RECLAMATION

Managing Water in the West

Upper Klamath Offstream Storage Study at Long Lake Valley

Canal-Tunnel-Power Optimization Study



U.S. Department of the Interior
Bureau of Reclamation
Mid-Pacific Regional Office
Klamath Basin Area Office
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Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Upper Klamath Offstream Storage Study at Long Lake Valley

Canal-Tunnel-Power Optimization Study

Team Members:

Rose L Reynolds, P.E. — 05-29-2009

Rose Reynolds, PE – 86-68110 — Date

Canals

D. Kevin Atwater — 5/29/2009

Kevin Atwater, – 86-68140 — Date

Tunnels

Chou Cha, P.E. — 5/29/2009

Chou Cha, PE – 86-68140 — Date

Intake/Fish Screen Structures

Rick Benik P.E. — 5/29/2009

Rick Benik, PE – 86-68130 — Date

Intake Towers

Brian K. Goplen P.E. — 5/29/2009

Brian Goplen, PE – 86-68120 — Date

Structural – Pumping Plants and Powerplants

Bob Zelenka — May 29, 2009

Bob Zelenka, PE – 86-68420 — Date

Hydraulic Equipment

Team Members (continued):

John Brooks, PE – 86-68420
Power Studies — May 29, 2009 Date

Rick Christensen – 86-68410
Mechanical Equipment and Fish Screens — May 29, 2009 Date

Larry Rossi, PE – 86-68430
Electrical Equipment — 5/29/09 Date

Lisa Gamuciello, PE – 86-68430
Transmission Lines/Switchyards — 5/29/09 Date

Tom Lippert, PE – 86-68313
Geotechnical Member — 5-29-09 Date

Steve Willcut – 86-68320
Geology — 5-27-09 Date

Lonnie Zlomke, PE – 86-68170
Construction Cost Estimate — 5/29/09 Date

Steve Hiebert – 86-68290
Fish Issues — 5/29/2009 Date

Paula Engel – 86-68270
Economic Analysis — 5/29/09 Date

Al Bernstein, PE – 86-68120
Study Coordinator — 5/29/2009 Date

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Introduction

In April 2008, the Klamath Basin Area Office (KBAO) requested the Technical Service Center (TSC) to perform a Canal-Tunnel Optimization Study and a Power Optimization Study for providing additional storage of water in Long Lake Valley (LLV) from Upper Klamath Lake (UKL) by utilizing a 350,000-acre-foot reservoir. In October 2008, KBAO requested the TSC to perform similar studies for a 500,000-acre-foot reservoir at Long Lake Valley. For a location plan, see attachment B, figure B1.

The purpose of the Canal-Tunnel Optimization Study was to investigate five different tunnel/canal alternatives between Upper Klamath Lake and Long Lake Valley. The purpose of the Power Optimization Study was to investigate three different pumping and/or power generation options for all five alternatives studied in the Canal-Tunnel Optimization Study. A summary of the Alternatives and Options is included as attachment A; for a map of the alternatives, see attachment B, figure B2. Both studies were to provide the following information for each alternative to be used for determining which, if any, alternatives continue forward to feasibility level design:

- Provide a description
- Document the pros and cons
- List the risks, fatal flaws, and assumptions used
- Provide appraisal level cost estimates

The five canal-tunnel alternatives (water conveyance alternatives, alternatives) studied were:

1. Alternative 1.—Canal adjacent to Wocus Marsh from UKL to pumping plant, through tunnel to multilevel inlet tower structure in LLV (per Reconnaissance report[1]—longer canal)

2. Alternative 2.—Pumping plant at UKL (Howard Bay), through tunnel to multilevel inlet tower structure in LLV

3. Alternative 3.—Canal across Wocus Marsh from UKL to pumping plant, through tunnel to multilevel inlet tower structure in LLV

[1] Bureau of Reclamation, *Upper Klamath Offstream Storage Study at Long Lake Valley Reconnaissance Level Cost Estimate*, March 2006.

4. Alternative 4.—Canal adjacent to Wocus Marsh from UKL to pumping plant through tunnel to multilevel inlet tower structure in LLV (shorter canal)

5. Alternative 5.—Pumping plant on UKL (at Fremont Bridge—head of Link River) through tunnel south of LLV to multilevel inlet tower structure in LLV

The three pumping and/or power generations options studied for each of the above alternatives were:

1. Pumping only (baseline).—Utilize only pumping units to maintain reservoir storage in LLV Reservoir for release back to UKL

2. Pumping and generating.—Employ a separate pumping plant for filling LLV Reservoir with a separate generating plant for power generation back into UKL during times when releases are required from LLV Reservoir

3. Pump-turbine.—Utilize reversible, pump-turbine (P-T) units for pump storage operations to maximize power generation capability of the P-T equipment

Two different flow rates (1,000 ft^3/s and 2,000 ft^3/s) were studied for each of the canal-tunnel alternatives comprising six options for each alternative. These flow rates were also used for the pumping and/or power generation options.

For each alternative, three types of concrete intake structures were examined including a vertical intake tower in the reservoir with an access bridge to the reservoir rim (baseline), an inclined box type structure along the slope of the reservoir rim, and a vertical shaft excavated into the reservoir rim with horizontal tunnels leading to the reservoir.

All alternatives, options, and flow rates were studied for both the 350,000 acre-foot reservoir and the 500,000 acre-foot reservoir except for Alternative 5, Options E and F, which were not studied for the 500,000 acre-foot reservoir (see *Canals and Upper Klamath Lake Intakes/Fish Screens* for more information).

Plan and profiles of all alternatives and options are shown in attachment B, figures B3 through B12.

Background

In 1987, the Bureau of Reclamation (Reclamation) began investigative studies on constructing and operating an offstream storage project involving a system of three reservoirs in the Upper Klamath Lake area. In 2003, the 1987 study was

revised and updated for only one of the reservoirs: Long Lake Valley. The Mid-Pacific Regional Office (MPRO) conducted additional geologic investigations in 2004 and 2005, which indicated that the water-holding capability of Long Lake Valley was more promising than originally estimated.

In December 2005, Reclamation's Klamath Basin Area Office requested that the Mid-Pacific Region, Division of Design and Construction, Engineering Branch (MP-210) perform an appraisal level study to evaluate using Long Lake Valley as an offstream storage reservoir. In March 2006, MP-210 completed a reconnaissance level construction cost estimate of the proposal.

To provide the appraisal level evaluation, in 2006, Reclamation initiated the Upper Klamath Basin Offstream Storage (UKBOS) investigation. The UKBOS investigation is based on the 1987 study and evaluated potential offstream water storage projects in the Upper Klamath River Basin that could improve water supply and reliability, provide fish and wildlife benefits, and provide additional water for agricultural uses. Storage of excess winter/spring runoff is a potential solution to water shortages in the Klamath River Basin. LLV has advanced in the UKBOS investigation and is in the appraisal level planning phase, with authorization from the Klamath Basin Water Supply Enhancement Act of 2000 (P.L. 106-498) to proceed to feasibility level. The basis for the appraisal level planning design is the *Upper Klamath Offstream Storage Study at Long Lake Valley Reconnaissance Level Cost Estimate*, March 2006 (Reconnaissance report), which uses information from the study performed by MPRO staff in 1988 and updated in 1993.

General Comments

Since the Canal-Tunnel Optimization Study and the Power Optimization Study have several interlocking parts, both of the studies will be discussed in this one report. Each major component of the project is discussed in detail in the following sections. In addition:

- To maintain consistency with other reports, the Reconnaissance report prepared by the MP Region in May 2006 and the *Long Lake Valley Reservoir: Operational Simulations and Water Quality Assessment* draft report (March 2008) were used as the basis for these studies.

- Where appropriate and applicable, items listed in the Constructability Review Report (November 2007) as *Issues to Be Studied for Completion of Appraisal Level Design* were included in these studies. Items listed in this report as *Feasibility Design—Issues to Be Studied* were not included.

- Due to the lack of design data, gross assumptions had to be made. Many of these assumptions are at a preappraisal level. This is particularly true with the geotechnical/foundation criteria, project operation parameters, and the power generation analysis. When design data is obtained for future studies, these assumptions can be refined.

- Link River Dam, which impounds Upper Klamath Lake, was constructed in 1921 using a Bureau of Reclamation vertical datum (USBR). Elevations for the new Long Lake Valley Reservoir are based on the 1988 North American Vertical Datum (NAVD88). The conversion between elevations using the USBR datum at Upper Klamath Lake and elevations using NAVD88 at Long Lake Valley Reservoir is approximately 0.64 feet (USBR plus 0.64 feet equals NAVD88).

Canals

In order to convey flow from Upper Klamath Lake to a new pumping plant that will lift the water into Long Lake Valley Reservoir, a canal section is proposed that roughly follows the existing alignments of Caledonia Canal and Wocus Drainage Canal. This location is designated as Alternative 1. Initially, both concrete-lined and earth-lined canal sections were estimated for 1,000-ft^3/s and 2,000-ft^3/s capacities.

For Alternative 1, the canal section is assumed to be 19,000 feet long, as in the March 2006 reconnaissance estimate. With adjustments in length, the same canal section developed for Alternative 1 was also used for Alternative 3 and 4. The canal for Alternative 3 extends across Wocus Marsh with a length of 18,000 feet. The canal for Alternative 4 follows the same alignment as Alternative 1, but with a shorter length of 13,000 feet. For typical canal sections and properties, see attachment B, figures B13 and B14.

A pipe option was considered for Alternative 4. However, in general, pipe is a more costly option than open channel for a given application. As the flow rate increases, the relative cost differences tend to increase even more. For the 1,000-ft^3/s canal option, with a length of 19,000 linear feet, it is estimate that four 12-foot diameter, mortar-lined steel pipes would be required. This estimate is based on sizing pipe that will provide the same friction loss that a canal would provide (friction slope = difference in water surfaces over 19,000 linear feet = 0.0000684). These pipes would require 12-foot cover to give a 1.5 safety factor against flotation. The pipes would require the same 15-foot overexcavation with 5:1 cutslopes that were required for the canal. For a 19,000-linear-foot pipe system, excavation is estimated to be 7,064,000 yd^3 as opposed to 4,200,000 yd^3 for the canal. Pipe trench backfill would require 6,750,000 yd^3 of imported material. A design flow of 2,000 ft^3/s would require a total of eight pipes, and

even more earth materials. With earth material requirements being approximately 70 percent more than that required for a canal, one can conclude that, from strictly a cost standpoint, a pipe system cannot compete with a canal for this application.

Operation

The canal is designed to be bidirectional, with water pumped from Upper Klamath Lake for storage in Long Lake Valley during the winter months and then released back into Upper Klamath Lake during the drier summer months against the adverse slope of the canal. Per an e-mail forwarded from the Reclamation Hydrology Group on June 26, 2008, the high water surface (WS) at Klamath Lake is the normal water surface (NWS) elevation 4143.30 and the low water surfaces are elevation 4139.0 (optimal minimum level), elevation 4138.0 (dry condition minimum level), and elevation 4137.50 (emergency level).

Initial flow is designated as starting at Upper Klamath Lake flowing to Long Lake Valley. Return flow is designated as starting at Long Lake Valley flowing back to Upper Klamath Lake. To ensure canal operation at all expected lake and reservoir WS elevations with the bidirectional flow, it was necessary to increase the canal depths to encompass this range of WS elevations at Upper Klamath Lake. Thus, at the Upper Klamath Lake side, the initial flow WS start point was set to match the Upper Klamath Lake low elevation of 4137.50. For the return flow, the starting point WS elevation at the Long Lake Valley side was increased until the resulting end point WS on the Upper Klamath Lake side matched the Upper Klamath Lake high elevation of 4143.30.

Design

Using the above minimum depths, the canal sections were initially sized using the Reclamation General Canal Design Flow Charts. For the discharge capacities (Q) considered (1,000 ft^3/s and 2,000 ft^3/s), the minimum base width / depth ratio, b/d is 3.5 for an earth canal and 1.3 for a concrete-lined canal. A maximum velocity (V_{max}) of approximately 2.5 ft/s was selected from the range of 1 to 3.5 ft/s for the earth canal. Similarly, a maximum velocity of 3.5 ft/s was selected from the range of 2 to 4.5 ft/s for the concrete-lined canal. For the earth-lined canal, friction was estimated using a Manning's n value of 0.0225. For the concrete-lined canal, friction was estimated using a Manning's n value of 0.015. Using these boundaries with Manning's Equation, optimum (with least value of wetted perimeter, p) values for b, d, and slope s (rounded to 5 digits), hydraulic radius (r), and area of flow (A) were back-calculated as:

Concrete-lined canal

Q	A	V_{max}	R	N	S	d	B
1,000	289.09	3.45	5.34	0.015	0.00013	9.20	13
2,000	582.99	3.43	7.59	0.015	0.00008	13.16	18

Earth-lined canal

Q	A	V_{max}	R	n	S	d	B
1,000	404.75	2.47	5.92	0.0225	0.00013	8.58	30
2,000	817.26	2.45	8.40	0.0225	0.00008	12.15	43

Although the concrete-lined canal section is significantly smaller than the earth section, it was subsequently dropped from further consideration as an option part way through the study for the following reasons:

- Local high groundwater, combined with anticipated rapid fluctuation in canal water surface, would likely cause the concrete canal lining to displace, buckle, and heave.

- In order to avoid displacement of the concrete lining due to groundwater, a full time pumping scheme would be required to remove groundwater from behind the lining.

- It is believed that suitable earth lining material is readily available at a nearby location. Compacted earth is an excellent and proven material for canal linings.

- Further studies may indicate that canal lining of any kind is not required for this application. Given the local high groundwater, there may not be enough head differential between the canal water surface and the groundwater elevation to provide energy for significant seepage losses.

For the alternatives (1 and 4) that encroach on the existing Wocus Drainage Canal, a small trapezoidal earth canal section was provided on the east side of the alignment as replacement for the existing drainage path. A flow of 60 ft^3/s was assumed with a velocity of 2 ft/s. The resulting section has 2:1 side slopes, a 7-foot base width and 5-foot depth.

To obtain precise WS elevations along the length of the main canal sections, the optimum values in the above tables were used as input to the Reclamation water surface profile program, “zprof.” Initial depths in the program were varied by trial and error until an energy balance was reached with the minimum b/d ratio and the maximum designated velocity. For Alternative 1, initial flow was

assumed to start from Upper Klamath Lake at sta. 0+00 and extend for 19,000 feet to sta. 190+00, the location of a pumping plant to lift the water into Long Lake Valley. Using the same canal invert slope, return flows were started at sta. 190+00 and ended at sta. 0+00. This results in the return flow traveling against an adverse (uphill) slope. Due to the adverse slope, larger starting depths were required at sta. 190+00 in order to initiate the return flow and achieve an energy balance for the flow equations. The longer length of 19,000 feet used for Alternative 1 results in the largest required depths with the maximum canal depth and section required at sta. 190+00. Although the depth and section could theoretically be reduced at sta. 0+00 for Alternative 1, and also be reduced for the shorter lengths of Alternatives 3 and 4, the maximum section was used for all estimates to provide a more conservative result for the appraisal level study.

To encompass the range of operating levels in Upper Klamath Lake, the resulting WS profiles were projected by matching the initial flow WS at sta. 0+00 to the Upper Klamath Lake low WS of 4137.50 and matching the return flow WS at sta. 0+00 to the Upper Klamath Lake high WS of 4143.30. The maximum bank height for each case was calculated by adding the bank height freeboard to the projected return flow WS along with an additional 1 foot (to account for entrance and exit return flow losses in the canal). The minimum canal invert was calculated by subtracting a 1-foot loss component (to account for entrance and exit initial flow losses in the canal) from the invert used for each flow case. The resulting elevations were tabled and plotted on figures B13 and B14 (see attachment B).

For each capacity (1,000 ft^3/s and 2,000 ft^3/s), the pumping plant was designed with two pump units. To provide WS elevation information during operation of only one unit, profiles were run through "zprof" using the previous criteria (base width, slope, etc.) with the flow rate reduced by half. The resulting elevations are listed in the following table. These are the lowest operating flow depths that would be expected at the pumping plant.

	1,000 ft^3/s		2,000 ft^3/s	
	Full capacity	Half capacity	Full capacity	Half capacity
Earth	4136.64	4135.92	4135.91	4135.28

Pros and Cons of Canal Features

Pros:

1. The canal section has a relatively simple trapezoidal cross section and may be easier and/or quicker to build than other options.

Cons:

1. Foundation materials appear to be extremely poor. This is thought to require overexcavation, off-site removal, and replacement with suitable imported materials. Even with these measures, the final stability of the canal section may always be questionable, due to the high groundwater and high moisture content of the surrounding soils.

2. Drainage appears to be extremely poor. The surrounding area was previously marshland that was drained for agricultural production. The remaining available construction area for the canal system tends to be at a pocketed lower elevation that cannot be readily drained. There is no adjoining area to drain to that is lower than the proposed construction site.

3. Since the surrounding area appears to have a high water table and the local materials have a corresponding high water content, dewatering may be difficult and time consuming. In addition, dewatering may prove to be ineffective as a result of the presumed nature of the soils along the canal alignment; more geologic and geotechnical information is needed.

4. Due to the required width of the canal section, a portion of agricultural land would need to be taken out of production in order to implement any of the canal alternatives.

5. Operating the canal bidirectionally requires a much deeper canal section with an associated increase in material quantities, construction cost and operation and maintenance (O&M) costs.

Items to Be Studied If Proceeding to Feasibility Level Studies for Canal Features

- A thorough investigation of the foundation materials and drainage must be performed in order to provide foundation and excavation recommendations for the canal. More information is needed to correctly ascertain the difficulty of dewatering or unwatering potential construction sites and the actual usability of local earth materials. Due to the lack of detailed site information, quantity estimates for this alternative have assumed a worst-case scenario: 15 feet of overexcavation under structures; cut lines at relatively flat 5H:1V slopes; and all excavated material disposed of off site with all fill material imported from a borrow area. These assumptions substantially increase the right-of-way requirements, material volumes, and costs.

- More information is needed as to what head drops are survivable for the particular fish species.

- The assumption that an emergency overflow spillway for the reservoir at Long Lake Valley is unnecessary should be confirmed. There have been instances of dike and slope failures at other sites when reservoirs were filled to previously unseen water levels and no emergency release was available.

- Although the canal alternatives were designed to have a canal lining at the appraisal level, future consideration should be given as to whether an unlined canal would be a suitable alternative. Given the relatively short length of canals and the anticipated high groundwater, the potential for significant seepage from the canal prism seems to be minimal. Significant savings may be realized by utilizing an unlined canal prism.

Recommendations for Canal Features

None identified

Tunnels

General Design

The plans and profiles of the tunnels in Alternatives 1, 2, 3, and 4 are shown in attachment B, figures B15 through B19. The profile of Alternative 5 is shown on figures B20 through B22.

The invert of each tunnel alternative is set at elevation 4270.0 feet to match the elevation of the lower intake of the intake structure. This is also the top of dead storage in the reservoir. The slope of the tunnel would be essentially flat with a small slope toward the pumping plant to aid in draining the tunnels during inspection and maintenance. A pipeline would connect the tunnel to the pumping plant.

Hydraulic Design

The tunnel and pipeline diameters were sized for flows of 1,000 ft^3/s and 2,000 ft^3/s with flow velocities of 12.1 ft/s and 12.5 ft/s, respectively. The sizing was based on an article by F. Fahlbusch, "Determining diameters of power tunnels and pressure shafts," *Water Power and Dam Construction*, 1987. For the 1,000-ft^3/s option, the inside tunnel diameter has been determined to be 10.25 feet. For the 2,000 ft^3/s option, the inside tunnel diameter has been determined to be 14.25 feet.

Tunnel Design

The appraisal designs for the tunnel support and lining were based on the limited existing geologic design data and Chapter 4 of Reclamation's Design Standards No. 3. The tunnel designs include initial and final support. The initial support stabilizes the excavated tunnel opening until the installation of the final support or lining. The contractor would install the initial support immediately after advancing the heading. The details for the initial and final support used in this assessment are shown in attachment B, figure B23.

For the shorter tunnels (Alternatives 1, 3, and 4), tunnel excavation would probably be excavated by drill and blast. The longer tunnels (Alternatives 2 and 5) could conceivably be excavated by a tunnel boring machine (TBM) but were assumed to also be excavated by drill and blast because of variable and potentially difficult ground conditions that the tunnel could encounter.

The same geologic assumptions were applied to all five alternative alignments. In reality, the geologic conditions that each tunnel would encounter could vary significantly.

From the available geologic data, the tunnels would be above the current water table, and groundwater should not be a problem. Rainfall would eventually enter the tunnels. The tunnel can be excavated uphill to drain the tunnel by gravity flow.

In order to prevent potentially substantial leakage from the tunnels, a steel lining was assumed to be required for the entire length of tunnels for the following reasons: (1) internal pressure head greater than 150 feet, (2) an assumption that the tunnels would encounter significant reaches of rock with low moduli of deformation, and (3) an assumption that the tunnels would encounter long reaches of highly permeable nonlithified to poorly lithified rock or intensely fractured rock of high permeability. The space behind the steel liner would be backfilled with concrete and then backfill grouted. The thickness of the steel lining is a function of the tunnel diameter and the internal pressure. The steel lining varied as shown in the following table:

Steel lining thicknesses

	Alternatives 1,2,3,4, and 5	
Reservoir size	Q = 1,000 ft^3/s	Q = 2,000 ft^3/s
350 TAF	½ in	$^{11}/_{16}$ in
500 TAF	⅝ in	$^{13}/_{16}$ in

Pros and Cons of Tunnel Features

Cons:

1. There could be some risk of the TBM getting stuck in bad ground.

Items to Be Studied If Proceeding to Feasibility Level Studies for Tunnel Features

- Based on the collection of site specific geologic data for each tunnel alternative, the excavated shape, initial support, and lining requirements for each alternative should be evaluated.

- Based on feasibility design data, the tunnel size should be optimized.

Recommendations for Tunnel Features

1. The geologic conditions that each tunnel alignment would encounter may differ significantly. For each tunnel alternative that could be pursued during a feasibility study, sufficient site specific geologic data should be collected to clearly define those geologic conditions.

Canals and Upper Klamath Lake Intakes/Fish Screens

Plans and details for the intake structures/fish screens for all alternatives and options are shown in attachment B, figures B24 through B39.

Fish Screen Structures

The fish screen structures for Alternatives 1, 3, and 4 under all plant configuration options for both 1,000 ft^3/s and 2,000 ft^3/s flows are all similar at this appraisal design level. They are assumed to transition into a trapezoidal canal section. The pumping/generation plant configuration has little impact on the fish screen structure dimensions. The fish screen structures would be located near the intake of the canal from Upper Klamath Lake, and the pumping plant would be located at the downstream end of the canal.

The fish screen structures for Alternatives 2 and 5 are slightly different because these two alternatives transition immediately from Upper Klamath Lake into the pumping/generation plant. The multiple pumping/generation plant configuration

options either widen or narrow the concrete transitions between the fish screen structure and the plant.

Design Concept Description

Alternatives 1, 3, and 4 for 1,000-ft^3/s Flows and Pumping/Generation Plants

The fish screen structure for these alternatives consists of cast-in place concrete structures with three bays. Two bays would house the "V" configuration fish screens, and the third bay would serve as a return channel bypassing the fish screen when water flow were reversed from Long Lake Valley Reservoir back to Upper Klamath Lake. The structure would include trashracks on the intake side from Upper Klamath Lake, radial gates upstream of the fish screens, fish screens, fish bypass pipe entrances dropping through the invert of structure floor, and downstream radial gates. The radial gates in both the two fish screen bays and the return flow channel bay would serve to isolate the compartments under the different operation scenarios. If the pumping plant were drawing water from Upper Klamath Lake to Long Lake Valley, the fish screen bay channels would be in operation, and the return flow channel bay would be isolated by the radial gates. If the return flows were made from Long Lake Valley back into Upper Klamath Lake, then the radial gates would isolate the fish screen bays, and the return flow channel would pass the flow.

The total width of the structure from inside to inside of the outside walls would be 103 feet with three 33-foot bays separated by 2-foot thick concrete divider walls. The structure is preliminarily designed to resist uplift. The outside concrete walls would be tapered from 2 feet thick at top of wall to a 4-foot bottom thickness. The wall height for this concept would be 21 feet, allowing the top of the concrete wall to be at elevation with the canal bank. The floor slab would be 4 feet thick as well. These preliminary dimensions are based on past structural design of similar structures. The length of the fish screen structure, including the sections housing the radial gates, would be approximately 160 feet. Concrete transition structures would be incorporated to interface with the trapezoidal canal sections.

The fish screens are laid out in a "V" configuration angling from the line of flow at an angle less then 10 degrees. The screen length per leg of "V" for the 1,000-ft^3/s flow capacity would be approximately 90 feet long along the face of the screen and would converge to a bypass inlet. The screen length of 90 feet is to minimize fish exposure time along the screens.

Fish bypass would be accomplished with two drop-down bypass intakes through the structure floor into bypass pipes. The bypass system would be driven by fish-friendly pumps housed in a bypass pump structure. Bypass pipes are assumed to be 63-inch outside diameter high density polyethylene (HDPE) smooth wall pipes. Another appurtenance included in these concept layouts is a monitoring facility structure below grade.

Alternatives 1, 3, and 4 for 2,000-ft^3/s Flows and Pumping/Generation Plants

At this higher flow capacity, the fish screen structure would remain in a similar layout as described above. The difference is the increase in structure width and length. To accommodate the 2,000-ft^3/s flow, the structure width would be increased to approximately 133 feet. Again, there will be three bays, each 43 feet wide, separated by 2-foot thick concrete walls. The outside walls and dimensions would be similar to those described above. The wall height would increase approximately 3.6 feet to a make it a 24.6 feet tall wall at the elevation of the canal banks. The length of the structure including the portions housing the radial gates would be approximately 190 feet. The bypass system and monitoring facility would be similar to what was described above for the 1,000-ft^3/s alternatives.

Alternative 2 and 5 for 1,000-ft^3/s Flows and Pumping/Generation Plants

The fish screen structure for these alternatives consists of three bays similar to the bays in previous Alternatives 1, 3, and 4 at 1,000 ft^3/s. Because the fish screen structure would transition to the pumping plant immediately, the transition structure would change with the different plant configurations. For Option A (Pump Only [PO]), the transition to the pumping plant would narrow from a width of 103 feet at the fish screen to 75 feet at the plant. The angles of expansion or contraction to pumping plants would be made at 22.5 degrees. For Option C (Pump and Generation), the transition structure expands from a 103-foot width at fish screen structure to a 165-foot width at the plant.

Alternative 5 has six options that include a combination of pumping plant only; pumping and generating plant; and pump turbine plant for the two flows at 1,000 ft^3/s and 2,000 ft^3/s. Options E and F, which are for the two flow pump turbine plants, were not considered because they could not reasonably accommodate the return flow flexibility of both bringing water back from Long Lake Valley into Upper Klamath Lake at Link River and passing water into A Canal. The return flow back into A Canal would include running two bypass 10-foot diameter pipes buried under Link River to a location downstream of the A Canal fish screen.

In the pump turbine options, the same pumping units are utilized in reverse for power generation. The intake transition between the fish screen headwork structure and the plant needs to be designed in a manner to meet hydraulic efficiency requirements. A bypass pipes system, which allows the return flow to be diverted to A Canal, needs to come off at this transition between the pump turbine plant and the fish screen headwork. To make this transition work would be pushing the physical limitation of balancing hydraulic efficiency with the return flow flexibility. Inefficient hydraulics would require higher pumping costs and generate less power. A hydraulically efficient intake and discharge for the pump turbine plant would not allow for return flow to be bypassed under Link River into A Canal directly.

Alternative 2 and 5 for 2,000-ft^3/s Flows and Pumping/Generation Plants:
The fish screen structure for these alternatives at a flow of 2,000 ft^3/s is similar to those of Alternatives 2 and 5 at 1,000 ft^3/s. The structure, however, would be wider by 30 feet for a total width of 133 feet for Option B at the fish screens. Again for Option E (Pump Turbine), the return flow channel bay was eliminated, and operation of the return flow would be as described previously.

Design Criteria

Design criteria for the Fish Screen Intake Structure and fish bypass system are in accordance to the National Marine Fisheries Service (NMFS)—Northwest Region 1995 criteria for juvenile salmonids.

Fish Screen Intake Structure

The fish screens in the Fish Screen Intake Structure channel are configured in multiple "V" configuration bays each with a center bypass dropping below the bottom of the intake channel. The screen approach velocity would be 0.4 ft/s in accordance with NMFS fry criteria, and the sweeping velocity would be greater than the approach velocity.

Fish Bypass System

Although the fish screen criteria for the NMFS—Northwest Region do not recommend fish pumps within the bypass system, Reclamation has had success with fish pumps in existing facilities (i.e., A Canal fish screen fish-friendly pump and the fish-friendly pumps at the Red Bluff Pump Demonstration Project). The pipe bends for the bypass system would be made at a radius of five times the diameter of the pipe. The velocity in the bypass pipe would range between 3 ft/s and 5 ft/s. These velocities exceed the minimum criteria of 2 ft/s and are far below the 25 ft/s for outfall impact velocity.

Intake/Screening Structures Upstream of Plants

The intake structures for all alternatives would contain a trashrack structure with trashracks, automated trash rake for cleaning the trashracks, and stoplogs and guides. The trashracks would be designed to protect the downstream fish screens and fish bypass systems from large debris. The trashrack bars would be spaced with approximately 2-inch clear openings and sized for a canal velocity at the trashracks of approximately 2 ft/s.

Several positive barrier fish screen structure configurations were considered during this study. Each configuration utilized vertical flat screen panels installed within metal guides/supports. For both the 1,000-ft^3/s and 2,000-ft^3/s flow options, the configurations evaluated were: single diagonal line of fish screens across the flow (similar to Durango Pumping Plant screen structure); "V" configuration of screens in a single bay (similar to the A Canal screen structure); and "V" configuration of screens in multiple bays (similar to the Grand Valley screen structure). Due to the length of the screens required based on the

minimum water depth at the screens (see table 1), the screening configuration with two bays, each with "V" configuration of screens, was selected to be carried forward for estimating. Each screen bay would be provided with a fish bypass at the downstream end of the "V". This multiple bay "V" screen configuration was selected because it shortens the length of the structure as well as minimizes the exposure time for the fish along the screen face.

The screening structure located within the canal alternatives (Alternatives 1, 3, and 4) and in the intake channel for Alternative 5 each have a gated (radial gates) entrance channel, gated exist channel, and gated bypass channel. The bypass channel would be provided so flows being returned to Upper Klamath Lake could be diverted around and not through the fish screens. For the Alternative 2 options, radial gates are only provided in the entrance channel to the plant. For the P-T options for Alternative 2, four fish screen panels are assumed to be lifted to allow flows returning to Upper Klamath Lake to pass through these openings in lieu of the bypass or separate return channel. Other possibilities (e.g., gates within the screen structure) should be evaluated during a feasibility level study in lieu of pulling screens.

The fish screens would be vertical, flat panels installed within metal guide/support structures. The screen panels were assumed to be all stainless steel wedge wire or profile bar panels. The screen slot (narrowest dimension) openings shall not exceed 0.0689 inches (1.75 mm). For each alternative, assuming an approach velocity of 0.4 ft/s with an additional 10 percent screen area for structural members, 2,750 ft^2 was used for the minimum required fish screening area for the 1,000-ft^3/s flow options, and 5,500 ft^2 was used for the minimum required fish screening area for the 2,000-ft^3/s flow options. Using the minimum available depth at the maximum flows (either 1,000 ft^3/s or 2,000 ft^3/s), the length and number of screen bays were determined; see table 1. The exposure time for the fish along the face of the screen is approximately 36 seconds for the 1,000-ft^3/s options using a sweeping velocity of 2.5 ft/s. The exposure time for the fish along the face of the screen is approximately 48 seconds for the 2,000-ft^3/s options using a sweeping velocity of 2.5 ft/s.

Table 1.—Screen sizing

Flow (ft^3/s)	Approach velocity (ft/s)	Screen area + 10% (ft^2)	Assumed minimum water depth at screens (ft)	Required screen length (ft)	Size of each screen panel (ft x ft)	No. of screens per leg of "V" (4 legs)	Barrier panel size (ft x ft)
1,000	0.40	2,750	8.58	320.51	10 x 10	9 (36)	10 x 10.21
2,000	0.40	5,500	12.12	458.33*	10 x 12	12 (48)	10 x 12.12

* Uses 12 ft of screen height since less than minimum water depth

Adjustable baffles would be provided in guides directly downstream of the screens to provide for uniform flow distribution over the screen surface. Horizontal brush-type fish screen cleaners would clean the fish screens. Since the screens are designed for the maximum flow at the minimum operating water depth, metal barrier panels would be provided above the screens. These barrier panels would block flow passage above the screens and extend above the maximum design operating water surface. Secondary screens were assumed to not be required for this study since the fish bypass flows based on the water depth range at the fish bypass entrance do not appear excessive. This should be re-evaluated during feasibility studies should the decision be made to proceed.

Two fish bypass systems would be required for each alternative. Each fish bypass system would consist of: a bypass inlet transition located immediately downstream of the fish screens, bypass pipe, a centrifugal screw pumping unit, a monitoring structure, and an outfall structure. To provide at least a 2 ft/s water velocity at the bypass inlet (inlet assumed to be 2 feet wide) at the maximum water depth, a bypass flow capacity of approximately 58 ft^3/s per fish bypass system would be required for the 1,000-ft^3/s options (water depth range of 8.58 to 14.38 feet). A bypass flow capacity of approximately 72 ft^3/s per fish bypass system would be required for the 2,000-ft^3/s options (water depth range of 12.15 to 17.95 feet).

The bypass inlet transitions would be located immediately downstream of the fish screens. The bypass inlet transition would serve to collect screened fish and move the fish forward to the bypass pipe. Pipe bends for the fish bypass system would be made at a radius of five times the diameter of the pipe. The bypass pipes would have a diameter not less than 24 inches to minimize the potential for debris clogging. The bypass pipe velocities would exceed the minimum criterion of 2 ft/s and be below the 25 ft/s for outfall impact velocity.

A gravity-driven fish bypass system is not possible at this location (although preferable) due to the lack of available head to pass the fish back to Upper Klamath Lake. Therefore, the layout at this site would assume the use of fish centrifugal screw pumps (fish-friendly pumps) to bypass the screened fish back into Upper Klamath Lake. Reclamation has had success with fish pumps at existing facilities, but this would require a variance from the fish agencies since the screen criteria from the NMFS-Northwest Region does not allow fish to be pumped within a fish bypass system.

One centrifugal screw pumping unit would drive each fish bypass system (two systems per alternative required). A spare third pumping unit (pump and motor) would be provided as a backup to provide for quick replacement to allow the facility to continue operations. The fish pump structure would support the pair of centrifugal screw pumping units and also provide storage for the spare pump and motor. Heating, ventilating, air conditioning, sump pumps, fire extinguishers, and

an overhead crane would be provided within the building. The fish pump structure would be similar to the A Canal fish pump structure.

The fish pumps would lift the bypassed water and fish to the monitoring structure. The monitoring structure for this study is assumed to be similar to the A Canal structure. Fish would then gravity flow to the outfall structure.

The outfall structure is designed as a concrete encasement around the bypass pipe and would be installed in Upper Klamath Lake at a location that decreases the chances of predation and fish recycling back into the main pump system. The outfall structure would be positioned to prevent a vertical drop at the structure and ensure the pipe outlet were always submerged.

Fish Screens—General

The species of concern are the short nosed suckers and the Lost River suckers, both listed as federal endangered species. No specific screening criteria have been established for these species, so as in the designs for the A Canal and Chiloquin fish screening structures, the fish screens and fish bypass systems would be designed to meet the National Marine Fisheries Service, Northwest Region, screen criteria for juvenile salmonids. For this appraisal study, Reclamation used the salmonid fry criteria (less than 2.36 inches [60 mm] length) for fish screens located both at the intake/screening structures located upstream of the plants and also for the fish screens located on the intake structures within Long Lake Valley Reservoir. The criteria states that for salmonid fry, the approach velocity shall not exceed 0.40 ft/s. Approach velocity is defined as the water velocity component perpendicular to and approximately 3 inches in front of the screen face. The total submerged screen area required (excluding area affected by structural components) was then calculated by dividing the maximum diverted flow by the allowable approach velocity. The criteria include channel velocities, screen approach velocities, sweeping velocities, exposure time along the screen, maximum fish bypass pipe flow velocity, and minimum radius of fish bypass pipe bends.

Pros and Cons of Canal Intake Structures/Fish Screen Features

Pros:

1. For all the canal alternatives (Alternatives 1, 3, and 4):

    a. The gated bypass channel would pass the return flows around the fish screens so flows would not have to pass back through the fish screens and adjustable baffles.

b. Since fish screens would not be lifted as part of the normal operation, fish screen seals and gaps could be maintained.

2. None of the Alternative 2 P-T options would require a separate bypass channel with gates around the fish screens, reducing costs.

3. For the Alternative 2 Pump Only options and the pump and generating options:

   a. Return flows would not have to pass back through the fish screens.

   b. Since fish screens would not be lifted as part of the normal operation, fish screen gaps and seals could be maintained.

Cons:

1. For all alternatives.—Fish-friendly pumps would be required to drive the fish bypasses since there would be no available head. This would require a variance from the fish agencies.

2. For the Alternative 2 P-T options:

   a. The back of the fish screens could not be cleaned when returning flows since the adjustable baffles would be in the way.

   b. An increased potential for operating and sealing problems would require four jib cranes or hoisting mechanisms to lift four barrier panel/fish screens every time flow were returned to Upper Klamath Lake. Therefore, automatic controls would have to operate these hoists. Since screening criteria require very tight tolerances and small gaps, this raising and lowering would raise questions about whether screens could be lowered back into position or whether debris, sediment, or the tight tolerances would restrict the screens.

   c. Adjustable baffles would not be provided downstream of the four upstream fish screen panels (panels that would be hoisted) to reduce any additional blockage of the returning flow. If the hydraulics determined that baffles were required at these bays to get a uniform flow distributed over the fish screens, then hoisting additional fish screens may be required.

3. For all the canal alternatives (Alternatives 1, 3, and 4):

   a. The need for a gated bypass channel to pass the return flows around the fish screens would raise costs compared to Alternative 2.

   b. The risk of predation in the canal section upstream of the screen structure may be higher if the fish screen structure were located farther

away from the intake structure (distance between structures) compared to Alternative 2.

4. For the Alternative 2 Pump Only options and the pump and generating options.—Additional costs would arise since these options would require either an increased length of piping or an extended wall (concrete and/or sheetpile) that extended out into Upper Klamath Lake to direct return flows away from the fish screen intake.

