provided to pass groundwater directly to the EC process, bypassing the Enhanced Wetland Process, although this is not expected to be the normal mode of operation. Sample valves are in the EC Building for untreated groundwater, Enhanced Wetland Process effluent, and EC process effluent.

The EC system has a supervisory control and data acquisition (SCADA) system consisting of a PLC, human-machine interface (HMI), and a cell-phone-based communication system for remote access. The HMI is a touchscreen panel located on the face of the control system cabinet. The SCADA system provides automated monitoring and control of many of the system processes, local and remote alarm enunciation, remote monitoring of process conditions and equipment status, and control of programmed interfaces. The system also has a data historian to record programmed process conditions for later retrieval and review.

2.2.6 Treated Effluent Discharge

Treated effluent from the EC system is pumped through underground piping, following the same alignment and in the same trench as the groundwater force main, to the infiltration basin located downgradient of the extraction wells. Drawing Sheet 005-C-001 in Appendix A shows a plan of the infiltration basin.

The infiltration basin will be sized to handle a maximum flow rate of 75 gpm. The basin will consist of a below-grade trench or cell partially filled with granular material to allow for infiltration into the subsurface. Treated effluent will be piped into the basin to risers located in the trench and set below the media surface. The infiltration basin is designed for treated effluent infiltration without ponding in the basin, refer to calculations in Appendix D for sizing conditions. The basin structure is designed for infrequent wetting conditions (such as a rain on snow event) that could result in minor ponding (estimated at less than 12 inches) over a few days.

2.3 Civil

2.3.1 Design Codes and Standards

The civil elements of demolition and construction are designed to the following codes and standards:

- Washington Department of Transportation (WSDOT) Standard Plans
- 2020 WSDOT Standard Specification
- Spokane County Standard Plans
- 2019 Avista Electric Service Requirements and Distribution Standards

2.3.2 Groundwater Extraction Wells

As stated above, the wellfield consists of five groundwater extraction wells. Well TW-1B is an existing extraction well, constructed previously for groundwater extraction pilot testing and screened in the B-zone saturated unit. Four additional extraction wells (TW-2B, TW-3B, TW-4B, and TW-5B) have been constructed laterally across the groundwater plume and screened in the B-zone saturated unit. The groundwater extraction well construction details and boring logs are included in Appendix D.

After extraction well construction, the wells, including TW-1B, performed short-duration pumping throughout the screened interval. Groundwater extraction rates, well drawdown, and field parameters specific conductance (SC) and pH were collected during the pumping to further characterize the B-zone hydraulic conditions and indirectly measure relative groundwater contaminant concentrations. The results of the well development were used to provide estimates of specific capacity and transmissivity to update the groundwater capture zone analysis.

Groundwater samples were collected and submitted for analytical testing at the end of development from each well. The results of the analytic testing results were used to compare to field parameters pH and SC values and verify their use in performance monitoring. The groundwater wells were allowed to equilibrate for several days after pumping, and then field parameter profiles were logged within each screened saturated interval. The profiling results indicated that the highest concentrations in groundwater were measured in the lower portion of the well screens. The lower screen interval was defined at the target interval for groundwater pumping and location for pump intake installation.

The groundwater analytical results were used to evaluate different proposed extraction well pumping schedules. The extraction system design assumption is a nominal 50 gpm from the wellfield. Groundwater extraction rates were focused in the centrally located wells, TW-3B and TW-4B, to optimize extraction concentrations of TCN and fluoride from the plume. The revised pumping schedule resulted in changed assumptions of submersible pump sizing, and increased horsepower requirements for these centrally located wells. Submersible pumps have an optimal flow curve based on delivery head with a range of high and low flow rates. The submersible pump equipment has been revised in the design to accommodate the proposed pumping schedule and pump curves based on proposed flow rates.

The remedial investigation and feasibility study groundwater model provided by the Custodial Trust's consultant Hydrometrics was revised and used to approximate groundwater conditions in the groundwater extraction well field. The proposed pumping schedule was also used in the groundwater model and used to review the approximate groundwater capture in the B-zone aquifer. The results of the groundwater model are provided along with the previously discussed calculations in Appendix D.

2.3.3 Earthwork

Common fill will be acquired onsite. Existing asphalt pavement will be processed (sized to 3 inches or less and blended with earthfill) for reuse as fill in the wetland berms or as road-surfacing materials for the roadway along the process pipeline corridor. Impermeable surfaces of the wetland ponds and the EC Building foundations will cover the majority of disturbed asphalt surfaces and infiltration will be minimized. Wetland berms will be covered with topsoil, seeded, and graded to drain to control runoff and minimize infiltration. Specific media for the wetland pond materials will be sourced from local yards when possible.

The infiltration basin location has not significantly changed from the proposed location downgradient of the extraction wells and infiltration influence on groundwater is considered relatively unchanged from preliminary groundwater calculations. The infiltration basin is dug into a hill that will provide the needed fill for the wetland construction. Compaction of access road and wetland berms will be performed to 95 percent compaction following ASTM D1557 (Modified Proctor) standards.

2.3.4 Wetland Liner

The wetland cells and interior berms are lined with a composite geosynthetic liner system consisting of a sodium bentonite geosynthetic clay liner underlying a 60-mil, high-density polyethylene geomembrane. The composite liner is placed on specified, carefully prepared subgrade and, as such, does not require a separate geotextile cushion-layer under the liner. A 6-inch layer of sand placed under the liner was considered and determined not necessary, given that subgrade preparation includes removal of sharp or protruding objects that would contact the liner. A 12-ounce geotextile cushion with a puncture strength that far exceeds the maximum allowable dead and live loads will separate the composite liner and cell media that could cause liner damage, including drainage and treatment media. The bottom rock layer in Cells 1 and 2 is specified as 1.5-inch-diameter round river rock used for a drainage layer. Cell 1 has a transition layer of 1-inch-diameter round river rock over the drainage rock to reduce the potential for the organic media to migrate into the drainage rock. Cells 2A and 2B have ¾-inch angular basalt gravel as a treatment media over the drainage rock, which has higher cation exchange capacity than river rock and benefits treatment. Cell 3A has all drainage rock to allow for a uniform flow distribution across the transition from Cell 2B to Cell 3B, and Cell 3B has only ¾-inch angular basalt gravel with no drainage rock layer below it.

The Cell 2A pipe outlet near the bottom of the liner is made with enough clear space beneath the pipe penetration to complete the boot installation, clamp connections, and geomembrane welding. This lower penetration is below the operating water levels in the wetland cell and has a robust leak control system consisting of an anchor block with integral embedment strip, free bentonite at the point of pipe penetration, geomembrane boot welded to the anchor block (at the embedment strip) and the pipe penetration, gaskets and clamps on the boot, and a concrete backfill to secure and protect the penetration seals. The drainage pipe and infiltrators in each cell lay on the geotextile that protects the liner at the bottom of the cell. All pipelines inside the liner have extensions up the berm side slopes to the top of the berm for cleanouts on one end so that a liner penetration is not needed. Upper penetrations will use a similar detail without the use of the concrete backfill. Design calculations for the liner system including liner anchor pullout resistance and wetland liner/embankment stability are presented in Appendix D.

Rigorous quality assurance/quality control testing requirements will be performed on the liner system. Testing requirements are detailed in the drawings (Appendix A) and technical specifications (Appendix B) for the design. A construction quality assurance plan that summarizes these requirements has been submitted to Ecology under separate cover. All geomembrane seams will be welded and tested at the time of installation. Geomembrane panels are welded using double wedge fusion welds, and patches and other connections are welded using extrusion welds. Following installation, two electronic leak location surveys will be performed – an initial test on the bare liner to check for pinhole leaks before cushion geotextile and initial rock placement, and a second test after rock placement in the cell.

The media in Cells 1 and 2A will have 1.5 feet of wood chips as an insulation layer to protect the water from freezing and so environmental exposure is minimized. The insulation layer of wood chips will also include a layer of 12-ounce geotextile as separation between the wood chips and the underlying media layer. The geotextile, with a permittivity of 0.8 sec ^-1, will allow needed gas exchange from the surface of the cells. Cells 2B and 3B will be vegetated and will have a 6-inch layer of wood chips above the water table to provide insulation. No geotextile fabric will be used in Cells 2B and 3B so the plants can be planted through the wood chip layer and can spread uninhibited by a fabric. Over time, the wetland plants that senesce each winter will create an organic layer on top of the wood chip layer to increase heat retention.

The berm around the wetland perimeter will have an 8-foot-wide surface consisting of a seeded native grass surface to support access by light all-terrain vehicles. The berm tops will be 8 feet wide between cells and 10 feet wide on the perimeter of the wetlands when water is only on one side of the berm. The liner anchor trench at the top of the berm is 2 feet wide and must be outside of any traffic area.

Ecology has identified that the wetland liner system must comply with the design requirements of Ecology's Criteria for Sewage Works Design, Section G3-3.5.2, which provides the design criteria for surface impoundment liner systems. This standard calls for either a double-liner system with leak detection layer or a single-membrane liner with groundwater monitoring wells capable of detecting a release from the facility. Following further discussions with Ecology, it was determined that the existing groundwater monitoring wells KM-14, HC-7, and HC-8 can be utilized as detection monitoring for the wetland liners, based on field reconnaissance and their continued functionality verified through downhole investigations and sampling activities. Refer to the Enhanced Wetlands Civil and Liner Plan, Drawing 002-C-001 in Appendix A, for locations of these wells. Jacobs has examined these wells and determined them to be functional but requiring modification of the surface completions, a step that was completed by Budinger & Associates for the Custodial Trust. These wells will be added to the groundwater monitoring plan and submitted as a separate document to this Final Design.

2.4 Architectural

2.4.1 Electrocoagulation Building

The EC Building is the only above-grade structure subject to the Washington State Building Code and Energy Code in this project and therefore is the only structure discussed in this section.

2.4.2 Design Codes and Standards

The EC Building is designed to the following codes and standards:

- 2015 IBC International Building Code (as amended by the State of Washington)
- 2015 IECC International Energy Conservation Code (Washington State Energy Code)
- 2015 IFC International Fire Code
- 2015 IMC International Mechanical Code
- 2015 IEC International Electrical Code
- National Fire Protection Association (NFPA)
- Washington State Occupational Safety and Health Administration

The EC Building is designed as a pre-engineered steel structure with insulated walls and roof to provide environment control for the EC process consistent with the Washington State Energy Code definition of Conditioned Space. Ventilation is provided to prevent over-heating of the space and space heaters are provided to maintain a room temperature above 40°F.

Although this is a water treatment process, one stage of the process uses sulfuric acid, which will push this to a Group F-1 moderate hazard industrial process. Storage of sulfuric will occur outside the building with only the distribution lines holding amounts of the chemical far below the minimum allowable for a nonhazardous occupancy.

A smoke and security alarm system will be provided in the EC Building. The system will have door sensors at each man-door, a motion sensor, a smoke alarm at each end of the building, and a loud siren. It will also have a cellular-based offsite monitoring system to automatically alert the operator as well as authorities.

Table 2.4-1 summarizes the EC Building Washington State building code. Table 2.4-2 summarizes the Prescriptive Path for Conditioned Spaces Washington State energy code.

Table 2.4-1. EC Building Washington State Building Code Summary

Building Name	EC Building Code
Occupancy:	F-1
Actual Floor Area:	3,870 ft^2
Actual Height:	1 Story (> 25 feet)
Type of Construction:	Type II-B
Allowable Area:	15,500 ft^2/floor (per IBC Table 503) + 9,065 ft^2 (Frontage) + 0 ft^2 for sprinklers (Sprinklers not provided)
Allowable Height:	3 Stories (55 feet)
Fire Separation:	None Required (Buildings are more than 40 feet apart)
Design Occupant Load:	39 People
Actual Occupant load:	2 People
Fire Sprinklers:	No Fire Sprinklers provided
Americans with Disabilities Act:	Not required (IBC 1103.2.9 Equipment Spaces exception)
Travel Distance Allowed (Max):	200 feet in F1 (IBC Table 1016.2)
Occupancy Separation (Rating):	Not Required
Hazardous Materials:	None at quantities that exceed limit in Table 414.2.5 or Table 307.1
Fire Resistance Rating:	None required
Structural Frame:	0 hours
Bearing Walls	0 hours
Nonbearing Wall, Interior	0 hours
Floor Construction	0 hours

Table 2.4-1. EC Building Washington State Building Code Summary

Building Name	EC Building Code
Roof Construction	0 hours
Shaft Enclosures	NOT Rated
Stairway Enclosures	N/A
Fire Suppression System	None Required
This Building is for Public Access	No

Table 2.4-2. EC Building Prescriptive Path for Conditioned Spaces, Washington State Energy Code Summary

Prescriptive Path for Conditioned Space		Washington State Energy Code
Climate Zone		5B
	Required Value	**Provided Value**
Walls - Exposed Metal Building Batt insulation with white vinyl vapor barrier	U-0.052	U-0.052
Perimeter Insulation	R-10	R-10
Roof - Exposed Metal Building Batt insulation with white vinyl vapor barrier	U-0.031	U-0.031
Coiling Doors – Insulated metal coiling doors	R-4.7	R-8
Swing Doors – Insulated Hollow Metal doors	U - 0.37	U = 0.25
Windows	SHGC = 0.53 N and 0.4 E, W, S	N/A
Skylights	U – 0.50	N/A

Note:

N/A = not applicable

2.4.3 Building Components

The EC Building is a pre-engineered metal building with exterior, metal siding, metal building blanket insulation sufficient to achieve an overall U-value of U-0.052 and metal roofing over metal building blanket insulation sufficient to achieve and overall U-value of U-0.031. The building will have concrete spread footing under columns and a slab on grade floor. The slab will be recessed 3 inches below door sill to provide a minimum of 110 percent containment for the largest single water processing tank in the building, which is the 6,500-gallon EQ tank. This does not include the additional capacity provided in the floor drain and sump. There will be three 3 x 7 insulated HM man-doors for personnel access and two 12-by-12 Insulated coiling overhead doors for vehicle access into the structure. The personnel doors will be fitted with panic bars and closer and will be lockable from the outside. The coiling overhead doors will have a manual chain hoist and will be lockable from the inside.

2.5 Structural

This section provides a summary of structural design codes and standards, design loads, and the EC Building structure.

2.5.1 Design Codes and Standards

- 2015 International Building Code (IBC) (as amended by the State of Washington)
- American Concrete Institute
  - ACI 318-14 Building Code Requirements for Structural Concrete
- American Institute of Steel Construction (AISC)
  - Manual of Steel Construction, 2011, Fourteenth Edition
- American Society of Civil Engineers (ASCE)
  - ASCE 7-10 Minimum Design Loads for Buildings and Other Structures
- American Welding Standards (AWS)
  - AWS D1.1 Structural Welding Code – Steel
- Metal Building Manufacturers Association
  - Metal Building System Manual 2012

2.5.2 Design Loads

2.5.2.1 Building Risk Category

Building Risk Category shall be II.

2.5.2.2 Floor Live Loads

Floor live loads will be calculated in accordance with the codes and standards listed previously, and the following minimum loads:

- Process Rooms: 200 pounds per square foot (psf) on slabs
- Electrical Rooms: 300 psf
- Storage Areas: 250 psf
- Stairs, Walkways, and Platforms: 100 psf
- Platforms Only for Access: 60 psf

2.5.2.3 Roof Live Loads

- Live Load: 30 psf
- Roof Collateral Load: 10 psf

2.5.2.4 Wind Loads

- Ultimate Wind Speed, V (3-Gust): 110 mph
- Exposure Category: C
- I_w: 1.0

2.5.2.5 Snow Loads

- Ground Snow Load (Pg): 39 pounds per square foot
- Exposure Coefficient (Ce): 1.0
- Thermal Factor (Ce): 1.0
- Importance Factor (I): 1.1

Flat roof minimum snow load will be 30 psf. All roofs with a slope less than 0.5 inch per foot will have a 5-psf rain-on-snow surcharge load applied to establish the design snow loads.

2.5.2.6 Earthquake Loads

- Soil Site Class: **D**
- Seismic Parameters:
  - S_S: 0.337 g
  - S_1: 0.116 g
  - S_{DS}: 0.344 g
  - S_{D1}: 0.18 g
- Seismic Design Category: C
- Importance Factor: 1.00

2.5.2.7 Deflection

Design of structural members will adhere to deflection limits established in IBC Section 1604.3, referenced material codes and standards, and the EC Building description that follows.

2.5.3 Electrocoagulation Building and Foundation

The EC Building will be a single-story, pre-engineered metal building with a footprint of 90 feet long by 44 feet wide. Primary moment frames will run in transverse direction and rod braces will be installed in the longitudinal direction. The building will have four bays and a gable roof with 20-foot clear-height. The foundation system for the EC Building will be cast-in-place concrete footings and stem walls in the perimeter. Building columns will be founded on individual spread footings that can resist the wind uplifting and sliding loads. Thrust tie will be casted below the floor slab to resist the thrust forces from the building columns. The floor will be slab on grade with concrete curb at the perimeter served as the containment walls.

Steel or aluminum platforms will be designed to access the equipment inside the building. Process equipment will be founded on equipment pads.

2.6 Process Mechanical

2.6.1 Codes, Standards, and Regulations

The mechanical design will meet the requirements of the following codes and standards, as applicable:

- 2015 IMC International Mechanical Code
- 2015 UPC Uniform Plumbing Code
- 2015 IFC International Fire Code
- American Society of Mechanical Engineers B31.3, Process Piping Code

2.6.2 Design Criteria

Submersible pumps at the extraction wells and wetland effluent pump station will be designed for adequate submergence and to meet pump Net Positive Suction Head requirements for avoiding cavitation conditions. Submersible well pumps will include pump shrouds as necessary to assure that groundwater flow passes the motors for cooling purposes. The pumps will be equipped with a “pump saver” module that is integrated into the controls to monitor pump temperature and resistance, and to provide for shutdown in the event of pumping conditions that are likely to damage the pump motor. Pump station pumps will include safety devices for detecting moisture intrusion into the motor housing and motor overheating that will be alarmed and the pumps stopped. Well pumps will be suspended in the well by the discharge piping with stainless steel wire rope as safety cable for securing the pump. Pump station pumps will be mounted on guide rails for withdrawal for maintenance without having to enter the wet well.

Process piping will be sized to maintain proper flow velocities between 2 and 8 feet per second to avoid solids deposition at the lower velocity and excessive head/friction losses at high velocities. Pipes will typically be buried below the frost level (at least 3 feet of soil cover) to avoid the need for freeze protection.

2.6.3 Materials

Mechanical equipment and materials will be suitable for the environment in which they will be installed and will carry a listing label from a listing agency recognized by the State of Washington. Materials in potentially hazardous areas (e.g., NFPA-classified spaces) will be approved as suitable for installation under the designated classification.

2.6.4 Site Utilities

Utilities needed for operation of the groundwater treatment collection and treatment systems include electrical power and potable water. Connection to Avista Electric Service (Avista) power is required to operate the extraction and treatment system and is in development with Avista. Potable water is preferred for operation of the treatment system for chemical makeup, equipment washdown, and emergency eyewash and safety showers.

Potable or treated water can be used for fire protection at the treatment building, and options were evaluated for the source and delivery of this water based on cost-efficiency. The preferred option is development of a fire water pond to hold required volumes necessary to meet fire flow requirements established by Spokane County Fire District No. 9 (SCFD). Treated effluent would be used to maintain required pond volumes. Installation of a water main from the Whitworth Water District system to near the EC Building for a new fire hydrant and connection to the building is another option that could be considered if acquisition of property for the fire water pond becomes a challenge.

Utilities must be installed and functional in order to complete construction installation, startup, and testing of the facility for operation. Installation and testing of the fire water pond (or other water source) will be required to receive final permits for the project.

2.7 Heating, Ventilation, and Air Conditioning

This section describes the provisions for the heating, ventilation, and air conditioning (HVAC) systems for the EC Building.

2.7.1 Codes, Standards, and Regulations

The following are the applicable codes, standards, and regulations pertaining to the design of the HVAC systems for the EC Building.

- 2015 IBC International Building Code (as amended by the State of Washington)
- 2015 IECC International Energy Conservation Code (Washington State Energy Code)
- 2015 IMC International Mechanical Code
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- American Society of Mechanical Engineers
- Air Moving and Conditioning Association
- Sheet Metal and Air Conditioning Contractor’s National Association HVAC Duct Construction Standards

2.7.2 Outdoor Design Conditions

Weather data for the project are referenced from the 2017 ASHRAE Fundamentals Handbook. Table 2.7-1 summarizes these weather data. Humidity within the spaces will not be controlled.

Table 2.7-1. EC Building HVAC Basis of Design

Weather Data Location[a]	Spokane, 17 SSW
Weather Data Location Elevation	2,267 feet above sea level
ASHRAE Climate Zone	5B
Winter Design Temperature[b]	2.5°F dry bulb
Summer Design Temperature[c]	92.6°F dry bulb/ (N/A)°F Wet Bulb

[a] Closest published ASHRAE weather station to project site.

[b] ASHRAE 99.6% annual cumulative frequency of occurrence.

[c] ASHRAE 0.4% annual cumulative frequency of occurrence.

2.7.3 Indoor Design Conditions

The indoor design temperatures, ventilation criteria, and plumbing design criteria for the EC Building are listed in Table 2.7-2. These temperatures and ventilation rates will be used for selecting and sizing the HVAC equipment. The safety shower/eyewash stations will be fed by potable water and will include a heating unit to ensure water temperature meets code for tepid water supply for these systems. Potable water will also be used for washdown water within the facility and polymer solution makeup.

Table 2.7-2. EC Building Indoor Design Temperatures and Criteria

Occupied	No
EC Building Summer Temperature, max[a]	104°F
EC Building Winter Temperature, min	40°F
Process Equipment Ventilation Requirements[b]	Min 100 CFM Exhausted at high point of space, constant (200 CFM Exhaust Provided)
Safety Shower/Eyewash Stations	2 (1 Interior, 1 Exterior)

[a] Short-term temperature excursions will occur on days where the ambient temperature exceeds that of the Summer Design Temperature.

[b] Criteria provided by United Rentals.

2.7.4 HVAC Design of EC Building

The HVAC systems for the EC Building include a single thermostat-controlled supply fan with filter module, a single exhaust fan, unit heaters, and motorized dampers.

For heat management during the cooling season, a thermostat-controlled fan will be used to supply ventilation-cooling air to the EC Building. Outside air will be drawn through a wall-mounted louver and filter module before being distributed to the space through a galvanized steel ductwork system. Filtration will be equivalent to a Minimum Efficiency Reporting Value (MERV) 8 efficiency. Air will be relieved by pressure from the space through a wall-mounted exhaust plenum and open ductwork situated at the high point of the space. This high-point exhaust duct is intended to collect buildup of process-related byproducts which tend to accumulate at the high-point of the space. Motorized dampers isolate supply and exhaust ductwork when the associated fans are not in operation. Short-term temperature excursions exceeding the EC Building Summer Temperature in Table 2.7-2 will occur on days where the ambient temperature exceeds the Summer Design Temperature in Table 2.7-1.

During the heating season, the building envelope will be heated by wall-mounted unit heaters installed along the interior perimeter of the EC Building. A winter exhaust fan will collect the buildup of process-related byproducts at the high-point of the space and exhaust them from the building at the wall-mounted exhaust plenum.

Equipment controls will be accomplished through self-contained electrical control wiring and relays, with no central alarm or fault monitoring.

A fire sprinkler system will not be provided for the EC Building; however, a security and smoke alarm system with remote monitoring will be installed.

2.8 Electrical

The purpose of the section is to describe the electrical design for the overall Custodial Trust site, including the EC Building, extraction wells, and wetland sump pumps.

2.8.1 Codes, Standards, and Regulations

Applicable codes, standards, and regulations for electrical design are as follows:

- 2017 NFPA 70 (National Electrical Code)
- 2018 NFPA 70E (Standard for Electrical Safety in the Workplace)
- ANSI
- Occupational Health and Safety Administration
- Underwriters Laboratory
- 2017 National Electrical Safety Code (ANSI C21987)
- National Electrical Manufacturers Association
- Institute of Electrical and Electronic Engineers
- Instrument Society of America
- Insulated Cable Engineers Association
- American Society for Testing Materials
- Illuminating Engineering Society
- International Electrical Testing Association (NETA)

2.8.2 Design Criteria

This section describes the electrical design of the overall site, EC Building, extraction wells, and wetland effluent pump station.

2.8.2.1 Overview

The electrical system will be installed in coordination with the local utility for power to two separate sites: the extraction wellfield with pump control cabinet and vault site, and the EC Building. The extraction wellfield site will connect utility power to five VFD enclosures that feed five extraction well pumps. Four future extraction well pumps are considered in the design for utility sizing and the pump control cabinet. However, additional wells will require more pumps, power trenches, and connections into controls in the cabinet. The EC Building will provide a 1,200-amp (A), 480-volt (V) utility service and panelboard to power vendor-provided water treatment systems. The EC Building panelboard will subfeed power to the wetlands site. The electrical design also includes lighting, receptacles, and other facility loads for the EC Building and extraction wells pump control panel.

Site electrical primary conduit will be provided for utility use to feed utility junction cabinets, new and existing, utility structures, and utility transformers. The utility provides medium-voltage conductors to and from utility-owned, new and existing equipment. Utility services include 480-volt, 3-phase service at the EC Building and 240-volt, 1-phase service at the pump control cabinet and flow metering vault.

2.8.2.2 Electrocoagulation Building

The utility will provide 480-volt, 3-phase service to the EC Building with a 1,200-amp capacity service, by providing and sizing a transformer with 480-volt secondary. The design includes a service entrance rated 480-volt panelboard. Panelboard enclosure is to withstand exterior conditions. This panelboard will feed vendor-provided equipment and HVAC equipment within EC Building. Typical equipment fed from 480-volt panelboard includes pumps, special vendor-provided EC packaged systems, and an exhaust and supply fan. For EC Building HVAC equipment, a separate control station is provided for proper HVAC operation.

The 480-volt panelboard subfeeds wetland effluent pump station electrical equipment, a 120/240-volt miniature power center providing power to two submersible pumps, and pump station instruments. Load accounts for future incorporation of lighting and a receptacle at the wetland effluent pump station.

The design includes a 120/240-volt panelboard fed from EC Building 480-volt panelboard. Lighting receptacles and equipment rated at 120-volt or 240-volt in the EC Building are powered from this panelboard. Typical equipment includes eyewash showers, HVAC heaters, and duplex-powered pumps.

Electrical EC Building design criteria are summarized as follows:

- Provide electrical equipment to feed power to EC system.
- Provide electrical equipment and material required by utility to be supplied by customer (CT Cabinet, Utility Meter).
- Provide and install building lights and receptacle.
- Route conduit and conductors to vendor-provided EC system.
- Route conduit and conductors to HVAC equipment.
- Route conduit and conductors from EC Building to wetland effluent pump station.