Items to Be Studied If Proceeding to Feasibility Level Studies for Canal Intake Structures/Fish Screen Features

- Look at the possibility of using Hydrolox type traveling fish screens in lieu of the stationary panel fish screens. Examine whether these traveling fish screens could be reversible to allow cleaning with flow in either direction. Would adjustable baffles be required if this type of screen were used?

- Should monorail type hoisting systems be required at the screen structure to assist in the installation and removal for future maintenance of the fish screens, barrier panels, and adjustable baffles? Present schemes assume use of a mobile crane for the initial installation and future maintenance work.

- Should there be secondary screens to allow reducing the fish bypass flows and associated equipment and structures downstream (fish pump structure, monitoring structure, bypass pipe size, etc.).

- Further develop the fish monitoring structure(s). Requirements and goals at this structure need to be further defined by KBAO.

- Foundation investigation to determine the foundation for the intake headworks, fish screen structures, bypass pump structure, and fish monitoring structure(s).

- Evaluation of the impact of the algae bloom on the trashracks.

- For any selected alternatives that may proceed to the feasibility study, determine the location(s) in Upper Klamath Lake where the bypassed fish would be returned. This location(s) would take into account the available hydraulics and gradient of the fish bypass system.

- Look at possibilities of stranding of fish with canal section and gates. Also look at fish salvage requirements.

Recommendations for Canal Intake Structures/Fish Screens Features

1. Due to technical issues, recommend that flow is not returned through the fish screens.

Long Lake Valley Intake Structures

Intake Structures at Long Lake Valley Reservoir

For the five different canal-tunnel alternatives, there are four potential tunnel portal locations within Long Lake Valley Reservoir. For each tunnel portal location, three possible reinforced concrete intake structures were examined for the 350,000 acre-foot reservoir including an intake tower with an access bridge, a box-type structure along the slope of the reservoir rim, and a vertical shaft structure excavated into the reservoir rim with horizontal tunnels leading to the reservoir. Only the intake tower with an access bridge was examined for the 500,000-acre-foot reservoir. The slope distance and shaft excavation (and thus, construction costs) become excessive for the box-type structure and vertical shaft structure, respectively, for the 500,000-acre-foot reservoir. Each intake structure was sized for a discharge of either 1,000 ft^3/s or 2,000 ft^3/s flowing in either direction. Intake structure drawings are shown in attachment B, figures B40 through B51.

Each intake structure would have the ability to draw water from near the bottom of the new reservoir to make most of the storage available for releases. Each intake structure would have an opening to create artificial head to pump against when filling a near empty reservoir. The option for drawing water from a third opening was included in the appraisal level estimate for the 350,000 acre-foot reservoir. A fourth opening for drawing water was included in the appraisal level estimate for the 500,000 acre-foot reservoir. Additional openings have the advantage of drawing water from different levels in the new reservoir for water quality and temperature purposes. All of the openings would be gated for flow regulation, creating artificial head, and drawing water from different levels in the reservoir. All the openings for pumping water into the reservoir would have an energy dissipater and be protected by a trashrack. All of the openings for withdrawing water from the reservoir would have a fish screen.

Reservoir Elevations

Link River Dam regulates the flow from Upper Klamath Lake into the Link River. Upper Klamath Lake is a natural lake that typically varies from a maximum water

surface elevation 4143.3 (top of active conservation) in the spring to a minimum elevation 4138.0 by the end of September. Although in very dry years Upper Klamath Lake could go as low as elevation 4137.5. These elevations are based on a Bureau of Reclamation vertical datum (USBR). The water surface at elevation 4143.3 is shown on a 1951 proposed stilling basin modification drawing to Link River Dam and on a 1984 Reservoir Capacity Allocations sheet for Upper Klamath Lake.

Elevations for the new Long Lake Valley Reservoir were taken from the *Long Lake Valley Reservoir: Operational Simulations and Water Quality Assessment* draft report dated March 6, 2008 and are based on the 1988 North American Vertical Datum (NAVD88). The valley floor in Long Lake Valley is at approximately elevation 4255. The full pool in the Long Lake Valley Reservoir would be at either elevation 4432 providing approximately 350,000 acre-feet of storage at a depth of 177 feet or elevation 4485 providing approximately 500,000 acre-feet of storage at a depth of 230 feet. The top of dead storage in each reservoir will be at elevation 4270. The top of inactive storage in each reservoir was assumed to be at elevation 4285. This provides approximately 30,000 acre-feet of minimum storage that would not typically be taken out of the reservoir.

The conversion between elevations using the USBR datum at Upper Klamath Lake and elevations using NAVD88 at Long Lake Valley Reservoir is approximately 0.64 feet (USBR plus 0.64 feet equals NAVD88).

The top of dead storage is considered to be the lowest elevation in a reservoir from which water can be drawn by gravity. For the purposes of this appraisal level study, the invert elevation of the bottom opening in the intake structure and the invert in the tunnel will be located at elevation 4270, the top of dead storage. This represents the lowest point that water can be withdrawn from the reservoir by gravity.

The full pool water surface in the 350,000 acre-foot reservoir (elevation 4432 NAVD88) minus the minimum Upper Klamath Lake water surface (elevation 4138 USBR) produces the maximum head to pump against, or approximately 294 feet (347 feet for the 500,000 acre-foot reservoir). The minimum required amount of head to pump against is estimated to be approximately 250 feet. The minimum pump head provided would be equal to the difference between the invert of the upper intake in the intake structure and the maximum canal water surface. The canals were developed for this appraisal level study using NAVD88. The canal water surface at the pumping plant is estimated to vary between elevation 4135.0 and 4136.6 for pumping 1,000 ft^3/s into Long Lake Valley Reservoir, depending on the material used to build the canal. The canal water surface ranges from elevation 4135.8 to 4135.9 for pumping 2,000 ft^3/s into the reservoir (a wider canal is used for the larger flow). Elevation 4385 was chosen as the invert of the upper opening to provide approximately 250 feet of head to pump against, not including head losses.

For the purposes of this appraisal level study, openings in the intake structures for withdrawing water from Long Lake Valley Reservoir have been located at the top of dead storage at elevation 4270 and at elevation 4327.5. An additional gate opening for withdrawing water was located at elevation 4435 in the intake tower for the 500,000-acre-foot reservoir. Openings for pumping water into the reservoir have been located at elevation 4385 to create artificial head to pump against. Elevation 4327.5 represents the halfway point between the top of dead storage and elevation 4385. Elevation 4435 represents the halfway point between elevation 4385 and the full 500,000-acre-foot reservoir at elevation 4485.

Table 2 provides a summary of key Long Lake Valley Reservoir elevations and storage capacities.

Table 2.—Key Long Lake Valley Reservoir elevations (NAVD88)

Reservoir elevation	Total storage (acre-feet)	Feature
4255	0	Bottom of reservoir
4270	6,850	Top of dead storage, invert of withdrawal opening
4285	30,219	Top of inactive storage
4327.5	107,857.5	Invert of withdrawal opening
4385	232,074	Invert of opening to provide minimum 250 feet of head
4432	349,322	Full pool for 350,000-acre-foot reservoir
4435	357,393	Invert of withdrawal opening for 500,00-acre-foot reservoir
4485	502,928	Full pool for 500,000-acre-foot reservoir

Gate Openings

A gate controls each opening or port in the intake structures. For the 1,000-ft^3/s option, the inside tunnel diameter has been determined to be 10.25 feet. For the 2,000-ft^3/s option, the inside tunnel diameter has been determined to be 14.25 feet. The openings and gates were sized according to these tunnel diameters in order to maintain control of the flow at the intake structure during the pumping mode or downstream of the tunnel during reservoir withdrawal mode. The decision was made to use two small gate openings rather than one large gate opening at each port in order to reduce the hoist loads at the top of the intake structures and to improve the structural integrity of the concrete structures. The gates for the pumping mode and reservoir withdrawal mode will consist of slide gates mounted on the outside of the intake structure with gate stems extending up to the hoists on top of the intake structures. This will help provide a water tight seal whenever these gates are closed and the intake structure is dewatered. In addition, a guard gate was provided at the tunnel portal within each intake

structure for redundancy, inspection and maintenance of the tunnel, and emergency closure during power outages at the pumping plant. The guard gate will consist of a fixed-wheel gate mounted on the inside of the intake structure at the tunnel portal with a single gate stem extending up to the hoist on top of the intake structure. This will help provide a water tight seal whenever this gate is closed and the tunnel is dewatered. There would be a transition section between the tunnel and the rectangular shape of the fixed-wheel gate.

The purpose of the openings at elevation 4385 is to provide approximately 250 feet of static head to pump against. Water would be pumped through the tunnel, into the intake structure, through these openings and into Long Lake Valley Reservoir. Energy dissipation would have to be provided at the intake structure when the reservoir is low. The openings at elevation 4385 would not typically be used to withdraw water from the reservoir, so only trashrack options were estimated for these openings. To maintain control at the openings at elevation 4385 during the pumping mode, the openings and gates were sized to be approximately 10 percent smaller than the tunnel diameter. The gate openings and gate sizes are shown in tables 3 through 6.

The purpose of the other gated openings in the intake structure is for reservoir withdrawal. Fish screens were provided around these gated openings. Trashrack options (in lieu of fish screens) for each gated opening were also estimated for the intake structures for the 350,000-acre-feet reservoir. The gated openings for reservoir withdrawal were sized to be approximately 10 percent larger than the tunnel diameter to maintain flow control downstream. The gate openings and gate sizes are shown in tables 3 through 6. The maximum head on each gate is computed as the difference between the full pool at either elevation 4432 for the 350,000-acre-foot reservoir or elevation 4485 for the 500,000-acre-foot reservoir and the invert of each gate opening.

The guard gate was sized to be approximately the same size as the tunnel.

Table 3.—Gate openings for 1,000 ft^3/s for 350,000-acre-foot reservoir (tunnel diameter 10.25 feet and tunnel area 82.52 ft^2)

Port	Invert elevation	Gate openings and sizes	Maximum head on gate	Area (ft^2)	Gate area / Tunnel area
Pump	4385	Two 5-ft by 7.5-ft gates	47.0	75.0	0.91
Withdraw	4327.5	Two 6-ft by 8-ft gates	104.5	96.0	1.16
Withdraw	4270	Two 6-ft by 8-ft gates	162.0	96.0	1.16
Guard	4270	One 8-ft by 11-ft gate	162.0	88.0	1.07

Table 4.—Gate openings for 2,000 ft^3/s for 350,000-acre-foot reservoir (tunnel diameter 14.25 feet and tunnel area 159.49 ft^2)

Port	Invert elevation	Gate openings and sizes	Maximum head on gate	Area (ft^2)	Gate area / Tunnel area
Pump	4385	Two 7.5-ft by 10-ft gates	47.0	150.0	0.94
Withdraw	4327.5	Two 8-ft by 11-ft gates	104.5	176.0	1.10
Withdraw	4270	Two 8-ft by 11-ft gates	162.0	176.0	1.10
Guard	4270	One 11-ft by 16-ft gate*	162.0	176.0	1.10

*An 11-ft by 15-ft gate would also work.

The gate sizes shown in tables 3 and 4 were used for all three intake structures. The invert for the tunnel between the reservoir and the pumping plant is located at the top of dead storage at elevation 4270 for each alternative. Locating the tunnel invert at the top of dead storage means that the reservoir cannot be completely drained by gravity.

Table 5.—Gate openings for 1,000 ft^3/s for 500,000-acre-foot reservoir (tunnel diameter 10.25 feet and tunnel area 82.52 ft^2)

Port	Invert elevation	Gate openings and sizes	Maximum head on gate	Area (ft^2)	Gate area / Tunnel area
Withdraw	4435	Two 6-ft by 8-ft gates	50.0	96.0	1.16
Pump	4385	Two 5-ft by 7.5-ft gates	100.0	75.0	0.91
Withdraw	4327.5	Two 6-ft by 8-ft gates	157.5	96.0	1.16
Withdraw	4270	Two 6-ft by 8-ft gates	215.0	96.0	1.16
Guard	4270	One 8-ft by 11-ft gate	215.0	88.0	1.07

Table 6.—Gate openings for 2,000 ft^3/s for 500,000-acre-foot reservoir (tunnel diameter 14.25 feet and tunnel area 159.49 ft^2)

Port	Invert elevation	Gate openings and sizes	Maximum head on gate	Area (ft^2)	Gate area / Tunnel area
Withdraw	4435	Two 8-ft by 11-ft gates	50.0	176.0	1.10
Pump	4385	Two 7.5-ft by 10-ft gates	100.0	150.0	0.94
Withdraw	4327.5	Two 8-ft by 11-ft gates	104.5	176.0	1.10
Withdraw	4270	Two 8-ft by 11-ft gates	215.0	176.0	1.10
Guard	4270	One 11-ft by 16-ft gate*	215.0	176.0	1.10

*An 11-ft by 15-ft gate would also work.

The gate sizes shown in Tables 5 and 6 were for all the intake tower for the 500,000-acre-foot reservoir. The invert for the tunnel between the reservoir and

the pumping plant is located at the top of dead storage at elevation 4270 for each alternative. Locating the tunnel invert at the top of dead storage means that the reservoir cannot be completely drained by gravity.

Fish Screens

Because of the potential for fish to be transported out of Long Lake Valley Reservoir, fish screens will be provided around the gated openings associated with reservoir withdrawal. The fish screens will be designed to meet NOAA's National Marine Fisheries Service, Northwest Region, screen criteria based on salmonid fry criteria. This states that for salmonid fry [less than 2.36 inches (60 mm) in length], the approach velocity shall not exceed 0.40 ft/s. Approach velocity is defined as the water velocity component perpendicular and approximately three inches in front of the screen face. The total required submerged screen area (excluding area affected by structural components) is calculated by dividing the maximum diverted flow by the approach velocity. Using an approach velocity of 0.4 ft/s with an additional 10 percent screen area for structural members, 2,750 ft^2 of fish screening area was used for the 1,000-ft^3/s flow option and 5,500 ft^2 of fish screening area was used for the 2,000-ft^3/s flow option. These screening areas are required at all withdrawal openings. The screens will be designed to handle increase loadings because trashracks are not provided around the fish screens. To meet fish screening criteria, the screens require approximately five times more effective area than the trashracks would require.

The fish screens would be stainless steel profile bar screens with slotted openings not to exceed 0.0689 inch (1.75 mm). The shape of the screen structure around the gate openings could be rectangular (or shaped similar to a half a cylinder). The fish screens will require a cleaning method (air burst, back spray, back flush, other). The best shape that fits the selected intake structure and the best method to clean the screens should be studied in more detail at a feasibility level.

For typical fish screen details for an intake tower with an access bridge, a box-type structure along the slope of the reservoir rim, and a vertical shaft structure excavated into the reservoir rim with horizontal tunnels leading to the reservoir associated with the 350,000-acre-foot reservoir, see attachment B, figures B52 through B54. For typical fish screen details for an intake tower associated with the 500,000-acre-foot reservoir, see attachment B, figure B55.

Trashracks

Trashracks will be provided around the gated openings at elevation 4385 (openings associated with the pumped flow) to protect the structure and equipment from large debris, and also as a safety issue (see attachment B, figures B52 through B55). Trashracks are also provided on the energy dissipation

portion of the intake tower. Trashracks in lieu of fish screens for the intake structures for the 350,000-acre-feet reservoir were also estimated for all withdrawal gate openings (see attachment B, figure B56). All trashracks are sized for the approach velocity not to exceed 2 ft/s.

Tower Intake Structure for the 350,000-Acre-Foot Reservoir

The tower intake structure or intake tower extends from the top of dead storage at elevation 4270 to the top of full pool at elevation 4432. The hoist controls for the regulating and guard gates are located on top of the tower above elevation 4432. It was assumed that a control house would not be required for the hoists. The tower intake structure was modeled after the two intake towers at New Waddell Dam which are 224 feet high and were designed to resist a 10,000-year seismic event with a magnitude M_L 5.5 at an epicentral distance of 17 km. The 10,000-year seismic event at Long Lake Valley Reservoir has a peak horizontal acceleration of 0.5g.

The tower intake structure at Long Lake Valley Reservoir consists of an octagonal-shaped base slab with a four-sided vertical tower that is 162 feet high and supported by wing walls. The octagonal-shaped base slab eliminates the high stress concentrations in the corners of the base slab during a seismic event. An access bridge connects the top of the tower to the shoreline. During times when the reservoir is low, energy dissipation of the flow being pumped back into the reservoir is being provided by a vertical shaft along the outside of the tower directing the flow to the base slab and wing walls.

The tower was located at the tunnel portal for each alternative to minimize the length of the access bridge. This will increase the amount of excavation at the tunnel portal for the base slab of the tower and it was assumed that the foundation at each tunnel portal would be in rock and able to support the tower. The width of each side of the tower was sized to provide enough room for the two slide gates to be mounted side by side at each opening. Gate openings and gate stems for pumping into the reservoir and withdrawing from the reservoir are located on three of the sides of the tower. The guard gate is located on the fourth downstream side of the tower.

The tower would behave like an inverted pendulum during a seismic event and would need to be sized to resist this loading. The axial weight of the tower itself helps to resist the shear load at the base of the tower during the dewatered condition with a full reservoir.

Tower Intake Structure for the 500,000-Acre-Foot Reservoir

The tower intake structure for the 500,000-acre-foot reservoir would be 53 feet taller than the tower for the 350,000-acre-foot reservoir. The walls of the taller tower are thicker and the base slab supporting the tower is much larger and thicker to provide stability during the 10,000-year seismic event with a peak horizontal acceleration of 0.5g. The tower intake structure or intake tower extends from the top of dead storage at elevation 4270 to the top of full pool at elevation 4485. The hoist controls for the regulating and guard gates are located on top of the tower above elevation 4485. It was assumed that a control house would not be required for the hoists. Similar to the 350,000-acre-foot reservoir tower, the tower intake structure was modeled after the two intake towers at New Waddell Dam which are 224 feet high and were designed to resist a 10,000-year seismic event with a magnitude M_L 5.5 at an epicentral distance of 17 km.

The taller tower intake structure would consist of an octagonal-shaped base slab with a four-sided vertical tower that is 215 feet high and supported by wing walls. The octagonal-shaped base slab eliminates the high stress concentrations in the corners of the base slab during a seismic event. A longer access bridge connects the top of the taller tower to the shoreline. During times when the reservoir is low, energy dissipation of the flow being pumped back into the reservoir is being provided by a vertical shaft along the outside of the tower directing the flow to the base slab and wing walls.

The location of the taller tower may have to be adjusted to accommodate the larger base slab, but would still be located at the tunnel portal of each alternative to minimize the length of the access bridge. The access bridge would need to be longer to accommodate the taller tower and sloping hillside. Additional geologic information indicates that the tower will likely be founded on Basalt for each alternative site. For alternatives 1 through 4 the top of rock is approximately 30 feet deep overlain with colluvium and tuff. For alternative 5 the top of rock is less than approximately 10 feet deep. An excavation slope of ¼:1 was assumed in the Basalt and 2:1 in the colluvium and tuff.

The width of each side of the tower was sized to provide enough room for the two slide gates to be mounted side by side at each opening. Gate openings and gate stems for pumping into the reservoir and withdrawing from the reservoir are located on the outside of all four sides of the tower. The guard gate is located on the inside of the downstream side of the tower. It was assumed that the width of the intake tower would be large enough to accommodate the stems and hoists of the guard gate and slide gates for the fourth opening on the downstream side of the tower.

Sloping Intake Structure for the 350,000-Acre-Foot Reservoir

The sloping intake structure consists of a reinforced concrete box-type structure lying on its side along the slope of the reservoir rim. The sloping intake structure extends from full pool elevation 4432 to top of dead storage at elevation 4270. The hoist controls for the regulating and guard gates are located at the top of the sloping intake structure above elevation 4432. It was assumed that a control house would not be required for the hoists. A short conduit section extends from the tunnel portal to the backside of the sloping intake. The sloping intake structure is located as close to the tunnel portal of each alternative as possible to minimize the length of the short conduit section. The flow to and from the sloping intake structure through the short conduit and tunnel represents a change in direction of approximately 170 degrees, which requires a thrust block at the base of the sloping intake structure.

The sloping intake structure is rectangular in shape and is divided up into three sections. The middle section intersects the short conduit section that leads to the tunnel at elevation 4270 and houses the openings for pumping back into the reservoir at elevation 4385. The two sections on either side of the middle section house the openings for reservoir withdrawal at elevations 4327.5 and 4270. The width of each section was sized to provide enough room for the two slide gates to be mounted side by side at each opening.

The thicknesses of the concrete walls of the sloping intake structure were sized to resist shear with the tunnel dewatered and a full reservoir. Shear walls between the sections and the gate openings are required to keep the wall thicknesses from becoming excessive. There are openings in the shear walls so that the water can flow between sections from the openings to the short conduit and tunnel. Common excavation into the side of the hill was assumed to be required to provide a constant slope for the downstream face and thrust block of the sloping intake structure.

A reinforced concrete baffled chute, located on top of the middle section of the sloping intake structure, provides energy dissipation of the water being pumped back into the reservoir. The baffled chute takes advantage of the concrete surface of the sloping intake structure and consists of rows of piers which provide energy dissipation due to impact. Chute walls contain the flow and extend from the pump openings at elevation 4385 to the top of inactive storage at elevation 4285. The top of inactive storage represents the lowest elevation that water would typically be taken out of the reservoir. The chute walls coincide with the shear walls separating the sections of the sloping intake structure.

Because of the relatively flat slopes of the reservoir rim, the length of the sloping intake structure from full pool at elevation 4432 to top of dead storage at elevation 4270 can become very long for the sites considered, on the order of 500 feet or

more. The sloping intake structure for the alternative 5 site has a length of 900 feet. The hoist controls for the regulating and guard gates are located at the top of the sloping intake structure above the full pool at elevation 4432. The concrete surface of the sloping intake structure supports the stems that operate the gates between the hoist controls and their respective gates. For this reason the shape of the sloping intake structure was maintained for its full length between the top of dead storage at elevation 4270 and the full pool at elevation 4432. Being close to the ground the sloping intake structure has an advantage over the tower intake structure in resisting loads from a seismic event.

Shaft Intake Structure for the 350,000-Acre-Foot Reservoir

The shaft intake structure includes a vertical shaft excavated into the reservoir rim from full pool elevation 4432 to top of dead storage at elevation 4270. The hoist controls for the regulating and guard gates are located at the top of vertical shaft above elevation 4432. It was assume that a control house would not be required for the hoists. The vertical shaft consists of three shafts side by side. The first shaft extends down to elevation 4270 and intersects the tunnel that extends from the Long Lake Valley Reservoir to the pumping plant. The middle shaft extends down to elevation 4327.5, the invert of the optional middle intake. The third shaft extends down to elevation 4385, the invert of the upper pumping opening. There are shear walls between the three shafts for stability. All three shafts are connected with openings in the shear walls so that water can flow from the tunnel to each opening. The vertical shaft operates as a wet well.

It is assumed that the vertical shaft is excavated into rock. The exterior of the vertical shaft is lined with a 2-foot thick reinforced concrete wall placed against the excavated rock. A reinforced concrete center wall is provided in the vertical shaft for the gate openings and gates. The thickness of the center wall was sized in shear for a dewatered tunnel with a full reservoir. The thickness of the center wall varies with height. The guard gate is located on the downstream wall of the shaft covering the tunnel opening.

The width of each shaft was sized to provide enough room for the two slide gates to be mounted side by side at each opening. The length of each shaft upstream and downstream of the center wall is determined by matching or exceeding the area of the tunnel and not creating a control point.

Horizontal tunnels extend from the lower and middle openings in the vertical shaft to the reservoir for withdrawal of water. A reinforced concrete fish screen or trashrack structure is provided at the upstream portals to both of these horizontal tunnels. A third horizontal tunnel extends from the upper openings in the vertical shaft to the reservoir for pumping water into the reservoir. A reinforced concrete baffled chute is provided at the portal of this upper third

tunnel for energy dissipation during reservoir filling. The baffled chute extends from the invert of the upper tunnel at elevation 4385 to the top of inactive storage at elevation 4285. The top of inactive storage represents the lowest elevation that water would typically be taken out of the reservoir. The baffled chute consists of rows of piers which dissipate energy in the water by impact and chute walls which contain the flow down the side of the hill and into the reservoir. Common excavation into the side of the hill was assumed to be required to provide a constant slope for the baffled chute.

Because of the relatively flat slopes of the reservoir rim, the length of the horizontal tunnels from the vertical shaft to the reservoir can become very long for the sites considered, on the order of 200 to 300 feet for the horizontal tunnel at elevation 4385 and 500 feet for the horizontal tunnel at elevation 4327.5. The horizontal tunnel length for the alternative 5 site at elevation 4385 is 440 feet long and 950 feet long at elevation 4327.5.

Additional Gate Openings or Ports

For the purposes of this appraisal level study, openings in the intake structures for withdrawing water from Long Lake Valley Reservoir have been located at the top of dead storage at elevation 4270 and at elevation 4327.5. An additional gate opening for withdrawing water was located at elevation 4435 in the intake tower for the 500,000-acre-foot reservoir. Openings for pumping water into the reservoir have been located at elevation 4385 to create artificial head to pump against. Elevation 4327.5 represents the halfway point between the top of dead storage and elevation 4385. Elevation 4435 represents the halfway point between elevation 4385 and the full 500,000-acre-foot reservoir at elevation 4485. Regulating gates have been located at each of these openings and a guard gate has been located within each intake structure at the entrance to the tunnel. Gate stems that extend to the top of the intake structures are used to operate each of these gates.

The top of inactive storage in each reservoir was assumed to be at elevation 4285. This represents approximately 30,000 acre-feet of storage that would not typically be taken out of each reservoir. The top of dead storage in each reservoir will be at elevation 4270 with approximately 6,850 acre-feet of dead storage below elevation 4270. The top of dead storage is considered to be the lowest elevation in a reservoir from which water can be drawn by gravity. For the purposes of this appraisal level study, the lowest opening for withdrawing water, the base of each intake structure, and the invert of the tunnel to the pumping plant have all been located at the top of dead storage at elevation 4270. This means that each reservoir can only be drained by gravity down to elevation 4270.

It is estimated that Long Lake Valley Reservoir may need to be completely drained once every four years. The purpose for completely evacuating the reservoir would be to excavate sediments that have accumulated over several

filling seasons and rid the reservoir of high amounts of nutrients and phosphorus in those sediments. Any sediments coming into the reservoir would be through the pumping operation. The quality of the water and the amount of sediments being pumped into Long Lake Valley Reservoir is unknown. It should also be noted that completely evacuating the reservoir releases all of the water in the reservoir downstream no matter what the quality.

One option for removing the remaining 6,850 acre-feet of dead storage would be by pumping through the intake structure and tunnel. Multiple large pumps would be required to pump this much water out in a reasonable period of time. Five 10,000-gal/min pumps would be able to evacuate the 6,850 acre-feet of dead storage in about 31 days.

Another option would be to lower each intake structure approximately 15 feet and place an opening at or near the bottom of the reservoir at approximately elevation 4255. This would also require lowering the invert of the tunnel to approximately elevation 4255 or lower to be able to drain the reservoir by gravity. Lowering the tower intake structure to elevation 4255 would add 15 feet to the height of the tower and would move the tower further out into the reservoir which would increase the lengths of the access bridge and tunnel by at least 70 to 100 feet, depending on the topography. Extending the sloping intake structure down to elevation 4255 would increase the length of the intake structure and tower by at least 70 to 100 feet, depending on the topography. Lowering the shaft intake structure to elevation 4255 would add 15 feet to the shaft and would increase the length of the three horizontal tunnels by at least 70 to 100 feet, depending on the topography. It is likely that an approach channel would have to be excavated from the low point in the reservoir topography to the intake structure in order to evacuate all of the water from the reservoir.

For the purpose of this appraisal level study it was assumed that reservoir withdrawal would typically occur down to the top of inactive storage at elevation 4285. Energy dissipation of the water being pumped into the reservoir is required during reservoir filling and is currently provided between the gated openings at elevation 4385 down to the top of inactive storage. If the reservoir is to be constantly evacuated and refilled below elevation 4285, energy dissipation would likely have to be extended down to the bottom of the reservoir. This would affect the length of the baffled chute energy dissipater used on the sloping and shaft intake structures more than the vertical shaft used along the outside of the tower intake structure.

The appraisal level study was done assuming openings for reservoir withdrawal at the top of dead storage at elevation 4270, at elevation 4327.5, and at elevation 4435 for the 500,000-acre-foot reservoir. The openings for pumping water into the reservoir were set at elevation 4385. While the openings were sized for pumping water into the reservoir, they could potentially be used to withdraw

water from the reservoir, if desired, which may require the use of fish screens in lieu of trashracks.

Additional ports for withdrawing water from the reservoir at different elevations may be needed and/or desired for water quality issues. Because of the gate stems extending from the slide gates at each opening up to the top of each intake structure, additional ports cannot be added without increasing the width of the concrete surface to make room for the additional gates and stems. The gate stem for one gate cannot cross over another gate. For the tower, additional ports would mean doubling the width of at least two sides of the tower (going from a square section to a rectangular section) to provide two additional ports or doubling the width of all four sides for four additional ports. There is the possibility of adding one additional port on the outside downstream face of the tower for the 350,000-acre-foot reservoir without conflicting with the fixed wheel guard gate on the inside downstream face of the tower. The additional cost of this additional port would only be for the additional gates and fish screens. Another possibility would be to increase the number of sides of the tower. Increasing the number of sides of the tower from four to six would make room for two additional ports. Additional ports on the sloping intake structure would require an additional section for each port and would roughly increase the cost by a third for each additional port. Additional ports on the shaft intake structure would require an additional shaft and horizontal tunnel for each port and would roughly increase the cost by a third for each additional port.

Instead of using gate stems from each gate leaf up to the hoists at the top of each intake structure to operate the slide gates at each opening, the gates could be equipped with submerged hydraulic actuators. Hydraulic fluid lines could be routed from the actuators to the hydraulic power units (HPU) on top of the intake structures. This arrangement would allow gates to be positioned in vertical alignment allowing for more ports without having to increase the width of the structure. There is an increase in risk in operating and maintaining the hydraulically-operated gates due to the potential for the hydraulic oil to leak into the reservoir. Divers would likely be needed to perform any repairs and the gates would have to be designed to be more easily disassembled and assembled underwater by divers. Using food-grade oil does not eliminate risk of a potential oil spill and would require periodic replacement of the fluid. From an operational and maintenance standpoint, using gate stems to operate the slide gates would be the first choice. The hydraulically-operated gates could be made to work, but may require increased maintenance.

At each port there are two gated openings at the same elevation. Another possibility would be to relocate one of the gated openings to a different desired elevation. Thus, water would be drawn from the reservoir at two different elevations for a mix of flow from one port. A smaller and separate fish screen or trashrack would be required at each opening. This is similar to the outlet works intake tower at Jordanelle Dam.

Pros and Cons of Long Lake Valley Intake Tower Structures

Tower Intake Structure

Pros:

1. The shortest distance between the top of dead storage and full pool is a vertical tower.

2. The vertical shaft energy dissipator is part of the tower and takes advantage of the wing walls and base slab.

3. There are several examples of Reclamation designed tower intake structures with multilevel intakes.

Cons:

1. Of the three intake structures examined, the tower is perhaps the most vulnerable to seismic loads.

2. The energy dissipating vertical shaft on the outside of the towers at New Waddell Dam was developed in a model study. A similar model study may be required for the tower at Long Lake Valley.

3. Keeping the fish screens clean will be difficult.

Sloping Intake Structure

Pros:

1. Laying on the ground the sloping intake structure is not as vulnerable to seismic loads as the tower intake structure.

2. The baffled chute energy dissipator is located directly on top of the sloping intake structure.

Cons:

1. The flat slopes of the reservoir rim at the locations examined require the sloping intake structure to be more than 500 feet long (over 900 feet long for alternative 5).

2. The sloping intake structure requires thick walls and supporting inner walls to resist the dewatered loading condition.

3. Keeping the fish screens clean will be difficult.

Shaft Intake Structure

Pros:

1. Most of this intake structure is underground and not as vulnerable to seismic loads.

2. Require vertical shaft excavation in rock

Cons:

1. The flat slopes of the reservoir rim at the locations examined require the horizontal tunnels of the shaft intake structure to be 200 to 500 feet long (950 feet long for alternative 5).

2. A separate structure is required for the baffled chute energy dissipator.

3. The vertical shaft center wall requires thick walls and supporting inner walls to resist the dewatered loading condition.

4. Keeping the fish screens clean will be difficult.

Fish Screens vs Trashracks at LLV Middle and Lower Intake Openings

Pros:

1. Fish screens at the middle and lower intake openings provide a fish barrier for the flows to be returned to Upper Klamath Lake.

2. Increases fish survival since fish in LLV Reservoir will not go back through the turbines.

Cons:

1. The fish screens will be more costly than if trashracks were provided at the middle and lower openings.

2. Fish screens will be harder and more costly to keep clean than trashracks.

3. Fish may still need to be salvaged in LLV (depends on future operation requirements and if access below the dead storage is required)

Items to Be Studied If Proceeding to Feasibility Level Studies for Long Lake Valley Intake Tower Structures

- The 0.64-foot conversion between elevations using the USBR datum at Upper Klamath Lake and elevations using the NAVD88 datum at Long Lake

Valley Reservoir should be verified. A common datum should be used for the entire project.

- It should be determined whether or not a control house is required at the top of each intake structure.

- The frequency event for the seismic loading for designing the intake structure should be determined.

- The amount of sediments being pumped annually into the Long Lake Valley Reservoir should be estimated to determine how often the reservoir needs to be completely emptied for sediment removal.

- The number of openings and elevations of those openings in the intake structure for temperature and water quality withdrawal from the reservoir should be determined and optimized. This includes potentially using the upper pump openings for reservoir withdrawal and locating the two openings at each port at different elevations to mix the flow being withdrawn.

- If additional openings are required, the type of gate control (gate stem or hydraulic actuator) should be determined. The advantage of hydraulic actuators is the additional gates could be stacked without increasing the size of the intake structure.

- It should be determined if energy dissipation of flows pumped into the reservoir is required below the top of inactive storage at elevation 4285.

- The need for fish screens in Long Lake Valley Reservoir and the criteria to design them should be determined. Trashracks at openings cost less than fish screens and would require less cleaning. Trashracks do not provide a fish barrier.

- The need to withdraw water from the reservoir below the top of dead storage by gravity should be determined. This includes alternatives such as using pumps to pump out the dead storage. This affects the size and location of the intake structure and tunnel. It should be noted that completely emptying the reservoir releases the water downstream no matter what the quality.

- The minimum amount of head needed to pump against should be determined.

- The location of the intake structure in relation to the tunnel portal should be determined based on excavation, geology, length of access bridge (if needed) and length of additional conduit.

- The best shape that fits the selected intake structure and the best method to clean the screens should be studied in more detail if proceeding to feasibility.

- Look into the best shape of fish screen that fits the preferred intake configuration.
- Look into more detail how the screens can be cleaned (study may also include looking at traveling type screens.
- Will fish screens be required in lieu of the trashracks at the upper gate openings?
- How will fish be salvaged if access below the dead storage is required?
- A foundation investigation is required to determine the type of foundation required for the different intake structures.

Recommendations for Long Lake Valley Intake Tower Features

1. One of the three intake structures (tower, sloping, or shaft) should be chosen if proceeding to further study for feasibility level design. Cost would likely determine the selection of the intake structure. For purposes of this report, the tower was the least costly.

Structural (Pumping Plants and Powerplants)

Site

The site location for the plants and plant service yards were selected based on original layout proposed by the Klamath Basin Area Office. The arrangement of the plant service yard is based on the intake channel location, space requirements for the plant and switchyard, access into and around the plant, and access into the service bay. The high point of the service yard will provide compatibility with the existing ground elevation and will maintain the yard above the design maximum intake channel water surface elevation. Access to the service yard would be via a new access road. Access roads were not included in the field cost estimates. The service yard and switchyard will be surfaced with gravel surfacing and will also include bituminous pavement with a base course adjacent to the plant structures, yard entrance and service bay entrance. The service yard will be secured with 7-foot chain link fencing with an angled three-strand barbed wire top edge, and two 24-foot double swing gates for vehicle access.

Plant Excavation

Excavation quantities for the plants are based on 2:1 temporary cut slopes. Without specific geological data for each plant site, the excavation quantities include an additional 20 feet of excavation below the plant base slab for foundation improvement.

Plant Description

The same plant layouts have been assumed for each of the alternatives and both reservoirs . The plants are reinforced concrete, indoor type structures with precast concrete double tees roof members. The pumping plants and the pump-turbine plants for each option will have two equally sized units (two 500-ft^3/s units for the 1,000-ft^3/s options and two 1,000-ft^3/s units for the 2,000-ft^3/s options). The pumping and generating plants will have four units (two equally sized pumping units and two equally sized generating units).

The layout of the plants for each option is governed by the number, type, and size of the selected pumps, generators, and pump turbine units and equipment, the relationship between the electrical and mechanical systems, required clearances to maintain a safe work environment for the operation and maintenance personnel, and handling requirements for the various pieces of equipment during initial installation and subsequent maintenance operations. The plants are separated into two distinct areas: the unit bay and the service bay. A 1-inch-wide expansion joint separates these two distinct areas of the structure. The unit bay is that portion of the plant that houses the main pumping units, pump/turbine units, and/or generating units and associated manifold piping, gates, and valves. The service bay contains the majority of the electrical and mechanical equipment that is necessary for the operation and maintenance of the plant. The entrance to the service bay is located at the service yard elevation to allow access and the handling of equipment into and out of the building structure from the service yard elevation. The plant is designed with a lower profile to help mitigate the structural demand for lateral earthquake loads. These loads are anticipated to be significant based on available seismic data.

The elevation of the bottom floor of the pumping plant was established based on the assumed water surface elevations in the intake channel for various flow rates, hydraulic losses that will occur as the water passes through the intake structure and fish screen, and the required pump submergence that is needed to ensure that the pumps operate efficiently.

The length and width of the unit bay is based on the size and arrangement of the pumping units, pump/turbine units, and/or generating units and the required clearances for operation and maintenance of the plant. The length and width of

the service bay is based on the size and arrangement of the auxiliary electrical and mechanical and unit handling requirements between the unit bay and service bay.

Precast concrete double tees were selected for the roof structure based on span and anticipated availability. Handling requirements for the units controlled the building and overhead crane elevations and the selection of the overhead traveling bridge cranes in the unit and service bays for plant equipment maintenance activities. Space was provided in the plant for unit disassembly, auxiliary mechanical, and electrical equipment. An electric-traction type elevator is provided in the service bay to transport personnel and equipment to all floors of the plant. See attachment B, figures B57 through B62 for pumping plant general arrangement details.

Pros and Cons of Structural Features

Pros:

1. Alternative 1 site.—This site provides a relatively large, level space for the large service yard needed for each of the plant options, switchyard, and plant access and storage.