2.8.2.3 Extraction Wells

The utility will provide 240-volt, 1-phase service to the extraction wells pump control panel and vault. The Contractor provides primary and secondary conduit and secondary conductors. The utility transformer feeds a separate service entrance rated disconnect. The disconnect subfeeds 120/240-volt panelboard in the pump control cabinet. Electrical design criteria in pump control cabinet include the five VFD controllers and power to the flow meters and heater in the vault.

Motors are fed from VFD control units to the separate wells outside of the pump control panel and vault area. The system will provide conduit and conductors from the secondary of utility transformer to motors in wells and for other equipment such as flowmeters and vault heater.

2.8.2.4 Wetland Effluent Pump Station

Electrical at the wetland effluent pump station feeds from a 480-volt panelboard at the EC Building. This includes a 120/240-volt mini-power center providing power to two pumps, one for recirculation and the other for circulation to the EC Building. A VFD is included in the design for each pump. Electrical equipment will be mounted on a concrete pad outdoors.

The electrical system will provide conduit and conductors from the wetland electrical equipment to the wetland effluent pump station. The system will include control conductors for communication with the EC

Building PLC. The electrical design includes space for future lighting. One receptacle will be installed near electrical equipment mounted on strut.

2.9 Instrumentation and Control

The purpose of the section is to describe the instrumentation and control system design criteria for the overall Custodial Trust site, including the EC Building, extraction wells, and wetland sump pumps.

2.9.1 Codes, Standards, and Regulations

Applicable codes, standards, and regulations for instrumentation design are as follows:

- ANSI
- ASTM International:
  - A182/A182M, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
  - A276, Standard Specification for Stainless Steel Bars and Shapes
  - A312/A312M, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
  - B32, Standard Specification for Solder Metal
  - B88, Standard Specification for Seamless Copper Water Tube
- Deutsche Industrie-Norm: VDE 0611, Specification for modular terminal blocks for connection of copper conductors up to 1,000-volt alternating current and up to 1,200-volt direct current
- Institute of Electrical and Electronics Engineers, Inc.: C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits
- International Society of Automation:
  - RP12.06.01, Recommended Practice for Wiring Methods for Hazardous (Classified) Locations Instrumentation Part 1: Intrinsic Safety
  - S5.1, Instrumentation Symbols and Identification
  - S5.4, Instrument Loop Diagrams
  - S50.1, Compatibility of Analog Signals for Electronic Industrial Process Instruments
  - TR20.00.01, Specification Forms for Process Measurement and Control Instruments, Part 1: General
- International Conference on Energy Conversion and Application
- National Electrical Code
- National Electrical Manufacturers Association:
  - 250, Enclosures for Electrical Equipment (1,000 Volts Maximum)
  - ICS 1, Industrial Control and Systems General Requirements
- National Fire Protection Association: 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities
- NSF International (NSF):
  - NSF/ANSI 61, Drinking Water System Components - Health Effects
  - NSF/ANSI 372, Drinking Water System Components - Lead Content
- Underwriters Laboratory, Inc.: 508A, Standard for Safety, Industrial Control Panels

2.9.2 Control Overview

Control system design includes providing local control functionality for the pump controls and wetland effluent pump station (see reference drawings and P&IDs for details). The key components of the extraction well control system are the VFDs, flowmeters, sump level, and pressure switch. Key components of the effluent pump station are the VFDs. The VFDs are Yaskawa V1000 Drives or equivalent with enough input/output to meet design requirements. The flowmeters will be an E&H 10D25 or equivalent with 4-20mA output. The pressure switch will be an E&H Cerephant or equivalent.

PLCs will be Maple Systems modular PLCs with expansion input/output as needed for the system and one PLC for the wetland effluent pump station control. A Maple Systems HMI Touch Panel will be provided for each of the aforementioned PLC systems, to allow operator control locally at the control panel. A Falcon online double-converting uninterruptible power supply or approved equivalent will filter incoming power for each control system panel and provide at least 15 minutes of control system operation time on a full charge.

2.9.2.1 Extraction Wells

The current design shows five extraction wells in the system, with space available in the pump control cabinet for future expansion of controls for four additional extraction wells, at the same combined capacity. The extraction wells will be controlled using a Proportional Integral Derivative (PID) feature in a local PLC. Each pump will be controlled to an individual flow setpoint. Flow of each individual well is measured by a flowmeter on the respective well outlet. The flowmeter will be a magnetic flow, separately sourced with power, providing a 4-20 mA flow signal that is input to the PLC to allow for pump speed control using a PID method to maintain the flow setpoint. The flow setpoint is set via an HMI unit that provides pump controls for each well, and for flow, pressure, moisture, and other operational inputs used in the pump controls.

Pressure is measured at the force main before leaving the vault and leakage within the vault is measured by a sump high-level switch located on the floor of the vault. If high pressure reaches the preset high level to prevent system over-pressurization, conversely a sudden low pressure while pumps are still in operation, or attainment of the sump high-level condition, will result in a system shutoff. In the event of a shutoff, the pumps will require manual reset of the interlock condition before run is allowed again. This reset will be available via the HMI touch panel. This is to allow the system to be evaluated and any issues corrected by an operator as needed. Interlock faults for an individual well include ”pumpsaver” relay faults, which will result in individual pump shutoff and alarm. The five extraction wells feed into a shared force main that routes to the EC Building. A total flowmeter and flow control valve interface with the EC system will allow for manifold shutoff (triggering pressure system fault in the flow metering vault and system shutdown) in the event of EC system faults. If the EC system commands the extraction well flow control valve shut, the extraction well force main pressure will increase and cause the extraction wells to shut off.

Extraction well controls will be located on the face of the HMI panel located in the pump control cabinet, allowing control as required, and displaying individual flows, respective flow setpoints, and indication lights.

2.9.2.2 Wetland Effluent Pump Station

The wetland effluent pump station consists of a wet well with two sump pumps controlled by level and VFDs. One pump recycles water back into the wetland system and the other sends a portion of the wet well water to the EC system. A control signal from the EC package system will act as a run permissive and a general alarm is sent back to the EC system in the event of system fault. Pumps can be in Auto or Manual mode as set on the HMI panel. Speed of pumps can be adjusted via a panel face mounted potentiometer switch.

Pump VFD controls (HIM keypad) will be located on the face of the VFD panel located in the wetland effluent pump station, allowing for local or remote control with via keypad as required. The HMI will allow for Auto/Manual control and will display individual flows, respective flow setpoints, and process indication, and alarms as required.

2.9.2.3 EC Control Interface

The EC-supplied system will have PLC controls and local HMI supplied by others. System fault signal from the wetland effluent pumps will feed into the EC control system via hardwired input/output to be used as process interlocks. The EC system will monitor the flow from the force main, via a magnetic flowmeter as part of the EC package system, to detect if the extraction system is not operating. A flow control valve on the extraction well force main header will also be managed via the EC control system, and in the event of an EC system fault, can shut this valve. This will in turn cause pressure in the extraction well header to increase to its high limit, and the extraction well pumps will be interlocked off, which will require manual reset at the local control panel.

2.10 Security

The treatment system is located on Custodial Trust property within security fencing and with locked gate access. The area is covered by a wireless remote security system that includes motion sensors, local audible alarm, and notification of monitoring service for follow-up with site managers and local law enforcement. A separate smoke and security alarm system will be provided in the EC Building. The system will have door sensors at each man-door, a motion sensor, a smoke alarm at each end of the building, and a loud siren. The system will also have cellular-based offsite monitoring to automatically alert the operator and authorities.

2.11 Landscaping

Landscaping is not required for the project. As part of erosion control systems for the project, the exterior of the wetland and infiltration basin embankments will be hydroseeded with native grass seed, tackifier, and mulch to stabilize and protect these exposed surfaces.

3. Design Flexibility, Adaptability, and Optimization

This section summarizes the features and functionality incorporated in the design to provide operational flexibility, adaptability, and optimization over time.

3.1 Extraction System

Each extraction well pump is driven by a VFD controlled from the pump control cabinet. Based on extraction well development and analytical results (refer to calculations in Appendix D), a pumping schedule has been developed that uses different-sized pumps to meet a flow rate distribution in the extraction wellfield of 2.5, 5, 20, 20, and 2.5 gpm in wells TW-1B, TW-2B, TW-3B, TW-4B, and TW-5B, respectively. This pumping schedule results in the highest combined concentration and mass removal of TCN and fluoride from the extraction wellfield. The flows can be adjusted based on performance monitoring of the system as an ongoing process of optimization.

The pump intake will be placed near the bottom of each screened interval, as this zone has the highest EC concentration within each well screen zone as determined during readings taken during well development (refer to results in Appendix D). This combination of pump intake location within the well screen, and adjustable flow rate from each well, provides considerable flexibility and adaptability for optimizing contaminant extraction. The flow from each well can be manually sampled via sample ports in secured sample stations located outside of the vault. The individual flows are measured for each well using flowmeters in the vault prior to discharge combining in the discharge force main. The combined flow is automatically measured, recorded, and totalized in the EC Building, and can be manually sampled there as well.

The pump control cabinet and vault have been sized to accommodate additional piping and controls for an additional four extraction wells, still supplying a nominal 50-gpm flow combined flow. Space has been reserved for additional VFD panels within the pump control cabinet. The utility services have been sized to accommodate a combined total of eleven, 11-horsepower of submersible pumps, in case needed at a later date.

3.2 Enhanced Wetland Process

The below-ground, three-cell enhanced wetland process provides year-round treatment and protects from freezing and inhibition by snow cover. The operating water level in each cell can be adjusted independently, allowing adjustment of the hydraulic retention time (HRT). Overall effluent quality can also be adjusted by changing the recirculation flow rate from the wetland effluent pump station. The recirculation flow rate is manually adjustable. A sample can be collected from the discharge Agri-drain structure of each cell to track each cell’s treatment performance to provide data for optimization. Nutrient or other influent chemical conditioning is not required. However, chemical injection is possible at all the Agri-Drain weir structures.

Cell 1 discharge water quality can be adjusted by changing the water level. Lowering the water level in Cell 1 changes the HRT, which in turn changes the amount of carbon leaching and sulfate reduction and allows adjusting discharge water quality to assist in optimization. The Cell 1 drainage system valves are also used to throttle the rate of discharge into Cell 2. The design allows flexibility in Cell 1 HRT from 160 hours with no recycle flow to as low as 80 hours per flow pass with 50 gpm of recycle flow and a low water level setting.. Any amount of HRT between the low of 80 hours and high of 160 hours is possible. Additional HRT reduction is achieved by lowering the water level from the normal level of 1,944.25 feet to a minimum level of 1,942.5 feet, which still allows four or five cycles of Cell 2A per day with no recycle flow from the pump station into Cell 1 and six, seven, or eight cycles per day with up to 50 gpm of recycle flow. Normal operation is planned with six cycles of Cell 2A per day, 50 gpm of recycle water, and the Cell 1 water level at 1,944.25 feet.

Cell 2 is subdivided with approximately 20 percent of the cell area in Cell 2A and 80 percent of the area in Cell 2B. Cell 2A is a fill/drain aeration cell that fills and drains from four to eight times per day. Cell 2B is a shallow subsurface flow wetland with vegetation that will root to the bottom of the cell to improve aeration and dampen flow surges from the rapid release of water in Cell 2A. Cell 1 discharges into Cell 2A through an agri-drain weir box that has both an overflow weir for a high water level overflow at elevation 1,944.25 feet and a solar-powered, automated slide gate 2 feet below the weir. The automated 12-inch slide gate valve adds flexibility in control of the rate of flow during filling of Cell 2A and can stop flow from Cell 1 completely during draining of Cell 2A. Stopping flow during draining eliminates short circuiting and dilution with partially treated water that occurs when a cell continuously fills and rapidly drains at the same time. The duration that Cell 2A remains drained without any inflow controls the completeness of the drainage as capillary water that is slow to drain trickles down through the media. Air contact time with the biofilm is adjustable with inlet flow control provided by the automated valve in the weir box. The Cell 1 discharge slide gate valve normal operation is either fully open or fully closed. . When Cell 2A fills to the target level, an automated 12-inch slide gate valve in the agri-drain weir box at the Cell 2A outlet opens and rapidly drains the water into Cell 2B in a tidal-like cycle that starts and stops approximately every 3 to 6 hours with discharge flow for approximately 0.5 hour and no discharge for approximately 2.5 to 5.5 hours. The target number of tidal cycles per day can be adjusted by changing the timing of the automated valve in the outlet of Cell 2A to raise or lower the water level before the valve opens and starts a drain cycle. The HRT in Cell 2A is flexible and can be set between 1.8 hours and 2.8 hours per flow pass by adjusting the number of cycles per day. The planned normal operation of six cycles per day provides 2.3 hours of HRT per flow pass in Cell 2A.

Cell 2A discharges to Cell 2B with a high rate of flow through a discharge pipe on the liner bottom that has risers extending 2 inches above the top of the rock media plus two 2-inch outlets at the wetland bottom. The energy of the discharge with up to 4 feet of head will create an aeration fountain at each riser that will splash on the surface of the rock media to further increase aeration and provide brief sunlight exposure on the thin film of water discharging from the fountain risers. The water level in the media in the splash zone will be 6 inches to 1 foot below the surface so the water will rapidly infiltrate and not freeze. The two outlets at the wetland bottom will drain the water in the risers to at least 6 inches below the media surface so the risers do not freeze. A gate valve on each 2-inch riser is used to throttle the flow rate to control the duration of drainage for Cell 2A. The gate valves are fully open for four cycles per day and partially closed incrementally as the number of cycles per day increases and the volume per cycle decreases. Cell 2B is a vegetated subsurface flow aerobic polishing wetland with a minimum water flow depth of 20 inches and a maximum flow depth of 2 feet to further enhance aerobic polishing as the surge of flow enters from Cell 2A on each cycle. Cell 2B discharges into Cell 3B through a transitional zone designated Cell 3A which consists of a 24-inch drain gravel zone underlying an unplanted 6-inch wood chip insulation layer. The Cell 3A transition zone releases water continuously even with the rise and fall of water levels and the cyclic flow from Cell 2A. The normal water surface elevation in Cell 2B is 1,939.5 feet and the level will fluctuate from 1,939.5 feet to 1,940 feet depending on the number of cycles per day in Cell 2A and the recycle pump flow rate. The HRT in Cell 2B can vary from 6.8 hours to 13.7 hours per flow pass depending on the recycle flow rate. The hydraulic residence time in Cell 3A can be varied with recycle flow rate from about 3.5 to 6.9 hours.

Cell 3B is a vegetated subsurface flow wetland with a flow depth of 1.52 feet. Normal operation will be with the discharge weir boards set at 1939 feet so the cell will have a water level at 1,939.5 feet. The combined volume of Cell 2B and Cell 3A/3B will minimize the level fluctuations that are caused by the surge of flow released from Cell 2A. The Cell 3A transition zone will cause the level fluctuation to occur primarily in Cell 2B with a dampened constant flow rate through Cell 3B. The Cell 3B water level will be continuously 1.5 feet deep and will be filled with roots from bulrush to enhance biological treatment. Cell 3B discharges to the wetland pump station through a weir box that can be used to adjust the depth of flow in the cell, which in turn adjusts the HRT. The normal operation of Cell 3B is with the water level at 1,939.5 feet for a HRT of 13.7 hours to 27.3 hours per flow pass depending on the recycle flow rate. The wetland pump station can recycle from 0 to 75 gpm back to Cell 1 for additional polishing and dilution of the extraction well water. The planned normal recycle flow rate is 50 gpm. The total wetland system will have an HRT of 3.8 to 8.8 days per flow pass and the planned normal operation will have 4.4 days HRT. Table 1 in Appendix D, *Enhanced Wetland Treatment System Calculations: Hydraulics*, lists the range of parameters for operations from four to eight cycles per day in Cell 2A with either 50 gpm from the wells and no recycle or 50 gpm from the wells plus 50 gpm of recycle flow.

3.3 Electrocoagulation Process

The EC process can be adjusted by changing a number of system setpoints and operating conditions, summarized as follows:

- The flow rate can be adjusted either by changing the groundwater extraction rate, or by operating the EC system in batch mode via the EQ tank level setpoints.
- The amperage of each of the two EC reactors can be independently set. Voltage automatically “floats” depending on the conductivity of the water.
- The polarity reversal frequency of each EC reactor can be adjusted.
- The type of anode plate (iron or aluminum), and the number of each, can be changed.
- The calcium chloride dose can be adjusted.
- The reaction pH within the EC reactors can be adjusted and once set is automatically maintained.
- The pH of the treated effluent can be adjusted, and can be automatically maintained.
- The treated effluent flow is automatically measured, recorded, and totalized.
- The treated effluent can be manually sampled prior to discharge to the infiltration basin.
- The PLC tracks and records system inputs, allowing for monitoring either on the touchscreen interface on the control panel, or remotely using the cell phone-based SCADA system.
- The historical feature of the PLC/HMI allows the operator to review past conditions and trends, facilitating decision making for process adjustments.
- Equipment that can be automatically operated can also be operated manually.

Additional process flexibility is provided by the following:

- The clarifier is conservatively sized. This will facilitate settling efficiency and reduce solids load on the subsequent filters and reduce backwashing.
- The sludge holding tank can hold more than a day’s worth of sludge, providing operator flexibility for when sludge must be pressed,
- The sludge press is sized for nominally one press cycle a day to reduce operator time at site. If needed, more than one press cycle per day can be performed.

4. Permitting

This section describes the regulatory permitting requirements for residuals disposal at the site, and other potentially required local, state, and federal permits, their need, and their applicability to the interim action.

4.1 Residuals Disposal

Remediation wastes anticipated to be generated from the groundwater cleanup interim action include the following:

- Wellfield Installation Media
  - Cyanide and fluoride-containing groundwater and sediments (drill cuttings) generated during construction of groundwater monitoring and groundwater extraction wells
- Water Treatment Residuals
  - Cyanide and fluoride-containing solids (sludge) housing the cyanide and fluoride removed from groundwater
  - At cessation of the interim action, wetland and bioreactor media (mixtures of aggregate rock, wood chips, manure, and other carbonaceous material that contacted contaminated groundwater)

4.1.1 Wellfield Installation Media

Drill cuttings collected within the saturated zone of each well installation and groundwater during drilling and development will be collected and contained in the wetland treatment area for incorporation as part of remedial construction in the wetlands.

4.1.2 Water Treatment Residuals

The water treatment residuals will be designated according to the Ecology Dangerous Waste Regulations (Washington Administrative Code [WAC] 173-303), which consider both listed hazardous waste code applicability as well as characteristic waste code applicability. Because one of the disposed wastes identified in the former waste management disposal area is spent potliner, a review of the applicability of Resource Conservation and Recovery Act of 1976 (RCRA)-listed hazardous waste code K088 was completed. Per 40 *Code of Federal Regulations* 261.32, the definition of RCRA-listed waste code K088 is "Spent potliners from primary aluminum reduction." Ecology reviewed information in its files as well as site historical waste management and environmental sampling information compiled by the Custodial Trust of potential sources of cyanide in the groundwater to be extracted during this interim action. Ecology's review concluded that the contaminants currently found in groundwater at the site may have originally come from a number of sources. Based on the review along with the U.S. Environmental Protection Agency's (EPA's) guidance *Management of Remediation Wastes Under RCRA* (EPA, 1998), Ecology concluded that the Custodial Trust should proceed with the determination that the contaminated groundwater (and subsequent waste residuals to be generated during this interim action) do not require management as containing a listed hazardous waste. The applicability of any Dangerous Waste Regulations characteristic hazardous waste criteria will be determined at the time of waste generation based on analytical testing as needed.

4.1.3 Offsite Disposal

For purposes of compliance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Offsite Rule for hazardous wastes that will be shipped offsite for disposal, the EPA Region 10 Offsite Rule Coordinator will be contacted by Ecology for approval of the offsite disposal facility prior to shipment. In addition, the team will support Ecology in confirming with EPA Region 10 that nonhazardous wastes proposed for offsite disposal will not require review of the selected disposal facility by the EPA Region 10 Offsite Rule Coordinator.

4.2 Other Permits

Table 4.2-1 lists potentially required permits, their need (for example, whether they are required), and their applicability to the interim action that includes construction and operations. It has been updated based on a Spokane County Pre-Application Meeting that was held on January 23, 2020. The potential permits are listed as completed, exempt, required, not required, or not applicable. The only permit that is exempted under the Model Toxics Control Act (173-340 WAC) but with "substantive permit requirements" in the IAWP (Hydrometrics, 2019) is the State Waste Discharge permit.

Table 4.2-1. Potentially Required Permits

Permit	Need	Applicability
Environmental Evaluation, Review, and Approval per the State Environmental Policy Act (SEPA)		
SEPA Environmental Checklist (Spokane County)	Completed as part of the IAWP	Ecology, as lead agency, issued a Determination of Nonsignificance for the project on March 23, 2019. No further SEPA action is required.
Critical Areas Ordinance (Spokane County)	Required	Critical areas regulated under the Critical Areas Ordinance include wetlands, fish and wildlife habitat, geohazards, and protected aquifers. None of these resources applies except for protected aquifers because the project lies above the Spokane Valley Rathdrum Prairie Aquifer within the Critical Aquifer Protection Areas (CARA). The interim actions will provide fluoride and cyanide treatment to prevent further groundwater degradation and to provide for protection of the aquifer. CARA will be addressed when Spokane County receives a project approval letter from the Ecology Toxic Waste Control Program. Timeline: Spokane County will approve after the hazardous materials list is submitted. The County has also requested the project's hydrogeologic report and a copy of an Ecology letter that approves the Model Toxics Control Act project.
Cultural Resources (Washington State Department of Archeological and Historic Preservation (DAHP)	Required	Prior to construction, the Spokane Tribe will be consulted to determine the likelihood of potential cultural resources in the project area. An "Inadvertent Discovery Plan" is required for the project that will describe the appropriate measures to be taken during construction for identification and protection of cultural resources, and notifications to appropriate parties.
Local Permits		
Demolition Permit (Spokane County)	Required	No buildings need to be demolished. However, the asphalt paving where the EC Building and wetland treatment system are to be installed will be demolished. A demolition permit will need to be issued simultaneously with a grading permit and a building permit for the EC Building permit. Timeline: Demolition permit issued after design drawings and building permit package has been approved by the County.
Building/Grading/Site Development Permit (Spokane County)	Not required from County	The pump control cabinet and vault will not need a building permit.
	Required	Building/Site Development Permits are exempt per Revised Code of Washington 70.105D.090, but because the building permit was not included in the IAWP as an exempt permit, it is required per Ecology's direction and includes: • Electrocoagulation Treatment Building (90 feet by 40 feet) • Grading/Land Clearing (with drainage and erosion and control plans) • Onsite Road Improvements and Parking. Locate pipeline crossings within utility easement and deep enough to avoid future roadwork. • Lighting must be downward and within property boundary • Solid Waste (discussions with County may show as nonapplicable) • Compliance with fire codes (see Aquifer Protection/Fire Suppression Permits row below) • Stormwater – must show where emergency overflows go

Table 4.2-1. Potentially Required Permits

Permit	Need	Applicability
		Timeline: Building permits issued after design drawings and building permit package have been approved by the County. The building permit package was submitted to the County on February 24, 2020. The County comments received by March 23, 2020, were from the Building Department, Fire Department, Health District, and Public Works and are being addressed. Critical Areas comments received at the Pre-Application Meeting on January 23, 2020, will be addressed directly by Ecology. Building permits are anticipated to be issued 2 weeks from the submittal of response comments, potentially during the week of April 13-17, 2020.
	Not required from County	• Groundwater Extraction System • Constructed Treatment Wetlands • Effluent Discharge to the Infiltration Basin
Aquifer Protection/Fire Suppression Permits [Spokane County Fire District No. 9 (SCFD)]	Required	Reagents that include calcium chloride, sulfuric acid, and an anionic polymer (a food grade nontoxic material) are materials that may be used to operate the EC facility. A Critical and Hazardous Materials List/Hazardous Materials Management Plan and Spill Prevention, Control, and Countermeasures Plan will be prepared to protect the aquifer and inform the SCFD of fire-fighting site conditions. Fire suppression requirements will be reviewed with the SCFD. In addition, proper engineering controls, personal protective equipment, and standard operating procedures will be prepared for storage, handling, and use of potentially harmful chemicals during operations. Fire flows must be tested, inspected and approved prior to issuance of building permits, unless a waiver is issued allowing fire flows to be tested prior to occupancy. Typically, fire hydrants are required within 400 feet of a building with a 1,750-gpm flow. However, for this project's type of construction and occupancy, flows may be reduced to 1,500 gpm and onsite water sources such as the treatment wetlands may be approved by the SCFD. Must provide quantity and by-product/waste information/classification. Materials must be covered, double contained, and disposed of at approved disposal site (Graham Road Landfill, in this case). Must meet fire apparatus road access (20 feet wide and vertical distance of 13.5 feet) with a turnaround if access is longer than 150 feet. Timeline: Issued when drawings and permit package are approved by the SCFD.
Septic System Permit (Spokane Regional Health District)	Not applicable	No septic tank system will be installed. A temporary holding facility (e.g., Porta-potties) will be used onsite for the one (1) or less than one full-time employee(s) operating the facilities.
Water Connection	Not applicable	Potable water will be supplied to the EC Building for process use and housekeeping. This will be supplied by truck delivery.
Air Emissions Permitting under the Clean Air Act [Spokane Regional Clean Air Agency (SRCAA)]	Required if triggers are met	Bench testing has confirmed air emissions anticipated from the EC facility are below detectable values for hydrogen cyanide and hydrogen gas. Air emission permits therefore should not be required unless air emissions from the remedial action are sufficient to trigger the need for Title V air operating permits, prevention of significant deterioration permits, or nonattainment new source review permits. The SRCAA should be contacted to determine if there is a need to prepare a Notice of Construction and the likelihood of a permit once emission loads and concentrations have been identified.
Road Access and/or Obstruction Permits (Spokane County)	Not applicable	No new access to the site is needed off of a public road and no obstruction to public roads will be required for this project.