2. Pump-turbine options.—The Pump-Turbine options for each alternative will require the same number of unit bays, similar plant space requirements, and civil/structural quantities as the Pump Only options.

Cons:

1. Alternative 1, 3, and 4.—Due to the depth of the plant, the proximity of the pumping plant to the existing hillside, and the assumed 2:1 excavation temporary cut slopes, the structural excavation quantities will be large and difficult to perform.

2. Alternative 1 and 2.—The proposed site location for the pumping plant service yard will require large quantities of fractured rock site excavation into the existing hillside. The service yard layout is designed to minimize the site and structural excavations. In addition, due to the depth of the plant, the proximity of the pumping plant to the existing hillside, and the assumed 2:1 excavation temporary cut slopes, the structural excavation quantities will be large and difficult to perform.

3. Pumping and generating plant options.—The pumping and generating options for each alternative will require additional space and unit bays and will significantly increase the civil/structural quantities with respect to the Pump Only and Pump-Turbine options.

Items to Be Studied If Proceeding to Feasibility Level Studies for Structural Features

- The site locations for the plants should be studied to minimize the site and structural excavations, requirements for slope stabilization, benches and retaining walls, and dewatering requirements. Geotechnical investigations are required and data should provide the necessary information to determine foundation improvements and dewatering requirements.

- A more detailed slope stability analysis will be required to evaluate the slope at both plant sites and determine the best method to stabilize the slope.

Recommendations for Structural Features

None identified

Power Discussion and Hydraulic Equipment

Power Discussion

Options A and B.—Baseline Pumping Only, 1,000-ft^3/s or 2,000-ft^3/s Pumping Units

Pumps are provided to move excess flows out of Upper Klamath Lake and store it in the Long Lake Valley Reservoir for use when the natural flows are less than required to meet obligations. Excess flow needs to be moved when available so a lot of water is moved in a short period. In good years, the pumps are used for a few months. In dry years the pumps are not used at all. Due to the wide head range possible in LLV it was not possible to have a single pumping unit capable of the entire head range, Also multiple units with ranges to cover the entire operating range would minimize the power costs but would double the pumping plant cost. A pump designed for the high head range of the reservoir can be used at the low head range with a fixed discharge elevation. Power costs to pump to the higher head would be 5 percent higher than multiple head pump sets. The fixed discharge level of elevation 4393 in LLV was used as a cost effective design.

Options C and D.—Pumping and Generating, Multiple Separate Units Option C and D

When using multiple pump sets to match flow or head, a separate generating unit would be used for generating power when water is released back into Upper

Klamath Lake. Multiple pump sets are not a viable option at LLV for several reasons. The pumping requirement of 500 or 1,000 ft^3/s exceeds the standard, pre-engineered pump sizes typically used for multiple pump units. Multiple pump sets are useful when matching a varying flow requirement; the LLV concept allows pumping as much as possible of the excess flows when they occur. The large pumps can run at capacity whenever the flow is available with no requirement for flow matching. The use of an overflow, fixed elevation discharge allows a more reasonable head range without multiple units. Using a custom designed pump and then providing a separate generating unit is substantially more expensive than a single, reversible unit designed for both pumping and generating. The reversible P/T itself is more expensive due to the wicket gates which are needed to control flow during synchronizing and load following. Overall there are substantial costs savings on civil works and controls with a reversible unit. If a single pumping unit was a cost basis 1, then a separate generating unit would add 1½, for a total of 2 ½, while a reversible P/T would be less than 2 and provide all the features of the separate pump unit and generating unit. A 15-MW unit, available for up-regulation 95 percent of the time might earn $250,000 per year in a reserve status with minimal power releases. As water transfer will be a priority, there would be limits on the reserve status. Additional revenue would be available for black-start capability with little capital cost.

Option E and F.—Daily Pump-Storage Option, Reversible Pump/Turbines, 2,000 ft^3/s and 1,000 ft^3/s

The basic premise of a pumped storage system is using off-peak power to pump water to a storage reservoir and during the next day release the pumped water at a time of day when power value is at a peak. The difference in power value between the Heavy Load Hour (HLH) and the Light Load Hour (LLH) is how a pumped-storage system profits. The power market is constantly adjusting to new facilities, weather conditions and outages. A single value of power by which to plan is not realistic. As an example, in the table below are two snapshots of the Western energy market. In February the California/Oregon Border (COB) HLH/LLH ratio was 1.42 to 0.97 while in June during the 2008 run-up in oil prices, it was as much as 5. The June values also are skewed due to the high flows of most Pacific Northwest rivers due to spring runoff and fish flushing.

To be a viable asset, the pump-gen cycle losses have to be low, the operating efficiency of the pump/turbine has to be high, and the energy has to be available rapidly to meet peak capacity demand or correct frequency disruptions. With a dual purpose project such as LLV, the pumping requirement may impact the attractiveness of the pump-generation. Pumping occurs only 7 percent (2,000 ft^3/s) or 14 percent (1,000 ft^3/s) of the time but when the excess flows occur, the pumping must be available. Releases would not be a problem and generation would occur into the high load periods at high value.

Western electricity prices		
Mid-week: June 2 - 4, 2008		
	Hub peak (heavy) HLH $/MWh	Off-peak (light) LLH $/MWh
Mid-Columbia	5 - 28	-5.00 - 3
COB	60 - 83.50	16 - 32
N P15	81.50 - 96	37.70 - 53.50
S P15	80.75 - 97	37.75 - 54
Palo Verde	82.50 - 96.25	41.75 - 52
Mid-week: February 23-27, 2009		
	Hub peak (heavy) $/MWh	Off-peak (light) $/MWh
Mid-Columbia	31 - 37	26 - 32
COB	31 - 37	26 - 32
N P15	32 - 36	22 - 31
S P15	29 - 35	20 - 27
Palo Verde	26 - 30	20 - 24

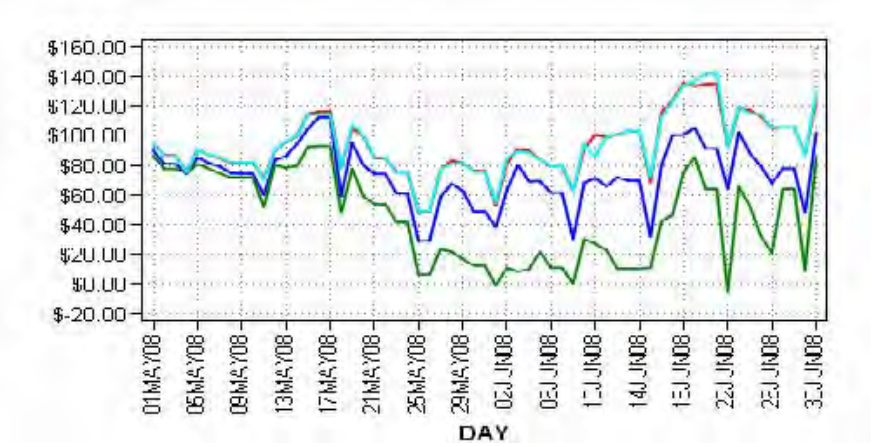
Power Values

As the market is highly volatile there is not an easily accessed value to use when assessing the Alternatives, however the Western Price Survey (WPS) published by Energy News Data does provide the range of actual power prices on a weekly basis at the various trading hubs. Using the range of weekly WPS values reported and averaging 4 months of power prices, provides a guide to power pricing. The peak power averaged between $31 and $80/MW-hr with an overall weighted average about $50/MW-hr. Within these averages absolute highs and lows ranged from over $150/MW-hr to under $20/MW-hr for peak power. The duration of power prices at the highest prices reflect regional shortages resulting in spiked prices. For the analysis of LLV, using the averages is a reasonable approach. On the light load side, power prices average $26 to 70/MW-hr with a weighted average of around $38/MW-hr. The duration of light load is much less than the broad peak and that is reflected in the average light load being on the high end of the range. Peak load price of $80/MW-hr will be used for power sales.

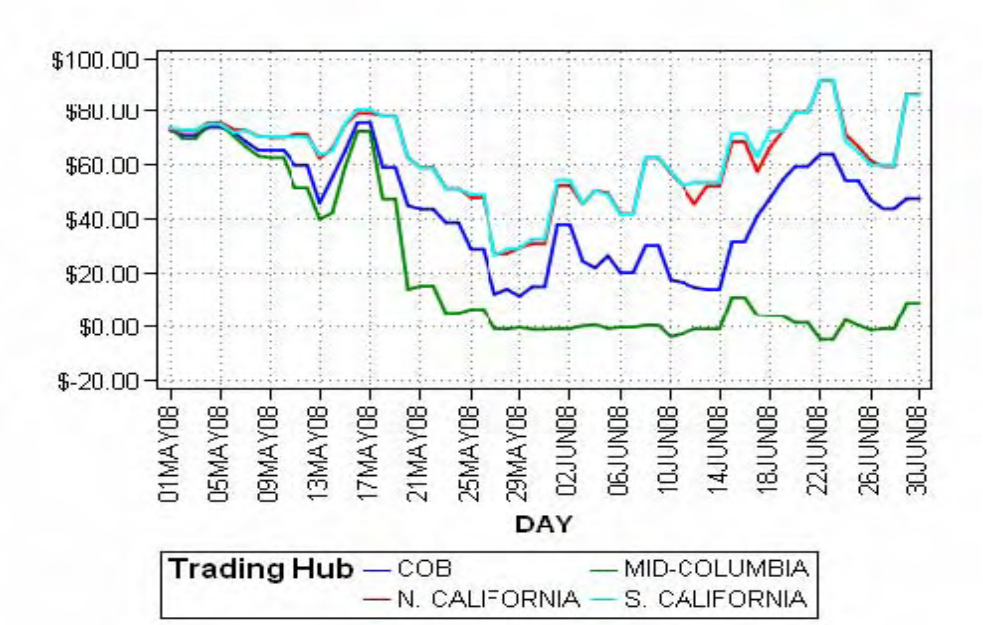
The following chart is a typical system load curve. Off-peak, $40/MW-hr, would occur from 00 to 08 hours, and peak, $80/MW-hr, would occur from 17 to 22 hours.



The charts below show the fluctuation of on-peak and off-peak energy prices for May-June 2008.



On-peak energy prices, $/MW-hr



Off-peak energy prices, $/MW-hr

Pumping Power

Pumping power may be available at the preference power rate which is higher than project use power but substantially less than market rates. Bonneville Power Administration (BPA) preference energy rate for public power is around $30/MW-hr with additional transmission/wheeling costs bring the effective rate to $45/MW-hr. Preference power at $45/MW-hr is the assumed power rate for water transfer pumping and by extension may be available for pumped-storage pumping. Power studies for the pumped-storage options used the preference power rate which is very optimistic. Even with preference power the power operation studies did not indicate a viable pumped-storage project.

Private Entity Involvement

Alternative 1 has the best configuration of the five alternatives in regards to power operations because it has the shortest tunnel and lowest head losses. Several inherent difficulties are observed with Alternative 1. For a viable pumped-storage system the cycle efficiency has to be high as well as a large differential between off-peak pumping energy prices and on-peak generating energy prices. While the use of public preferential power for pumping is attractive, a private entity would not be given the preferential rate. The market rates of $40/MW-hr off-peak and $65/MW-hr peak are not a large enough differential to support pumped-storage. Typically very low cost power from constant load coal or nuclear will provide the low off-hour pricing to justify pumped-storage. The COB market does not have an inherent low cost base load. The Mid-Columbia hub is low-cost seasonally but it is not very suitable for daily cycling. Preference power at $45/MW-hr is the assumed power rate for water

transfer pumping and by extension may be available for pumped-storage pumping. Power studies for the pumped-storage options used the preference power rate which is very optimistic. Even with preference power the power operation studies did not indicate a viable pumped-storage project. Head losses amount to 5.5 percent of the potential energy when generating and add 5.5 percent to pumping costs for Alternative 1. A total of 11 percent cycle losses due to head loss is not very attractive. Purpose built pumped-storage can achieve 4 percent head losses. Overall unit efficiency is low due to the wide head range of the facility. Due to the hydraulic design constraints of pump-turbines, cost-effective pumped-storage operates within a narrow head range, typically less than 10 percent of the total head. A narrow head range with high head can satisfy the trade-offs between pump features and turbine features. At lower head and wider head range, efficiency and operational stability are compromised. As a power facility utilizing return flows for power, the releases are sporadic and not of sustained duration to attract investment. Ancillary services can be a source of revenues. These services include the providing of on-demand up-capacity, down-capacity, spinning reserve and nonspinning reserve. The current market for ancillary services relies on a day before bidding. Power providers bid and the grid controller accepts the lowest bids for the quantity of services expected. Power providers will daily look at their release requirements, storage and the value of peak energy to determine how their next day generation could best be utilized. Some power providers with high costs and restricted operations might never have a bid accepted if sufficient capacity exists at lower bid prices. For a typical hydro project, the value of services can not support the entire capital investment but would provide additional revenue. Pure pumped storage is designed entirely to make a profit from the differential daily power values and ability to provide reserve power. A pure pumped-storage facility would be more flexible and more productive in most categories of ancillary services and therefore would be more likely to operate daily. A private entity investing in LLV would want a guarantee of operations and a firm market value for those operations. In the foreseeable future there is a substantial risk that the services provided would be not be economically marketable as better, pure, flexible hydro comes on-line. Private investors are attracted to guaranteed returns or the capturing of a long term string of dependable revenues in return for up front capital. The LLV plan of operation has a plant factor of about 7 percent for power releases. This low plant factor is inadequate to provide sufficient revenues to cover the capital costs. A low plant factor does allow an opportunity for pumped-storage in those times when diversion flows are not needed. However the system configuration of the power/pumping units means the discharge/penstock is long, with considerable friction losses. A surge tank is necessary but the optimum position for system/power regulation is not suitable from a structural stability aspect. A private entity would not find LLV attractive as the basic energy released is low and the opportunity for ancillary services is also low.

General Description—350,000-Acre-Foot Reservoir

The hydraulic equipment for each option applies to each alternative, with minor differences. A detailed description of each option for alternative 1 is listed below. The differences for each of the alternatives follow.

Alternative 1, Option A: 1-Pump 1,000 ft^3/s

1,000 ft^3/s of pumping only is accomplished with two 500-ft^3/s, (19,000-hp, 14,000-kW) vertical, mixed flow, spiral case custom pumps. Pumps have an operating head range of 250 to 300 feet. Pumping capacity (1,000 ft^3/s) sized to take advantage of most of the larger, historical excess flows by operating continuously when excess flows are available from UKL. At other times when the excess flows are not so large the facility can run with just one pump (500 ft^3/s) and reduce losses. Average annual pumping costs at the preference public power rate of $45/MW-hr would be $765,000 (17,000 MW-hr).

Alternative 1, Option B: 1-Pump 2,000 ft^3/s

2,000 ft^3/s of pumping only is accomplished with two 1,000-ft^3/s (38,000-hp, 28,000-kW) vertical, mixed flow, spiral case custom pumps. Pumps have an operating head range of 250 to 300 feet. Pumping capacity (2,000 ft^3/s) is sized to take advantage of most of the larger, historical excess flows by operating 50 percent of the time when excess flows are available from UKL. A few more opportunities to transfer water are available with the larger capacity pumps. The pumps can catch short, high flow bursts with 2,000 ft^3/s of capacity. At other times when the excess flows are not so large the facility can run with just one pump (1,000 ft^3/s) and reduce losses. About 10 percent more volume of water is pumped with Option B, the average annual pumping costs at the preference public power rate of $45/MW-hr would be $840,000.

Alternative 1, Option C: 1-P&G 1,000 ft^3/s

1,000 ft^3/s of pumping and 1,000 ft^3/s of generating is accomplished with two 500-ft^3/s (19,000-hp, 14,000-kW) vertical, mixed flow, spiral case custom pumps and a set of two 500 ft^3/s vertical, Francis turbines. Pumps are the same as Option A and have an operating head range of 250 to 300 feet. Pumping capacity (1,000 ft^3/s) is sized to take advantage of most of the larger, historical, excess flows by operating continuously when excess flows are available from UKL. At other times when the excess flows are not so large the facility can run with just one pump (500 ft^3/s) and reduce losses. Average annual pumping costs at the preference public power rate of $45/MW-hr would be $765,000. The two generating units would be utilized to release water from LLV back into UKL when stored water was needed. Generating units are sized to be similar to the pump footprint making the bays similar. The generating units are rated 7 MW each at 235 feet head which corresponds to reservoir elevation 4365. The generating units would nominally operate over a head range from full reservoir down to minimum power pool. Minimum power pool will not coincide with the absolute minimum pool as the head range is too large for Francis turbines and would operate poorly at the very lowest heads. Units would be provided with

black start, condensing and spinning reserve capability. Response to system load changes would not be great as the surge tank is not optimally sited for response but rather to fit the terrain. The response with one unit would be better as the flow velocity and head loss would be less. Assuming releases could be made at HLH (peak) energy times with an average value of $80/MW-hr, average annual power revenues would be $810,000 from generating 10,000 MW-hr. Operating and maintenance costs for the four units are estimated to be $5,000/MW and would be $300,000 per year. Power sales and pumping costs including O&M but not capital repayment would just break-even.

Alternative 1, Option D: 1-P&G 2,000 ft^3/s

2,000 ft^3/s of pumping and 2,000 ft^3/s of generating is accomplished with two 1,000-ft^3/s (38,000-hp, 28,000-kW) vertical, mixed flow, spiral case custom pumps and a set of two 1,000-ft^3/s vertical, Francis turbines. Pumps are the same as Option B and have an operating head range of 250 to 300 feet. Pumping capacity (2,000 ft^3/s) is sized to take advantage of most of the larger, historical excess flows by operating 50 percent of the time when excess flows are available from UKL. A few more opportunities to transfer water are available with the larger capacity pumps. The pumps can catch short, high flow bursts with 2,000 ft^3/s of capacity. At other times when the excess flows are not so large the facility can run with just one pump (1,000 ft^3/s) and reduce losses. Average annual pumping costs at the preference public power rate of $45/MW-hr would be $765,000.

The two generating units would be utilized to release water from LLV back into UKL when the stored water could be used as supplemental. Generating units are sized to be similar to the pump footprint making the bays similar. The generating units are rated 14 MW each at 235 feet head which corresponds to LLV Reservoir at elevation 4365. The generating units would nominally operate over a head range from full reservoir down to minimum power pool. Minimum power pool will not coincide with the absolute minimum pool as the head range is too large for Francis turbines and would operate poorly at the very lowest heads. Assuming releases could be made at HLH (peak) energy times with an average value of $80/MW-hr, average annual power revenues would $810,000 from generating 10,000 MW-hr. Operating and maintenance costs for the four units are estimated to be $5,000/MW and would be $600,000 per year. Due to the higher O&M for the larger units with the same net energy, this option does not repay the pumping costs.

Alternative 1, Option E: 1-P/T 2,000 ft^3/s

2,000 ft^3/s of pumping and 2,000 ft^3/s of generating is accomplished with two 1,000-ft^3/s (38,000-hp, 28,000-kW) vertical, custom, reversible pump/turbines. Pump operation is the same as Option B and the P/T's have an operating head range of 250 to 300 feet when operating in the pump mode. Pumping capacity (2,000 ft^3/s) is sized to take advantage of most of the larger, historical excess flows by operating 50 percent of the time when excess flows are available from UKL. A few more opportunities to transfer water are available with the larger

capacity pumps. The pumps can catch short, high flow bursts with 2,000 ft^3/s of capacity. At other times when the excess flows are not so large the facility can run with just one unit in pump mode (1,000 ft^3/s) and reduce losses. Average annual pumping costs at the preference public power rate of $45/MW-hr would be $765,000. The generating mode of the reversible P/T units would be utilized to release water from LLV back into UKL when the stored water could be used as supplemental. The generating mode is rated 14 MW each at 235 feet head which corresponds to LLV Reservoir at elevation 4365. The generating units would nominally operate over a head range from full reservoir down to minimum power pool. Minimum power pool will not coincide with the absolute minimum pool as the head range is too large for Francis Pump/Turbines and would operate poorly at the very lowest heads. The minimum operating head of the P/T's would not be as low as the turbines of Option D.

Assuming releases could be made at HLH (peak) energy times with an average value of $80/MW-hr, average annual power revenues would be $810,000 for meeting water releases. Operating the P/Ts during off-times when pumping into LLV is not required, opens up benefits of pumped-storage operation. If pump power is available in unlimited amounts for pumped-storage pumping and releases are made into the peak on a daily basis, then the cycle power value differential of $45/MW-hr pumping and $80/MW-hr peak power would barely provide a breakeven with daily net revenues of $400 (60-percent cycle efficiency). Assuming operating an average of 200 days a year would provide another $80,000 of yearly P/T revenues. Including O&M costs of $7,500/MW brings the total net revenue loss of this option to $165,000 per year without capital repayment. Revenues would be substantially less if preference power would not be available for pumped-storage pumping.

Alternative 1, Option F : 1-P/T 1,000 ft^3/s

1,000 ft^3/s of pumping and 1,000 ft^3/s of generating is accomplished with two 500-ft^3/s (19,000-hp, 14,000-kW) vertical, custom, reversible pump/turbines. Pump operation is the same as Option A and the P/T's have an operating head range of 250 to 300 feet when operating in the pump mode. Pump capacity (1,000 ft^3/s) is sized to take advantage of most of the historical excess flows by operating continuously when excess flows are available from UKL. At other times when the excess flows are not so large the facility can run with just one unit in pump mode (500 ft^3/s) and reduce losses. Average annual pumping costs at the preference public power rate of $45/MW-hr would be $765,000. The generating mode of the reversible P/T units would be utilized to release water from LLV back into UKL when the stored water could be used as supplemental. The generating mode is rated 7 MW each at 235 feet head which corresponds to LLV Reservoir at elevation 4365. The generating units would nominally operate over a head range from full reservoir down to minimum power pool. Minimum power pool will not coincide with the absolute minimum pool as the head range is too large for Francis Pump/Turbines and would operate poorly at the very lowest heads. The minimum operating head of the P/T's would not be as low as the turbines of Option C. Assuming releases could be made at HLH (peak) energy

times with an average value of $80/MW-hr, average annual power revenues would be $810,000 for meeting water releases. Operating the P/Ts during off-times when pumping into LLV is not required, opens up benefits of pumped-storage operation. If pump power is available in unlimited amounts for pumped-storage pumping and releases are made into the peak on a daily basis, then the cycle power value differential of $45/MW-hr pumping and $80/MW-hr peak power would barely provide a breakeven with daily net revenues of $200 (60-percent cycle efficiency). Assuming operation an average of 200 days a year would provide another $40,000 of yearly P/T revenues. Including O&M costs of $7,500/MW the total net loss is $20,000 per year without capital repayment. Revenues would be substantially less if preference power would not be available for pumped-storage pumping.

Alternative 2.—Howard Bay Pumping Plant, Long Tunnel

The positioning of the plant results in a very long delivery tunnel. Head losses are higher than the Wocus Marsh configuration and results in higher pumping costs to $855,000 per year.

The higher losses also reduces power revenues to $702,000.

The cycle losses for the Pump/Turbine are much worse than the Wocus Marsh location and are not viable.

Surge tank for power or air chamber for pumping will be necessary for operation and will be very large and unresponsive due to the long waterway and distance of the surge tank to the plant.

Alternative 3.—Canal across Wocus Marsh

The positioning of the plant at UKL increases head losses in comparison to the alternative 1.

Air tank for pumping plant will be larger than the Alternative 1; siting of a surge tank for power would be difficult to achieve good response for power operations with the longer penstock.

Alternative 4.—Shorter Canal with a Longer Tunnel than Alternative 1

Longer tunnel marginally increase head losses, very similar pump costs and power revenues as Alternative 1.

Alternative 5.—Long Tunnel/Pipeline with Plant Sited at Fremont Bridge

Air tank/surge tank would be the largest of all the alternatives with many transient issues due to the waterway profile and need for good regulation with power.

Head losses would be highest with corresponding higher pumping energy required and reduced power revenues.

General Description—500,000-Acre-Foot Reservoir

The hydraulic equipment for each option applies to each alternative, with minor differences. A detailed description of each option for alternative 1 is listed below. The differences for each of the alternatives follow.

Alternative 1, Option A.—1-Pump 1,000 ft^3/s

1,000 ft^3/s of pumping only is accomplished with two 500-ft^3/s, (19,000-hp, 14,000-kW) vertical, mixed flow, spiral case custom pumps. Pumps have an operating head range of 260 to 353 feet. Pumping capacity (1,000 ft^3/s) sized to take advantage of most of the larger, historical excess flows by operating continuously when excess flows are available from UKL. At other times when the excess flows are not so large the facility can run with just one pump (500 ft^3/s) and reduce losses. Average annual pumping costs at the preference public power rate of $45/MW-hr would be $1.1 million (25,000 MW-hr).

Alternative 1, Option B.—1-Pump 2,000 ft^3/s

2,000 ft^3/s of pumping only is accomplished with two 1,000-ft^3/s (38,000-hp, 28,000-kW) vertical, mixed flow, spiral case custom pumps. Pumps have an operating head range of 260 to 353 feet. Pumping capacity (2,000 ft^3/s) is sized to take advantage of most of the larger, historical excess flows by operating 50 percent of the time when excess flows are available from UKL. A few more opportunities to transfer water are available with the larger capacity pumps. The pumps can catch short, high flow bursts with 2,000 ft^3/s of capacity. At other times when the excess flows are not so large the facility can run with just one pump (1,000 ft^3/s) and reduce losses. About 10 percent more volume of water is pumped with Option B, the average annual pumping costs at the preference public power rate of $45/MW-hr would be $1.3 million. (28,000 MW-hr)

Alternative 1, Option C.—1-P&G 1,000 ft^3/s

1,000 ft^3/s of pumping and 1,000 ft^3/s of generating is accomplished with two 500-ft^3/s (19,000-hp, 14,000-kW) vertical, mixed flow, spiral case custom pumps and a set of two 500 ft^3/s vertical, Francis turbines. Pumps are the same as Option A and have an operating head range of 260 to 353 feet. Pumping capacity (1,000 ft^3/s) is sized to take advantage of most of the larger, historical, excess flows by operating continuously when excess flows are available from UKL. At other times when the excess flows are not so large the facility can run with just one pump (500 ft^3/s) and reduce losses. Average annual pumping costs at the preference public power rate of $45/MW-hr would be $1.1 million. The two generating units would be utilized to release water from LLV back into UKL when stored water was needed. Generating units are sized to be similar to the pump footprint making the bays similar. The generating units are rated 7 MW each at 235 feet head which corresponds to reservoir elevation 4365. The generating units would nominally operate over a head range from full reservoir down to minimum power pool. Minimum power pool will not coincide with the absolute minimum pool as the head range is too large for Francis turbines and would operate poorly at the very lowest heads. Units would be provided with

black start, condensing and spinning reserve capability. Response to system load changes would not be great as the surge tank is not optimally sited for response but rather to fit the terrain. The response with one unit would be better as the flow velocity and head loss would be less. Assuming releases could be made at HLH (peak) energy times with an average value of $80/MW-hr, average annual power revenues would be $900,000 from generating 11,000 MW-hr. Operating and maintenance costs for the four units are estimated to be $5,000/MW and would be $300,000 per year. Power sales and pumping costs including O&M but not capital repayment would almost break-even.

Alternative 1, Option D.—1-P&G 2,000 ft^3/s

2,000 ft^3/s of pumping and 2,000 ft^3/s of generating is accomplished with two 1,000-ft^3/s (38,000-hp, 28,000-kW) vertical, mixed flow, spiral case custom pumps and a set of two 1,000-ft^3/s vertical, Francis turbines. Pumps are the same as Option B and have an operating head range of 260 to 353 feet. Pumping capacity (2,000 ft^3/s) is sized to take advantage of most of the larger, historical excess flows by operating 50 percent of the time when excess flows are available from UKL. A few more opportunities to transfer water are available with the larger capacity pumps. The pumps can catch short, high flow bursts with 2,000 ft^3/s of capacity. At other times when the excess flows are not so large the facility can run with just one pump (1,000 ft^3/s) and reduce losses. Average annual pumping costs at the preference public power rate of $45/MW-hr would be $1.3 million.

The two generating units would be utilized to release water from LLV back into UKL when the stored water could be used as supplemental. Generating units are sized to be similar to the pump footprint making the bays similar. The generating units are rated 14 MW each at 235 feet head which corresponds to LLV Reservoir at elevation 4365. The generating units would nominally operate over a head range from full reservoir down to minimum power pool. Minimum power pool will not coincide with the absolute minimum pool as the head range is too large for Francis turbines and would operate poorly at the very lowest heads. Assuming releases could be made at HLH (peak) energy times with an average value of $80/MW-hr, average annual power revenues would $900,000 from generating 11,000 MW-hr. Operating and maintenance costs for the four units are estimated to be $5,000/MW and would be $600,000 per year. Due to the higher O&M for the larger units with the same net energy, this option does not repay the pumping costs.

Alternative 1, Option E.—1-P/T 2,000 ft^3/s

2,000 ft^3/s of pumping and 2,000 ft^3/s of generating is accomplished with two 1,000-ft^3/s (38,000-hp, 28,000-kW) vertical, custom, reversible pump/turbines. Pump operation is the same as Option B and the P/T's have an operating head range of 260 to 353 feet when operating in the pump mode. Pumping capacity (2,000 ft^3/s) is sized to take advantage of most of the larger, historical excess flows by operating 50 percent of the time when excess flows are available from UKL. A few more opportunities to transfer water are available with the larger

capacity pumps. The pumps can catch short, high flow bursts with 2,000 ft^3/s of capacity. At other times when the excess flows are not so large the facility can run with just one unit in pump mode (1,000 ft^3/s) and reduce losses. Average annual pumping costs at the preference public power rate of $45/MW-hr would be $1.3 million. The generating mode of the reversible P/T units would be utilized to release water from LLV back into UKL when the stored water could be used as supplemental. The generating mode is rated 14 MW each at 235 feet head which corresponds to LLV Reservoir at elevation 4365. The generating units would nominally operate over a head range from full reservoir down to minimum power pool. Minimum power pool will not coincide with the absolute minimum pool as the head range is too large for Francis Pump/Turbines and would operate poorly at the very lowest heads. The minimum operating head of the P/T's would not be as low as the turbines of Option D.

Assuming releases could be made at HLH (peak) energy times with an average value of $80/MW-hr, average annual power revenues would be $900,000 for meeting water releases. Operating the P/Ts during off-times when pumping into LLV is not required, opens up benefits of pumped-storage operation. If pump power is available in unlimited amounts for pumped-storage pumping and releases are made into the peak on a daily basis, then the cycle power value differential of $45/MW-hr pumping and $80/MW-hr peak power would barely provide a breakeven with daily net revenues of $400 (60-percent cycle efficiency). Assuming operating an average of 200 days a year would provide another $80,000 of yearly P/T revenues. Including O&M costs of $7,500/MW brings the total net revenue loss of this option to $530,000 per year without capital repayment. Revenues would be substantially less if preference power would not be available for pumped-storage pumping.

Alternative 1, Option F .—1-P/T 1,000 ft^3/s

1,000 ft^3/s of pumping and 1,000 ft^3/s of generating is accomplished with two 500-ft^3/s (19,000-hp, 14,000-kW) vertical, custom, reversible pump/turbines. Pump operation is the same as Option A and the P/T's have an operating head range of 250 to 300 feet when operating in the pump mode. Pump capacity (1,000 ft^3/s) is sized to take advantage of most of the historical excess flows by operating continuously when excess flows are available from UKL. At other times when the excess flows are not so large the facility can run with just one unit in pump mode (500 ft^3/s) and reduce losses. Average annual pumping costs at the preference public power rate of $45/MW-hr would be $1.1 million. The generating mode of the reversible P/T units would be utilized to release water from LLV back into UKL when the stored water could be used as supplemental. The generating mode is rated 7 MW each at 235 feet head which corresponds to LLV Reservoir at elevation 4365. The generating units would nominally operate over a head range from full reservoir down to minimum power pool. Minimum power pool will not coincide with the absolute minimum pool as the head range is too large for Francis Pump/Turbines and would operate poorly at the very lowest heads. The minimum operating head of the P/T's would not be as low as the turbines of Option C. Assuming releases could be made at HLH (peak) energy

times with an average value of $80/MW-hr, average annual power revenues would be $900,000 for meeting water releases. Operating the P/Ts during off-times when pumping into LLV is not required, opens up benefits of pumped-storage operation. If pump power is available in unlimited amounts for pumped-storage pumping and releases are made into the peak on a daily basis, then the cycle power value differential of $45/MW-hr pumping and $80/MW-hr peak power would barely provide a breakeven with daily net revenues of $200 (60-percent cycle efficiency). Assuming operation an average of 200 days a year would provide another $40,000 of yearly P/T revenues. Including O&M costs of $7,500/MW the total net loss is $305,000 per year without capital repayment. Revenues would be substantially less if preference power would not be available for pumped-storage pumping.

Alternative 2.—Howard Bay Pumping Plant, Long Tunnel

The positioning of the plant results in a very long delivery tunnel. Head losses are higher than the Wocus Marsh configuration and results in higher pumping costs to $1.2 million per year.

The higher losses also reduces power revenues to $840,000.

The cycle losses for the Pump/Turbine are much worse than the Wocus Marsh location and are not viable.

Surge tank for power or air chamber for pumping will be necessary for operation and will be very large and unresponsive due to the long waterway and distance of the surge tank to the plant.

Alternative 3.—Canal across Wocus Marsh

The positioning of the plant at UKL increases head losses in comparison to the alternative 1.

Air tank for pumping plant will be larger than the Alternative 1; sitting of a surge tank for power would be difficult to achieve good response for power operations with the longer penstock.

Alternative 4.—Shorter Canal with a Longer Tunnel than Alternative 1

Longer tunnel marginally increase head losses, very similar pump costs and power revenues as Alternative 1.

Alternative 5.—Long Tunnel/Pipeline with Plant Sited at Fremont Bridge

Air tank/surge tank would be the largest of all the Alternatives with many transient issues due to the waterway profile and need for good regulation with power.

Head losses would be highest with corresponding higher pumping energy required and reduced power revenues.

Pros and Cons for Hydraulic Equipment Features (350,000- and 500,000-Acre-Foot Reservoirs)

Option A

Pros:

1. Lowest capital cost of pumping equipment
2. Smallest footprint

Cons:

1. Pumping at full capacity to maximize water transfer has some outage risk and therefore might not transfer all available water.
2. Small (500-ft^3/s), custom design pump units have few manufacturers.

Option B

Pros:

1. Can capture bursts of high flow with the higher capacity pumps.
2. Custom pump of 1,000 ft^3/s may be more competitive.
3. Two large pumps have more redundancy with the historically available excess flows.

Cons:

1. Larger canal and tunnel necessary for the larger capacity increasing capital costs.
2. Larger spiral case makes footprint wider.
3. Higher inrush current necessary for pump starts of 1,000 ft^3/s .

Option C

Pros:

1. System responsiveness should be good with one unit (7-MW) operating, full ancillary features.

Cons:

1. Pumping at full capacity to maximize water transfer has some outage risk and therefore might not transfer all available water.

2. Small (500 ft^3/s), custom design pump units have few manufacturers.

3. Small (500 ft^3/s), custom design generating units have few manufacturers.

4. Utilizing a pre-engineered turbine design would require civil works to be adapted to the turbine design after contract award.

5. Manifold and footprint is large.

6. Surge tank is sited in the ridge line and while adequate for pressure surge control is not adequate for a quick response hydro unit.

Option D

Pros:

1.With larger generating unit there will be some ancillary benefits from generating into the HLH peak with higher capacity and catching higher spot market capacity value, good one unit 14-MW response, full ancillary features.

Cons:

1. Pumping at full capacity to maximize water transfer has some outage risk and therefore might not transfer all available water

2. Custom design pump units have few manufacturers.

3. Custom design generating units have few manufacturers.

4. Utilizing a pre-engineered turbine design would require civil works to be adapted to the turbine design after contract award.

5. Manifold and footprint is large.

6. Generating revenues are essentially the same. With higher O&M costs based on capacity.

7. Surge tank is sited in the ridge line and while adequate for pressure surge control is not adequate for a quick response hydro unit.

Option E

Pros:

1. With larger generating unit there will be some ancillary benefits from generating into the HLH peak with higher capacity and catching higher spot market capacity value.

2. Good one unit 14-MW response, full ancillary features.

3. Reversible P/T has minimal footprint.

4. Power revenues would balance pumping costs not including O&M and repayment.

Cons:

1. 1,000-ft^3/s P/T is small and head is low for typical P/T units and will increase unit cost. Head range is wide for a reversible unit and will not be of the highest efficiency or smoothest operation in the extremes.

2. Surge tank is sited in the ridge line and while adequate for pressure surge control is not adequate for a quick response hydro unit when two units 28 MW, operating.

Option F

Pros:

1. Capital costs are lower.

2. Good one unit 7-MW response, full ancillary features.

3. Reversible P/T has minimal footprint.

4. Power revenues would pay back pumping costs but not O&M costs or capital repayment.

Cons:

1. 500-ft^3/s P/T is very small and head is low for typical P/T units and will increase unit cost. Head range is wide for a reversible unit and will not be of the highest efficiency or smoothest operation in the extremes.

2. Surge tank is sited in the ridge line and while adequate for pressure surge control is not adequate for a quick response hydro unit when two units 14 MW, operating.

3. Net revenues of a $20,000 loss per year would not pay back any of the project.

Items to Be Studied If Proceeding to Feasibility Level Studies for Hydraulic Equipment Features

- Discussions should be held with equipment vendors to optimize sizes, settings and costs of the hydraulic equipment

- Transients and system response

- The surge tank and air tank locations

Recommendations for Hydraulic Equipment Features

1. Power generating and pump/turbine are not viable

Mechanical Equipment

For each alternative (1 through 5), trashracks are provided at the plant's pump intakes. Trashracks were not provided at the separate turbine outlets for the pump and generator (P-G) options. Trashracks will be designed to handle the reverse flow for the pump-turbine (P/T) options.

For each alternative (1 through 5), stoplog guides will be provided for each unit bay at the plant (i.e., two bays for the Pump Only and P/T options and 4 bays for the P-G options). One set of stoplogs will be provided to allow isolation and maintenance of one unit at a time.

A 125-ton capacity overhead traveling bridge crane was selected for handling the units in the 1,000-ft^3/s capacity plants for alternatives 1 through 5. A 300-ton capacity overhead traveling bridge crane was selected for handling the units in the 2,000-ft^3/s capacity plants for alternatives 1 through 5. The overhead traveling crane will also be used for plant equipment maintenance activities.

A 3,500-pound capacity elevator of the electric traction type will be provided to transport personnel and equipment between floors of the plant for all alternatives.