Table 4.2-1. Potentially Required Permits

Permit	Need	Applicability
State Permits		
Electrical (Avista and Washington State Labor and Industries [L&I])	Not required	Avista – will be installing electrical service to the site for connection to transformers located at the pump controls area and at the EC facility.
	Required	L&I Electrical Permit **–** Electric power from the transformers to the pump control area and to the EC facility will require an L&I electrical permit. Timeline: Issued after electrical permit is approved by L&I.
Notice of Intent to drill extraction wells (Ecology)	Required	A Notice of Intent must be filed with Ecology prior to construction of dewatering/resource protection wells. Timeline: Issued as part of the Model Toxics Control Act authority; this permit process was completed in October 2019 as part of well installation.
Stormwater (Washington State Department of Ecology)	Required but not needed in this case	General Stormwater Construction Permit: Pipeline excavations from the wellfield to the treatment systems and from the treatment systems to the infiltration basin will be reclaimed with soil and revegetated after construction and will not generate runoff. Runoff from the EC Building and from the area adjacent to the lined wetland treatment area will flow to a natural low spot (sump) in the topography, the same as existing conditions. The project will disturb more than one (1) acre but because the amount of impervious surface will remain the same as existing conditions and because all construction stormwater remains onsite, a permit is not anticipated.
	Not required	Operations: Not required because all stormwater will remain onsite and impervious surfaces area will not change from existing conditions.
Industrial Wastewater Discharge Permit	Exempt	Effluent will be contained onsite with no discharge to surface waters. Cyanide and fluoride will be treated in accordance with the IAWP (Hydrometrics, 2019). The treated effluent flows into an infiltration basin where it infiltrates to groundwater. Project is exempt from State Waste Discharge Permit for discharge of treated water to groundwater but must meet substantive permit requirements and water quality as described in Appendix A of the IAWP. Oversight and requirements for operations will be described in a Compliance Monitoring Plan approved by Ecology.
Sludge Waste Disposal (Ecology and Spokane Regional Health District)	Required	Sludge generated at EC facility will be characterized and disposed of per RCRA requirements – see Section 4.1 for more information. Quantities and characteristics must be reported to Spokane Regional Health District and Ecology. Timeline: Sludge disposal approvals obtained after sludge is generated to identify characteristics and determine regulatory needs.
Federal Permits		
Federal Permits	Not applicable	There are no known federal permits required for this project.
Future Redevelopment		
Permitting	Required	Exemption to local permits under Revised Code of Washington 70.105D.090 only applies to remedial actions. Work necessary to prepare the site for subsequent redevelopment is not subject to this exemption. However, no redevelopment is planned by the Custodial Trust or Ecology at this time.

Sources: Hydrometrics, 2019 (Table 6-2) and Custodial Trust, 2019 (SEPA Environmental Checklist; see Appendix E in this design report).

5. Confirmation of Siting and Location of Interim Action Elements

This section provides confirmation that the interim action elements are appropriately sited and located, proper easements are intact, and site access is reasonable.

5.1 Siting and Location

Figure 5-1 shows the general site location in relation to Spokane, Washington. Drawing Sheet 000-C-002 in Appendix A shows the location of the extraction wells, wetland basins, EC unit, and utility access within the general site. Initial concerns that wetland requirements would be larger than the available site conditions have been satisfied. The wetlands and EC unit fit within the Custodial Trust property boundaries, allowing extra room for vehicle circulation around the boundaries of the work.

5.2 Easement and Access Requirements

Site access is provided via easement through Spokane Recycling Company property. Access is coordinated through Budinger & Associates and provided to Jacobs for use. More desirable access is being acquired through teaming with Adam & Clark, Inc to provide access via Highway 2, near the extraction wells. Figure 5-2 provides an overview of access routes.

Work outside of Custodial Trust property boundaries includes Avista power easements; site access roads; and water pipelines between extraction wells, pump controls area, treatment system, and infiltration basin. Avista power is being pulled from public right-of-way off N Perry Rd and through an easement through Travis Pattern & Foundry Inc property that is under development by Avista (Travis Pattern & Foundry has agreed to allowing the easement). Based on conversations with Avista, Jacobs assumes that this is the best route to access power and that an easement will be secured.

The Final Design civil drawings show a fire water pond that provides a water source for fire flows, as required for the project by the SCFD (see Drawing Sheet 000-C-001 in Appendix A). The fire water pond is located on Spokane Recycling Company property and discussions are underway between the Custodial Trust and Spokane Recycling on the purchase of this property for permanent access. The fire water pond would hold treated effluent for use in fire protection applications.

An easement for connection to the Whitworth Water District water main (located on Perry Street) is an option considered to supply potable water to a fire hydrant. The hydrant would provide fire flow protection to the EC Building as a backup to the fire water pond if property acquisition cannot be completed. Whitworth Water District provided a preliminary review of required flows and indicated that it will allow connection to the District’s water main. An easement of the waterline through the same Avista power easement described above would be necessary to bring this water to the site.

Permanent access roads and pipelines will require easements through Spokane Recycling Company and Kaiser Aluminum Investments Company property. Access roads along the pipeline route will allow access to pipelines for maintenance. These easements have already been acquired. Infiltration basin and extraction wells are located on Kaiser Aluminum Investments Company property, and these easements have been acquired, as well.

6. Significant Operation and Maintenance Provisions

This section identifies O&M provisions that will have a substantial influence on the design approach (for example, unattended operation and remote instrumentation and communication). An O&M Plan outlining the proposed provisions has been submitted to Ecology under separate cover.

6.1 Extraction System

Extraction pump control is performed in the pump control cabinet. There is no relay of flow rates or pump run status to the EC Building because after startup and commissioning, it is expected that changes to extraction well flow rates will be infrequent.

The water from each well can be manually sampled via sample stations located just north of the pump control cabinet and vault. Flows from each well are measured individually and displayed in the pump control cabinet. The combined flow is automatically measured, recorded, and totalized in the EC Building, and can be manually sampled there as well. The EC PLC monitors the combined groundwater flow rate for a sudden drop (step change) in flow, such as if a pump quit working. If that condition is detected, it produces an alarm notifying the operator. Individual shutoff controls are routed into the VFD to shut off individual pumps and a pressure switch in the vault for monitoring pressure in the force main will shut off all pumps simultaneously if pressure is outside of its set range. There is also leak detection monitoring within the flow metering vault which, if leaks are detected, will shut down the pumping system.

6.2 Enhanced Wetland Process

The below-ground three-cell enhanced passive wetland process requires little O&M. The operating water level in each cell can be adjusted independently, allowing adjustment of the HRT. This is done by changing the weir level in the appropriate weir structure. Organic media and wood chips that enter the piping will accumulate at the weir structures and should be removed as necessary to prevent them from passing the weir and accumulating in infiltrators. The number of cycles per day in Cell 2A can be adjusted with the controls on the two automated weir structures. These structures operate on independent clocks that should be synchronized any time they are reset or adjusted. The battery pack that is charged by the solar panels has a manufacturer-recommended life and should be replaced at the recommended interval. The recirculation flow rate is manually adjustable at the local control panel. A sample can be collected from the discharge weir structure of each cell to track the cell’s treatment performance. Vegetation management of the bulrush in Cells 2B and 3 will include removal of invasive plants and replanting as necessary to maintain good plant density. The wetland bottom piping and infiltrators have cleanouts that allow jet rodding if reduced flows indicate partial plugging. The piping between cells uses 45-degree bends to allow jet rodding with access in both directions through the weir structures.

6.3 Wetland Effluent Pump Station

The wetland effluent pump station is operated from a local control panel mounted adjacent to the pump station. The flow rate from the wetland recirculation pump is manually set. The flow rate of the wetland effluent pump is automatically controlled based on the pump station wet well water level.

The run status of each pump is tracked from the EC PLC. The EC PLC can also shut down the pumps. While the system has the capability to automatically restart the pumps, this function will not be utilized because the operator needs to first assess the cause of the shutdown and ensure it has been remedied before the pumps are restarted.

Both pumps will be mounted on guide rails and level floats will be on cables to allow removal for maintenance without entry into the sump. Valves, pressure indicators, and a flowmeter will be in a shallow vault for easy maintenance access.

6.4 Electrocoagulation Process

The EC process is designed with a number of features to facilitate O&M. These features are summarized as follows:

- EC Reactors
  - Catwalk surrounds the EC reactor vessels for easy monitoring, cleaning, and cartridge change-out
  - Crane hoist allows for EC reactor cartridge replacement and rebuild; enough room under the hoist allows for a truck to back in under the hoist for anode delivery/removal
  - Scale purge system can automatically be set to remove accumulated solids from the bottom of the EC vessels
- Tanks
  - Catwalk height around the tanks allows for visual monitoring and maintenance of the system
  - Tank accessories are positioned to be accessed from the catwalk for maintenance and repair
- Pumps
  - Pumps are duplex and act as a redundant pair, allowing for repairs to be made while continuing to operate the system
  - Pumps have isolation valves to allow for easier change-out/repair when needed
- Final Filtration
  - Media filters and bag filters can be used for final water polishing
  - Media filters are equipped with automatic backwashing
- Filter Press
  - Filter press is equipped with semiautomatic plate shifting system to assist operator with cleaning the plates of sludge
  - Filter press sits on a frame that allows a roll-off box to collect solids from the filter press
  - Winch and rail system helps guide the roll-off box underneath the filter press
  - Catwalk surrounds the filter press for access for operating and cleaning the system
  - Dewatered sludge will not be stored on site. Once a roll-off bin is full it will be taken to the landfill.
- Chemicals
  - Chemical lines are double-lined for chemical containment
  - Exterior mini-bulk tanks are used for sulfuric acid and calcium chloride, eliminating the need for manual handling of chemical drums or totes
  - Polymer solution will be manually mixed in the feed tank. The use rate is low.
- Plumbing
  - Pneumatic actuated valves can be isolated with manual valves for maintenance
  - Most pneumatic actuated valves are fail closed.
  - Recirculation lines at various points throughout the system allow for water diversion
- Sump
  - Allows collection of any washdown water or spills within the building
  - A sump pump removes water and pumps it into the EQ tank to be treated and reused

  - Storage in the EQ tank is allocated for sump pump discharge which is in addition to the working volume of the tank
- Controls
  - HMI screen on the control panel allows operator to monitor system as well as operate the system components in manual or automatic mode
  - System presents alarms for high and low tank levels, pump and valve availability, conductivity, and pH readings out of range
  - System will automatically shut down when certain system components such as pumps, air supply pressure, rectifiers, or tanks do not meet set parameters
  - Data historian allows the operator to review historical setpoints and process conditions to facilitate operational decision making, such as EC reactor amperage, calcium chloride dose, and EQ tank pH

The following processes will help to ensure that the effluent does not exceed discharge limits:

- Voltage and current draw are continuously automatically monitored in the EC reactors. Out-of-spec values will automatically shut down the system and send an alarm to the operator.
- The pH is continuously monitored and automatically adjusted in the EQ tank, prior to the EC reactors, and then in the defoam tank, after the reactors. If pH is out of the allowable range programmed in the control system, the process will shut down and send an alarm to the operator.
- Conductivity is continuously monitored and automatically adjusted in the EQ tank, prior to the EC reactors. The conductivity is used to add calcium chloride. If conductivity is out of the allowable range programmed in the control system, then the process will shut down and send an alarm to the operator to assess and correct the problem.
- The operator will collect process samples from the effluent sample port on a routine basis and will manually measure pH and conductivity. Jacobs is working with Hach to determine if there is a suitable field test to track the concentration of fluoride.
- Discharge of TSS is controlled by use of both granular multi-media pressure filters, and follow-on bag filters.

6.5 Heating, Ventilation, and Air Conditioning Operation and Maintenance Requirements

The HVAC equipment will require the following periodic O&M activity to ensure proper operation and performance:

- EC Building: Supply Fan 03-SF-01 will require periodic filter change-out.

6.6 Infiltration Basin

The infiltration basin will be hydroseeded similar to the wetland berms with native grasses and no routine maintenance is anticipated. Once native plants are established weed control would be minimal and administered only if invasive species become apparent in this area.

7. Implementation Schedule Update, Key Milestones, and Cost Estimate Update

This section presents updates to the implementation schedule, key milestones, and cost estimates outlined in the RDWP.

7.1 Implementation Schedule Update

Figure 7-1 shows updates to the activities organized under Tasks 1 through 4.2, with the planned duration, start date, and finish date.

7.2 Key Milestones

The key milestones depicted in Figure 7-1 are updated to show the status of the project at the Final Design Submittal milestone. The project schedule has not changed significantly since the Preliminary Design Submittal. The project remains on schedule for the major design and construction key delivery milestones listed as follows:

- November 5, 2019 – Preliminary Design Report submittal to Ecology
- December 3, 2019 – Ecology approval of Preliminary Design Report
- December 24, 2019 – Treatability Study Report for Groundwater Treatment by Enhanced Treatment Wetlands submittal to Ecology and Custodial Trust
- January 23, 2020 – Begin equipment procurement for EC Treatment System
- March 26, 2020 – EC System Bench Testing (Final; draft results to Ecology and Custodial Trust in February 2020)
- February 13, 2020 – Pre-Final (90%) Design submittal
- April 3, 2020 – Final (100%) Design submittal
- June 2, 2020 – Final Design Revision 1 (this document)
- October 28, 2020 – Construction substantial completion
- October 28, 2021 – First-year operation completion

7.3 Cost Estimate Update

This section describes key elements of change to the project that have resulted in updates to the project delivery costs. Table 7.3-1 lists the completed and active change elements identified during design development for the project. The items that have been reviewed and approved by the Custodial Trust are noted as “Complete” in the “Archive or Active” column of the table. The items noted as active are under development by the team for presentation to the Custodial Trust in keeping with change management procedures established between Jacobs and the Trust. Approved change elements and contract adjustments follow the table.