The auxiliary mechanical systems in the plant will consist of fire suppression, unit cooling water, lubricating oil system, compressed air, service water, plant unwatering, gravity drainage, domestic water, sanitary waste plumbing and heating, ventilating, and air-conditioning for all alternatives.

The fire suppression system will consist of portable and wheel-mounted fire extinguishers, fire hose reels, and a wet pipe sprinkler system to extinguish fires in flammable materials and equipment in the interior of the plant. A fire department connection and a fire hydrant will be provided on the exterior of the plant. An automatic clean agent gas, life sustaining, fire extinguishing system will be provided for the control room. In order to provide fire suppression water of adequate pressure and capacity, a fire pump supplied with a water supply from both the discharge and suction side of the plant will be installed.

The unit cooling water system will provide cooling water for the air cooler heat exchangers for the units. The water supply for the unit cooling water system will come from the plant's suction raw water supply through the automatic, motor-operated, self-cleaning strainers which strain the water for large particles. Each unit will be supplied with cooling water from its own dedicated cooling water pump for automatically furnishing the proper amount of cooling water for the pumping unit components.

The compressed air system in the plant will provide air to the service air outlets located throughout the building for use by pneumatic tools and associated plant maintenance activities. It will also provide makeup air to the domestic water hydropneumatic tank and operational air for air-operated valves in the plant piping systems.

The plant unwatering system will consist of two high capacity, vertical turbine-type sump pumping units to empty the plant sump of water from the plant drainage system and from the unwatering of the units suction and discharge lines. The sump water will be removed from the plant by use of exposed and embedded piping. The sump pumping unit motors and discharge heads will be located above the sump, so that in the event the sump would become flooded with water, the sump pumping units will continue to operate. To completely empty the sump of all water that cannot be pumped out with the high capacity sump pumping units, a low-capacity drainage pumping unit will be provided. A waste oil collection skimmer will be provided in the plant sump to prevent environmental contamination when the sump water is discharged to the plant exterior.

Service water from the pumping plant raw water supply will be available from the service water hose outlets for maintenance purposes and to supply water to other plant systems such as the heating and ventilating system. The service water will be distributed throughout the pumping plant by use of the service water pumping unit which boosts the service water pressure in the hydropneumatic tank.

The gravity drainage system will consist of floor drains around the perimeter of the plant interior and in floor areas where the leakage of water can be expected. Sloped cast iron hub and spigot soil pipe will collect water from the floor drains and will convey the water by gravity to the plant sump. Floor drains from the restrooms will discharge into the sanitary waste system.

Domestic and sanitary waste plumbing systems will be provided for the men's and women's restrooms in accordance with the International Plumbing Code and state and local regulations. The sanitary waste sewage ejector system will collect and discharge liquid and solid sewage from the plant plumbing and sanitary waste system into the plant exterior wastewater treatment and disposal system.

The heating, ventilating, and air conditioning (HVAC) system will maintain space temperatures within the plant at acceptable limits for personnel and equipment.

The HVAC system will consist of standard commercially available equipment that plant personnel will easily maintain. Various exhaust and air transfer fans will be located throughout the plant to be used in conjunction with the main air handling units to remove stale or contaminated air from the plant. Hot water boilers will be used to provide freeze protection and comfort of plant personnel in the winter months. The control rooms and office areas will be air conditioned. The plant stairwells will be ventilated under positive pressures for life safety evacuation in the event of a fire or smoke event. The control system for all HVAC equipment will be designed to enable using the HVAC equipment for smoke purging of all areas of the plant. Control of HVAC equipment for smoke exhaust operation will be interfaced with the plant fire detection and alarm system.

Pros and Cons of Mechanical Features

None identified - mechanical equipment identified in this study is not unusual and will not determine the plant or alternative selection

Items to Be Studied If Proceeding to Feasibility Level Studies for Mechanical Features

None identified - All mechanical items associated with the selected plant(s) that would go on to the feasibility design would be re- evaluated and estimated during the study. Additional design data, if available, could change or eliminate some of the auxiliary mechanical systems required (i.e. - need for sanitary waste system).

Recommendations for Mechanical Features

None identified

Electrical Equipment

Plants

The electrical plant and switchyard equipment associated with each of the five alternatives remained relatively the same. There were six plant options for each of the water conveyance alternatives. For each plant option, the differences in the rating and type of electrical equipment provided for each plant are indicated as follows:

- Main unit motors.—Plant options A through D each contain two pumping units. The two motors at the 1,000-ft^3/s plant will be rated 17,000 hp at 13,200 volts. The two motors at the 2,000-ft^3/s plant will be rated 35,000 hp at 13,200 volts. The above listed motors will be of the vertical-shaft synchronous type with a brushless exciter and pilot static excitation system.

  The enclosure for the motors will be totally enclosed, water/air cooled (TEWAC) which will provide cooling of the motor by circulating internal air through an air-to-water heat exchanger.

  All motors will have similar control and protective devices supplied to provide for alarm and shutdown of the units for problem conditions.

- Main unit generators or generator/motors.—Plant options C and D each contain two generator units. The two generators at the 1,000-ft^3/s plant will be rated 13,400 kVA at 13,800 volts. The two generators at the 2,000-ft^3/s plant will be rated 27,500 kVA at 13,800 volts. The above listed generators will be of the vertical-shaft synchronous type with a static type excitation system.

  Plant options E and F each contain two pump/generator units. The pump/generators at the 1,000-ft^3/s plant will have a dual rating of 17,000 hp as a motor and 13,400 kVA at 13,800 volts as a generator. The two pump/generators at the 2,000-ft^3/s plant will have a dual rating of 35,000 hp as a motor and 27,500 kVA at 13,800 volts as a generator. The above listed pump/generators will be of the vertical-shaft synchronous type with a static type excitation system.

  The enclosure for all generators or generator/motors will be TEWAC which will provide cooling of the unit by circulating internal air through an air-to-water heat exchanger.

  All units will have similar control and protective devices supplied to provide for alarm and shutdown of the units for problem conditions.

- Bus and switchgear.—15-kV segregated phase bus (1,000-ft^3/s plant) or isolated phase bus (2,000-ft^3/s plant) will transmit power from the two main transformers located in the switchyard to the associated motor or generator breaker (metal clad switchgear) inside the plant. Bus will be continued from the unit breakers to their associated generator, motor, or generator/motor.

- Station service.—The station service power supply will be obtained by tapping off the main plant feeds into the plant and providing a double-ended unit substation. The 480-volt distribution equipment located inside the plant would provide the plant station service needs.

The station service equipment was sized to accommodate power requirements of outside structures such as outlet/inlet tower gates, fish screen structures, air chambers, and other gates and valves associated with each plant option. Electrical equipment associated with these outlying structures is assumed to be covered in the unlisted items in the estimate.

- Duplex control switchboard.—A duplex control switchboard will be utilized for control of the main units in the plant and for switchyard controls and protection. The control switchboard will contain the standard equipment, meters, selector switches, pushbuttons, and all unit protective and control devices. A programmable motor protective relay will be utilized for unit control and protective features.

  The duplex control board will centralize all plant operations including indicating, recording, operating, communications, and protective functions. Manual, automatic and supervisory type functions will be provided to allow full flexibility in plant operations

- 480-volt motor control centers.—480-volt motor control centers will be provided in the plant for operating all of the auxiliary systems such as hydraulic pumps, water cooling pumps, electrically driven valves, air compressors, etc.

Switchyard

The new switchyard associated with each plant will include transformers, circuit breakers, and disconnect switches. Only major switchyard equipment was included in the estimates. Two switchyard cost estimates were developed: one for the 1,000-ft^3/s plants and another for the 2,000-ft^3/s plants. The physical layout of the two switchyards is the same.

Transmission Line

It was assumed that the plants would tie into the power grid at an existing 115-kilovolt power line in the vicinity of the new plants.

The cost estimates for each plant option include the cost of a double-circuit transmission line with a switchyard at the tie-in point. A cost for single-circuit transmission line is shown for comparison.

The same type of conductor is used for all transmission line estimates. The 336.4-kcmil conductor size is recommended for the strength of the cable. This cable size will accommodate the electrical load for all plant sizes. The owner of the transmission line to be tapped must be consulted before any designs are performed.

Pros and Cons of Electrical Features

- Pros and cons of transmission lines and switchyards would be finalized during any proposed feasibility design when input is obtained from local power utilities.

- Other electrical equipment is as required to provide power and control to operate the facility.

Items to Be Studied If Proceeding to Feasibility Level Studies for Electrical Features

- Transmission line.—The owner of the local utility should be contacted during any potential feasibility design to determine a location to tie into the power grid.

- Power system study.—It was assumed in this study that these large motors could be started across the line without having a major impact on the power system. A power system study would need to be conducted to determine whether reduced voltage starting or soft starting equipment would be required.

  This starting equipment would be significant and would double or triple the space requirements for electrical equipment in the plant and drive costs upward. Also, if large motors could not be started by any means because of capacity or weakness in available power grid, then the plant would need to be reconfigured with a larger number of smaller units. Any change in number and size of units would also need to be studied further to verify impact to power system and type of starting method required.

Recommendations for Electrical Features

1. The electrical design can be optimized after an option and power source are selected.

Geologic/Geotechnical Issues

Geologic Issues

Future geologic investigations will focus on the actual sites selected for design considerations. Additional permits may be required to gain access into areas that have not been cleared for drilling and testing.

The depths of surficial materials have not been accurately defined along the Wocus Drainage Canal and the current plans for cone penetrometer and drill hole explorations will provide data on the subsurface conditions in this area. The contact between the lake bed sediments (Qlb) and the andesite (Qba) is unknown and needs to be better defined before foundation design of pumping plants and/or powerplants and canal foundation can be undertaken. The contacts between these materials are due to faulting and the locations of these faults should be determined.

The slopes above the Wocus Drainage Canal are very steep and several landslides are present above the area. Further geologic mapping will be required to determine the quantities and types of the materials on the slopes above Wocus Marsh, and depending on where selected locations of pumping plant sites are, these slide areas may require stabilization and/or removal to achieve stable slopes above the structures.

Drilling is currently underway for three proposed tunnel alignments (Alternatives 1, 2, 3, and 4). Data from these drill holes will be used to determine the lithology along these alignments as well as the relative hardness of the materials for excavation and information on fracture density and orientations will aid in the design of the types and quantity of supports.

A groundwater model was developed to determine the water holding capabilities of Long Lake Valley. The model is greatly simplified, and is based on scattered drill holes and geologic mapping around the proposed reservoir area. Although the valley bottom is known to be tight, the actual geologic and hydrogeologic conditions around the reservoir rim are not well known and further investigations including mapping and drilling will be required to determine where the seepage may occur. If it is determined that the reservoir rim has significant water loss issues, lining may be required and will significantly increase costs and investigations for borrow materials.

Groundwater data will also be a significant issue if pumping plants or powerplant sites are chosen on the western margin of Wocus Marsh. Pump out tests will be required if any of these sites have high water levels and proposed excavations encounter the groundwater table.

Geotechnical Issues

This comparison of the different alternatives for this project and the cost estimates have been requested to be at an appraisal level. However, the geotechnical information for all aspects of this project is at the pre-appraisal level at best. All geotechnical recommendations for foundation treatment, dewatering, and unwatering the excavations have questionable technical viability due to the lack of any data on which to base the recommendations provided. Conservative

assumptions were made in providing information to the designers in order for quantities to be developed. These assumptions will change significantly once more subsurface information is obtained and the subsurface conditions can be evaluated further.

Geologic mapping has been performed within Long Lake Valley, and the surrounding area to a lesser extent, and provides some insight into the subsurface conditions. However, no actual subsurface information is available along any of the canal alignments, pump plant sites, or the fish screen sites. Limited subsurface information is available along one of the tunnel alignments and within Long Lake Valley. Visual observations have been made of some of the canal alignments, pump plant sites, and fish screen sites and has been scoped to be poor for foundation conditions. This information was used to provide geotechnical recommendations.

To bring the geotechnical recommendations to appraisal level, appraisal level subsurface investigation would have to be conducted to obtain the soil and groundwater conditions for the following sites:

- All proposed canal alignments
- All proposed fish screen sites
- All proposed tunnel alignments
- All proposed pump plant sites

The geotechnical issues, which present challenges to the construction of the project, include the following:

- Poor foundation conditions along the proposed canal alignments.
- Poor foundation conditions at the proposed pump plant sites and proposed fish screen sites.
- Excavation limits for the proposed pump plant sites along the west side of Wocus Drainage Canal, including excavation/slope stability requirements along the hillside.
- Over-excavation requirements.
- Slopes of excavations.
- Control of groundwater in all excavations.

- Control of surface water from Wocus Marsh and Wocus Drainage Canal adjacent to the proposed canal alignments.

- Poor rock conditions along the proposed tunnel requirements that may require additional rock bolts or other ground support methods.

- Construction sequencing of the new Wocus Drainage Canal in order to not impact the new channel and slurry wall construction.

Liner

Measures are necessary to limit water losses from the proposed Long Lake Valley Reservoir, particularly from seepage through the ridges forming reservoir rim. Sediments in the valley bottom are expected to limit seepage by that pathway without the need for a liner.

The principle design attributes for a liner system are the liner material permeability, the liner thickness, and the head of water above the liner. Reducing the permeability of the liner material directly impacts the quantity of seepage through the system. The amount of fine material (clays and silts) is the governing factor, with a desired fraction of 20 percent, or more. Compactive effort also has a major effect. Increasing the degree of compaction from 95 percent to 98 percent can decrease permeability by an order of magnitude, or more. The thickness of the liner and the head of water above the liner determine the gradient, or driving force, for seepage through the system. Increasing the liner thickness or reducing the depth of water over the liner will reduce seepage.

Three alternatives were examined for each of two reservoir water surface (RWS) elevation options. These alternatives consisted of:

1. Full liner.—A liner around the entire valley extending up the sides from the valley bottom to the full RWS.

2. Half-height liner.—A liner around the entire valley extending up the sides from the valley bottom to an elevation representing half the height of the full RWS.

3. NE side half liner.—A liner along the east (Wocus Marsh) side of the valley extending up the sides from the valley bottom to the full RWS.

For a reservoir capacity of 350,000 acre-feet, a design elevation of 4430 feet was used for the full height liner. Elevation 4347 was used for the top of the half-height liner. Design RWS elevation for a 500,000-acre-foot reservoir was assumed at 4485 feet, with half-height at elevation 4375 feet. For appraisal-level estimates for the full-height alternatives, the top of the impervious zone of the

liner was assumed at the design RWS elevation, with no freeboard other than the riprap and bedding.

An appraisal-level cross section for the liner up the reservoir side slopes is shown in attachment B, figure B63. Due to uncertainties in the availability of appropriate materials, as well as ease of construction, the design incorporates a "clay" liner with a conservative minimum thickness or width of 10 feet. This thickness may be reduced once more accurate information on properties of available materials is obtained. A 2-foot layer of riprap on 1 foot of bedding material protects the liner. To ensure stability, the outer surface of the liner was allowed a maximum slope of 2H:1V. This value was selected based on assumed operating conditions with a maximum reservoir water surface drawdown rate of one foot per day. The original valley side slopes will be cleared, grubbed, and roughly shaped prior to placement of the liner material. The west side of the valley averages about a 2H:1V slope, but can be as steep as 1.75H:1V. On these steeper slopes, the 2H:1V liner slope limit means that the liner will be wider near the valley bottom. The east side of the valley, the Wocus Marsh side, has more gentle slopes, ranging from 10H:1V to 6H:1V (see attachment B, figure B64). Because of this difference in valley side slopes, the majority of the liner material (75 to 80 percent) is on the east side of the valley. The shallower slopes of the east side will afford easier construction than what will be required for the steeper west side.

Saddle Dam

The design RWS elevation for a 500,000-acre-foot reservoir was assumed at 4485 feet. The east side of the reservoir has two topographic lows (saddles) through the ridge forming the reservoir rim. One cuts through the NE ridge at about elevation 4460 (see attachment B, figure B64, Point "A"). An embankment is required at this location to provide impoundment for the higher RWS of the 500,000-acre-foot reservoir. The second saddle, in the SE area of the ridge (see attachment B, figure B64, Point "B"), has a minimum elevation above 4520, so needs no additional treatment.

The saddle area of point "A" is shown in more detail in attachment B, figure B65, which shows the plan view of the proposed saddle dam. A crest alignment was chosen to best use the topography of the existing ground. The ground downstream of the saddle (towards Wocus Marsh) slopes at about 2H:1V, while the upstream (reservoir) side is flatter. A 20-foot high knob is located almost in the center of the saddle.

A typical embankment cross section design was used for appraisal-level estimates (see attachment B, figure B66). A 20-foot wide crest is at elevation 4493, giving eight feet of freeboard at operating RWS elevation 4485. The downstream face of the dam slopes at 2H:1V to existing ground surface. The upstream face is at 3H:1V. The design includes a central zone 1 impervious core with a minimum

top width of ten feet at elevation 4485. Upstream and downstream faces of the core slope at 1H:1V down to original ground level. A 15-foot deep cutoff trench with 1H:1V side slopes was assumed to provide a positive cutoff. The core material was assumed to be similar to the material to be used for the reservoir liner. A graded sand filter and gravel drain are situated against the downstream face of the core. These are each five feet wide and tie into a blanket filter and drain that extend below the downstream shell. The filter blanket is excavated five feet into the existing ground and is five feet thick. The gravel blanket drain lies atop the filter and is also five feet thick. Placing the filter below existing ground surface increases the potential for intercepting and controlling any seepage under the embankment before it exits the natural ground slope downstream of the saddle. The upstream and downstream shells are miscellaneous fill which could be obtained from required excavation for other features of the project. Three feet of riprap on 2 feet of bedding protects the upstream face of the dam. The full-height reservoir liner will tie into the upstream toe of the embankment. The bottom five feet of the upstream shell should consist of material with at least 20-percent fines (or even liner material), to provide connection between the liner and embankment core.

The eight feet of freeboard between the full pool at elevation 4485 and the top of the saddle dam at elevation 4493 provides approximately 25,241 acre-feet of potential flood storage. Long Lake Valley Reservoir would be an offstream storage facility with a terminal watershed, minimal inflow beyond what is pumped into the reservoir and currently no surface outflow. The reservoir site consists of a relatively flat bottomed valley with steep sides. The size of the watershed, which consists mostly of the reservoir, is approximately 5 to 6 square miles. Hydrologic studies of Long Lake Valley would be needed to confirm that spillway discharge capacity is not needed to prevent a flood event from overtopping the saddle dam.

Borrow Area

Borrow area investigations, to date, have outlined about ½-million yd^3 (or less) of low-permeable material suitable for use as impermeable material for Long Lake Valley. Estimates of material required for reservoir lining range from 5 million to 13 million yd^3, depending on the option selected. It is unlikely that the borrow area currently being investigated will host quantities large enough to have a significant impact on the quantities required. Another possible source of low permeability material is the Long Lake Valley lakebed. Investigations to date indicate the lakebed sediments have should be suitable material, based on physical properties. However, because of their low permeability and saturated condition, processing of the sediments to a condition appropriate for construction will take some effort.

Other materials required include riprap (1.4 million to 3 million yd^3) and riprap bedding (0.7 million to 1.5 million yd^3). These materials should be available for

local commercial sources. Alternatively, borrow areas and processing facilities could be set up in the vicinity of the project.

For the 500-TAF alternative, considerably more material is required. Liner options require impervious material ranging from 7.6 million to 21 million yd^3. Riprap quantities range from 1.9 million to 4.3 million yd^3, and riprap bedding from 0.9 million to 2.1 million yd^3. In addition for the 500-TAF alternative, a saddle dam is required for a low area in the NE rim of the reservoir. Impervious material in the amount of 40,000 yd^3 is needed for the embankment. Other materials include 4,000 yd^3 of sand filter, 9,000 yd^3 of gravel drain, 13,000 yd^3 of riprap, 8,000 yd^3 of riprap bedding, and 50,000 yd^3 of random fill (about half of which may be obtained from required excavation for the embankment). These materials should be readily available from local commercial sources.

Water Treatment

Water impounded within Long Lake Valley Reservoir may require treatment prior to discharge into Upper Klamath Lake. A range of water treatment options were evaluated in the "Preliminary Design and Cost Estimate for Water Treatment, Upper Klamath Basin Offstream Storage Study at Long Lake Valley," December 2008. Among these preliminary treatment options, one was selected to carry forward to the appraisal level and is summarized herein for the optimization scenarios: "In-lake aeration, algae removal, and phosphorus removal." The term "in-lake" refers to treatment techniques that are performed while the water is stored within the reservoir, as opposed to conveyance of the water to an on-shore water treatment plant.

In-Lake Aeration

The water quality discharge target for dissolved oxygen ($DO \geq 5$ mg/L) would be addressed using a solar powered mixing device known as the SolarBee, which achieves long distance circulation of water by extracting water at depth through a vertical draft tube and spreading it radially across the surface of the reservoir. The low DO water from depth becomes aerated when brought to the surface while the circulation promotes a more uniform and higher concentration of DO within the entire reservoir. The depth of the SolarBee draft tubes can be adjusted to optimize the pattern of circulation and achieve the desired DO levels in the vicinity of the gate openings of the intake structures. SolarBee circulators are successfully used at hundreds of ponds, lakes, and reservoirs across the United States to meet DO objectives, as well other water quality parameters that are of concern for the Long Lake Valley Reservoir.

In-Lake Phosphorus and Algae Removal

Strategic operation of the SolarBee circulators may be adequate to eliminate or control potential algae blooms in the Long Lake Valley Reservoir, which would be the source of seasonally high levels of phosphorus, pH, and suspended solids near the reservoir surface. Additionally, strategic operation of the intake tower gates to selectively withdraw water at depths that possess the target levels of water quality parameters could potentially avoid the impaired water quality conditions associated with algae blooms near the surface. If additional measures are required to meet the water quality discharge targets, in-lake chemical treatment and/or algae harvesting can be performed.

In-lake chemical treatment consists of distributing a liquid ferric chloride solution across the surface using a fleet of barges or work boats. The ferric ion will react with dissolved constituents such as phosphorus and alkalinity to produce solid flocs. The flocs will gradually increase in size through surface mixing and adsorb suspended solids associated with the algae blooms. When the weight of the floc exceeds the buoyant force of the water it will settle to the bottom of the reservoir.

Another method to remove phosphorus particles and other suspended solids near the reservoir surface is commercial algae harvesting using barges and transporter boats. Traveling conveyor screens along the side of the barge remove the algae from the water and lift it to the barge deck. Transporter boats carry the collected algae to shore where trucks transport it to a local facility for processing and packaging into health products that are distributed nationwide. Commercial algae harvesting has been practiced in Upper Klamath Lake for more than 10 years.

Water Treatment Cost Estimates for Optimization

Appraisal level quantities and cost estimates for construction, operation, maintenance, and replacement were prepared for the 350,000-acre-foot and 500,000-acre-foot reservoir options. In-lake water treatment cost estimates are directly proportional to the surface area of the reservoir; the rate of discharge flow under the different optimization scenarios does not affect the estimates. The primary construction cost items for the in-lake treatment options are: SolarBee circulators, on-shore chemical storage tanks and supporting foundation, and barges for chemical distribution. Algae harvesting is a commercial enterprise that would not have associated costs to the Government.

Fish Issues

Technical Issues

For discussion of fish issues, see *Canals and Upper Klamath Lake Intakes/Fish Screens* and *Long Lake Valley Intake Structures*.

Biological Issues

The following considerations should be used for screening fish on Upper Klamath Lake and LLV Reservoir:

- Protecting fish in Upper Klamath Lake with a screening system and adequate bypass is required. The screens and associated criteria are important, but by-passed fish at the screens in Upper Klamath Lake must be returned to the lake at a considerable distance to prevent re-entrainment and recycling of fish thru the pumped by-pass system. Although this distance is not specified, in this lentic environment, a by-pass outlet several hundred meters away from the screens is recommended with further information needed on what is an adequate distance.

- The by-pass has potential to be used as opportunistic location to sample the fish community. An efficient fish handling system should be considered to trap, hold, and sort fish as a biological study tool. It would be valuable to include a design element that bypasses fish into a holding area rather than using a fyke (funnel/trap) net to sample the bypass.

- Endangered fish lifted in the water to Long Lake Valley Reservoir need to be considered and protected. Larval fish are documented passing through the 1.75-mm opening mesh screen in the A-canal screens from Upper Klamath Lake. From this information, undoubtedly fish will survive the lift to the Long Lake Valley Reservoir and depending upon water quality, develop into juvenile and potentially adults. Considerations should be made to prevent harm to these endangered fish either as they are passed down with flows to Upper Klamath Lake or screened to prevent loss from the LLV Reservoir. Anticipated complications in both of these protection scenarios are anticipated ranging from the lack of bypass/sweeping flows for the LLV screens, to salvage and safe fish handling abilities in LLV Reservoir.

- If fish screens are placed on the intake structure in LLV Reservoir, consideration for their use or placement during filling and then their placement during water delivery from the reservoir are needed. Screens placed with no sweeping (by-pass) flow capabilities will protect fish to a certain degree but also concentrate fish at the intake area.

- The 2008 Biological Opinion issued by the USFWS requires trap and haul of suckers caught in the A-Canal if doing so would increase fish survival. Fish trapped in LLV during low pool could potentially need to be salvaged. If a screen system is placed to protect fish from leaving LLV Reservoir, then a safe system of trapping and hauling fish from this reservoir during low pool events could be incorporated.

- Nonphysical fish screen techniques that illicit a behavioral avoidance in fish is not an established technology and generally site and species specific. In this LLV situation, behavioral responses of the endangered suckers needs to be determined and tested with varying technologies to demonstrate the most effective avoidance. At that point, a determination as to a nonphysical barrier design could be considered. In any situation 100-percent protection is not established for any protection system.

- Coordination with USFWS as to requirements as well as configuration advantages and disadvantages would need to be resolved if feasibility level plans progress.

Construction Cost Estimate

For each of the alternatives, appraisal level construction cost estimates were prepared. These estimates were not intended to capture full project costs, but will be used to compare items that change from either alternative to alternative or from option to option or from the 1,000-ft^3/s flow rate to the 2,000-ft^3/s flow rate. A summary of these cost estimate are in attachment C.

Appraisal Cost Estimates

The appraisal level cost estimates prepared for this report were generated using industry-wide accepted cost estimate methodology, standards and practices. Appraisal cost estimates, which are intended for planning and preliminary budgetary purposes, were developed from: approximate quantities and data gathered, and preliminary general designs and drawings. These estimates are normally used as an aid in selecting the most economical plan by comparing alternative features such as canal, tunnel or pipeline routes, and powerplant or pumping plant capacities.

The unit prices are based on historical, bid, and industry reference costing data along with some manufacturer’s budgetary quotes.

Escalation to notice to proceed is not included while escalation during construction is included in the unit price levels. It is assumed that competitive procurement methodologies will be employed for this project; therefore, no allowance for procurement strategies is included.

Appraisal cost estimates are also for the purpose of determining whether more detailed investigations of this project are justified. Appraisal cost estimates are not suitable for requesting authorization or construction fund appropriations from Congress.

Price Level

All costs shown in the appraisal level cost estimates are in July 2008 dollars.

Mobilization

Mobilization costs include contractor bonds and mobilizing contractor personnel and equipment to the project site during initial project start-up. The assumed 5 percent of the subtotal cost used in the appraisal price level cost estimates contained in this report is based on past experience of similar projects.

Design Contingency

The Reclamation Cost Estimating Handbook offers guidelines on selecting the allowance for design contingency in appraisal estimates and should be at least 10 percent of the listed items. It was determined that based upon the completeness of the listed items that the detail provided suggests the design contingency to be set at 15 percent of the listed items for all the features.

Construction Contingency

The Reclamation Cost Estimating Handbook offers guidelines on selecting the construction contingency line item that is to be included in all appraisal estimates. The purpose for construction contingency is to provide budget for overruns on quantities, changed site conditions, order for changes, etc. Construction contingencies are considered as funds to be used after construction starts and not for design changes in project planning. According to the Reclamation Cost Estimating Handbook guidelines, appraisal estimates should have 25 percent added for construction contingency. It was determined that based upon the completeness and reliability of the; engineering design data provided, geological information, projected quantities and the general knowledge of the conditions at the site, that 25 percent be added for contingencies for all the features.

Noncontract Costs

Noncontract costs were estimated to be 25 percent of the Total Field Costs based on typical noncontract cost percentage ranges from past large Reclamation projects (25 percent to 40 percent +/- noncontract costs range). Land acquisition is not included. Noncontract costs include some or all of the following: (This list may not be all-inclusive.)

Distributive type costs

- Services facilities.—Camps, construction roads, utility systems, temporary plants used for construction, etc.

- Investigations.—Studies and surveys (collection, assembly, analysis of data and preparation and review of reports such as environmental impact studies, cultural resources studies, mitigation studies, etc.)

- Design and specifications.—Preparation and review of final designs, construction drawings, specifications, and construction cost estimates, etc.

- Construction engineering and supervision.—Construction management, surveying, inspection, laboratory work, program engineering, safety engineering, etc.

- Other.—General expenses after appropriation of funds for construction not identified in the above items such as; general office salaries, transportation, supplies and rent/utility services, security, environmental oversight, mitigation/cultural resources services, legal services, etc.

Corollary type costs

- Parallel costs such as transitional development costs, and relocation, or right-of-way costs that may be required for construction of the project features.

Life Cycle Costs

Life Cycle Cost (LCC) estimating is the computation of the total present worth dollar cost of owning, operating, maintaining, and periodic replacement of a feature over a period of time. A summary of these cost estimates and assumptions are in attachment D.

One can breakdown the LCC equation into the following three variables: the pertinent costs of ownership, the period of time (term) over which these costs are incurred, and the interest (planning) rate that is applied to future costs to equate them with present day costs.

The first component in a LCC equation is cost. There are two major cost categories by which projects are to be evaluated in a LCC Analysis. They are Initial Capital Costs and Operations, Maintenance, and Replacement (OM&R) Costs. Initial Capital Costs are costs incurred prior to occupation of the facility. OM&R Costs are costs incurred after occupation of the facility. In this analysis, the Initial Capital Costs included are the construction costs of the project which include plant and other structures, water conveyance, hydraulic equipment, mechanical equipment, pipe line, electrical, the clay liner options and water treatment features, but does not included land acquisition costs. The Periodic Costs include replacement equipment costs calculated at Present Worth dollars. The Annual Costs include daily operational costs and routine maintenance costs. Operational Costs include costs to operate the facility, such as operator wages and benefits, utilities, etc. Maintenance costs include costs associated to maintain the facility and equipment in satisfactory condition. The Annual Costs are calculated as uniform series present worth costs.

The second component of the LCC equation is the term. The study period is the period of time over which ownership and operations expenses are to be evaluated. This study period is fifty years in accordance with the client request.

The third component in the LCC equation is the planning rate. The planning rate as suggested from *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* is 4.625 percent.

Benefit Cost Analysis

This section describes the results of the preliminary National Economic Development (NED) benefit cost analysis (BCA) developed for the proposed appraisal level alternatives.

The *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*, otherwise referred to as the P&Gs (U. S. Water Resources Council, 1983), represent the main set of guidelines for Federal water management agency economic analyses. The P&Gs describe the National Economic Development (NED) account which helps to facilitate the evaluation of the economic effects of proposed alternative plans. The NED account focuses on the economic benefits to the entire Nation.

As a Federal agency, Reclamation must analyze the NED effects so as not to favor one area of the country over another. Economic justification is determined for each alternative solely by the benefit-cost analysis and must be demonstrated on the basis of NED benefits exceeding NED costs.

The NED BCA compares the present value of a proposed project's benefits to the present value of its costs. If benefits exceed costs, the project is considered economically justified. Because both benefits and costs can occur at various points throughout the study period, it is important to convert them to a common point in time. For this analysis, the costs and benefits were measured as of the start of the benefits period (which is equivalent to the end of the construction period). The study period or period of analysis for the benefits period was assumed to be 50 years. The interest rate used to convert costs and benefits to a common year was Reclamation's fiscal year 2009 planning rate of 4.625 percent.

Preliminary Economic Justification

Tables summarizing the preliminary project costs, preliminary benefits, and preliminary benefit cost ratios for the 350,000-acre-foot and 500,000-acre-foot reservoirs are included in attachment E. The preliminary BCA ratios range from 0.01 to 0.04. A summary of the preliminary BCA ratios is shown in the tables below. None of alternatives or options can be economically justified under the P&G criteria. It should be noted that the benefit cost ratio is incomplete because several benefit categories were not calculated due to insufficient data.

Preliminary Project Costs

The cost analysis for each alternative is broken down into two subsections: (1) upfront construction costs (including noncontract costs), (2) Interest During Construction (IDC), and (3) annual operations, maintenance, and replacement (OMR) costs. The IDC calculation represents the cost of Federal borrowing during the construction period.

Preliminary Project Benefits

Potential economic benefit estimates were analyzed for the following areas: (1) agriculture; (2) recreation; and (3) fisheries. Appraisal level benefits are calculated for agriculture and hydropower. These analyses follow the criteria for measuring NED benefits defined in the P&Gs. Recreation and fisheries benefits are discussed qualitatively as data was not available to estimate these benefit categories.

Table 7.—Benefit cost ratios for 350,000-acre-foot reservoir with full, half, NE and no liners

Alternative and Option	350 TAF full liner	350 TAF half liner	350 TAF NE Liner	350 TAF no liner
Alternative 1 - Option A	0.02	0.02	0.02	0.03
Alternative 1 - Option B	0.01	0.02	0.01	0.02
Alternative 1 - Option C	0.02	0.03	0.02	0.04
Alternative 1 - Option D	0.02	0.02	0.02	0.03
Alternative 1 - Option E	0.02	0.03	0.02	0.03
Alternative 1 - Option F	0.02	0.03	0.03	0.04
Alternative 2 - Option A	0.02	0.02	0.02	0.03
Alternative 2 - Option B	0.01	0.02	0.01	0.02
Alternative 2 - Option C	0.02	0.03	0.03	0.04
Alternative 2 - Option D	0.02	0.02	0.02	0.03
Alternative 2 - Option E	0.02	0.03	0.02	0.03
Alternative 2 - Option F	0.03	0.04	0.03	0.05
Alternative 3 - Option A	0.02	0.02	0.02	0.03
Alternative 3 - Option B	0.01	0.02	0.01	0.02
Alternative 3 - Option C	0.02	0.03	0.02	0.04
Alternative 3 - Option D	0.02	0.02	0.02	0.03
Alternative 3 - Option E	0.02	0.03	0.02	0.03
Alternative 3 - Option F	0.03	0.03	0.03	0.04
Alternative 4 - Option A	0.02	0.02	0.02	0.03
Alternative 4 - Option B	0.01	0.02	0.02	0.02
Alternative 4 - Option C	0.02	0.03	0.03	0.04
Alternative 4 - Option D	0.02	0.02	0.02	0.03
Alternative 4 - Option E	0.02	0.03	0.02	0.04
Alternative 4 - Option F	0.03	0.04	0.03	0.05
Alternative 5 - Option A	0.01	0.02	0.01	0.02
Alternative 5 - Option B	0.01	0.01	0.01	0.02
Alternative 5 - Option C	0.02	0.03	0.02	0.03
Alternative 5 - Option D	0.02	0.02	0.02	0.02

Table 8.—Benefit cost ratios for 500,000-acre-foot reservoir with full, half, NE, and no liners

Alternative and Option	500 TAF full liner	500 TAF half liner	500 TAF NE Liner	500 TAF no liner
Alternative 1 - Option A	0.01	0.02	0.01	0.02
Alternative 1 - Option B	0.01	0.01	0.01	0.02
Alternative 1 - Option C	0.02	0.03	0.02	0.03
Alternative 1 - Option D	0.02	0.02	0.02	0.02
Alternative 1 - Option E	0.02	0.02	0.02	0.03
Alternative 1 - Option F	0.02	0.03	0.02	0.04
Alternative 2 - Option A	0.01	0.02	0.02	0.03
Alternative 2 - Option B	0.01	0.01	0.01	0.02
Alternative 2 - Option C	0.02	0.03	0.02	0.04
Alternative 2 - Option D	0.02	0.02	0.02	0.02
Alternative 2 - Option E	0.02	0.02	0.02	0.03
Alternative 2 - Option F	0.02	0.03	0.03	0.04
Alternative 3 - Option A	0.01	0.02	0.01	0.02
Alternative 3 - Option B	0.01	0.01	0.01	0.02
Alternative 3 - Option C	0.02	0.03	0.02	0.03
Alternative 3 - Option D	0.02	0.02	0.02	0.02
Alternative 3 - Option E	0.02	0.02	0.02	0.03
Alternative 3 - Option F	0.02	0.03	0.02	0.04
Alternative 4 - Option A	0.01	0.02	0.01	0.03
Alternative 4 - Option B	0.01	0.01	0.01	0.02
Alternative 4 - Option C	0.02	0.03	0.02	0.04
Alternative 4 - Option D	0.02	0.02	0.02	0.03
Alternative 4 - Option E	0.02	0.02	0.02	0.03
Alternative 4 - Option F	0.02	0.03	0.03	0.04
Alternative 5 - Option A	0.01	0.01	0.01	0.02
Alternative 5 - Option B	0.01	0.01	0.01	0.01
Alternative 5 - Option C	0.02	0.02	0.02	0.03
Alternative 5 - Option D	0.01	0.02	0.02	0.02

100-ft^3/s Inflow Scenario

A Long Lake Valley run was conducted with a 100-ft^3/s inflow and compared to similar runs with a 1,000-ft^3/s pump and a 2,000-ft^3/s pump. A 350,000-acre-feet unlined reservoir with an initial storage of 0 acre-feet was used. A comparison of these runs is shown in the following table.

Comparison of pumping alternatives for unlined 350,000-acre-foot reservoir

Item	Project delivery from Long Lake Valley Reservoir			Extra Iron Gate instream flow from Long Lake Valley Reservoir		
Scenario	Unlined 350 TAF 100 ft^3/s	Unlined 350 TAF 1,000 ft^3/s	Unlined 350 TAF 2,000 ft^3/s	Unlined 350 TAF 100 ft^3/s pump	Unlined 350 TAF 1,00 ft^3/s	Unlined 350 TAF 2,000 ft^3/s
Units	TAF	TAF	TAF	TAF	TAF	TAF
Average annual project benefit	2.21	9.79	11.70	0.14	16.70	17.01
Average annual percent benefit	0.55%	2.43%	2.91%	0.16%	18.96%	19.32%

Project supply and augmented instream flow requirements for Iron Gate are both reduced considerably with a 100-ft^3/s pump. Little benefit to project deliveries or augmented instream flow requirements for Iron Gate can be realized with a 100-ft^3/s pump compared to the 1,000-ft^3/s and 2,000-ft^3/s scenarios. It should also be noted that the reservoir will not fill with a 100-ft^3/s pump.