Table 7.3-1. Change Management Log

Item ID	Subject	Description	Progress Tracking	Date Submitted	Date Approved	Archive or Active
Item 1: CMF-01	Enhanced Wetlands Pilot Study	Additional pilot testing of wetland components requested by Ecology and Custodial Trust to verify enhanced wetland design elements.	Identified in September 2019 as part of bench testing	9-Dec-19	16-Dec - 19	Complete
Item 2: CMF-02	Chemical Feed Systems	Use of premixed liquid sulfuric acid and calcium chloride chemical feed systems delivered in “mini-bulk” loads to exterior tanks in place of bulk supersack or liquid tote system identified as improvement for operations and safety for EC treatment.	Identified in October 2019 as part of preliminary design	20-Dec-19	20-Dec-19	Complete
Item 3: CMF-02	Potable Water System	Use of potable water in place of treated water for washdown and safety systems identified as improvement for operations and safety for EC treatment.	Identified in October 2019 as part of preliminary design	20-Dec-19	20-Dec-19	Complete
Item 4	Remote Operation	Control network via fiber cable recommended to link both pump control and wetland effluent pump station systems to the United Rentals system to allow monitoring of the site from remote locations.	Identified in October 2019 as part of preliminary design	Determined during subsequent design development not to be necessary	N/A	Complete
Item 5: CMF-02	Extend Monorail Crane	Extension of the monorail crane which lifts a spent cartridge out of a reactor and lowers it to the floor for rebuild on site with new plates by the operator is being considered to allow a truck to be directly loaded and unloaded by the crane rather than by a separate lifting device. This facilitates rebuilding the spent cartridge at the plate manufacturers rather than by an operator onsite.	Identified in October 2019 as part of preliminary design	20-Dec-19	20-Dec-19	Complete
Item 6	EC Unit Bench Test Upgrades	Expanding EC unit bench testing to include performance testing for treatment of Total CN per previous discussions with Ecology and Custodial Trust. Also will be testing hydrogen cyanide off-gas to determine potential need for tank covers and vents for EC treatment systems.	Identified in September 2019 as part of bench testing	28-Feb-20	02-March-20	Complete
Item 7	Emergency Eyewash Stations	Expanded system to include three eyewash stations, one located outside at the bulk chemical storage tanks, and two located inside the EC Building.	Originally identified in October 2019, but expanded development as part of pre-final design	28-Feb-20	02-March-20	Complete

Table 7.3-1. Change Management Log

Item ID	Subject	Description	Progress Tracking	Date Submitted	Date Approved	Archive or Active
Item 8	Fire Alarming in EC Building	Fire detection and alarm notification requested for groundwater control and EC treatment buildings.	Identified as part of Custodial Trust comment resolution process and development of pre-final design	28-Feb-20	02-March-20	Complete
Item 9	Groundwater Monitoring Plan Support	Expanded scope to include plan writeup and execution of groundwater detection monitoring for the wetland pond liner system utilizing existing wells in the area. Development of integrated extraction system performance monitoring with the Custodial Trust's existing Monitoring Plan to be developed and performed by Jacobs. As part of this item per Trust request, Jacobs will prepare a brief technical memorandum that reviews the decision logic for selecting a single (composite) liner design for wetland ponds.	Identified as part of Ecology comment resolution process and development of pre-final design	28-Feb-20	02-March-20	Complete
Item 10	Future Groundwater Extraction System Expansion Capabilities	Potential expansion of the extraction well network was identified by the Custodial Trust as a potential to consider in the design of the pump control system. Additional wells added to the network (4 future wells) were added to the design of the pump control cabinet and vault with adequate power for future suppy to the facility.	Identified as part of Ecology comment resolution process for the Wellfield Engineering Design Report	28-Feb-20	02-March-20	Complete
Item 11	Increased Wellfield Pump Capacity for Extraction Wells TW-2B and TW-3B	Well development testing identified these two wells as being highest contaminant-impacted wells within the plume "channel". Optimization design for the extraction system has identified that these wells should be pumped at a higher rate (20 gpm) than originally anticipated in design sizing (15 gpm max). This upsizing increases motor size and power draw for these two wells.	Identified as part of extraction well installation and development, and as part of this pre-final design	28-Feb-20	02-March-20	Complete
Item 12	Fire Hydrant at EC Building	The SCFD requires installation of a fire hydrant to support potential fire-fighting at the EC treatment building. This will require identifying a water source, pipe routing and easement determinations, design, and	Identified as part of pre-application meeting for facility construction permitting. Options identified and discussed with the Trust.	08-May-20	11-May-20	Complete

Table 7.3-1. Change Management Log

Item ID	Subject	Description	Progress Tracking	Date Submitted	Date Approved	Archive or Active
		construction of this new water line.				
Item 13	Wetland Liner Electronic Leak Location Survey	An electronic leak location survey has been added to support liner installation quality assurance requested by Ecology.	Identified as part of Ecology comment resolution process for the Wellfield Engineering Design Report	28-Feb-20	02-March-20	Complete
Item 14	Wetland Optimization Design Elements	Costs for wetland optimization elements (based on ongoing design development, Pilot Study results, and reviews with Ecology and the Custodial Trust) exceed original cost basis. Path forward coordination with the Ecology and the Custodial Trust to be completed to set final wetlands design and performance features.	Cost basis first determined in March 2020 timeframe with initial bid received from prospective bidders. Confirmed during best and final offer (BAFO) process. Coordination with the Trust in April focused on redesign elements to streamline costs. Updated final BAFO package issued to bidder and pricing received. CMF-04 scope, budget, and approval completed during May period.	08-May-20	11-May-20	Complete

Note: CMF = Change Management Form

Key change elements approved by the Custodial Trust for the project include the following:

- CMF-01:
  - Prepare Enhanced Wetland Pilot Study (Item 1)
- CMF-02:
  - Chemical Feed Systems – Design upgrades for calcium chloride and sulfuric acid storage and delivery (Item 2)
  - Potable Water System – Provide potable water tank for process washdown water (Item 3)
  - Extend Monorail Hoist (Item 5)
  - High Temperature Rectifier Upsizing (Not on table)
- CMF-03:
  - EC Unit Bench Test Upgrades – Expand EC unit bench testing to include performance testing for treatment of Total CN per previous discussions with Ecology and Custodial Trust; also test hydrogen cyanide off-gas (Item 6)
  - Emergency Eyewash Stations – Expand system to include three eyewash stations, one located outside at the bulk chemical storage tanks, and two located inside the EC Building (Item 7)
  - Fire Alarming in EC Building – Design fire detection and alarm notification for groundwater control and EC treatment buildings (Item 8)
  - Groundwater Monitoring Plan Support – Expand plan writeup and execution of groundwater detection monitoring for the wetland pond liner system utilizing existing wells in the area (Item 9)
  - Future Groundwater Extraction System Expansion Capabilities – Provide potential expansion of the extraction well network to consider in the design of the pump control system (Item 10)

- Increased Wellfield Pump Capacity for Extraction Wells TW-2B and TW-3B – Upsize pumps for plume extraction optimization (Item 11)
- Wetland Liner Electronic Leak Location Survey – Add an electronic leak location survey to support liner installation quality assurance (Item 13)

- CMF-04:
  - Fire Pond – Lined, bermed pond and associated hydrant to store treated effluent for use in fire control at the site (Item 12)
  - Wetland Optimization Elements – Refined design elements for wetland treatment ponds based on completed studies to optimize cost and performance (Item 14)

The following contract adjustments to the project price were completed during this period:

- CMF-01: Pilot Study – $87,322. This work is to complete a pilot study of the enhanced wetland system with focus on treatment of cyanide in its various forms, including Total CN. This work is being tracked and performed under Task 2.1 Preliminary Design/Wetland. CMF-01 was approved by the Custodial Trust on December 16, 2019.
- CMF-02: EC Construction – $194,612. This work provides additional design features to enhance the operational performance and safety of the electrocoagulation treatment system. This work is being tracked and performed under Task 3.4 EC Construction. CMF-02 was approved by the Custodial Trust on December 20, 2019.
- CMF-03: Several Tasks – $127,770. This work addresses change items identified as part of design development. This work is being tracked under the following tasks:
  - Task 3.2 – Well Installation
  - Task 3.4 – EC Construction
  - Task 3.5 – Wetland and Infiltration Basin
  - Task 4.1 – 1-year Operation and Maintenance

  CMF-03 was approved by the Custodial Trust on March 2, 2020.
- CMF-04: Wetland Updates and Fire Pond – $470,000. This work addresses change items identified as part of permitting and construction procurement processes. This work is being tracked under Task 3.5 Wetland and Infiltration Basin Construction. CMF-04 was approved by the Custodial Trust on May 11, 2020.

The total price for the CMFs listed above is $879,704. The total price for the complete project including the CMFs listed above is $7,393,678.

8. Deliverables

This section summarizes updates to the deliverables that have occurred through Final Design from the Remedial Design Work Plan. Table 8.1-1 lists the deliverables, deliverable elements, and related key assumptions for the groundwater remediation system through the pilot test study and design.

Table 8.1-1. Deliverables and Related Key Assumptions

Deliverable	Deliverable Elements	Key Assumptions
30% Preliminary Design Report (extraction system)	Draft and final report Response to Ecology and Custodial Trust comments	Already submitted and approved.
Bench-Scale Test Report	Draft and final report Response to Ecology and Custodial Trust comments	This test is a batch treatment process.
30% Preliminary Design Report (extraction—excluding wells, treatment, and discharge systems)	Draft and final Response to Ecology and Custodial Trust Comments	Notice to proceed with EC unit manufacture will be by Jacobs to our Subcontractor at the completion of preliminary design.
Pilot Test Study	Draft and final report Response to Ecology and Custodial Trust comments	This test is a flow-through treatment process. Pilot study confirms anticipated site conditions, including groundwater influent concentrations, design parameters, and the efficacy of the approach used for the enhanced wetland and EC unit designs.
90% Pre-Final Design Report (extraction—excluding wells, treatment, and discharge systems)	Draft and final Response to Ecology and Custodial Trust Comments	None
100% Final Design Report (extraction—excluding wells, treatment, and discharge systems)	Final Response to Ecology and Custodial Trust Comments	Final Design – Revision 1 prepared to address final design revisions developed during permitting and construction procurement processes, and Ecology comments on the Final Design submittal.
Bench-Scale Test Report	Draft and final report Response to Ecology and Custodial Trust comments	This test is a batch treatment process.

No changes have occurred to the project-specific deliverables for construction and operation of the treatment facility components. Submittal of the O&M Plan will be delayed from the rest of the Final Design package to allow input to the plan by the Jacobs subcontractor team. The updated schedule shown in Figure 7-1 reflects the anticipated schedule for the O&M Plan delivery.

9. References

Hydrometrics, Inc. 2019. *Interim Action Workplan, Kaiser Mead NPL Site*. Prepared for Kaiser Mead Custodial Trust, Olympia, Washington. May.

Jacobs Engineering Group Inc. (Jacobs). 2019. *Kaiser Mead Groundwater Remediation Interim Action Remedial Design Work Plan*. Prepared for Kaiser Mead Custodial Trust. August.

Kaiser Mead Custodial Trust. 2019. *SEPA Environmental Checklist*. February 7.

U.S. Environmental Protection Agency (EPA). 1998. *Management of Remediation Wastes Under RCRA*.