Construction Schedule

Summary-level construction schedules were developed for all of the alternatives in conjunction with the different pumping options under each alternative. A complete set of construction schedules are included in this report for the 350-TAF storage reservoir and a second set of construction schedules are included for the 500-TAF reservoir.

Yearly spending caps do not constrain these schedules, and the construction is scheduled based on logical sequencing of work activities and interdependencies between features. The timing for contract award has been optimized to correlate to the first dry season.

The construction schedules have activities identified as “hammocks” that are summary-type activities. These hammocks will generally identify the overall duration of all of the activities for a specific feature such as the pumping plant or the fish screen intake. Similarly, the first activity for each schedule summarizes the total project duration for all features of each alternative.

In general for each schedule, the first contracts awarded are for the pumping plant, the tunnel and the canal if applicable. The construction sequencing has the tunnel work completed prior to the penstock/discharge pipes and also prior to the Long Lake Valley intake/outlet tower to allow for the interfaces between these features. Also, the pumping plant structure and its backfill are completed prior to the inlet transition from the canal in Alternatives 1, 3, and 4. The fish screen intake structure and the Long Lake Valley intake/outlet tower contracts are awarded approximately a year after the other contracts to stagger the work effort without impacting the completion date for the project.

The durations used in the schedules are based on past performance of similar work for Reclamation projects and based on information from the construction industry. Durations for activities that are directly related to estimate worksheets are based upon the line item description and quantity. The durations incorporate time for weather delays and normal equipment breakdowns. Specifically, the canal alternatives have incorporated approximately 100 calendar days for winter weather impacts to the canal construction work for each year. All durations shown are in calendar days.

Each major construction feature has an activity for testing the feature's systems. The pumping plants have a 90-day activity for testing all of the plant equipment. In addition to each feature's test activities, there is a 30-day commissioning period for testing and operating the entire project.

The construction schedules are in attachment F.

Other Issues

Water that is brought into Long Lake Valley from Upper Klamath Lake is likely to be poor quality with high levels of algae or agricultural contaminants. With the proposed variable operation schedule for Long Lake Valley, where the return flow to Upper Klamath Lake may be at 1-year, 3-year, or as long as 5-year cycles (for nonpower options), the water quality may become very stagnant and potentially toxic to any remaining or imported fish species.

The drop in head from Long Lake Valley to Upper Klamath Lake is approximately 260 feet. This may not be survivable for the fish species in question without a series of staged drops or holding areas. Interruptions to or holding of the return flow in this manner would not only increase costs but may significantly interfere with viable operation of the return flow lines.

Conclusions

In addition to the items listed under each technical section:

1. Based on the available design data and assumptions stated in this report, Alternative 2 appears to be the most favorable alternative with respect to design, constructability and long term O&M issues.
2. The canal option appears to have a significant impact to the Wocus Marsh area. Not only does the canal have a large cross-section, especially when rebuilding the existing Wocus drainage canal, but ensuring an adequate foundation is thought to require a significant excavation with a large footprint, based upon Reclamation's pre-appraisal level geotechnical data.
3. All of the pumping plant/powerplant locations identified in each alternative will require significant excavation.
4. There are issues regarding the fish screens that will need to be addressed in the future studies. This is true at both Upper Klamath Lake and at Long Lake Valley Reservoir. It is likely that a variance on screen criteria from fish agencies will be required for some parts of this project.
5. There are significant concerns with geologic and geotechnical issues with the alternatives involving canal alignments across or adjacent to Wocus Marsh. The issues need to be addressed in more detail once the current field investigation and report has been completed. The results of this field investigation could significantly impact all geotechnical and geological recommendations in this report.
6. Feasibility level design data may provide information that could eliminate one or more of the alternatives and/or options for technical reasons. If any alternative should proceed to feasibility, every effort should be made to ensure that a complete feasibility level design data package is completed before feasibility design is started.
7. The power studies indicate power generating and pump/turbine are not viable.
8. If power operations are studied in any feasibility level study, Alternative 1 has the best configuration of the five alternatives in regards to power operations because it has the shortest tunnel and lowest head losses. In addition, the pump-turbine option should be used. The pumping and generating options are more expensive, the footprint of the structure is twice as big and there is duplication of equipment.
9. Numerous factors affect the decision regarding the selection between the 1,000-ft^3/s or 2,000-ft^3/s delivery systems, including available funding and availability of water. A larger delivery system would be preferable because it will allow a faster fill of the reservoir and a faster delivery of water.

Recommendations

In addition to the items listed under each technical section:

1. Based on current design data, technical issues discussed in the sections above, the construction cost estimate, and life cycle costs, Alternative 2 without power generation appears to be the preferred alternative.

2. If power generating is included, even though it does not appear to be viable, Alternative 1 with the pump-turbine option should be used. The pumping and generating options are more expensive, the footprint of the structure is twice as big and there is a lot of duplication of equipment.

Attachment A
Summary of Alternatives and Option

Alternatives		Options – Each Alternative	
No.	**Description**	**No.**	**Description**
1	Canal adjacent to Wocus Marsh from UKL to Pumping Plant, through tunnel to multi-level, outlet/inlet tower structure in LLV (per recon report – longer canal)	A	Pumping Only – 1,000 cfs
		B	Pumping Only – 2,000 cfs
		C	Pumping and Generating – 1,000 cfs
		D	Pumping and Generating – 2,000 cfs
		E	Pump/Turbine – 2,000 cfs
		F	Pump/Turbine – 1,000 cfs
2	Pumping Plant at UKL (Howard Bay), through tunnel to multi-level, outlet/inlet tower structure in LLV	A	Pumping Only – 1,000 cfs
		B	Pumping Only – 2,000 cfs
		C	Pumping and Generating – 1,000 cfs
		D	Pumping and Generating – 2,000 cfs
		E	Pump/Turbine – 2,000 cfs
		F	Pump/Turbine – 1,000 cfs
3	Canal across Wocus Marsh from UKL to Pumping Plant, through tunnel to multi-level, outlet/inlet tower structure in LLV	A	Pumping Only – 1,000 cfs
		B	Pumping Only – 2,000 cfs
		C	Pumping and Generating – 1,000 cfs
		D	Pumping and Generating – 2,000 cfs
		E	Pump/Turbine – 2,000 cfs
		F	Pump/Turbine – 1,000 cfs
4	Canal adjacent to Wocus Marsh from UKL to Pumping Plant through tunnel to multi-level, outlet/inlet tower structure in LLV (shorter canal)	A	Pumping Only – 1,000 cfs
		B	Pumping Only – 2,000 cfs
		C	Pumping and Generating – 1,000 cfs
		D	Pumping and Generating – 2,000 cfs
		E	Pump/Turbine – 2,000 cfs
		F	Pump/Turbine – 1,000 cfs
5	Pumping Plant on UKL (@ Fremont Bridge – head of Link River) through tunnel south of LLV to multi-level, outlet/inlet tower structure in LLV	A	Pumping Only – 1,000 cfs
		B	Pumping Only – 2,000 cfs
		C	Pumping and Generating – 1,000 cfs
		D	Pumping and Generating – 2,000 cfs
		E	Pump/Turbine – 2,000 cfs See note below
		F	Pump/Turbine – 1,000 cfs See note below

Note: For Alternative 5, Options e and f were not included for technical reasons. See Section VI. Canals and Upper Klamath Lake Intakes/Fish Screens for more details

NAMING FORMAT:

For Alternative 1 (similar for other alternatives):

Option a: 1_Pump_1000

Option b: 1_Pump_2000

Option c: 1_P&G_1000

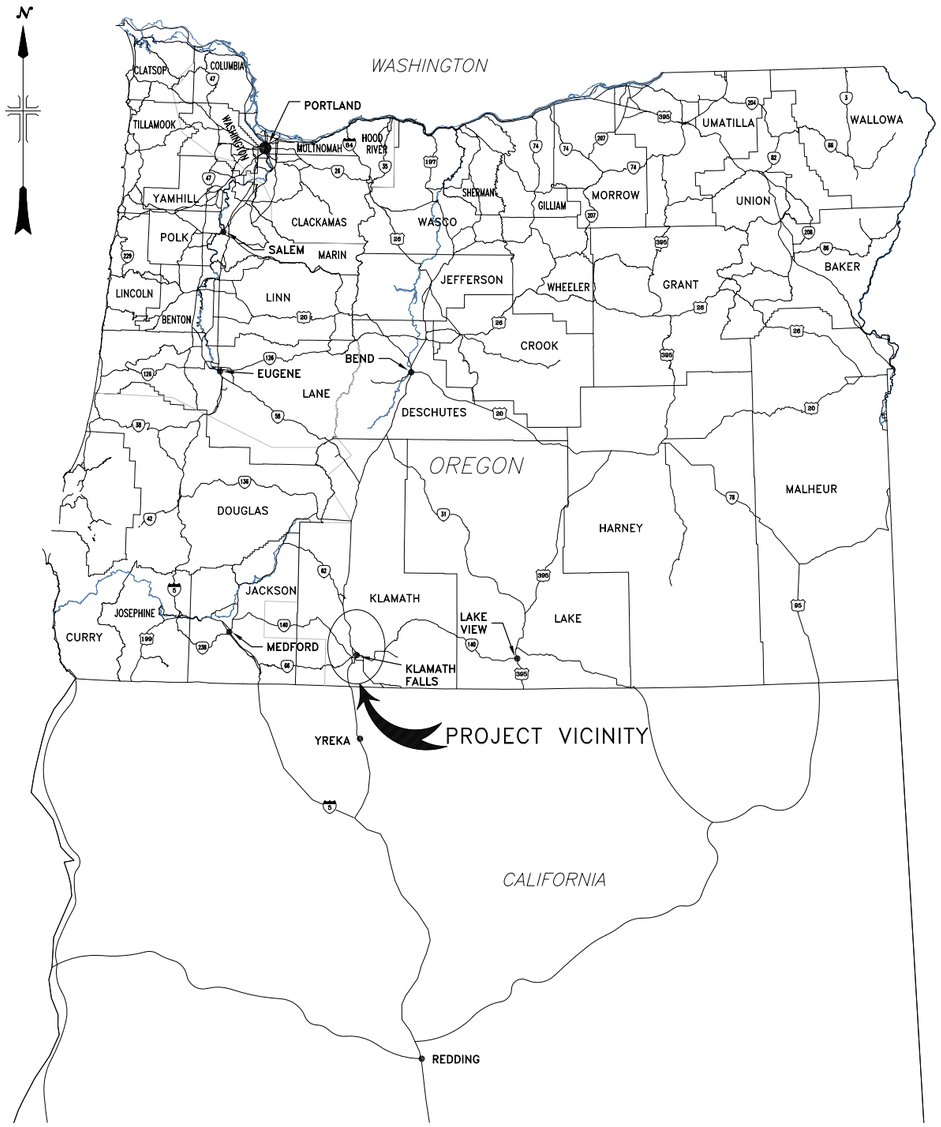
Option d: 1_P&G_2000

Option e: 1_P-T_2000

Option f: 1_P-T_1000

Attachment B—Drawings

FIGURE 1



LOCATION MAP

N.T.S.

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APPRAISAL LEVEL ESTIMATE

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Figure B1 (Final Draft)

Legend

LLV water conveyance alternative routes

Route alternative

- 1
- 2
- 3
- 4
- 5
- New Wocus Drain Alignment Centerline

US Bureau of Reclamation
Klamath Project - Oregon-California
2006 Plan of Feasibility Study
Appraisal Level Studies
Proposed Long Lake Valley Storage Project

RECLAMATION
Managing Water in the West

Compiled by Stan Mattingly USBR KBAO, 05/2008

0 0.3 0.6 1.2 1.8 2.4 Miles

1:44,000

Potential Borrow Source

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AT LONG LAKE VALLEY
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ALTERNATIVES MAP

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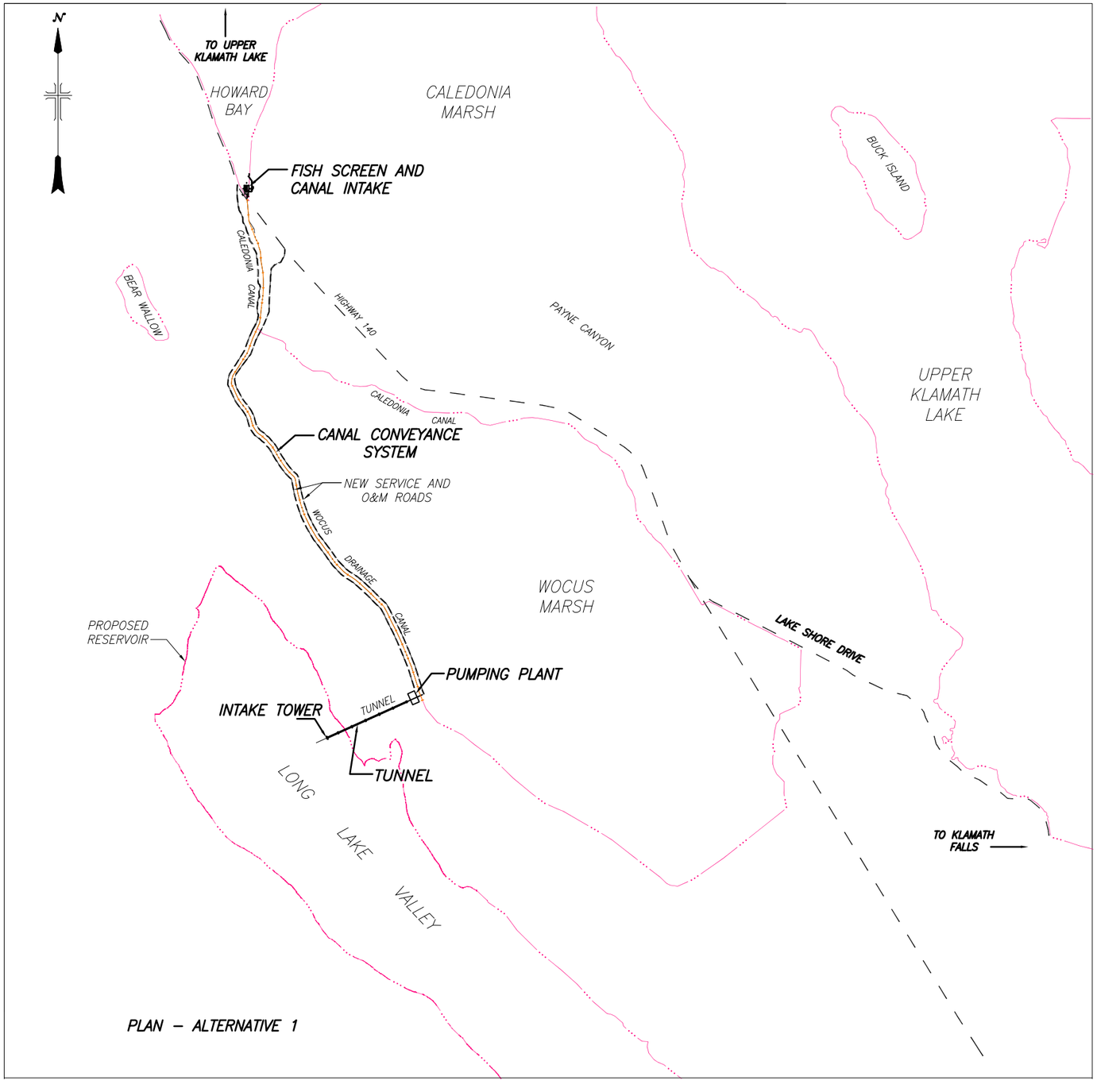

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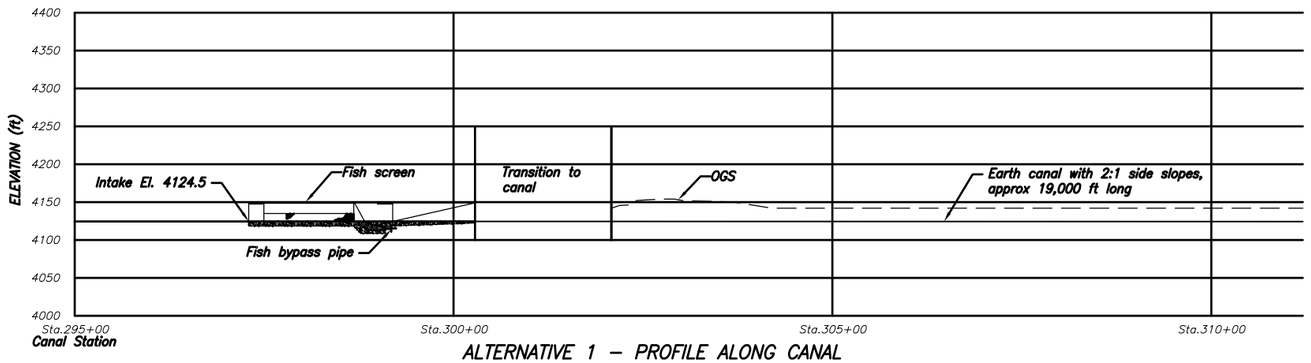
Figure B3 (Final Draft)



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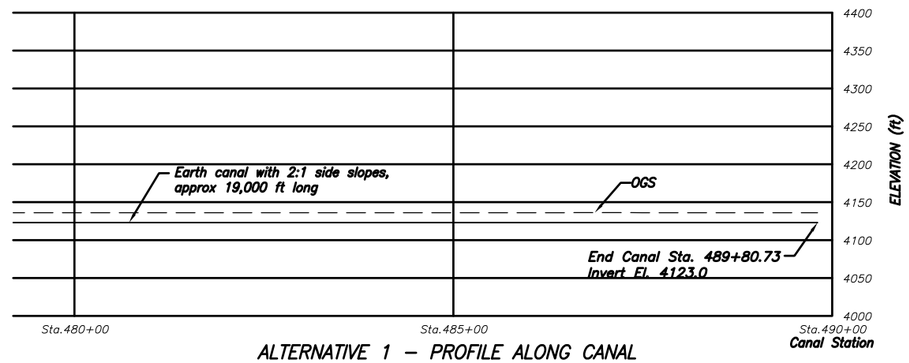

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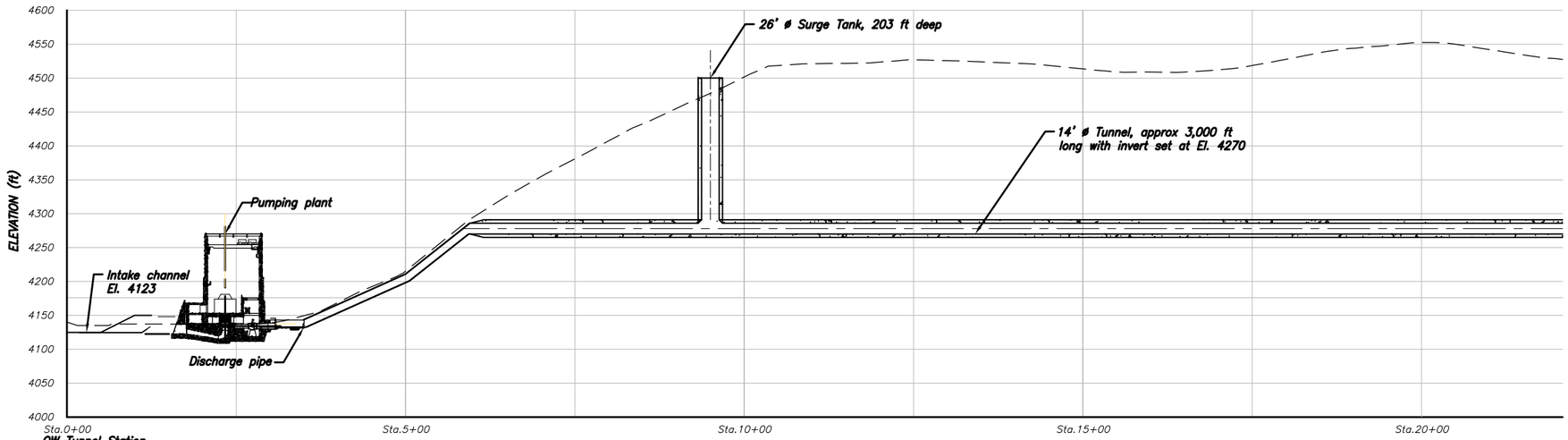
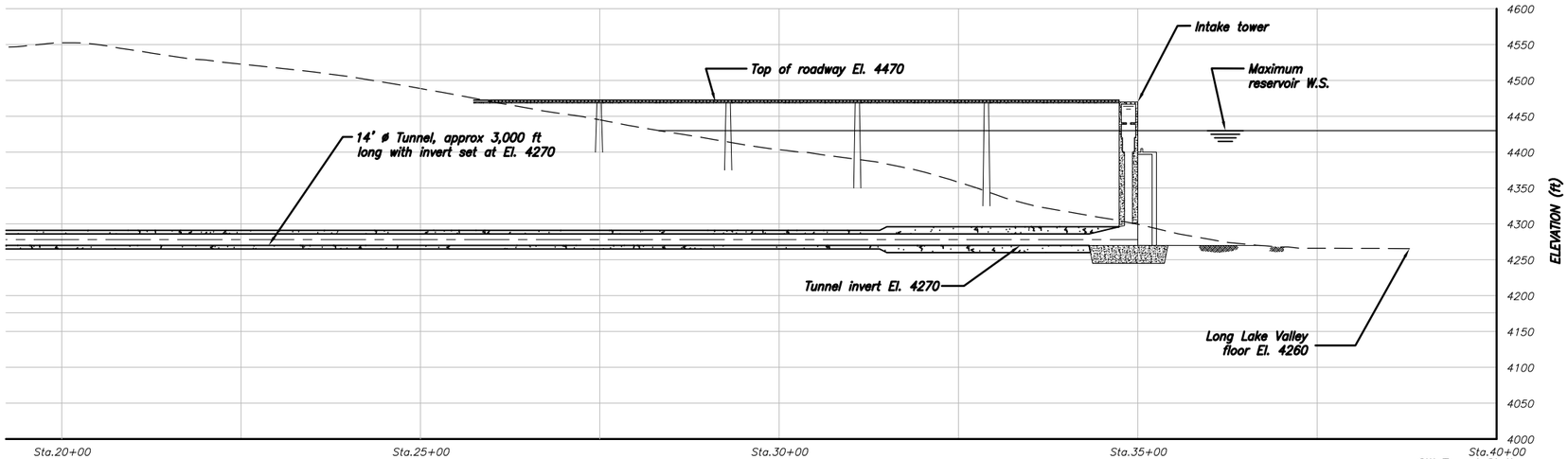


ALTERNATIVE 1 PROFILE THROUGH TUNNEL



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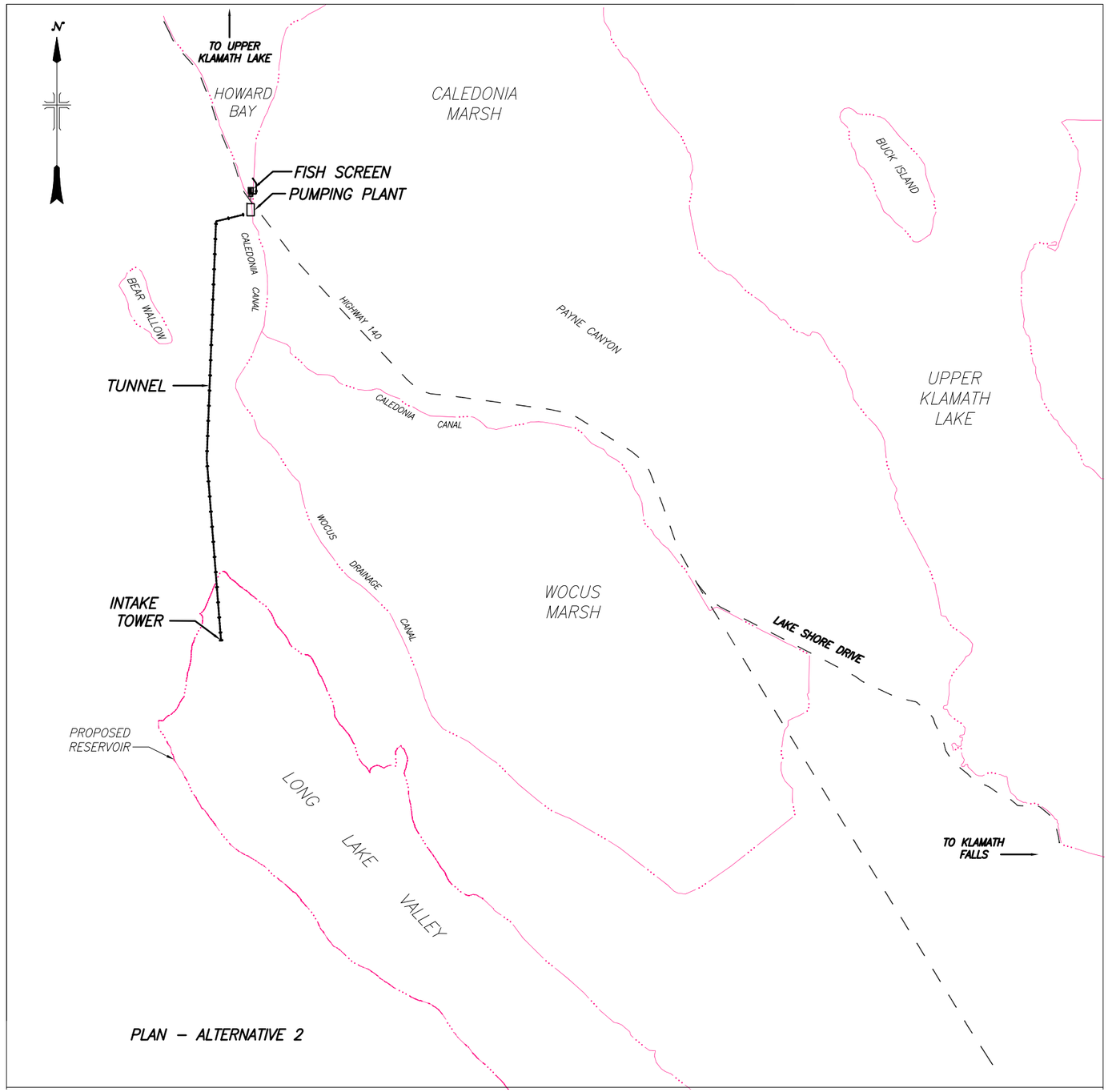

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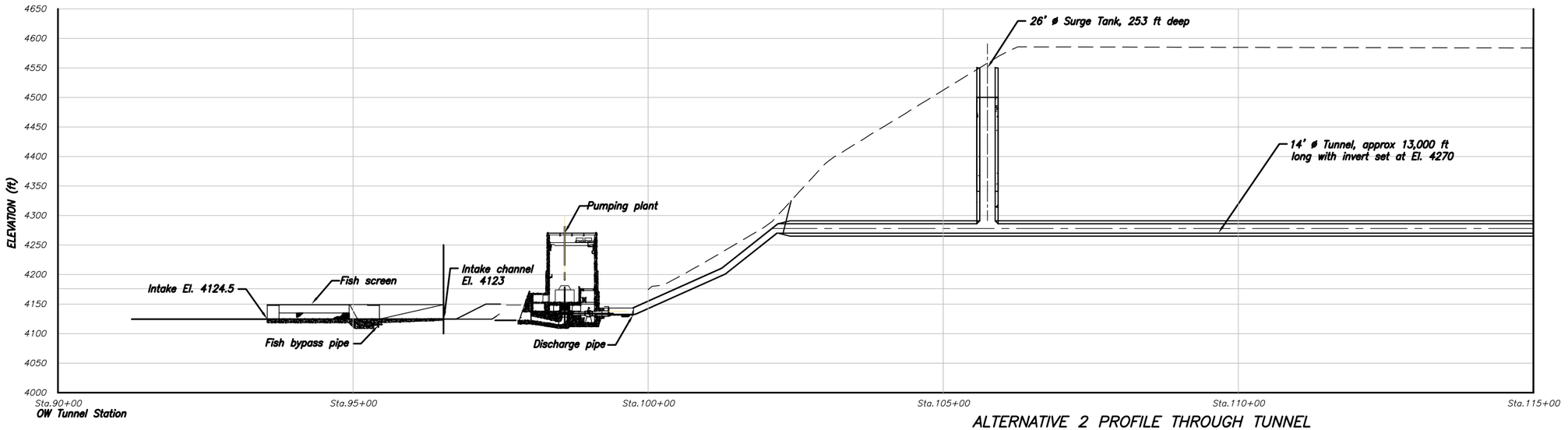

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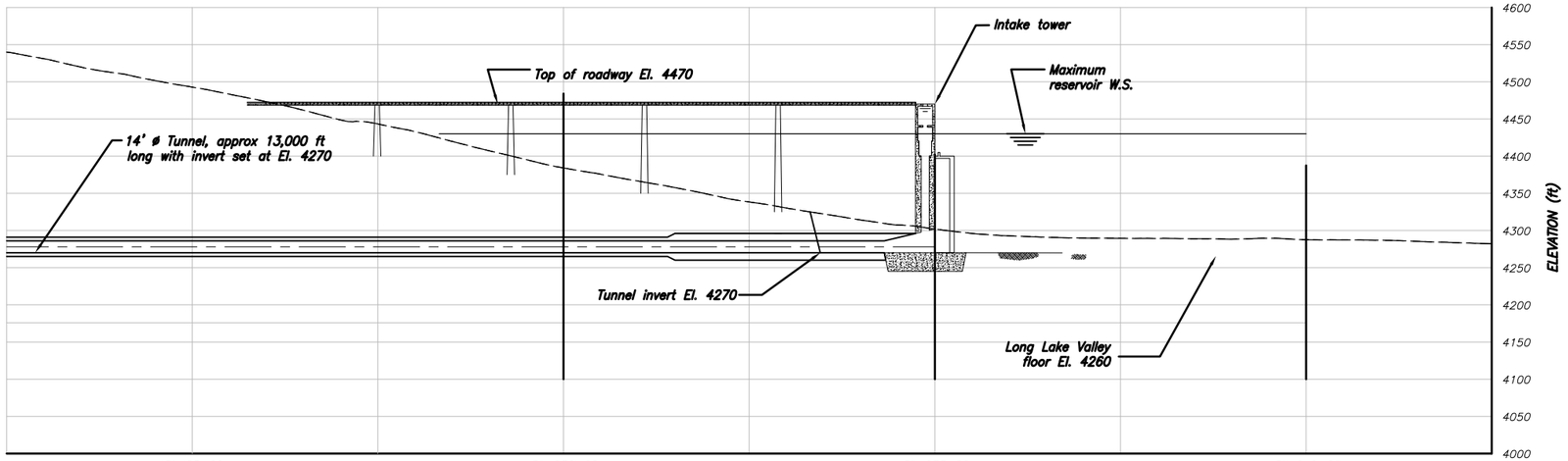

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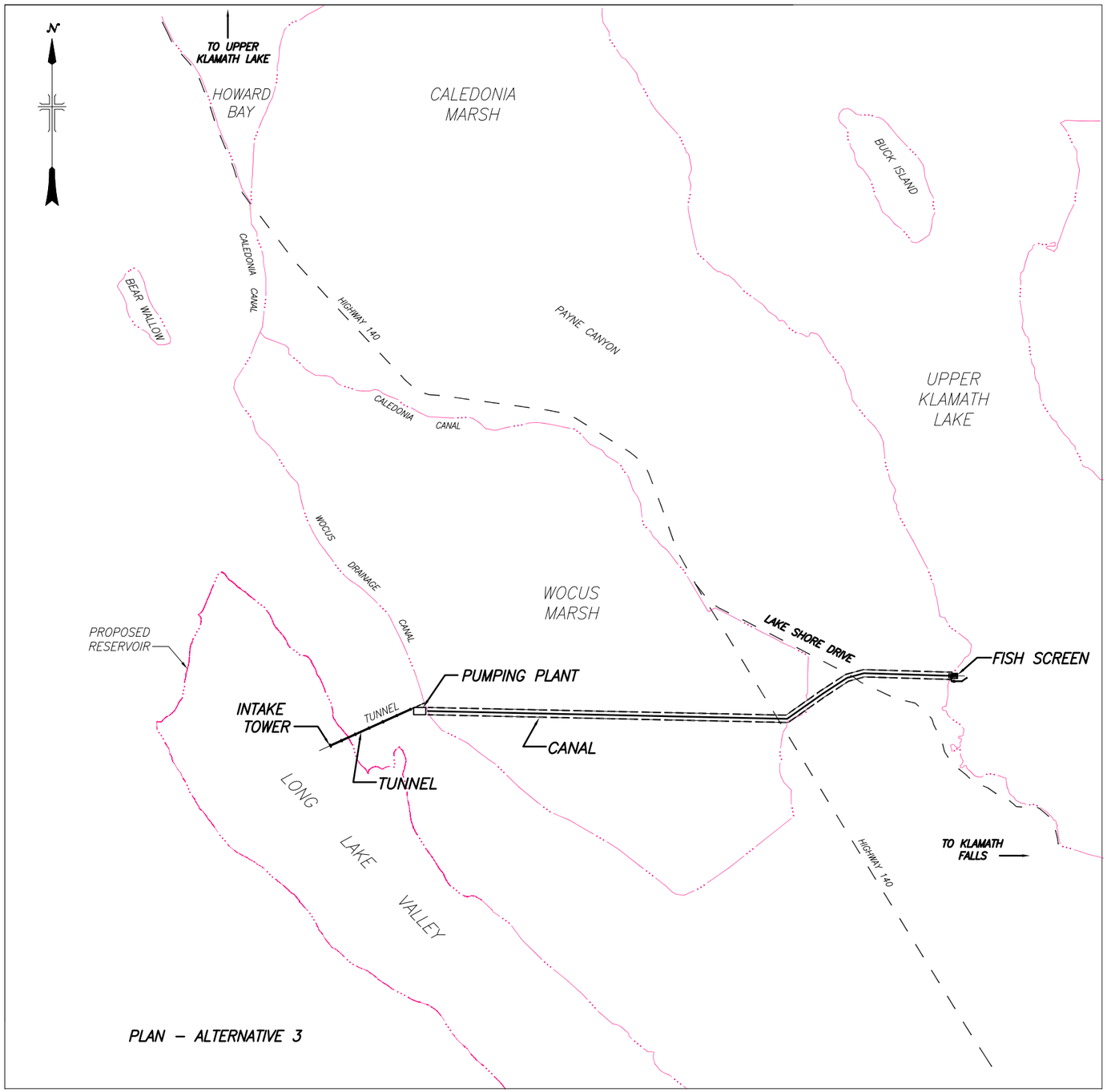

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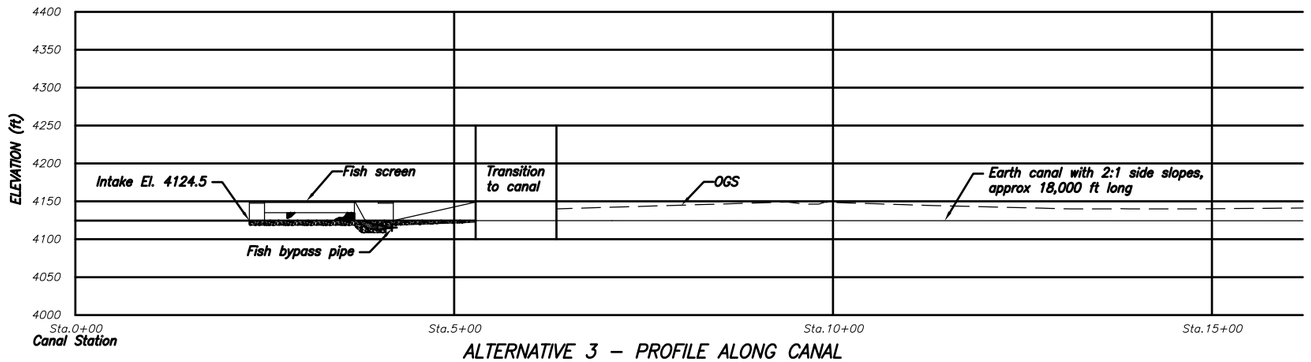

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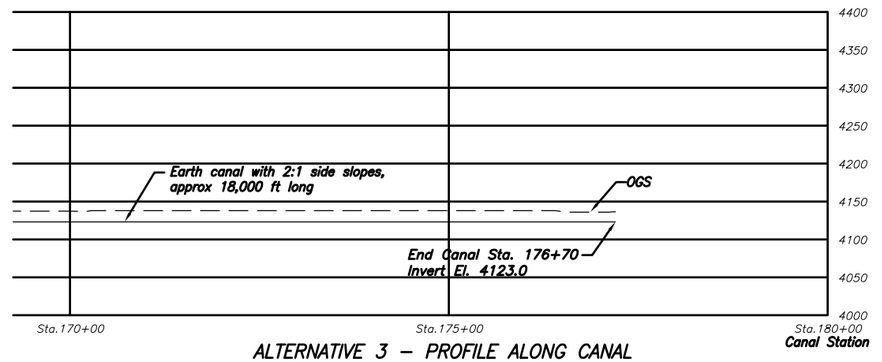

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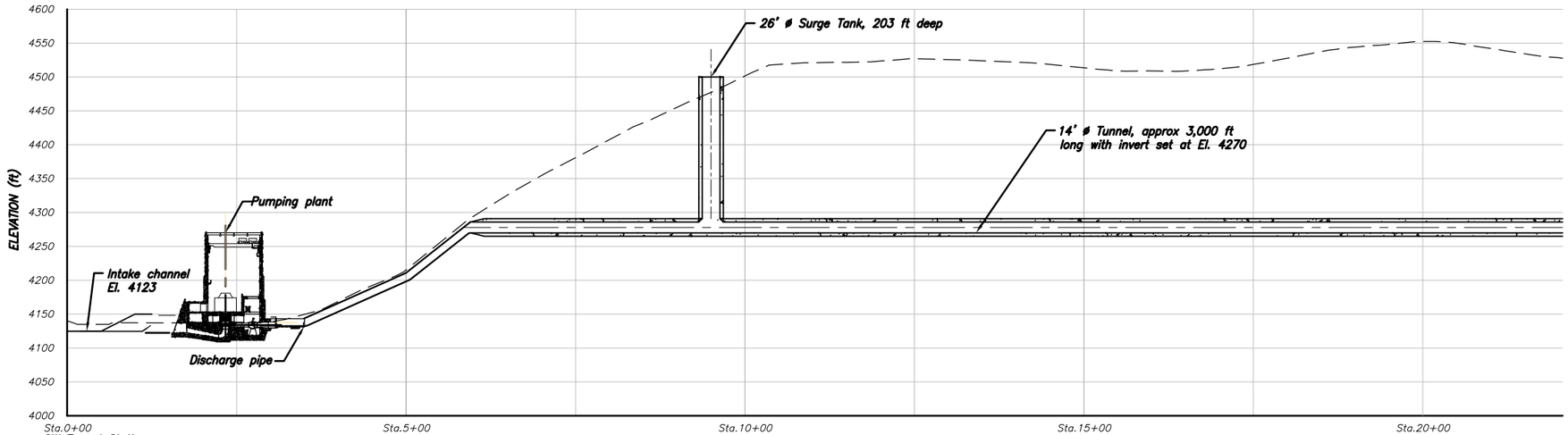

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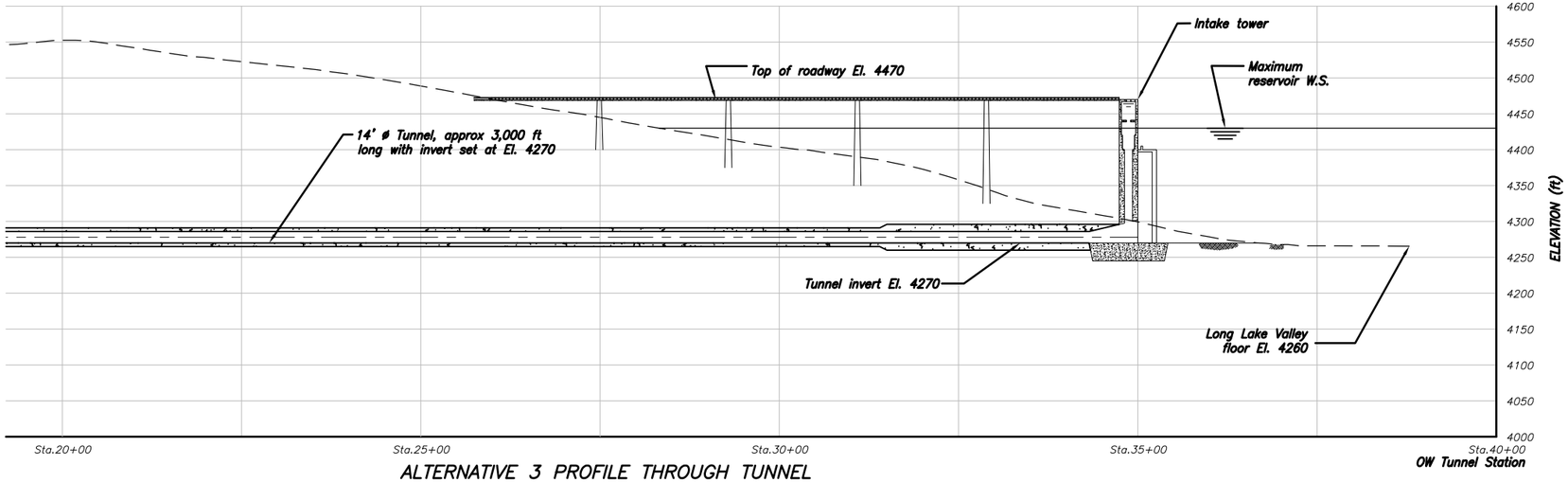

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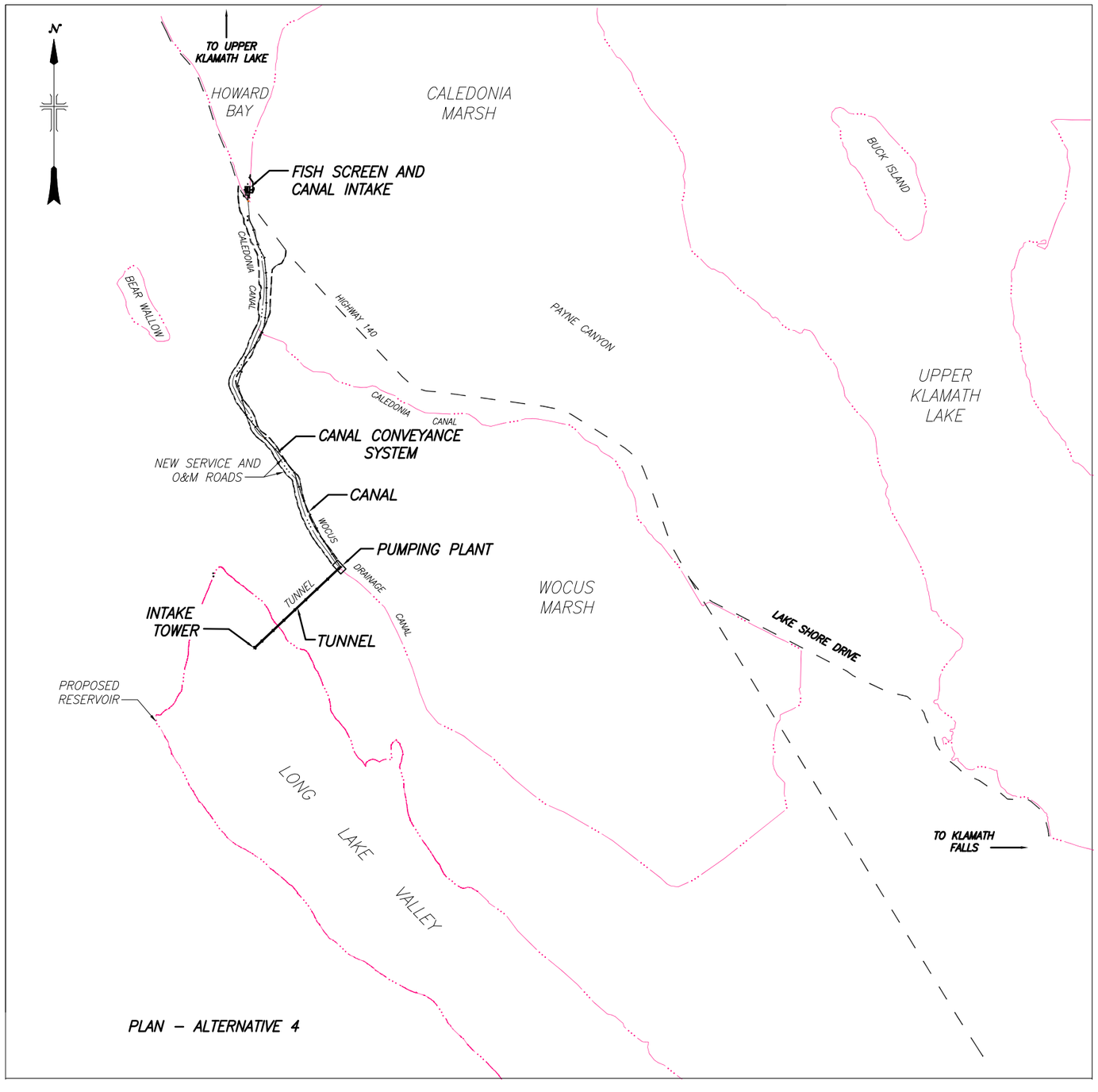

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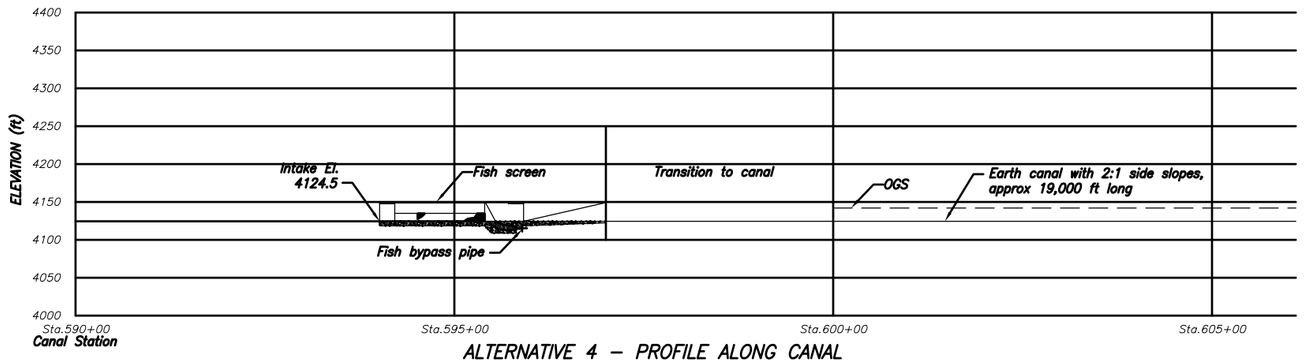

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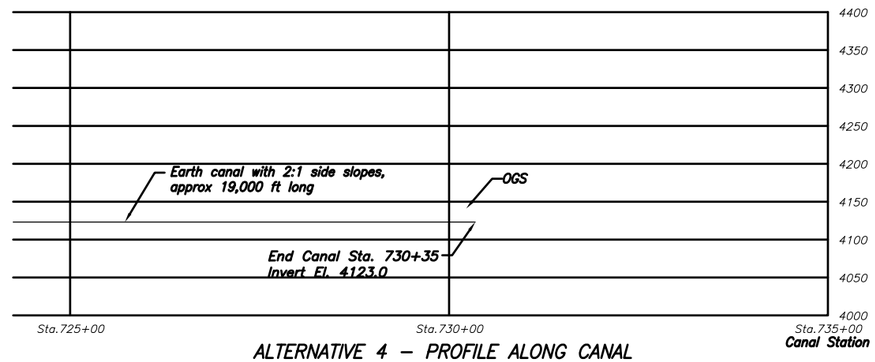

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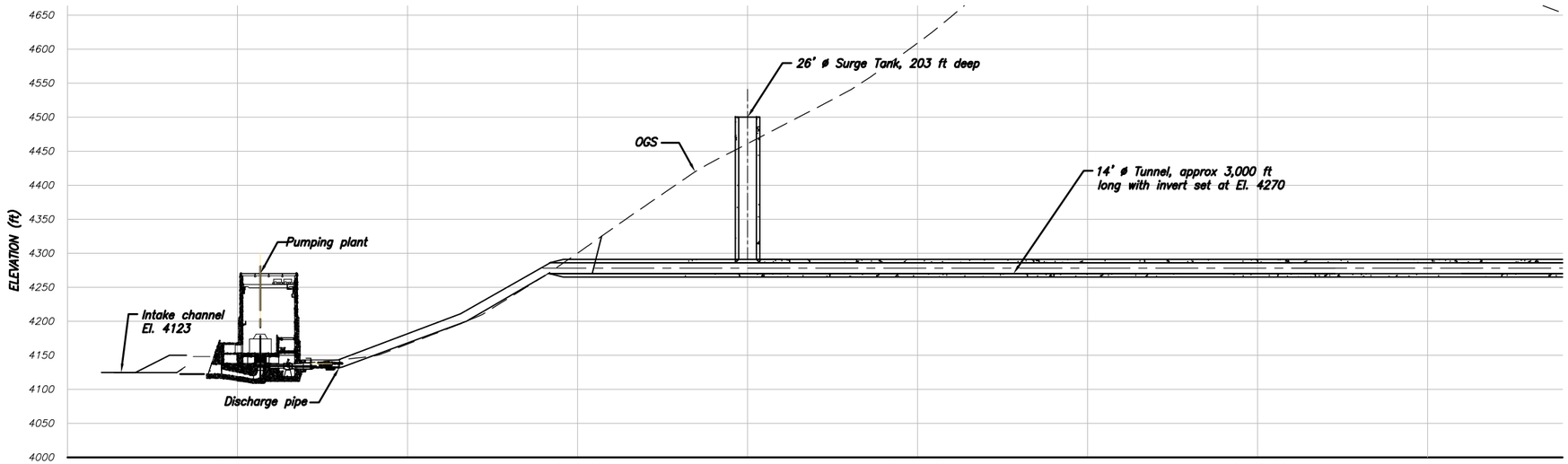

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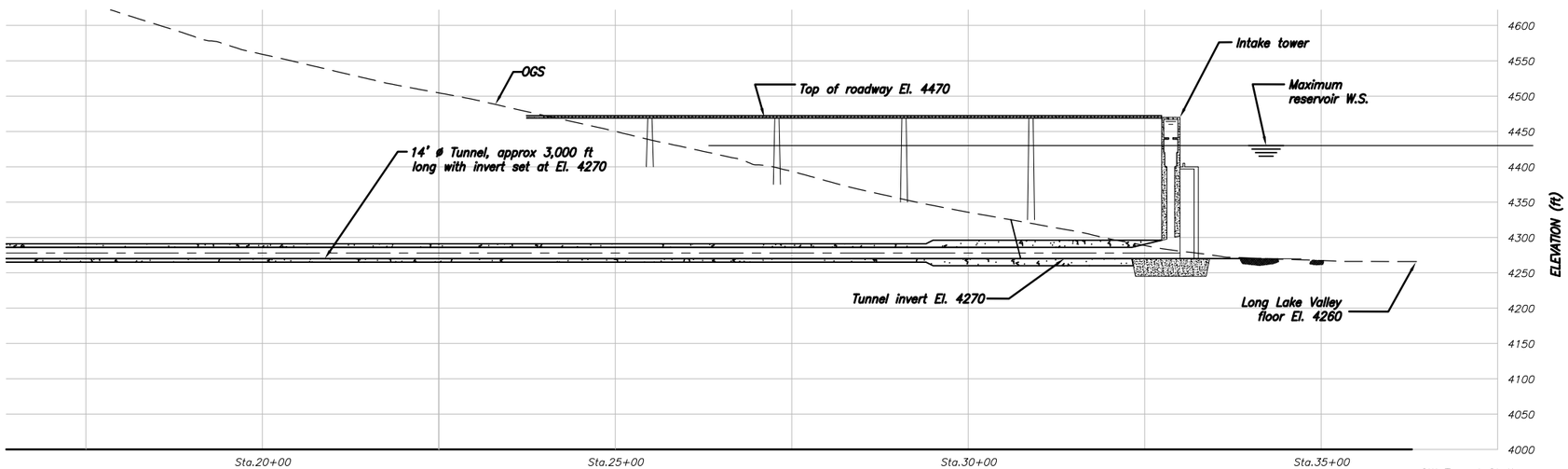

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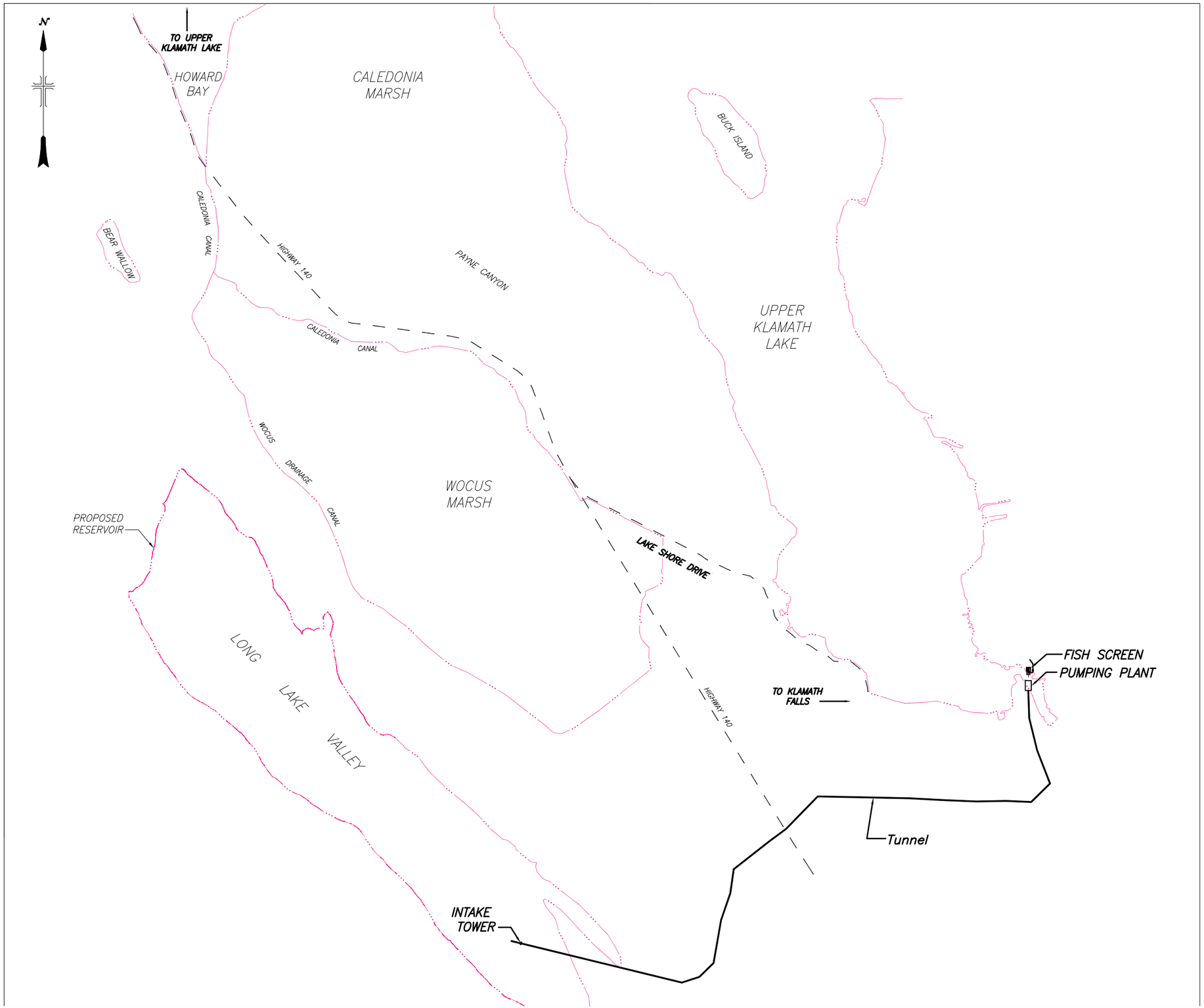

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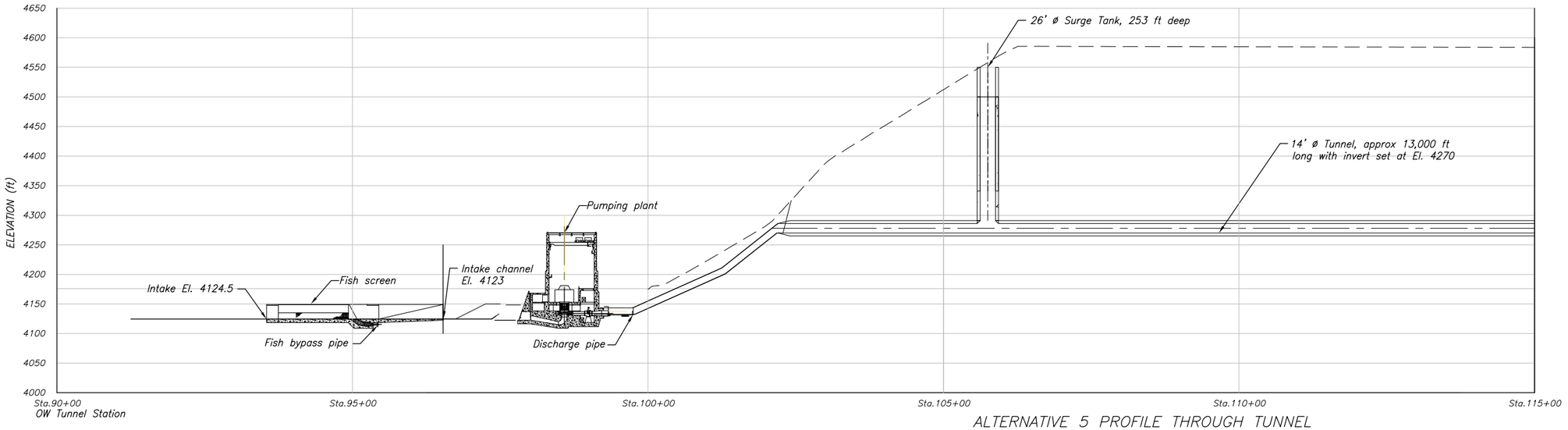

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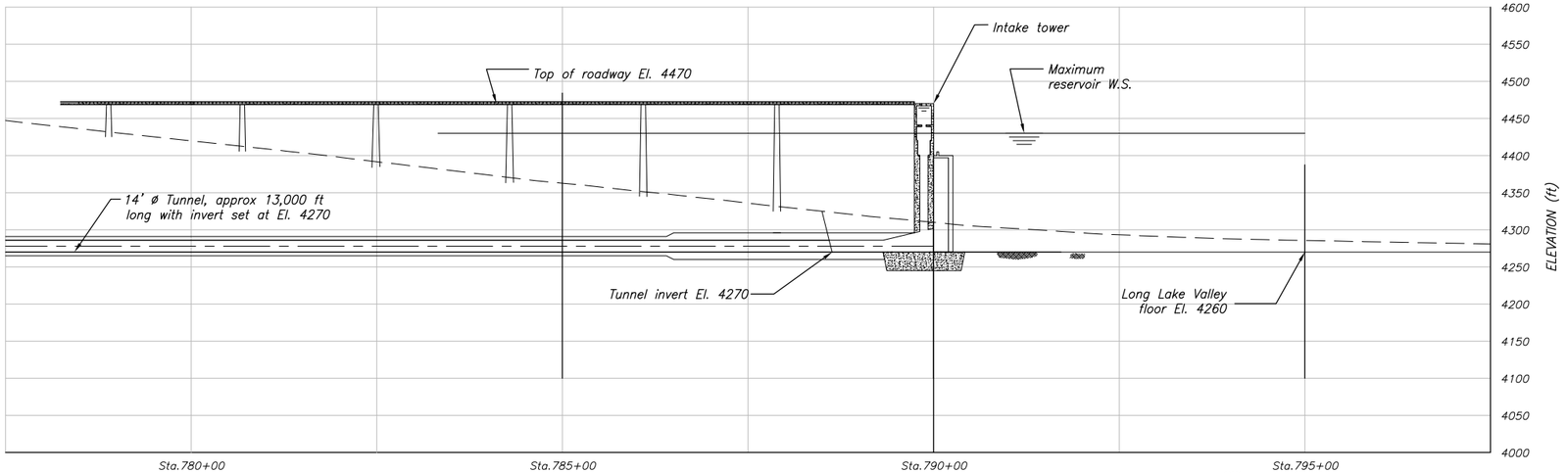

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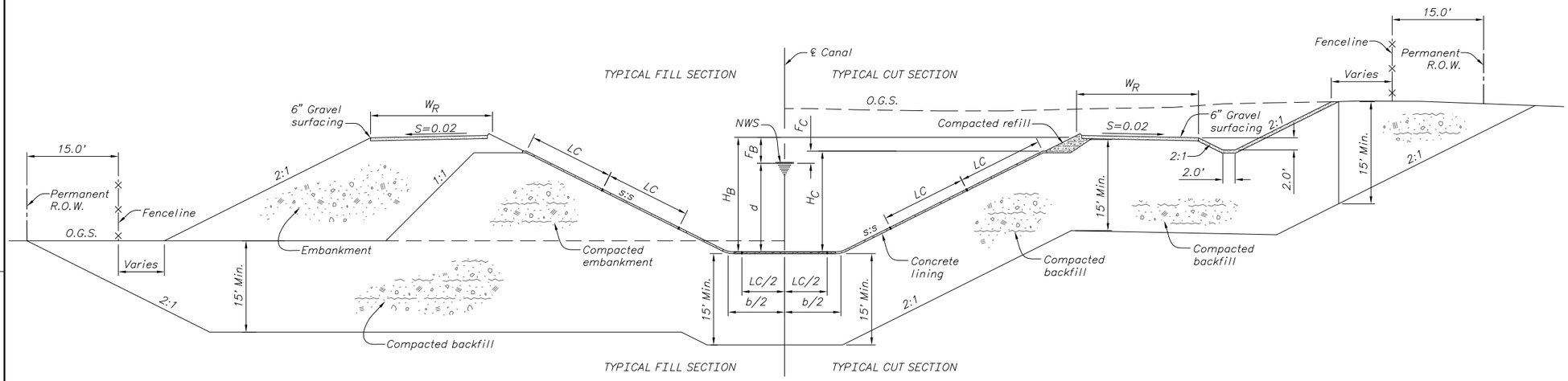
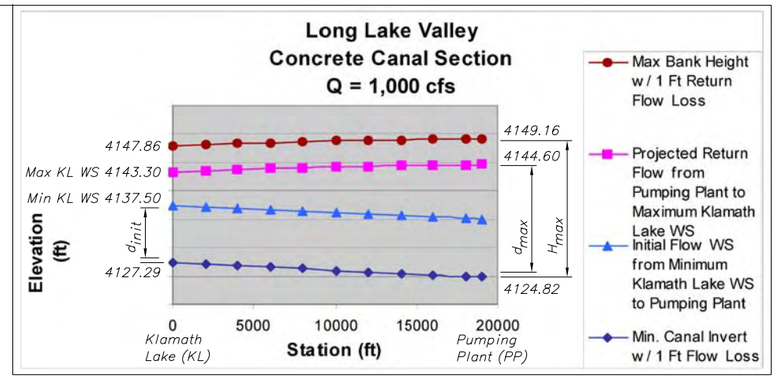
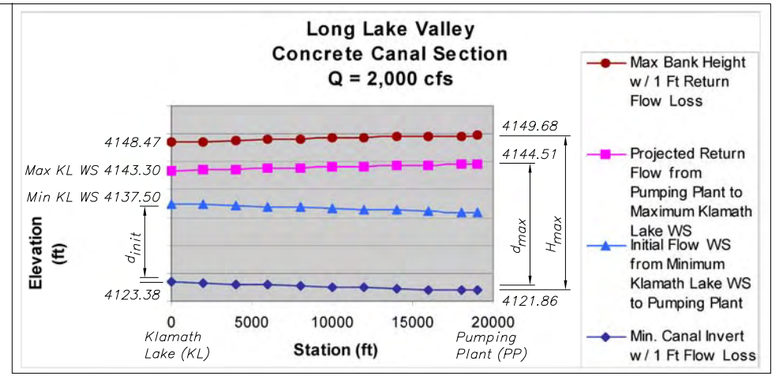


TYPICAL CANAL SECTION

CONCRETE LINED CANAL																		
HYDRAULIC PROPERTIES—INITIAL FLOW									PROPERTIES FOR MAXIMUM SECTION—RETURN FLOW									
Q	A	V_{max}	r	n	s	d	b		d_{max}	F_C	F_B	H_C	H_B	H_{max}	t	LC_t	LC_l	LC_p	W_R	s:s
1000	289.10	3.46	5.34	0.015	0.00013	9.20	13		18.78	1.60	3.56	20.38	22.34	24.34	3.0	12	12	20	18	2 :1
2000	582.99	3.43	7.59	0.015	0.00008	13.16	18		21.65	1.95	4.17	23.60	25.82	27.82	3.5	14	14	20	20	2 :1

Explanation of Symbols:
A= Area of flow (ft 2)
b = Canal bottom width (ft)
C–C = Center to center spacing of contraction joints
d = Normal depth (ft)
EGL = Energy grade line
F_L = Freeboard distance from NWS to top of earth lining (ft)
F_C = Freeboard distance from NWS to top of concrete lining (ft)
F_B = Freeboard distance from NWS to top of bank (ft)
HGL = Hydraulic grade line
H_L = Height of earth lining above NWS (ft)
H_C = Height of concrete lining above NWS (ft)
H_B = Height of bank above NWS (ft)
KL = Klamath Lake
L = Width of lining lip (ft)
LC = Contraction joint spacing (ft)
L.L. = Liquid limit
n = Mannings "n"
NWS = Normal water surface
OGS = Original ground surface
P = Perimeter of concrete lining (ft)
P.I. = Plasticity Index
PP = Pumping Plant
Q = Canal design capacity (cfs)
r = Hydraulic radius (ft)
S = Energy slope
S_c = Critical engergy slope
S:S = Canal sideslopes (Horizontal/Vertical)
t = Thickness of concrete lining (inches)
t_1 = Vertical thickness of earth lining at invert (ft)
t_2 = Horizontal thickness of earth lining along sideslopes (ft)
TF = Tractive Force (62.4)(d)(s)
t_s = Thickness of gravel surfacing (inches)
V = Canal velocity (ft/sec)
W_R = Width of O & M Road (ft)
WS = Water Surface





NOTES

Canal section slopes downward from Sta. 0+00 to Sta. 190+00. Maximum water depth at Sta. 190+00 is required for flow to return against the adverse slope.
Due to potential for unsuitable foundation material in the area, overexcavation to a depth 15 feet below OGS or structure limits has been assumed.
Concrete canal lining is based on material strength of : concrete at 28 days f'c= 3,000 lbs/in^2.
Safety ladders or escapes are required every 750' along the canal, alternating on each side.

CONCRETE 1000 CFS

INITIAL STATION (FT)	INVERT ELEV. (FT)	INITIAL H.G.L. ELEV	HGL ELEV PROJECT TO KLAMATH Low WS	PROJECTED INVERT EL Minus 1 FT Loss	RETURN STATION (FT)	RETURN H.G.L. ELEV.	RETURN HGL ELEV PROJECT TO KLAMATH High WS	Plus BANK HEIGHT FREEBOARD (FT)	Plus 1 FT Return Flow Loss
0	102.47	111.68	4137.50	4127.29	19000	113.01	4144.60	4148.16	4149.16
2000	102.21	111.42	4137.24	4127.03	18000	112.98	4144.57	4148.13	4149.13
4000	101.95	111.16	4136.98	4126.77	16000	112.90	4144.50	4148.06	4149.06
6000	101.69	110.90	4136.72	4126.51	14000	112.81	4144.41	4147.97	4148.97
8000	101.43	110.64	4136.46	4126.25	12000	112.73	4144.32	4147.88	4148.88
10000	101.17	110.38	4136.20	4125.99	10000	112.62	4144.21	4147.77	4148.77
12000	100.91	110.11	4135.93	4125.73	8000	112.50	4144.09	4147.65	4148.65
14000	100.65	109.85	4135.67	4125.47	6000	112.34	4143.94	4147.50	4148.50
16000	100.39	109.59	4135.41	4125.21	4000	112.18	4143.77	4147.33	4148.33
18000	100.13	109.32	4135.14	4124.95	2000	111.96	4143.56	4147.12	4148.12
19000	100.00	109.19	4135.01	4124.82	0	111.71	4143.30	4146.86	4147.86

CONCRETE 2000 CFS

INITIAL STATION (FT)	INVERT ELEV. (FT)	INITIAL H.G.L. ELEV	HGL ELEV PROJECT TO KLAMATH Low WS	PROJECTED INVERT EL Minus 1 FT Loss	RETURN STATION (FT)	RETURN H.G.L. ELEV.	RETURN HGL ELEV PROJECT TO KLAMATH High WS	Plus BANK HEIGHT FREEBOARD (FT)	Plus 1 FT Return Flow Loss
0	101.52	114.64	4137.50	4123.38	19000	115.71	4144.51	4148.68	4149.68
2000	101.36	114.46	4137.33	4123.22	18000	115.66	4144.47	4148.64	4149.64
4000	101.20	114.29	4137.16	4123.06	16000	115.58	4144.38	4148.55	4149.55
6000	101.04	114.12	4136.99	4122.90	14000	115.48	4144.28	4148.45	4149.45
8000	100.88	113.95	4136.82	4122.74	12000	115.37	4144.18	4148.35	4149.35
10000	100.72	113.77	4136.64	4122.58	10000	115.26	4144.06	4148.23	4149.23
12000	100.56	113.60	4136.47	4122.42	8000	115.14	4143.94	4148.11	4149.11
14000	100.40	113.42	4136.28	4122.26	6000	115.00	4143.80	4147.97	4148.97
16000	100.24	113.24	4136.10	4122.10	4000	114.85	4143.65	4147.82	4148.82
18000	100.08	113.07	4135.93	4121.94	2000	114.68	4143.48	4147.65	4148.65
19000	100.00	112.98	4135.84	4121.86	0	114.50	4143.30	4147.47	4148.47

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL LEVEL ESTIMATE

TYPICAL CONCRETE CANAL SECTIONS SECTIONS AND DETAILS

DESIGNED _____

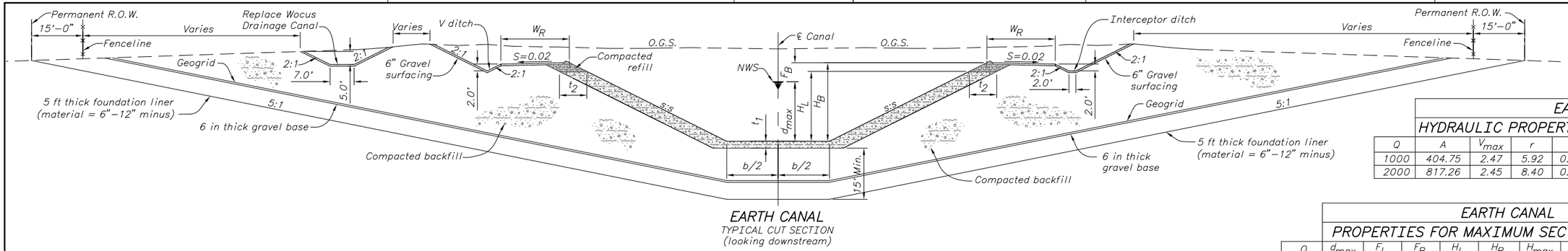
REVIEWED BY _____

DENVER, COLORADO June 11, 2008
SHEET 1 OF 1

Figure B13 (Final Draft)

DATE AND TIME PLOTTED
OCTOBER 17, 2008 09:44
PLOTTED BY
PREYNOLDS

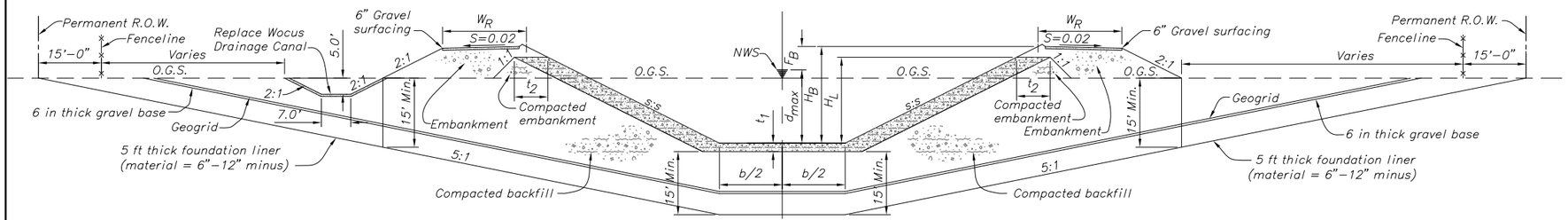
CAD SYSTEM
AutoCAD Rel. 17.1s
CAD FILENAME
LLV CANAL SECTIONS_RECOVER NEW2.DWG



EARTH CANAL
TYPICAL CUT SECTION
(looking downstream)

EARTH CANAL HYDRAULIC PROPERTIES–INITIAL FLOW							
Q	A	V_{max}	r	n	s	d	b
1000	404.75	2.47	5.92	0.0225	0.00013	8.58	30
2000	817.26	2.45	8.40	0.0225	0.00008	12.15	43

EARTH CANAL PROPERTIES FOR MAXIMUM SECTION–RETURN FLOW										
Q	d_{max}	F_L	F_B	H_L	H_B	H_{max}	t_1	t_2	W_R	s:s
1000	17.44	1.01	3.56	18.45	21.00	23.00	2.0	8.0	18	2 :1
2000	20.45	1.26	4.17	21.71	24.62	26.62	2.0	8.0	20	2 :1



EARTH CANAL
TYPICAL FILL SECTION
(looking downstream)

EXPLANATION OF SYMBOLS

- A = Area of flow (ft²)
- b = Canal bottom width (ft)
- C–C = Center to center spacing of contraction joints
- d = Normal depth (ft)
- EGL = Energy grade line
- F_L = Freeboard distance from NWS to top of earth lining (ft)
- F_C = Freeboard distance from NWS to top of concrete lining (ft)
- F_B = Freeboard distance from NWS to top of bank (ft)
- HGL = Hydraulic grade line
- H_L = Height of earth lining above NWS (ft)
- H_C = Height of concrete lining above NWS (ft)
- H_B = Height of bank above NWS (ft)
- KL = Klamath Lake
- L = Width of lining lip (ft)
- LC = Contraction joint spacing (ft)
- LL = Liquid Limit
- n = Mannings "n"
- NWS = Normal water surface
- OGS = Original ground surface
- P = Perimeter of concrete lining (ft)
- PI = Plasticity Index
- PP = Pumping Plant
- Q = Canal design capacity (cfs)
- r = Hydraulic radius (ft)
- S = Energy slope
- S_c = Critical engergy slope
- S:S = Canal sideslopes (Horizontal/Vertical)
- t = Thickness of concrete lining (inches)
- t_1 = Vertical thickness of earth lining at invert (ft)
- t_2 = Horizontal thickness of earth lining along sideslopes (ft)
- TF = Tractive Force (62.4)(d)(s)
- t_s = Thickness of gravel surfacing (inches)
- V = Canal velocity (ft/sec)
- W_R = Width of O & M Road (ft)
- WS = Water Surface

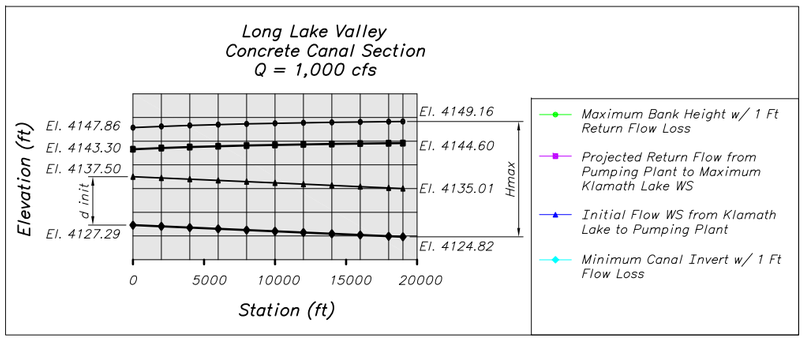
NOTES

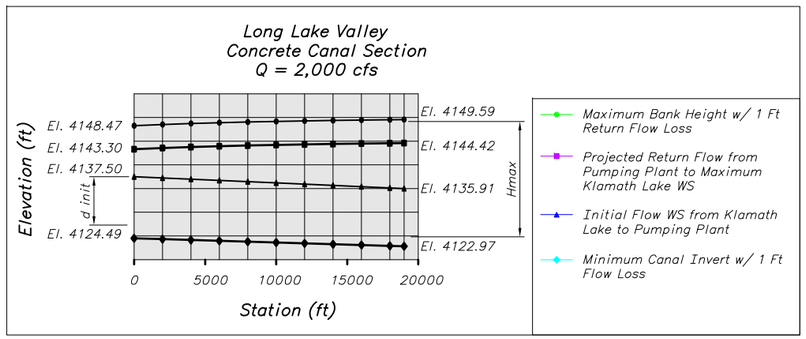
Canal section slopes downward from Sta. 0+00 to Sta. 190+00. Maximum water depth at Sta. 190+00 is required for flow to return against the adverse slope.