Figures

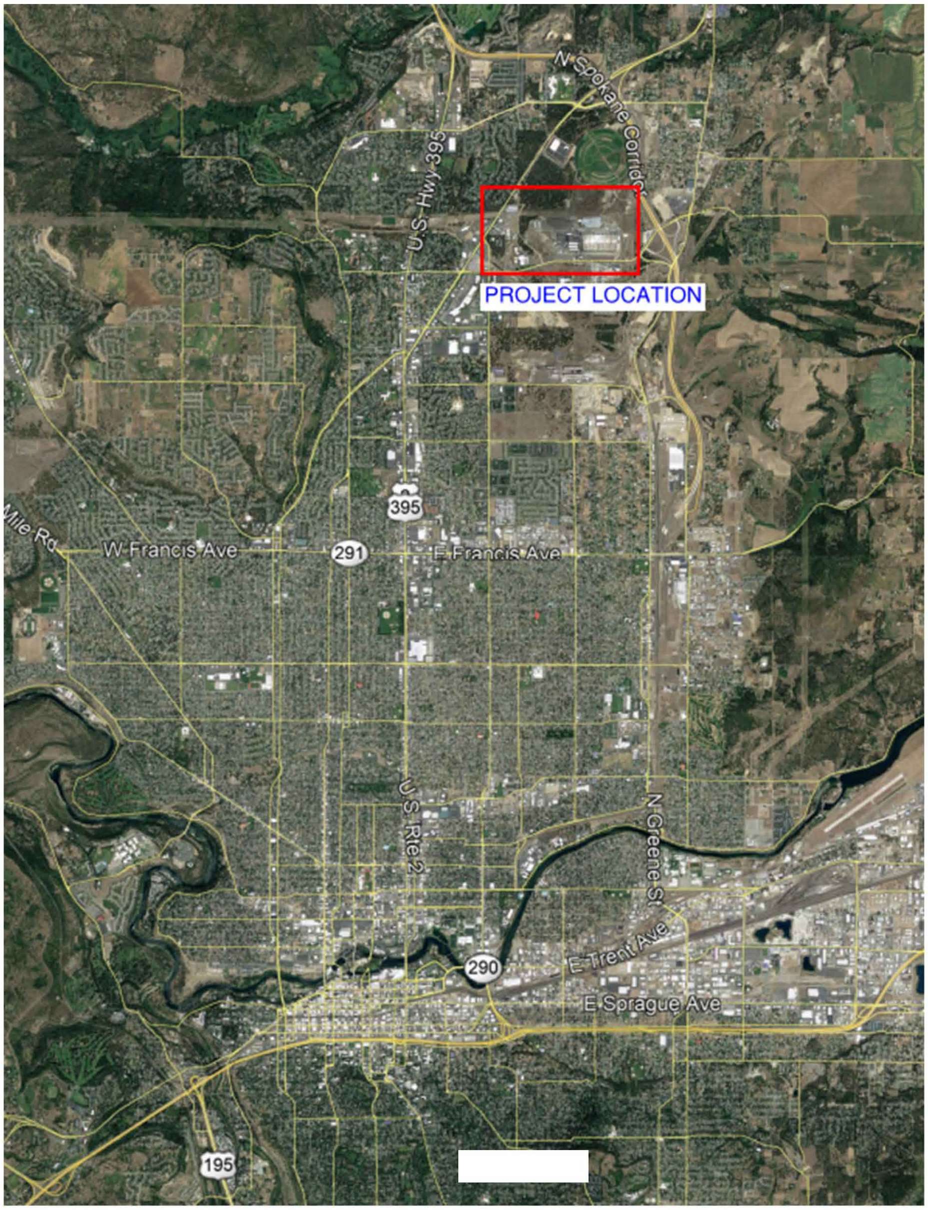


Figure 5-1. Project Location

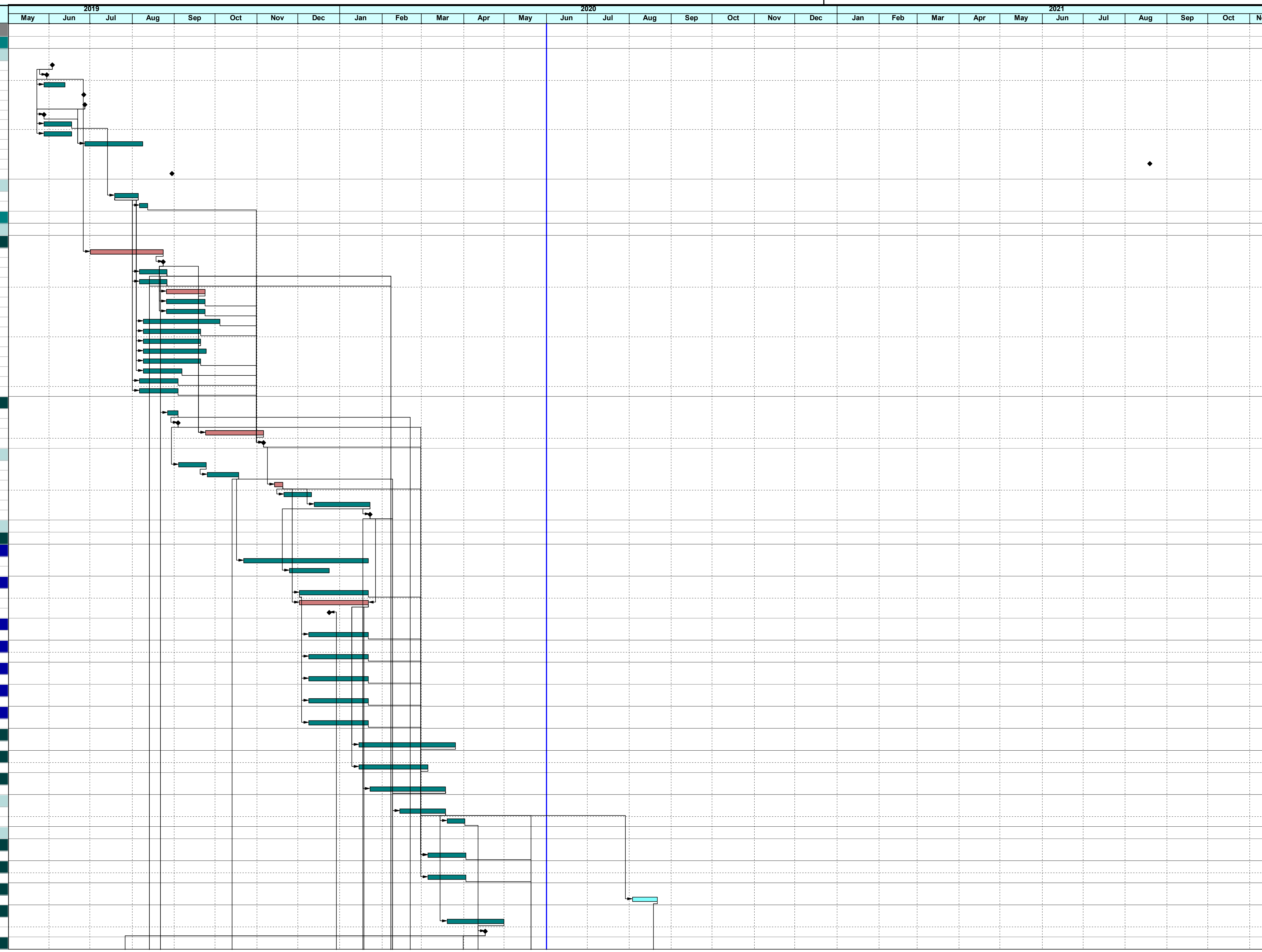
FIGURE 5-2: KAISER MEAD CUSTODIAL TRUST SITE ACCESS VIA HIGHWAY 2 AND HAWTHORNE ROAD

HIGHWAY 2 ACCESS
HAWTHORNE ACCESS OPTION 1
HAWTHORNE ACCESS OPTION 2

Kaiser Mead Custodial Trust

April 2020 Master Schedule

Activity ID	Name	Plan Dur	Rem Dur	Start	Finish
KAISER MEAD CUSTODIAL TRUST June 1 2020		608	355	28-May-19 A	28-Oct-21
TASK 1 - REMEDIAL DESIGN WORK PLAN (RDWP)		559	0	28-May-19 A	19-Aug-21 A
TASK 1.1 - PREPARE RDWP DELIVERABLES & SCHEDULE		559	0	28-May-19 A	19-Aug-21 A
T1.1005	Notice To Proceed - Partial	0	0	03-Jun-19 A	
T1.1010	Project Kick Off	0	0	30-May-19 A	
T1.1011	Proposal Addendum	12	0	28-May-19 A	12-Jun-19 A
T1.1012	Contract Finalized	0	0		26-Jun-19 A
T1.1013	Notice to Proceed - Full	0	0	27-Jun-19 A	
T1.1015	Team Charter	0	0	28-May-19 A	
T1.1020	RDWP Preparation	15	0	28-May-19 A	17-Jun-19 A
T1.1021	Waste Designation Permitting Tech Memo	15	0	28-May-19 A	17-Jun-19 A
T1.1025	EC Process Vendor Procurement	30	0	27-Jun-19 A	08-Aug-19 A
T1.1030	Target Substantial Completion	231	0	03-Jun-19 A	04-May-20 A
TX.0000	Washington State Tax	0	0		19-Aug-21 A
TX.0005	Builders Risk Insurance	0	0		30-Aug-19 A
TASK 1.2 - RDWP RESPONSE TO ECOLOGY & TRUSTEE		17	0	19-Jul-19 A	12-Aug-19 A
T1.2000	Ecology Trust Review	12	0	19-Jul-19 A	05-Aug-19 A
T1.2005	RDWP Final	5	0	06-Aug-19 A	12-Aug-19 A
TASK 2 - REMEDIAL DESIGN PLAN		303	73	01-Jul-19 A	14-Sep-20
TASK 2.1 - PRELIMINARY 30% DESIGN		89	0	01-Jul-19 A	05-Nov-19 A
Preliminary 30% Design Development		68	0	01-Jul-19 A	04-Oct-19 A
T2.0025	Bench Testing and Analysis	39	0	01-Jul-19 A	23-Aug-19 A
T2.0050	Enhanced Wetland Design Approach Verification	0	0		23-Aug-19 A
T2.1000	Extraction System: Well Design and Performance Evaluation	15	0	06-Aug-19 A	26-Aug-19 A
T2.1005	Extraction System: Pump System	15	0	06-Aug-19 A	26-Aug-19 A
T2.1010	Enhanced Wetland: Process	20	0	26-Aug-19 A	23-Sep-19 A
T2.1015	Enhanced Wetland: Process Mechanical & Electrical	20	0	26-Aug-19 A	23-Sep-19 A
T2.1020	Enhanced Wetland: Civil	20	0	26-Aug-19 A	23-Sep-19 A
T2.1025	Electrocoagulation Building: Procurement Spec	40	0	09-Aug-19 A	04-Oct-19 A
T2.1030	Electrocoagulation Building: Site Prep	30	0	09-Aug-19 A	20-Sep-19 A
T2.1035	EC Unit (Jacobs and United Rental)	30	0	09-Aug-19 A	20-Sep-19 A
T2.1037	EC Unit Shop Drawing Development	32	0	09-Aug-19 A	24-Sep-19 A
T2.1040	EC Unit Mechanical & Electrical	30	0	09-Aug-19 A	20-Sep-19 A
T2.1045	Infiltration Basin: Infiltration Design	20	0	09-Aug-19 A	06-Sep-19 A
T2.1050	Infiltration Basin: Civil	20	0	06-Aug-19 A	03-Sep-19 A
T2.1055	Infiltration Basin: Process Piping	20	0	06-Aug-19 A	03-Sep-19 A
30% Design Report Preparation		49	0	27-Aug-19 A	05-Nov-19 A
T2.1075	Extraction and Pilot	5	0	27-Aug-19 A	03-Sep-19 A
T2.1080	Submit Extraction and Pilot Preliminary Design for Agency Review	0	0		03-Sep-19 A
T2.1085	Treatment and Discharge	30	0	24-Sep-19 A	05-Nov-19 A
T2.1090	Submit Treatment and Discharge Preliminary Design for Agency Review	0	0		05-Nov-19 A
TASK 2.1a - PRELIMINARY 30% DESIGN - RESPONSE TO ECOLOGY & TRUSTEE		94	0	04-Sep-19 A	23-Jan-20 A
T2.1a001	Ecology and Trust Review of Extraction and Pilot	15	0	04-Sep-19 A	24-Sep-19 A
T2.1a005	Finalize Report of Extraction and Pilot	17	0	25-Sep-19 A	18-Oct-19 A
T2.1a010	Ecology and Trust Review of Treatment and Discharge	4	0	14-Nov-19 A	20-Nov-19 A
T2.1a015	Finalize Report of Treatment and Discharge	12	0	21-Nov-19 A	11-Dec-19 A
T2.1a020	EC Process Vendor Shop Drawing Fixup and Finalize	26	0	13-Dec-19 A	23-Jan-20 A
T2.1a025	EC Process Vendor Shop Drawing Approval	0	0		23-Jan-20 A
TASK 2.2 - PRE-FINAL DESIGN		105	0	22-Oct-19 A	26-Mar-20 A
Drawings, Technical Specifications, Basis of Design		60	0	22-Oct-19 A	22-Jan-20 A
Finalize Process Bench/Pilot Studies		60	0	22-Oct-19 A	22-Jan-20 A
T2.2000	Pilot Enhanced Wetland	60	0	22-Oct-19 A	22-Jan-20 A
T2.2005	Pilot EC Treatability	19	0	25-Nov-19 A	24-Dec-19 A
Process Design		34	0	02-Dec-19 A	22-Jan-20 A
T2.2010	Enhanced Wetland Design	34	0	02-Dec-19 A	22-Jan-20 A
T2.2015	EC Treatment System	34	0	02-Dec-19 A	22-Jan-20 A
T2.2020	Input From Pilot Studies	0	0		24-Dec-19 A
Civil		29	0	09-Dec-19 A	22-Jan-20 A
T2.2030	Civil Work	29	0	09-Dec-19 A	22-Jan-20 A
Geotech		29	0	09-Dec-19 A	22-Jan-20 A
T2.2040	Geotechnical Work	29	0	09-Dec-19 A	22-Jan-20 A
Structural and Architectural Work		29	0	09-Dec-19 A	22-Jan-20 A
T2.2050	Structural Work	29	0	09-Dec-19 A	22-Jan-20 A
Mechanical		29	0	09-Dec-19 A	22-Jan-20 A
T2.2060	Mechanical Work	29	0	09-Dec-19 A	22-Jan-20 A
Electrical and I&C Work		29	0	09-Dec-19 A	22-Jan-20 A
T2.2070	Electrical Work	29	0	09-Dec-19 A	22-Jan-20 A
QA/QC Plan		49	0	15-Jan-20 A	26-Mar-20 A
T2.2080	QA/QC Plan	49	0	15-Jan-20 A	26-Mar-20 A
O&M Plan		35	0	15-Jan-20 A	06-Mar-20 A
T2.2090	O&M Plan	35	0	15-Jan-20 A	06-Mar-20 A
Construction & Discharge Permitting		39	0	23-Jan-20 A	19-Mar-20 A
T2.2095	Construction & Discharge Permitting	39	0	23-Jan-20 A	19-Mar-20 A
TASK 2.2a - PRE-FINAL DESIGN REVIEW & FINALIZE		33	0	14-Feb-20 A	02-Apr-20 A
T2.2a005	Ecology Trust Review	23	0	14-Feb-20 A	19-Mar-20 A
T2.2a010	Response to Comments	9	0	20-Mar-20 A	02-Apr-20 A
TASK 2.3 - FINAL DESIGN DOCUMENTS		134	73	06-Mar-20 A	14-Sep-20
Drawings, Technical Specifications, Basis of Design		20	0	06-Mar-20 A	03-Apr-20 A
T2.3000	Drawings, Technical Specs, Basis of Design	20	0	06-Mar-20 A	03-Apr-20 A
QA/QC Plan		20	0	06-Mar-20 A	03-Apr-20 A
T2.3010	QA/QC Plan	20	0	06-Mar-20 A	03-Apr-20 A
O&M Plan		15	15	03-Aug-20	21-Aug-20
T2.3020	O&M Plan	15	15	03-Aug-20*	21-Aug-20
Construction & Discharge Permitting		30	0	20-Mar-20 A	01-May-20 A
T2.3030	Construction & Discharge Permitting	30	0	20-Mar-20 A	01-May-20 A
T2.3040	Final Design Complete	0	0		17-Apr-20 A
Review & Approval		113	73	06-Apr-20 A	14-Sep-20