Due to potential for unsuitable foundation material in the area, overexcavation to a depth 15 feet below OGS or structure limits has been assumed.

Concrete canal lining is based on material strength of : concrete at 28 days f'c= 3,000 lbs/in².

Safety ladders or escapes are required every 750' along the canal, alternating on each side.





EARTH 1000 CFS									
			HGL ELEV	PROJECTED			RETURN HGL ELEV	Plus BANK	
INITIAL STATION (FT)	INVERT ELEV. (FT)	INITIAL H.G.L. ELEV.	PROJECT TO KLAMATH Low WS	INVERT EL Minus 1 FT Loss	RETURN STATION (FT)	RETURN H.G.L. ELEV.	PROJECT TO KLAMATH Hgh WS	HEIGHT FREEBOARD (FT)	Plus 1 FT Return Flow Loss
0	102.47	110.98	4137.50	4127.99	19000	111.90	4143.96	4147.52	4148.52
2000	102.21	110.86	4137.37	4127.73	18000	111.88	4143.94	4147.50	4148.50
4000	101.95	110.75	4137.27	4127.47	16000	111.84	4143.90	4147.46	4148.46
6000	101.69	110.65	4137.16	4127.21	14000	111.79	4143.85	4147.41	4148.41
8000	101.43	110.55	4137.07	4126.95	12000	111.74	4143.80	4147.36	4148.36
10000	101.17	110.45	4136.97	4126.69	10000	111.69	4143.75	4147.31	4148.31
12000	100.91	110.38	4136.89	4126.43	8000	111.62	4143.68	4147.24	4148.24
14000	100.65	110.29	4136.81	4126.17	6000	111.55	4143.60	4147.16	4148.16
16000	100.39	110.22	4136.74	4125.91	4000	111.46	4143.52	4147.08	4148.08
18000	100.13	110.16	4136.67	4125.65	2000	111.36	4143.42	4146.98	4147.98
19000	100.00	110.12	4136.64	4125.52	0	111.24	4143.30	4146.86	4147.86

EARTH 2000 CFS									
			HGL ELEV	PROJECTED			RETURN HGL ELEV	Plus BANK	
INITIAL STATION (FT)	INVERT ELEV. (FT)	INITIAL H.G.L. ELEV.	PROJECT TO KLAMATH Low WS	INVERT EL Minus 1 FT Loss	RETURN STATION (FT)	RETURN H.G.L. ELEV.	PROJECT TO KLAMATH High WS	HEIGHT FREEBOARD (FT)	Plus 1 FT Return Flow Loss
0	101.52	113.53	4137.50	4124.49	19000	114.60	4144.42	4148.59	4149.59
2000	101.36	113.36	4137.33	4124.33	18000	114.56	4144.38	4148.55	4149.55
4000	101.20	113.19	4137.16	4124.17	16000	114.48	4144.30	4148.47	4149.47
6000	101.04	113.03	4137.00	4124.01	14000	114.39	4144.20	4148.37	4149.37
8000	100.88	112.86	4136.83	4123.85	12000	114.28	4144.10	4148.27	4149.27
10000	100.72	112.70	4136.67	4123.69	10000	114.18	4144.00	4148.17	4149.17
12000	100.56	112.53	4136.50	4123.53	8000	114.07	4143.88	4148.05	4149.05
14000	100.40	112.36	4136.33	4123.37	6000	113.94	4143.76	4147.93	4148.93
16000	100.24	112.19	4136.16	4123.21	4000	113.80	4143.61	4147.78	4148.78
18000	100.08	112.02	4135.99	4123.05	2000	113.65	4143.47	4147.64	4148.64
19000	100.00	111.94	4135.91	4122.97	0	113.48	4143.30	4147.47	4148.47

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U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL LEVEL ESTIMATE

TYPICAL EARTH CANAL SECTIONS
SECTIONS AND DETAILS

DESIGNED _____

REVIEWED BY _____

DENVER, COLORADO June 11, 2008
SHEET 1 OF 1

Figure B14 (Final Draft)

DATE AND TIME PLOTTED
OCTOBER 17, 2008 09:44
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AREYNOLDS

CAD SYSTEM
AutoCAD R14 17.1s
CAD FILENAME
LLV CANAL SECTIONS_RECOVER NEW2.DWG

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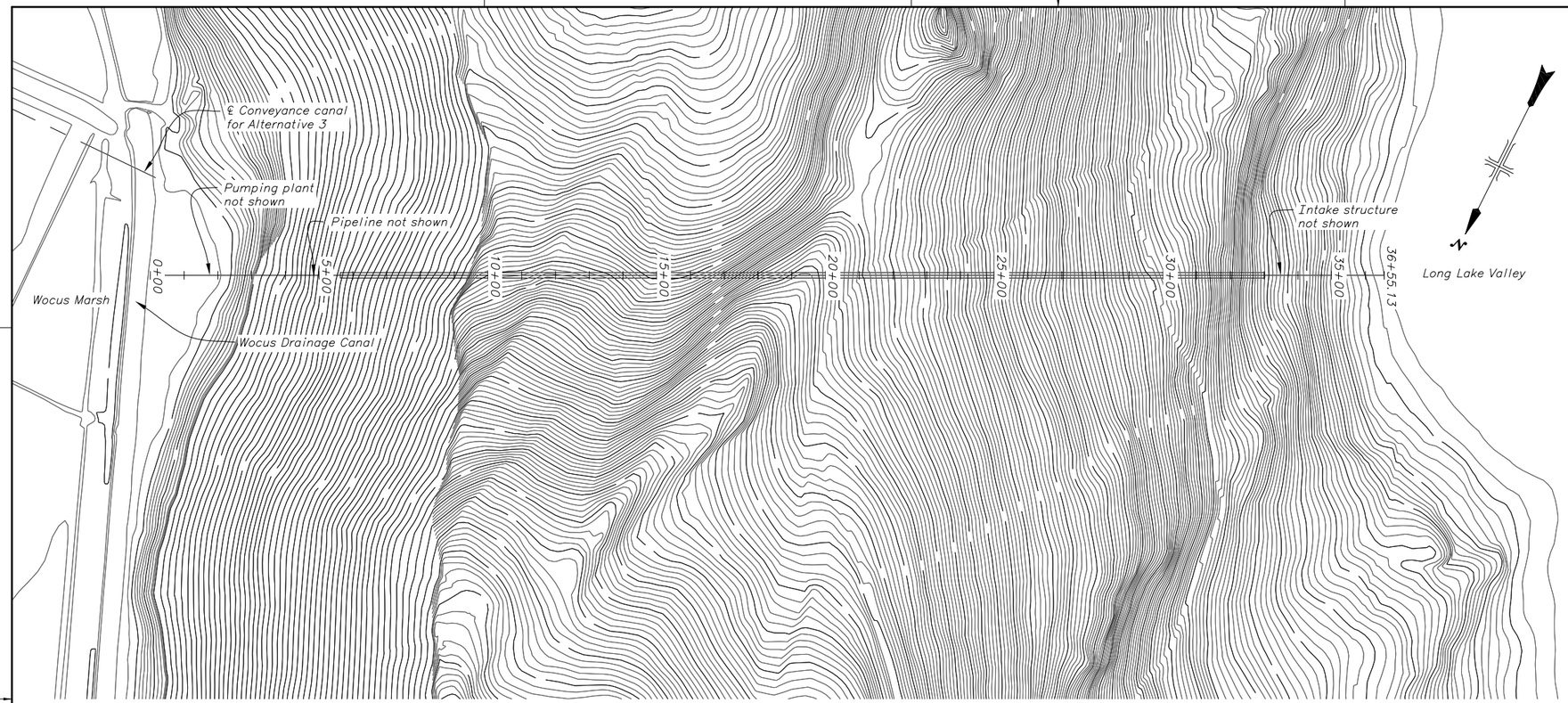
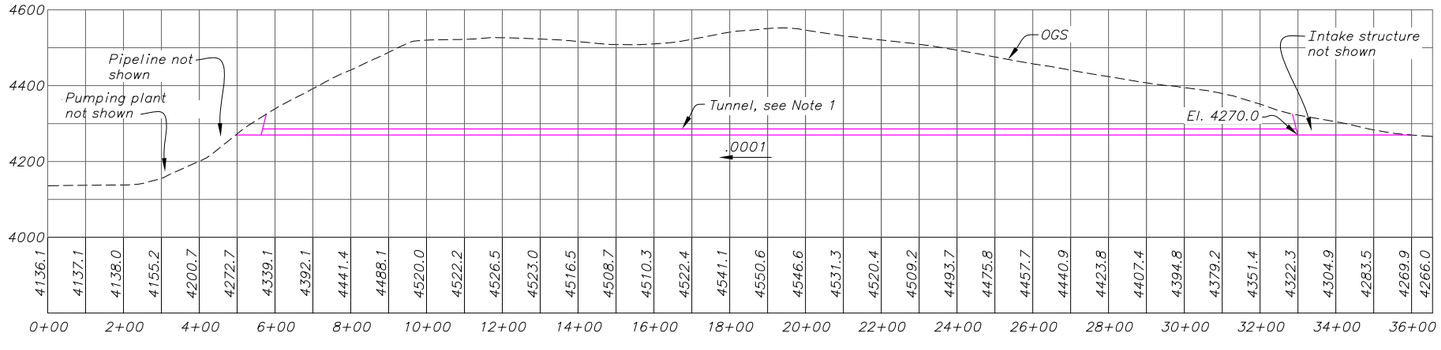
Managing Water in the West



PLAN

200 0 200 400 600
SCALE OF FEET



PROFILE

200 0 200 400 600
SCALE OF FEET

NOTES

1) Finished tunnel diameter = 10.25 feet for 1000 c.f.s. flow and 14.25 feet for 2000 c.f.s. flow.

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U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL LEVEL ESTIMATE

TUNNEL PLAN AND PROFILE ALTERNATIVES NO. 1 AND 3

DESIGNED _____ CHECKED _____
DRAWN _____ TECH. APPR. _____ NAME – TITLE
APPROVED _____ NAME – PEER REVIEWER

DENVER, COLORADO
SHEET 1 OF 1

Figure B15 (Final Draft)

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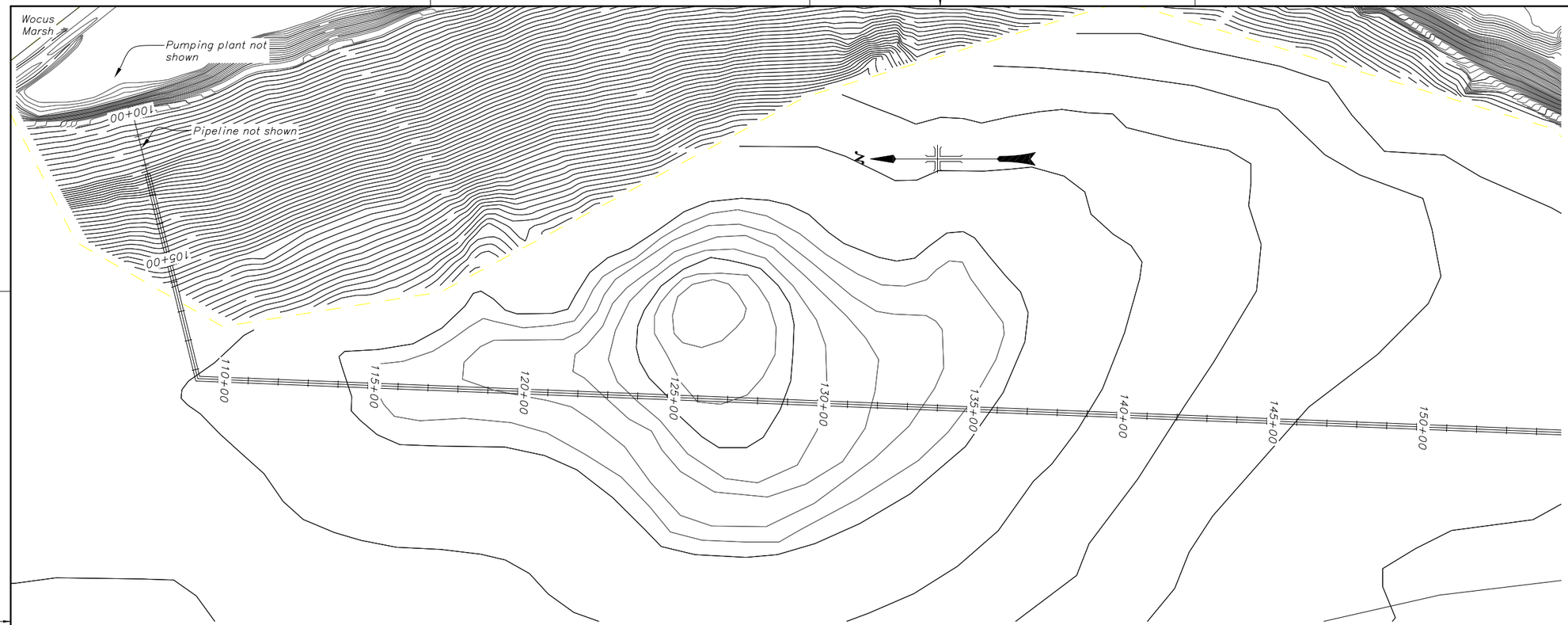
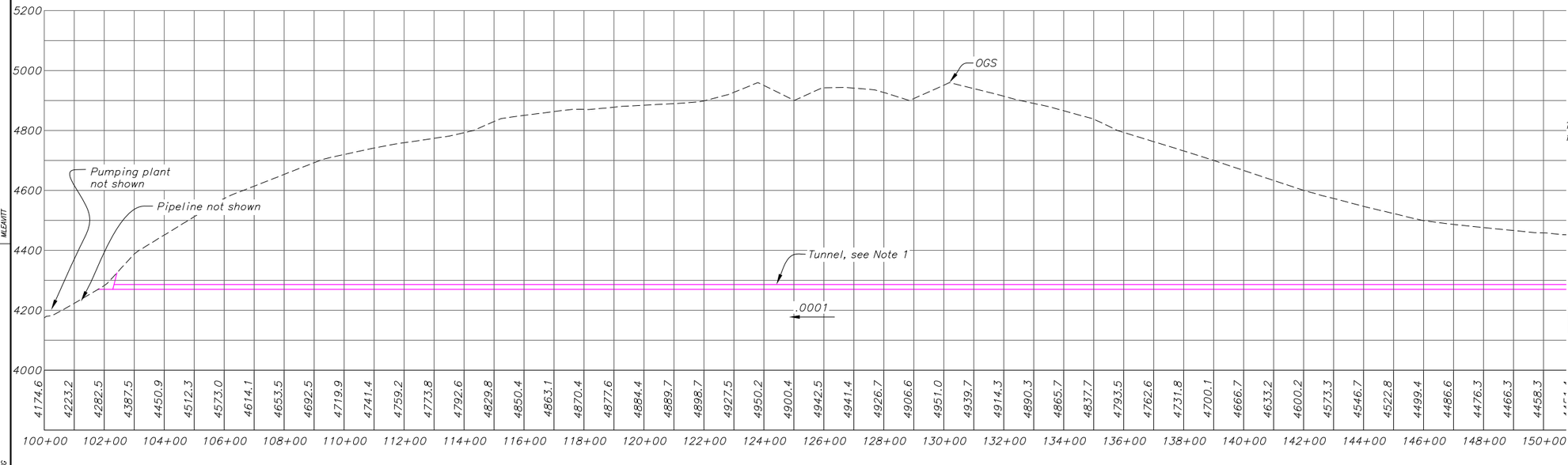
MLEAHY

CAD SYSTEM
AutoCAD RM 17.1s
CAD FILENAME
LLV TUNNEL KALONG



PLAN

200 0 200 400 600
SCALE OF FEET



PROFILE

200 0 200 400 600
SCALE OF FEET

NOTES

1) Finished tunnel diameter = 10.25 feet for 1000 c.f.s. flow and 14.25 feet for 2000 c.f.s. flow.

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL LEVEL ESTIMATE
TUNNEL PLAN AND PROFILE
ALTERNATIVE NO. 2
STA. 100+00 TO 150+00

DESIGNED _____ CHECKED _____
DRAWN _____ TECH. APPR. _____
NAME – TITLE
APPROVED _____
NAME – PEER REVIEWER

DENVER, COLORADO
SHEET 1 OF 3

Figure B16 (Final Draft)

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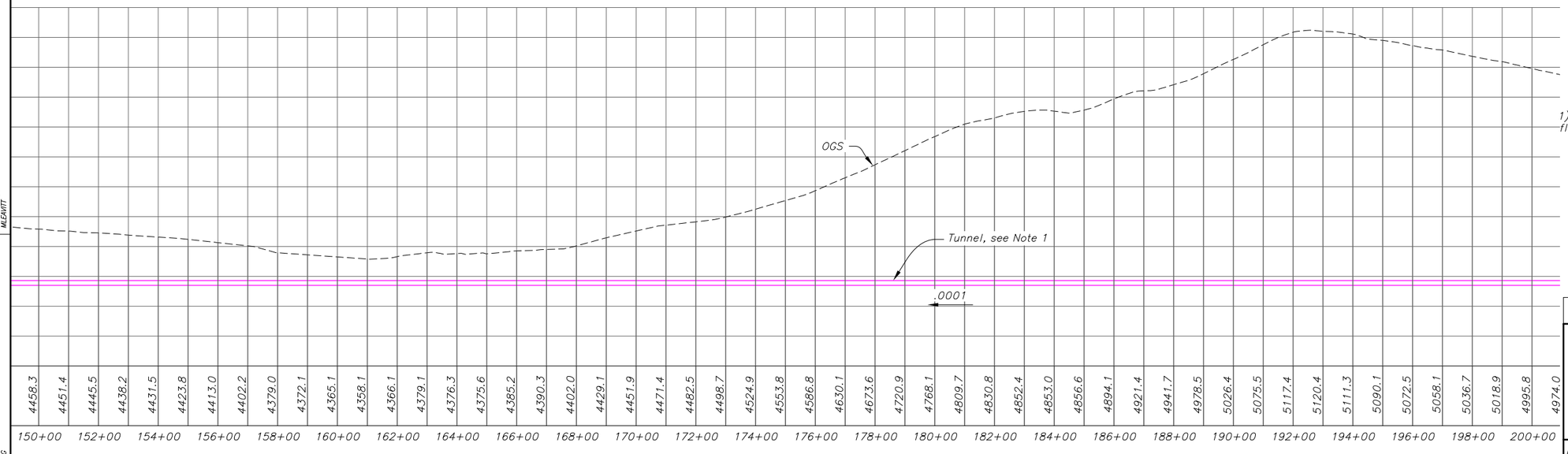
MLEAVITT

CAD SYSTEM
AutoCAD Rel. 17.1s
CAD FILENAME
LLV TUNNEL KALONG

RECLAMATION
Managing Water in the West



PLAN
200 0 200 400 600
SCALE OF FEET



150+00	152+00	154+00	156+00	158+00	160+00	162+00	164+00	166+00	168+00	170+00	172+00	174+00	176+00	178+00	180+00	182+00	184+00	186+00	188+00	190+00	192+00	194+00	196+00	198+00	200+00
4458.3	4451.4	4445.5	4438.2	4431.5	4423.8	4413.0	4402.2	4379.0	4372.1	4365.1	4358.1	4366.1	4379.1	4376.3	4375.6	4385.2	4390.3	4402.0	4429.1	4451.9	4471.4	4482.5	4498.7	4524.9	4553.8	4586.8	4630.1	4673.6	4720.9	4768.1	4809.7	4830.8	4852.4	4853.0	4856.6	4894.1	4921.4	4941.7	4978.5	5026.4	5075.5	5117.4	5120.4	5111.3	5090.1	5072.5	5058.1	5036.7	5018.9	4995.8	4974.0

PROFILE
200 0 200 400 600
SCALE OF FEET

NOTES

1) Finished tunnel diameter = 10.25 feet for 1000 c.f.s. flow and 14.25 feet for 2000 c.f.s. flow.

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL LEVEL ESTIMATE
TUNNEL PLAN AND PROFILE
ALTERNATIVE NO. 2
STA. 150+00 TO 200+00

DESIGNED _____ CHECKED _____
DRAWN _____ TECH. APPR. _____ NAME – TITLE
APPROVED _____ NAME – PEER REVIEWER

DENVER, COLORADO
SHEET 2 OF 3

Figure B17 (Final Draft)

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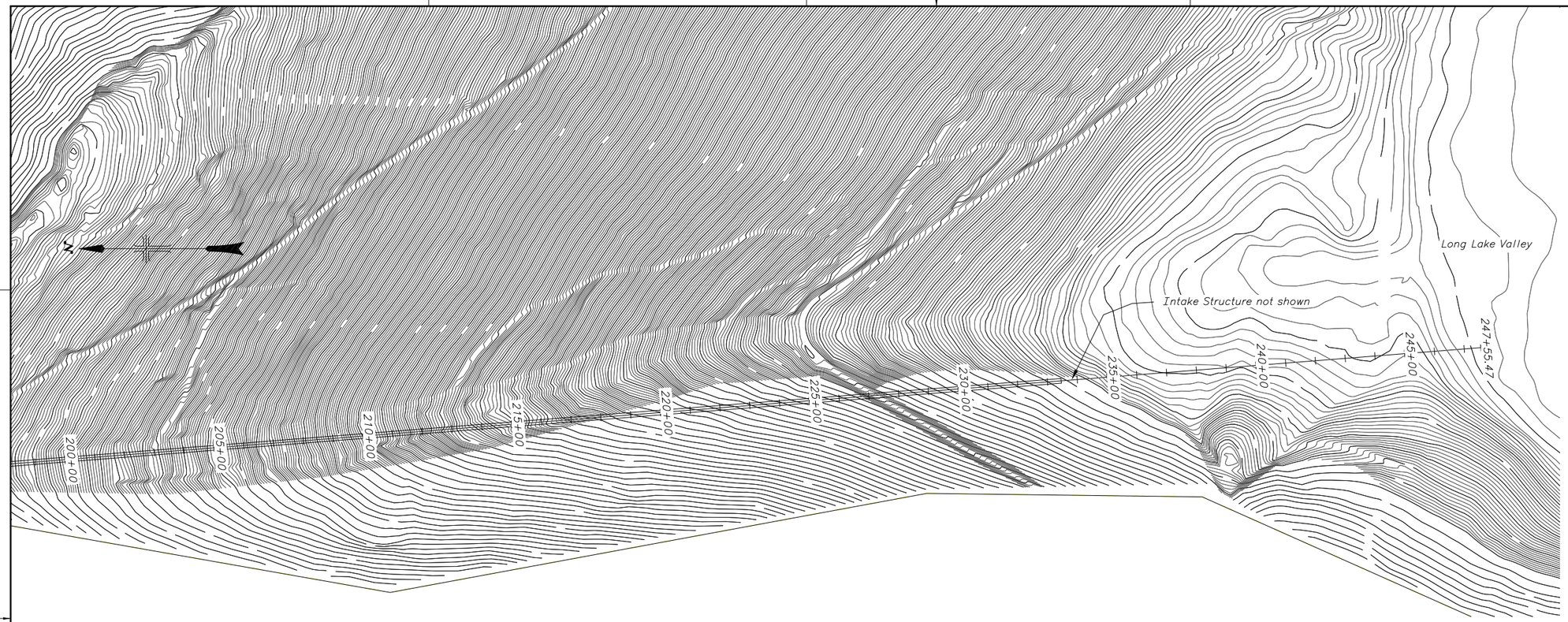
CAD SYSTEM
AutoCAD Rel. 17.1s
CAD FILENAME
LLV TUNNEL KALONG

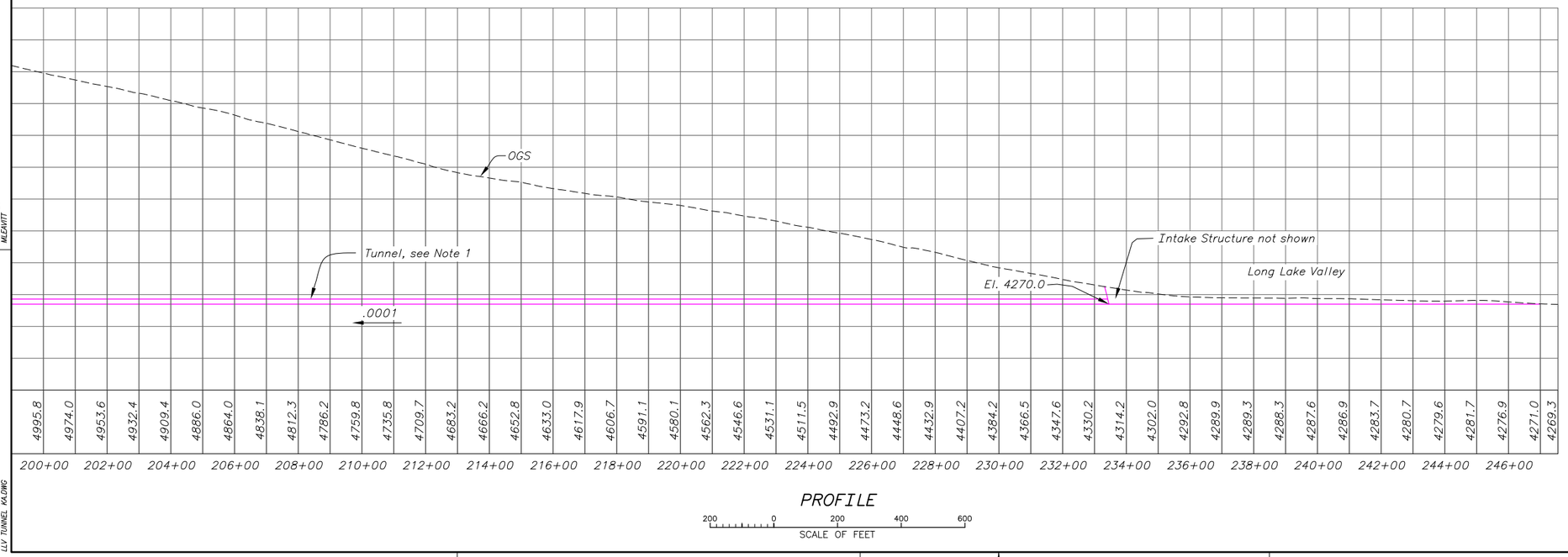
STA. 200+00 TO 250+00

RECLAMATION
Managing Water in the West



PLAN

200 0 200 400 600
SCALE OF FEET



PROFILE

200 0 200 400 600
SCALE OF FEET

NOTES

1) Finished tunnel diameter = 10.25 feet for 1000 c.f.s. flow and 14.25 feet for 2000 c.f.s. flow.

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL LEVEL ESTIMATE

TUNNEL PLAN AND PROFILE
ALTERNATIVE NO. 2
STA. 200+00 TO 250+00

DESIGNED _____ CHECKED _____

DRAWN _____ TECH. APPR. _____
NAME – TITLE

APPROVED _____
NAME – PEER REVIEWER

DENVER, COLORADO
SHEET 3 OF 3

Figure B18 (Final Draft)

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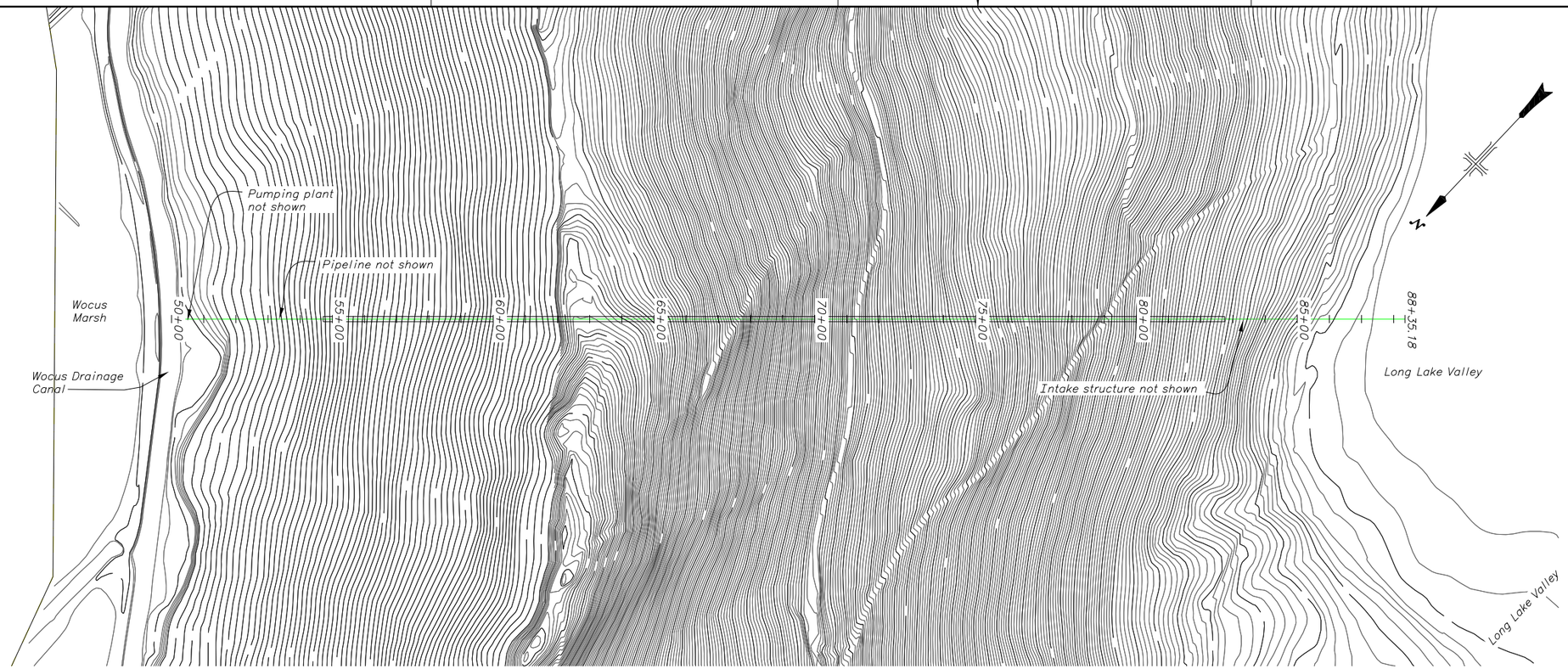
MLEAVITT

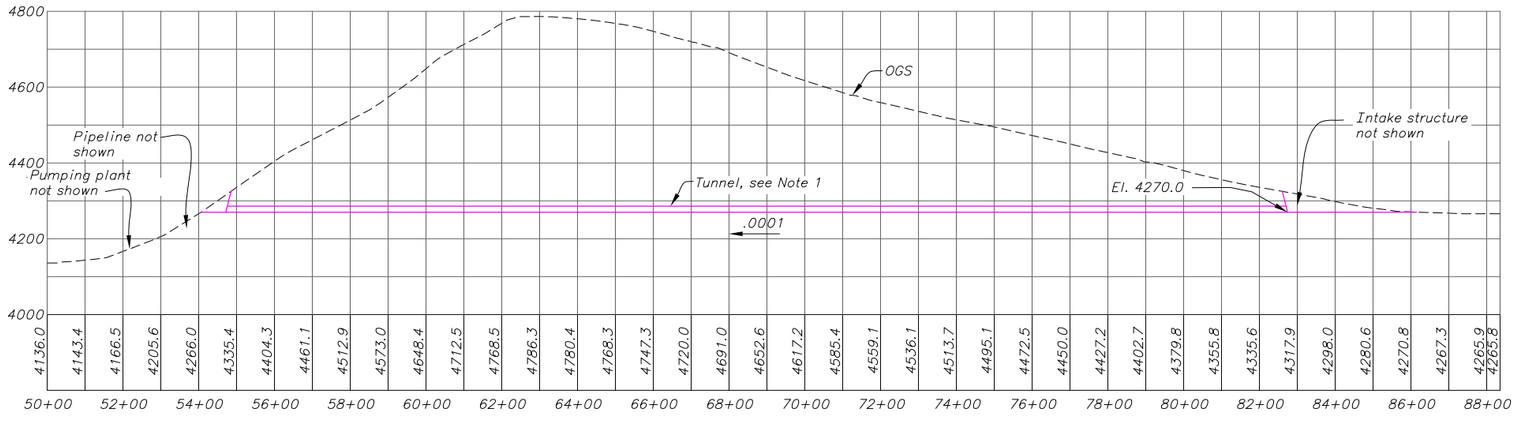
CAD SYSTEM
AutoCAD Rel. 17.1s
CAD FILENAME
LLV TUNNEL KALONG

RECLAMATION
Managing Water in the West



PLAN

200 0 200 400 600
SCALE OF FEET



PROFILE

200 0 200 400 600
SCALE OF FEET

NOTES

1) Finished tunnel diameter = 10.25 feet for 1000 c.f.s. flow and 14.25 feet for 2000 c.f.s. flow.

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL LEVEL ESTIMATE

TUNNEL PLAN AND PROFILE
ALTERNATIVE NO. 4

DESIGNED _____ CHECKED _____
DRAWN _____ TECH. APPR. _____ NAME – TITLE
APPROVED _____ NAME – PEER REVIEWER

DENVER, COLORADO
SHEET 1 OF 1

Figure B19 (Final Draft)

DATE AND TIME PLOTTED
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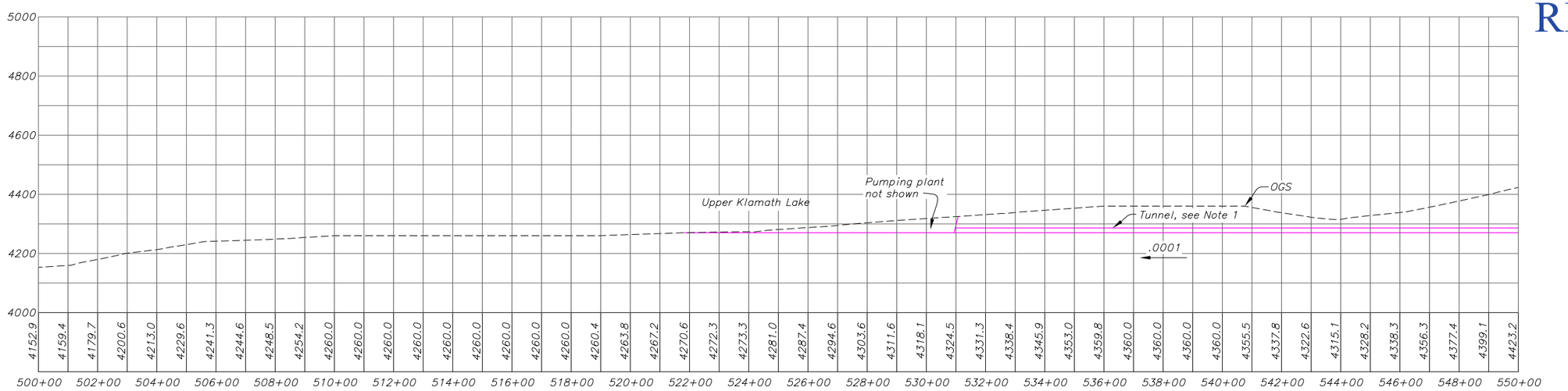
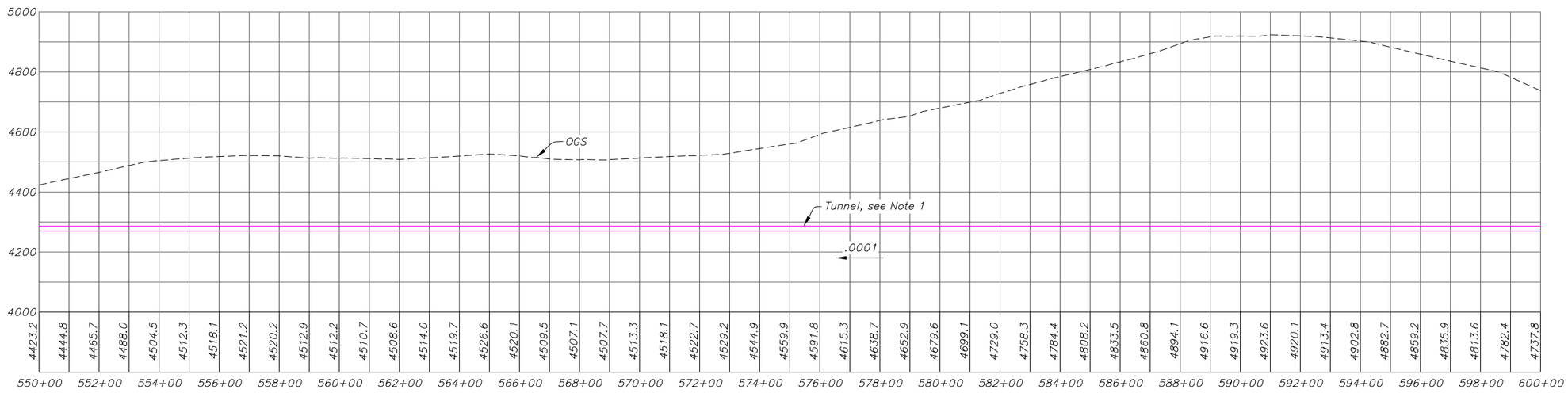
CAD SYSTEM
AutoCAD RM 17.1s
CAD FILENAME
LLV TUNNEL KALONG





PROFILE

200 0 200 400 600
SCALE OF FEET

NOTES

1) Finished tunnel diameter = 10.25 feet for 1000 c.f.s. flow and 14.25 feet for 2000 c.f.s. flow.