Actual Work | Critical Path ◆ | ◆ Milestone
Remaining Work | Original CP ◆ | ◆ Critical Milestone

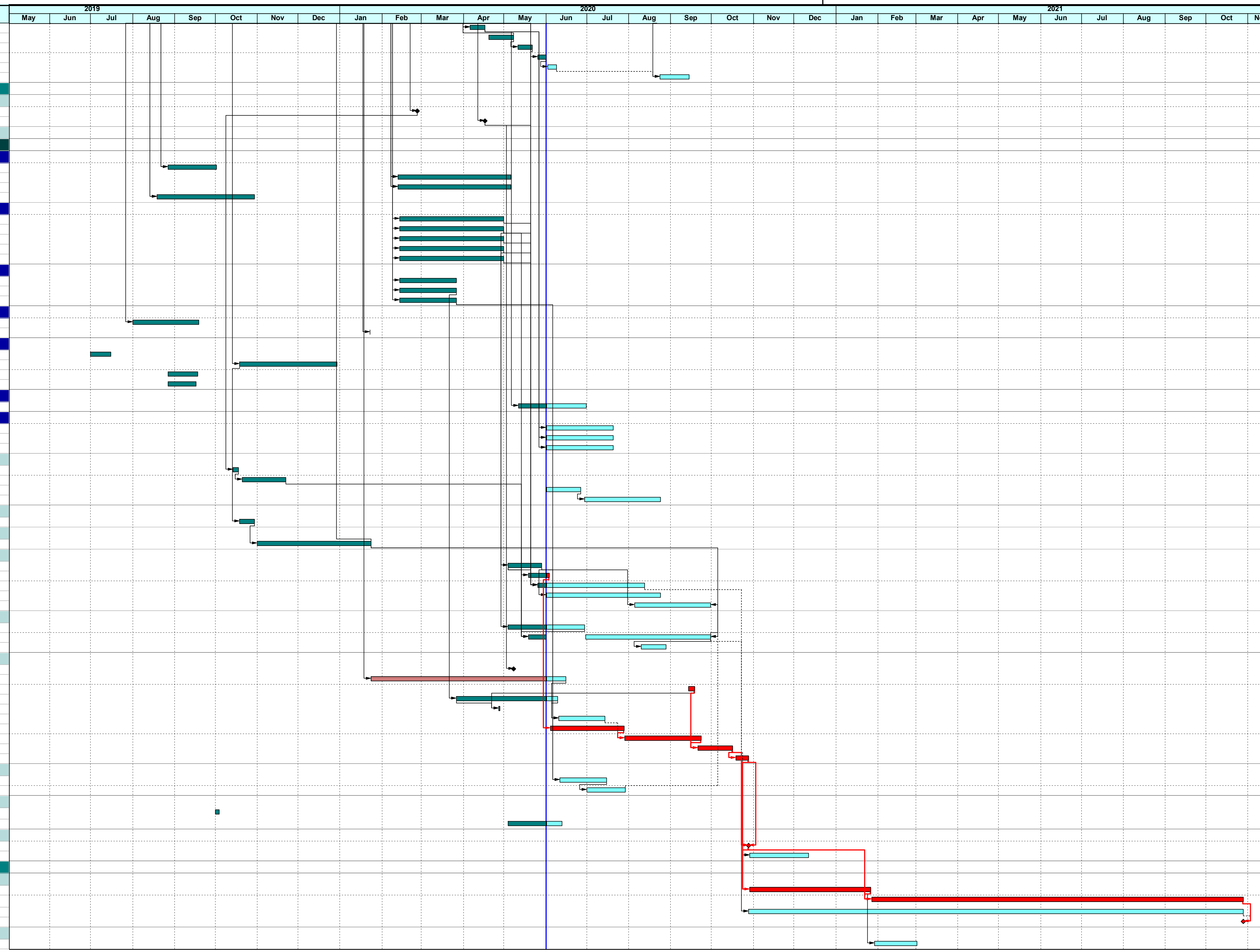
JACOBS®

FIGURE 7-1

April 2020 Master Schedule

Kaiser Mead Custodial Trust

Activity ID	Name	Plan Dur	Rem Dur	Start	Finish
T2.3050	Agency Review & Approval of Final Design	9	0	06-Apr-20 A	17-Apr-20 A
T2.3052	Final Design Addendum	14	0	20-Apr-20 A	08-May-20 A
T2.3054	Agency Review of Addendum	9	0	11-May-20 A	22-May-20 A
T2.3056	Response to Agency Review of Addendum	4	0	26-May-20 A	01-Jun-20 A
T2.3058	Agency Approval of Addendum	5	5	02-Jun-20	08-Jun-20
T2.3060	O&M Plan Review and Approval	15	15	24-Aug-20	14-Sep-20
TASK 3 - REMEDIAL CONSTRUCTION		363	134	01-Jul-19 A	11-Dec-20
TASK 3.0 - SITE ACCESS		36	0	27-Feb-20 A	17-Apr-20 A
T3.0000	Site Access for Pre-Construction Activities Completed	0	0	27-Feb-20 A	
T3.0005	Site Access for Construction Activities	0	0	17-Apr-20 A	
TASK 3.1 - PRE-CONSTRUCTION		264	35	01-Jul-19 A	20-Jul-20
Construction Subcontracts (Develop & Procure)		264	35	01-Jul-19 A	20-Jul-20
Extraction System (Package A)		178	0	19-Aug-19 A	06-May-20 A
T3.1010	Well Install	25	0	27-Aug-19 A	02-Oct-19 A
T3.1015	Groundwater Pumps	58	0	13-Feb-20 A	06-May-20 A
T3.1020	Mechanical/Electrical	58	0	13-Feb-20 A	06-May-20 A
T3.1025	Pilot Setup (Tanks and Temp Facilities)	50	0	19-Aug-19 A	30-Oct-19 A
Civil and Mechanical (Package B)		54	0	14-Feb-20 A	01-May-20 A
T3.1030	Earthwork (Clearing, Excavation, Fill, and Backfill)	54	0	14-Feb-20 A	01-May-20 A
T3.1035	Underground Piping	54	0	14-Feb-20 A	01-May-20 A
T3.1040	Liner Systems	54	0	14-Feb-20 A	01-May-20 A
T3.1045	Pumping, Siphons, Drains	54	0	14-Feb-20 A	01-May-20 A
T3.1050	Fencing	54	0	14-Feb-20 A	01-May-20 A
EC Building (Package C)		29	0	14-Feb-20 A	27-Mar-20 A
T3.1026	Treatment Building Procure	29	0	14-Feb-20 A	27-Mar-20 A
T3.1027	Foundation Slab and Pads	29	0	14-Feb-20 A	27-Mar-20 A
T3.1028	Electrical and I&C Work	29	0	14-Feb-20 A	27-Mar-20 A
EC Treatment (Package D)		117	0	01-Aug-19 A	23-Jan-20 A
T3.1055	Treatment System Design	34	0	01-Aug-19 A	19-Sep-19 A
T3.1060	EC Unit Material Payment for Production	0	0	23-Jan-20 A	23-Jan-20 A
Other Services (Package F)		123	0	01-Jul-19 A	30-Dec-19 A
T3.1091	Lab (Bench) F.1	10	0	01-Jul-19 A	16-Jul-19 A
T3.1092	Lab (Pilot) F.1	46	0	19-Oct-19 A	30-Dec-19 A
T3.1093	Survey F.2	15	0	27-Aug-19 A	18-Sep-19 A
T3.1094	Locates F.3	14	0	27-Aug-19 A	17-Sep-19 A
Plate Materials (Package G)		35	22	12-May-20 A	30-Jun-20
T3.1095	Original and Replacement Plates	35	22	12-May-20 A	30-Jun-20
Chemicals (Package H)		35	35	01-Jun-20 A	20-Jul-20
T3.1096	Sulfuric Acid	35	35	01-Jun-20 A	20-Jul-20
T3.1097	Calcium Chloride	35	35	01-Jun-20 A	20-Jul-20
T3.1098	Polymer	35	35	01-Jun-20 A	20-Jul-20
TASK 3.2 - WELL INSTALLATION (Package A)		216	60	14-Oct-19 A	24-Aug-20
T3.2000	Subcontractor Mob	3	0	14-Oct-19 A	18-Oct-19 A
T3.2010	Well Installation and Development	23	0	21-Oct-19 A	22-Nov-19 A
T3.2012	Subcontractor Mobilization 2 & Submittals	20	20	01-Jun-20 A	26-Jun-20
T3.2015	Pumps, VFDs, Meters & Valves, Piping and Building	40	40	29-Jun-20	24-Aug-20
TASK 3.2a - PILOT TESTING INSTALL (Package F.1)		7	0	19-Oct-19 A	30-Oct-19 A
T3.2a000	Pilot Testing Install	7	0	19-Oct-19 A	30-Oct-19 A
TASK 3.2b - PILOT TESTING (Package F.1)		54	0	01-Nov-19 A	24-Jan-20 A
T3.2b000	Pilot Testing (Follows 1st Well)	54	0	01-Nov-19 A	24-Jan-20 A
TASK 3.3 - PIPING INSTALLATION (Package B)		105	86	04-May-20 A	30-Sep-20
T3.3000	Subcontractor Mob & Submittals	18	0	04-May-20 A	29-May-20 A
T3.3001	EC Bldg Subgrade	11	3	19-May-20 A	03-Jun-20
T3.3002	Pipeline Installation (Clear, Grub, Trench, Install, Backfill)	56	52	26-May-20 A	12-Aug-20
T3.3003	Fire Water Pond & Hydrant	60	60	01-Jun-20 A	24-Aug-20
T3.3004	Wetlands Pump Station	40	40	05-Aug-20	30-Sep-20
TASK 3.4 - WETLAND & INFILTRATION BASIN (Package B)		105	86	04-May-20 A	30-Sep-20
T3.5000	Subcontractor Mob & Submittals	40	21	04-May-20 A	29-Jun-20
T3.5002	Enhanced Wetland (Clear, Grub, Trench, Install, Backfill)	94	65	19-May-20 A	30-Sep-20
T3.5004	Infiltration Basin	15	15	10-Aug-20	28-Aug-20
TASK 3.5 - EC PLANT CONSTRUCTION (Packages C & D)		194	105	24-Jan-20 A	28-Oct-20
T3.4000	Subcontractor Mob (Completed)	0	0	08-May-20 A	
T3.4005	EC Unit Assembly (Offsite)	100	11	24-Jan-20 A	15-Jun-20
T3.4010	EC Unit Shipped	5	5	14-Sep-20*	18-Sep-20
T3.4011	Bldg Shop Drawings	52	7	27-Mar-20 A	09-Jun-20
T3.4011a	Bldg Foundation Submittals	1	0	27-Apr-20 A	28-Apr-20 A
T3.4012	Bldg Fabrication (Offsite)	24	24	10-Jun-20*	14-Jul-20
T3.4014a	Bldg Foundation & Slab & Cure	38	38	04-Jun-20	28-Jul-20
T3.4014b	Bldg Installation	40	40	29-Jul-20	23-Sep-20
T3.4015	EC Unit Construction w/ Well & Utility Hook Ups	19	19	21-Sep-20	16-Oct-20
T3.4020	EC Startup & Comm	8	8	19-Oct-20	28-Oct-20
TASK 3.6 - UTILITY INSTALLATION (Package B)		34	34	11-Jun-20	29-Jul-20
T3.1a000	Conduit Installation	24	24	11-Jun-20	15-Jul-20
T3.1a002	Utility Install by Avista (Transformer & Wires)	20	20	01-Jul-20	29-Jul-20
TASK 3.7 - SURVEY AND LOCATES (Package F.2 & F.3)		175	10	01-Oct-19 A	12-Jun-20
T3.7000	Well Survey and Utility Locates	3	0	01-Oct-19 A	04-Oct-19 A
T3.7010	Facility Survey and Utility Locates	29	10	04-May-20 A	12-Jun-20
TASK 3.8 - CONSTRUCTION COMPLETION REPORT/QA CONSTRUCTION REPORT		29	29	28-Oct-20	11-Dec-20
T3.6000	Substantial Completion	0	0		28-Oct-20
T3.6010	Construction Completion Report	29	29	29-Oct-20	11-Dec-20
TASK 4 - OPERATION & OPTIMIZATION		250	250	28-Oct-20	28-Oct-21
TASK 4.1 - OPERATION & MAINTENANCE 1YR INCLUDING MATERIALS		250	250	28-Oct-20	28-Oct-21
T4.1000	System Start Up	90	90	29-Oct-20	26-Jan-21
T4.1005	Operation & Maintenance 1YR Including Materials	191	191	27-Jan-21	28-Oct-21
T4.101	Consumables	250	250	28-Oct-20	28-Oct-21
T4.103	Project Complete	0	0		28-Oct-21
TASK 4.2 - SYSTEM OPTIMIZATION		20	20	29-Jan-21	01-Mar-21
T4.2000	System Optimization and Demonstration	20	20	29-Jan-21	01-Mar-21



Actual Work | Critical Path ◆ | ◆ Milestone
Remaining Work | Original CP ◆ | ◆ Critical Milestone

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FIGURE 7-1