RECLAMATION
Managing Water in the West

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U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL LEVEL ESTIMATE

TUNNEL PLAN AND PROFILE
ALTERNATIVE NO. 5
STA. 500+00 TO 600+00

DESIGNED _____ CHECKED _____
DRAWN _____ TECH. APPR. _____ NAME – TITLE
APPROVED _____ NAME – PEER REVIEWER

DENVER, COLORADO
SHEET 1 OF 3

Figure B20 (Final Draft)

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AutoCAD Rel. 17.1s
CAD FILENAME
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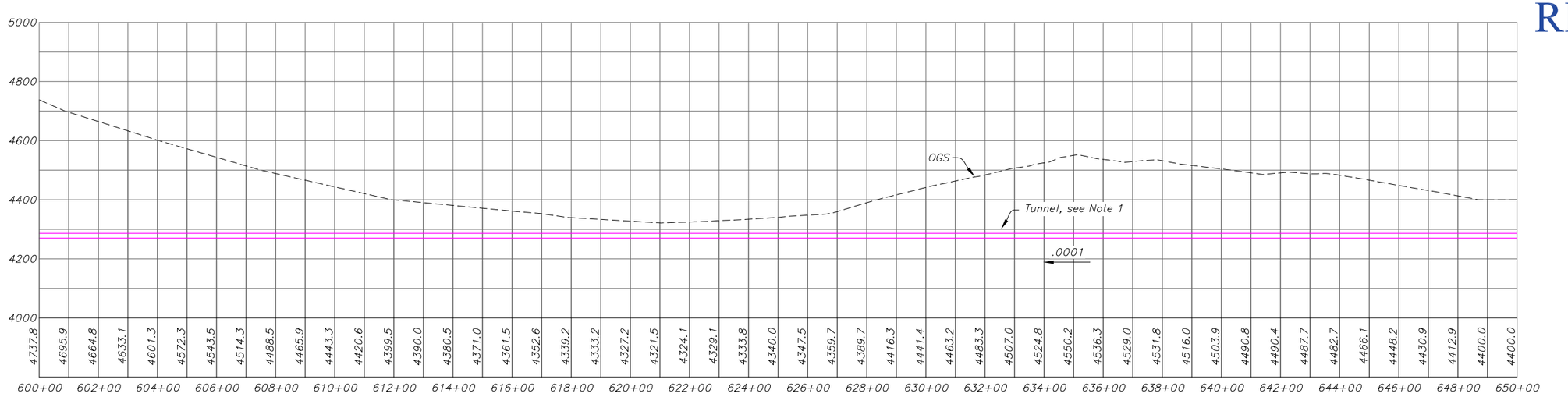

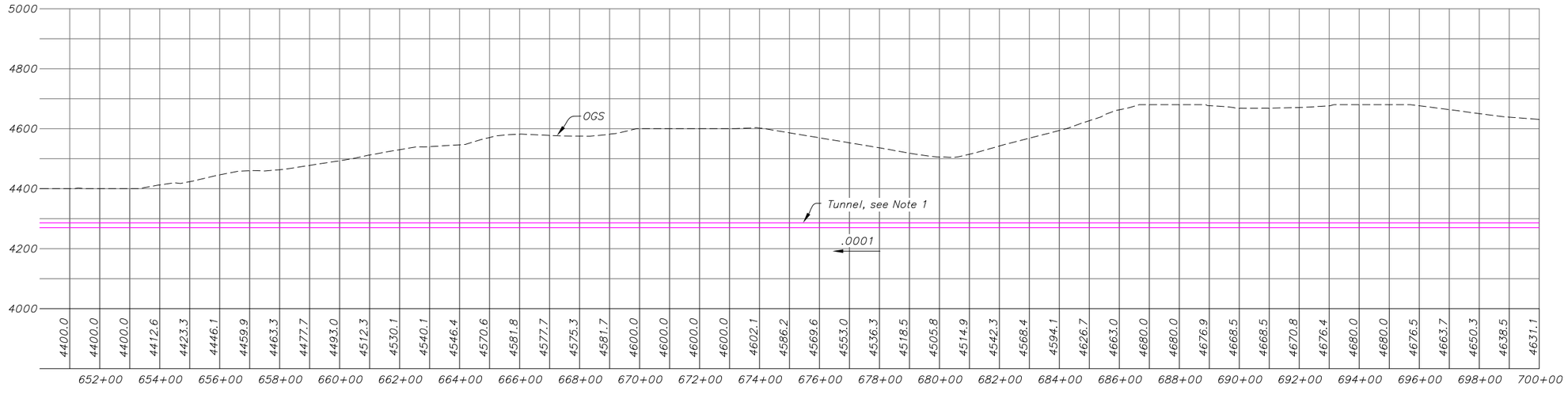

PROFILE

200 0 200 400 600
SCALE OF FEET

NOTES

1) Finished tunnel diameter = 10.25 feet for 1000 c.f.s. flow and 14.25 feet for 2000 c.f.s. flow.

RECLAMATION
Managing Water in the West

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL LEVEL ESTIMATE

TUNNEL PLAN AND PROFILE
ALTERNATIVE NO. 5
STA. 600+00 TO 700+00

DESIGNED _____ CHECKED _____
DRAWN _____ TECH. APPR. _____ NAME – TITLE
APPROVED _____ NAME – PEER REVIEWER

DENVER, COLORADO
SHEET 2 OF 3

Figure B21 (Final Draft)

DATE AND TIME PLOTTED
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MLEAVITT

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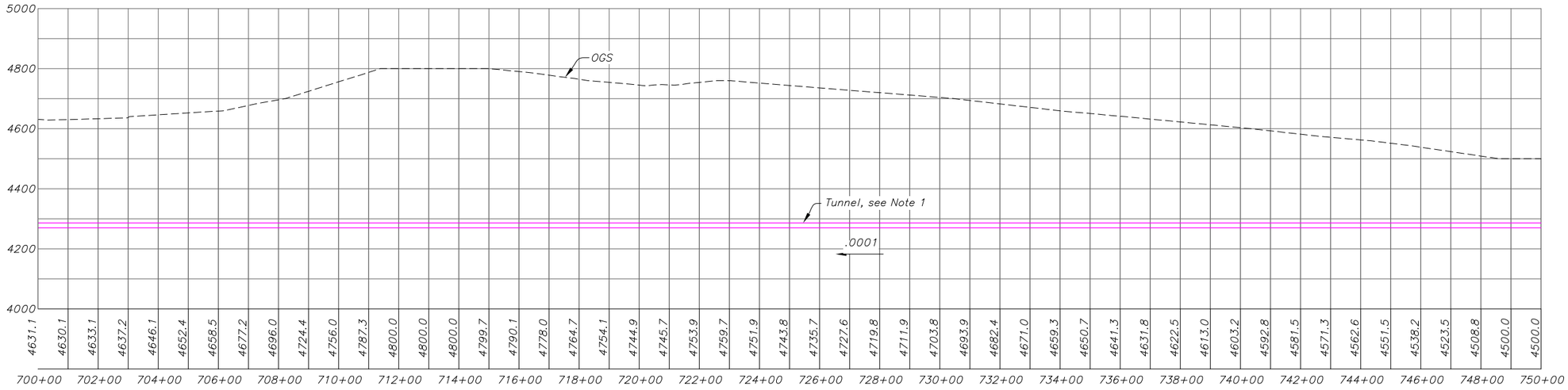
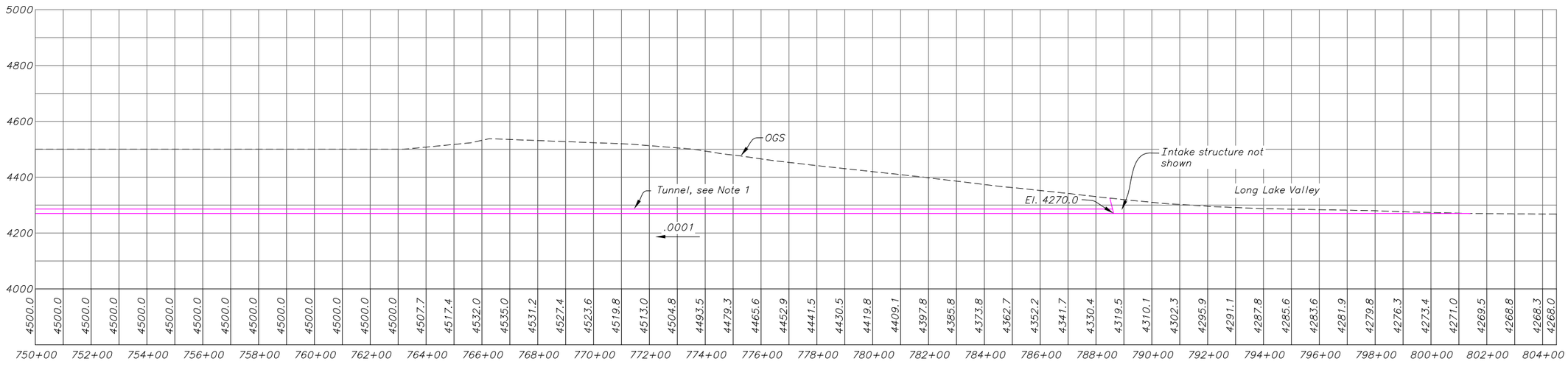
AutoCAD Rel. 17.1s
CAD FILENAME
LLV TUNNEL KALONG





PROFILE

200 0 200 400 600
SCALE OF FEET

NOTES

1) Finished tunnel diameter = 10.25 feet for 1000 c.f.s. flow and 14.25 feet for 2000 c.f.s. flow.

RECLAMATION
Managing Water in the West

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KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY
APPRAISAL LEVEL ESTIMATE
TUNNEL PLAN AND PROFILE
ALTERNATIVE NO. 5
STA. 700+00 TO 804+50

DESIGNED _____ CHECKED _____
DRAWN _____ TECH. APPR. _____ NAME – TITLE
APPROVED _____ NAME – PEER REVIEWER

DENVER, COLORADO
SHEET 3 OF 3

Figure B22 (Final Draft)

DATE AND TIME PLOTTED
OCTOBER 21, 2008 13:51
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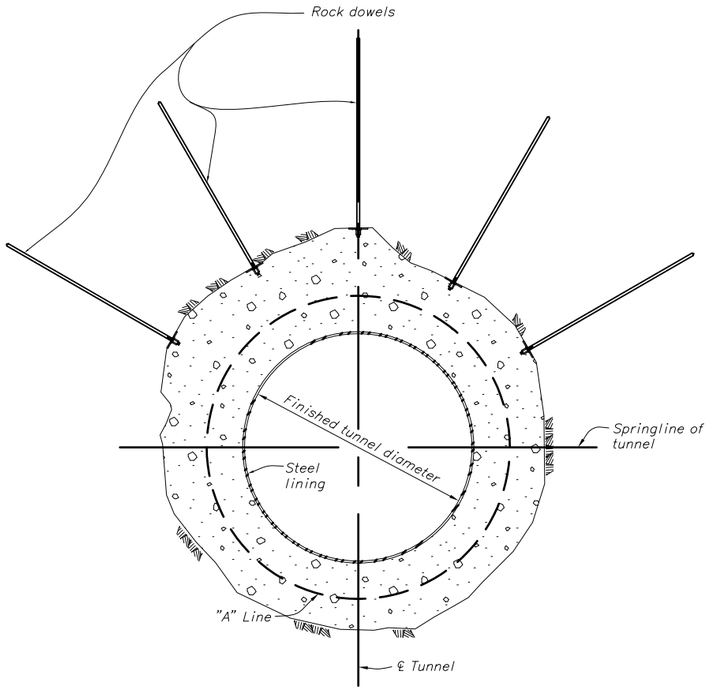
MLEAVITT

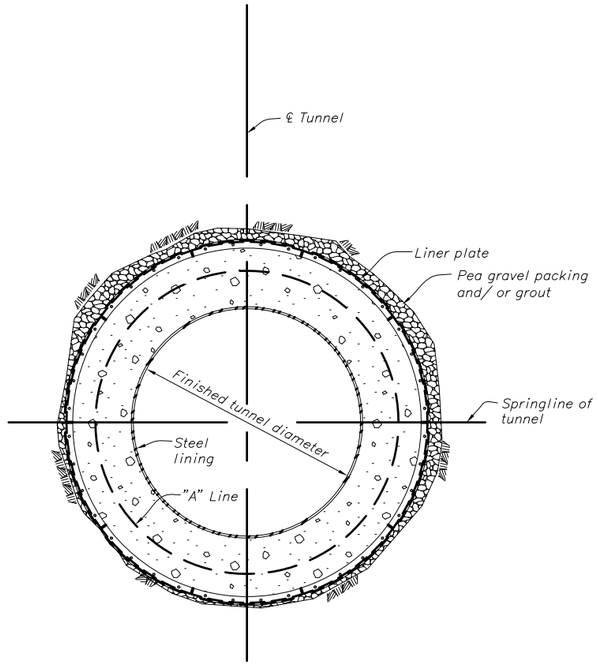
CAD SYSTEM
AutoCAD RM 17.1s
CAD FILENAME
LLV TUNNEL KA.DWG

STA. 200+00 TO 250+00

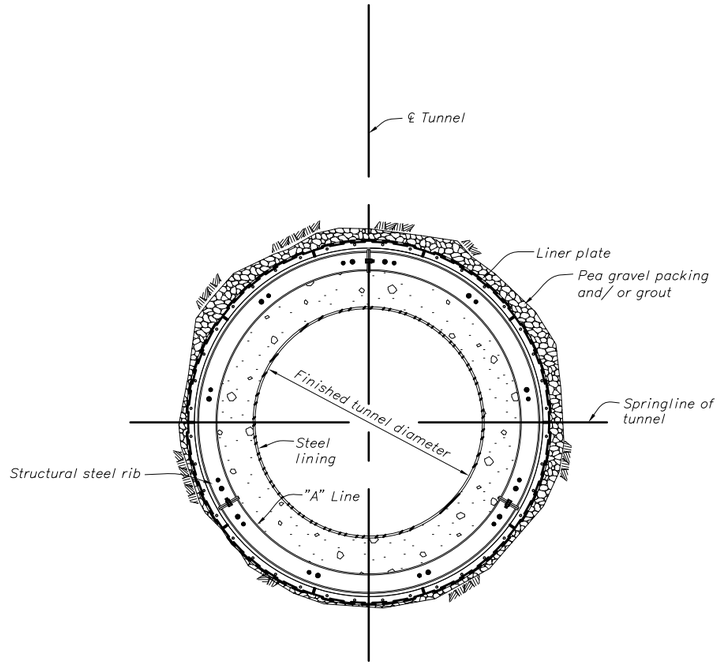
RECLAMATION
Managing Water in the West



SECTION
PATTERN ROCK ANCHORS SUPPORTED



SECTION
LINER PLATE SUPPORTED



SECTION
LINER PLATE WITH STRUCTURAL STEEL RIBS SUPPORTED

NOT TO SCALE

TUNNEL SUMMARY TABLE

Alternative	*1000 c.f.s. Finished Diameter (ft.)*	*2000 c.f.s. Finished Diameter (ft.)*	*Tunnel Length (ft.)*	*Support*				*Lining*
				Length of Tunnel Supported With Pattern Rock Anchors @ 5 feet Spacing (ft.)	*Length of Tunnel Supported With Pattern Rock Anchors @ 4 feet Spacing (ft.)*	*Length of Tunnel Supported With Liner Plate (ft.)*	*Length of Tunnel Supported With Liner Plate With Structural Steel Ribs (ft.)*	*Length of Tunnel With Steel Lining (ft.)*
1	*10.25*	*14.25*	*2,730*	*273*	*546*	*1,638*	*273*	*2,730*
2	*10.25*	*14.25*	*13,110*	*1,311*	*2,622*	*7,866*	*1,311*	*13,110*
3	*10.25*	*14.25*	*2730*	*273*	*546*	*1,638*	*273*	*2730*
4	*10.25*	*14.25*	*2,800*	*280*	*560*	*1,680*	*280*	*2,800*
5	*10.25*	*14.25*	*25,760*	*2,576*	*5,152*	*15,456*	*2,576*	*25,760*

NOTES

1. *For plan and profile of Alternative 1, see Figure .*
2. *For plan and profile of Alternative 2, see Figure .*
3. *For plan and profile of Alternative 3, see Figure .*
4. *For plan and profile of Alternative 4, see Figure .*
5. *For profile of Alternative 5, see Figure .*

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UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL LEVEL ESTIMATE

TYPICAL TUNNEL SUPPORT AND LINING SECTIONS AND TABLE

DESIGNED _____ CHECKED _____

DRAWN _____ TECH. APPR. _____

APPROVED _____

DENVER, COLORADO
SHEET 1 OF 1

Figure B23 (Final Draft)

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MEDWIT

CAD SYSTEM
AutoCAD Rel. 17.1s
CAD FILENAME
LLV TUNNEL KLAMG

RECLAMATION
Managing Water in the West



PLAN

200 0 200 400 600
SCALE OF FEET

NOTE
Pumping plant not shown.

PRELIMINARY

NOT TO BE USED FOR CONSTRUCTION

February 26, 2009

UNCHECKED

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KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING LEVEL
CONVEYANCE CANAL HEADWORKS FISH SCREEN STRUCTURE
1,000 CFS ALTERNATIVES 1, 2, AND 4
PLAN

DESIGNED – CHOU CHA
REVIEWED BY – Water Conveyance Group

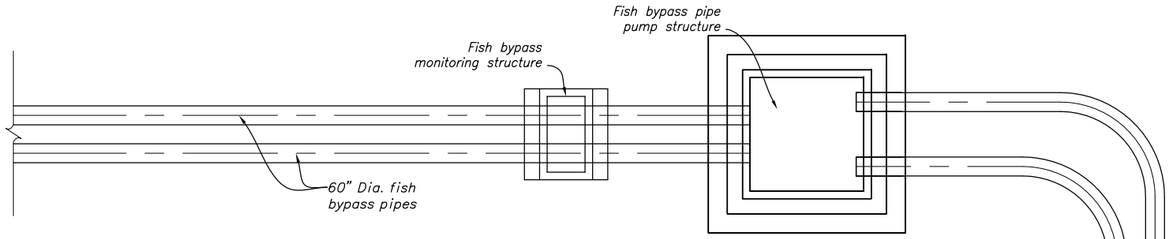
DENVER, COLORADO
SHEET 1 OF 1

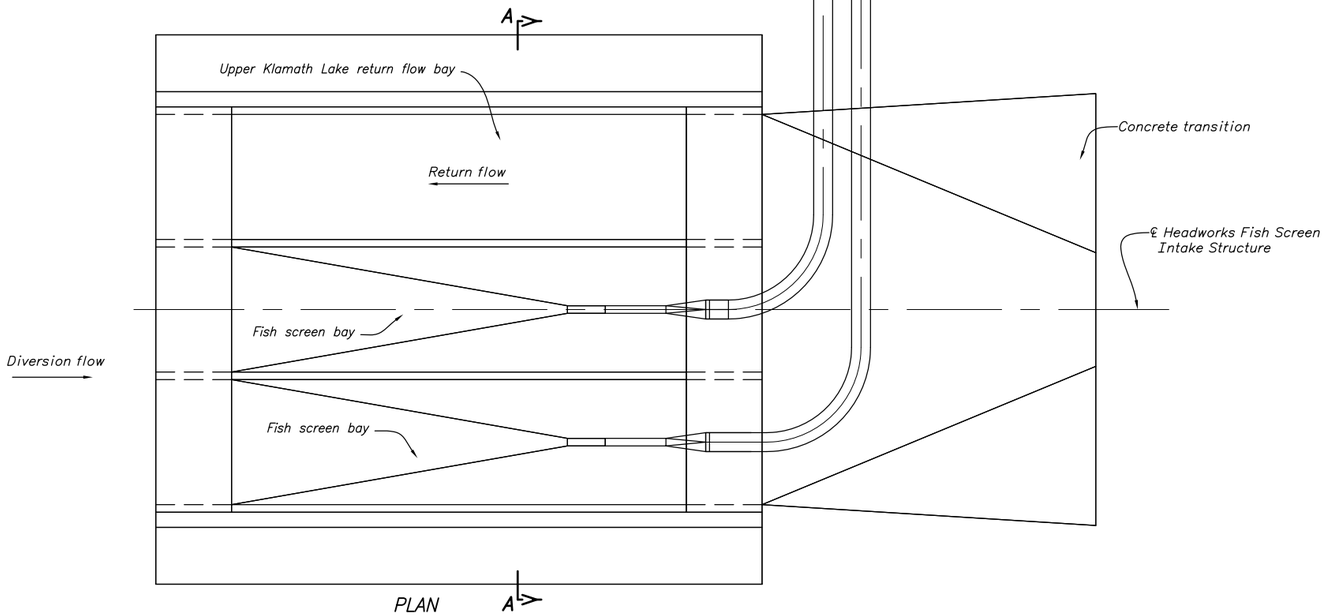
Figure B24 (Final Draft)

DATE AND TIME PLOTTED
JANUARY 8, 2009 16:37
PLOTTED BY
CCHA

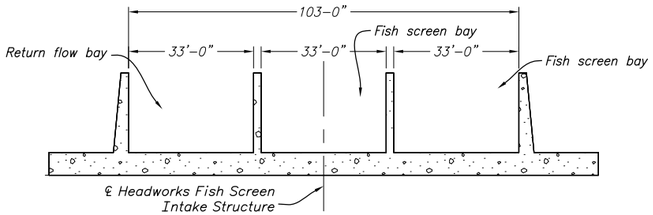
CAD SYSTEM
AutoCAD RM 17.1s
CAD FILENAME
AT 1_2_4 FS 1000 CFS APPRAISAL CONCEPT V3.DWG

RECLAMATION
Managing Water in the West

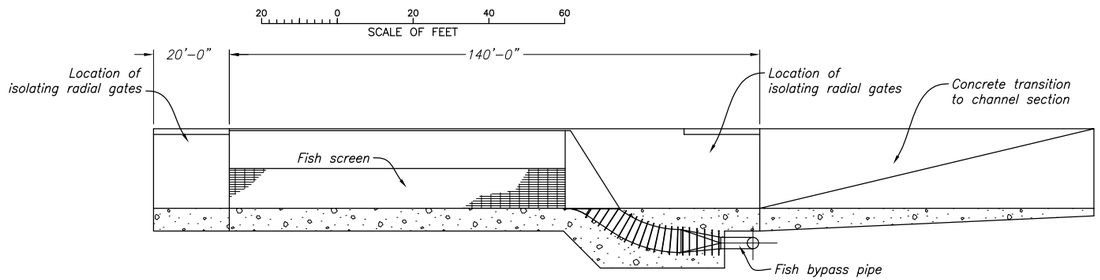




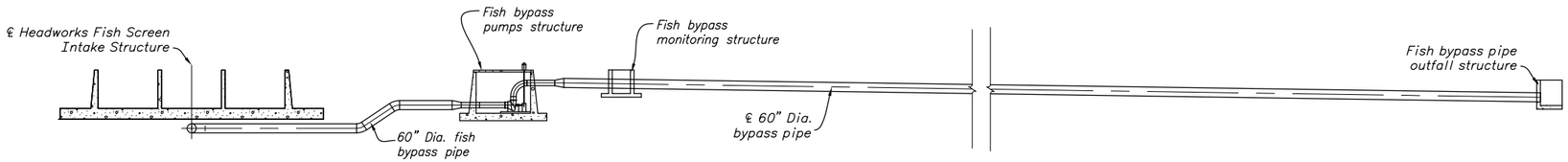
PLAN



SECTION A–A
(FISH SCREEN NOT SHOWN)



PROFILE ALONG HEADWORKS FISH SCREEN INTAKE STRUCTURE



PROFILE ALONG FISH BYPASS PIPE SYSTEM

PRELIMINARY

NOT TO BE USED FOR CONSTRUCTION

February 26, 2009

NOTE
Pumping plant not shown.

UNCHECKED

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
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KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING STUDY
CONVEYANCE CANAL HEADWORKS FISH SCREEN STRUCTURE
1,000 CFS ALTERNATIVES 1, 2, AND 4
PLAN, PROFILES, AND SECTION

DESIGNED CHDU CHA
REVIEWED BY Water Conveyance Group

DENVER, COLORADO
SHEET 1 OF 1

Figure B25 (Final Draft)

DATE AND TIME PLOTTED
JANUARY 8, 2009 16:37
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CCHA

CAD SYSTEM
AutoCAD Rel. 17.1s
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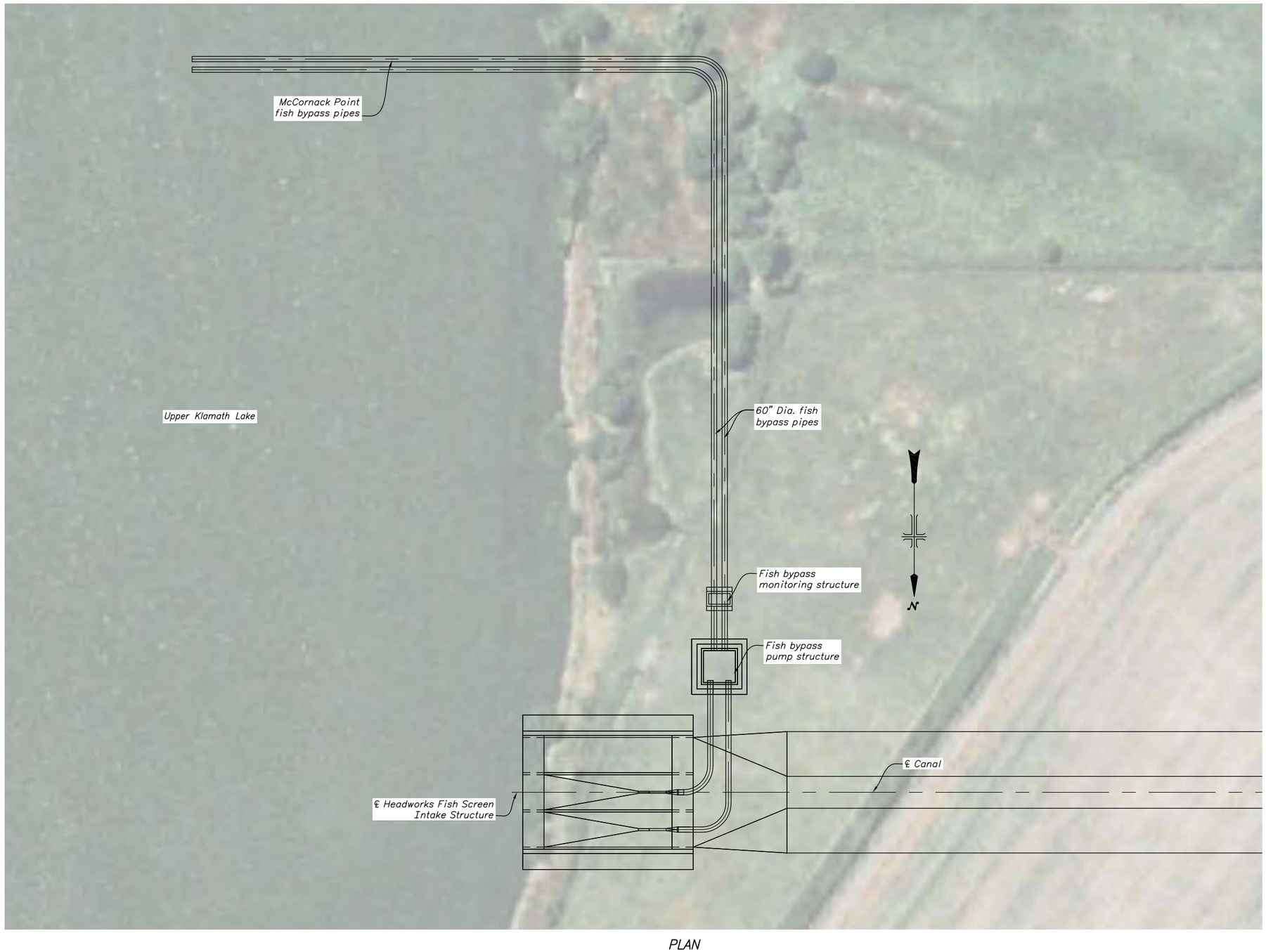
AT 1_2_4 FS 1000 CFS APPRAISAL CONCEPT V1.DWG

RECLAMATION
Managing Water in the West



PLAN

50 0 50 100 150
SCALE OF FEET

PRELIMINARY

NOT TO BE USED FOR CONSTRUCTION

February 26, 2009

NOTE
Pumping plant not shown.

UNCHECKED

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KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING LEVEL
CONVEYANCE CANAL FISH SCREEN INTAKE STRUCTURE
1,000 CFS ALTERNATIVE 3
FOR OPTIONS A, C, AND F
PLAN

DESIGNED – CHOU CHA
REVIEWED BY – Water Conveyance Group

DENVER, COLORADO
SHEET 1 OF 1

Figure B26 (Final Draft)

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CAD SYSTEM
AutoCAD Rel. 17.1s
CAD FILENAME
AT 3 FS 1000 CFS APPRAISAL CONCEPT.DWG

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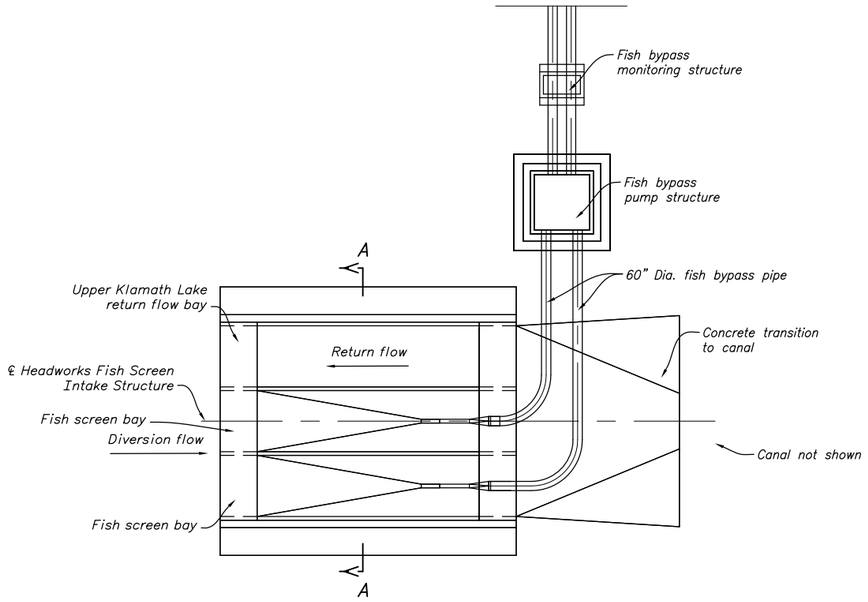
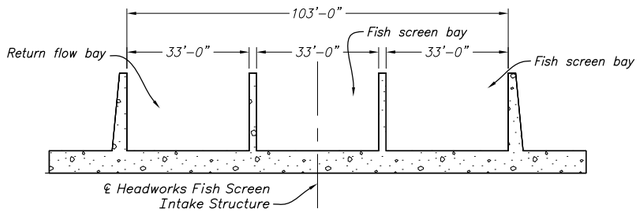
Managing Water in the West



PLAN

20 0 20 40 60
SCALE OF FEET



SECTION A–A
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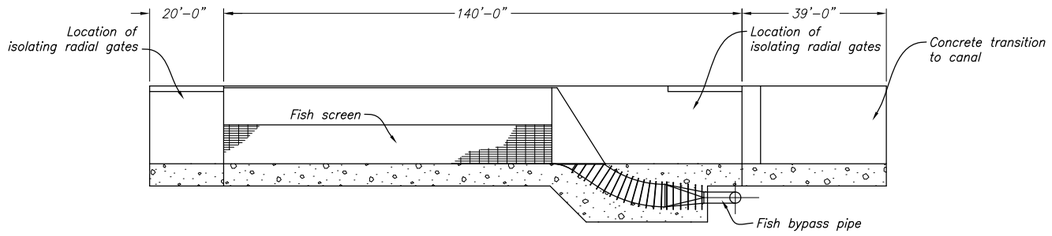
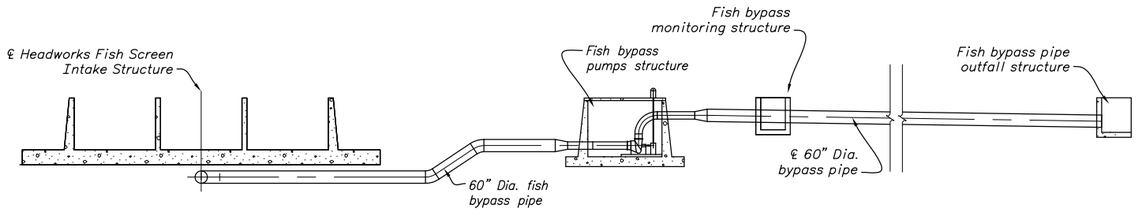


PROFILE ALONG HEADWORKS FISH SCREEN INTAKE STRUCTURE



PROFILE ALONG FISH BYPASS PIPE SYSTEM

PRELIMINARY

NOT TO BE USED FOR CONSTRUCTION

February 26, 2009

NOTE
Pumping plant not shown.

UNCHECKED

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING LEVEL
CONVEYANCE CANAL FISH SCREEN INTAKE STRUCTURE
1000 CFS ALTERNATIVE 3
FOR OPTIONS A, C, AND F
PLAN, PROFILES, AND SECTION

DESIGNED _ CHOU CHA _____
REVIEWED BY _____
Water Conveyance Group

DENVER, COLORADO
SHEET 1 OF 1

Figure B27 (Final Draft)

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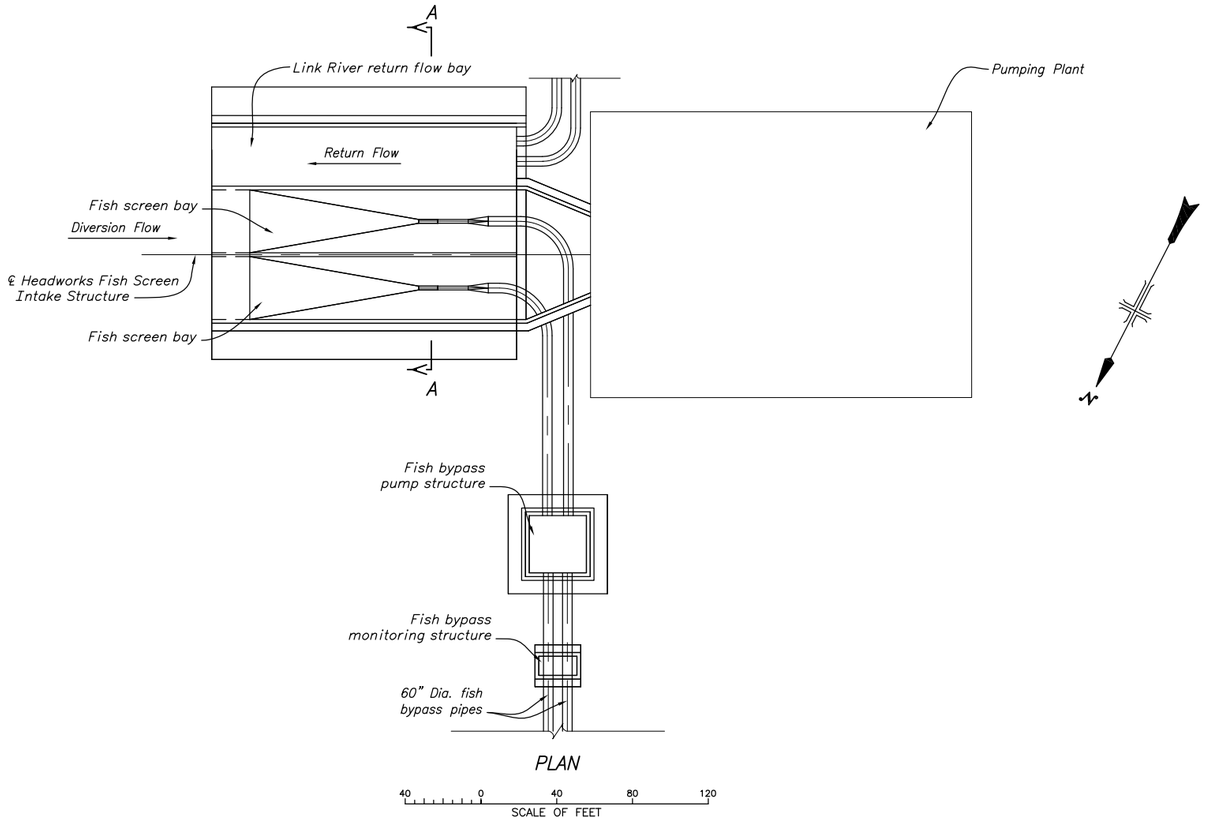
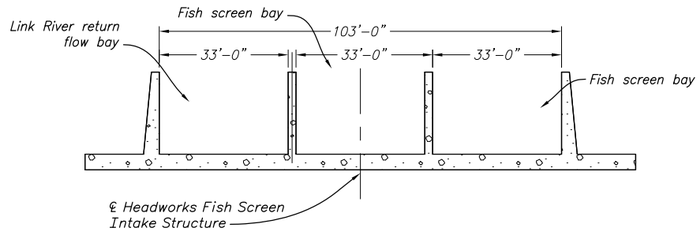
AT 3 FS 1000 CFS APPRAISAL CONCEPTUNG

RECLAMATION
Managing Water in the West



PLAN



SECTION A–A
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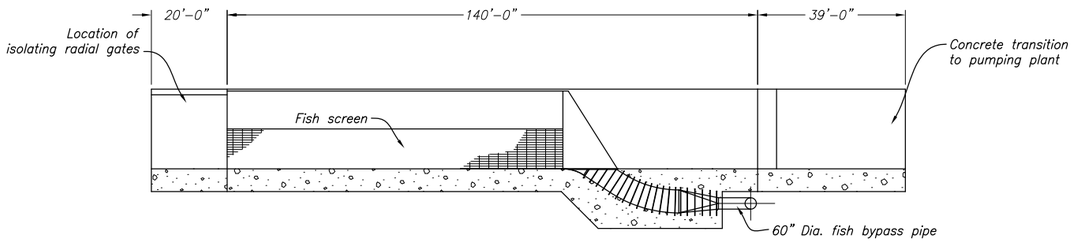
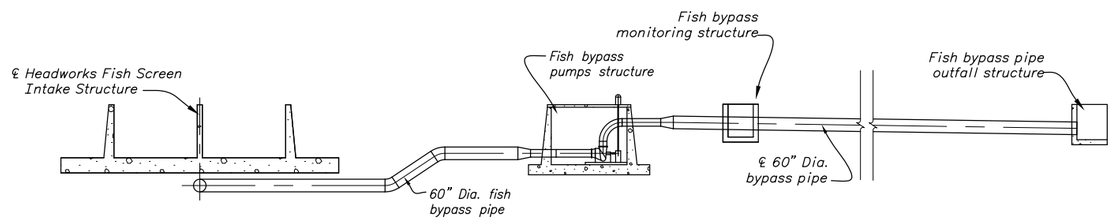


PROFILE ALONG HEADWORKS FISH SCREEN INTAKE STRUCTURE



PROFILE ALONG FISH BYPASS PIPE SYSTEM

PRELIMINARY

NOT TO BE USED FOR CONSTRUCTION

February 26, 2009

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KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING LEVEL
TUNNEL HEADWORKS FISH SCREEN INTAKE STRUCTURE
1000 CFS ALTERNATIVE 5
PUMPING PLANT OPTION A
PLAN, PROFILES, AND SECTION

DESIGNED – CHDU,CHA
REVIEWED BY – Water Conveyance Group

DENVER, COLORADO
SHEET 1 OF 1

Figure B29 (Final Draft)

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JANUARY 8, 2009 13:44
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CCHA

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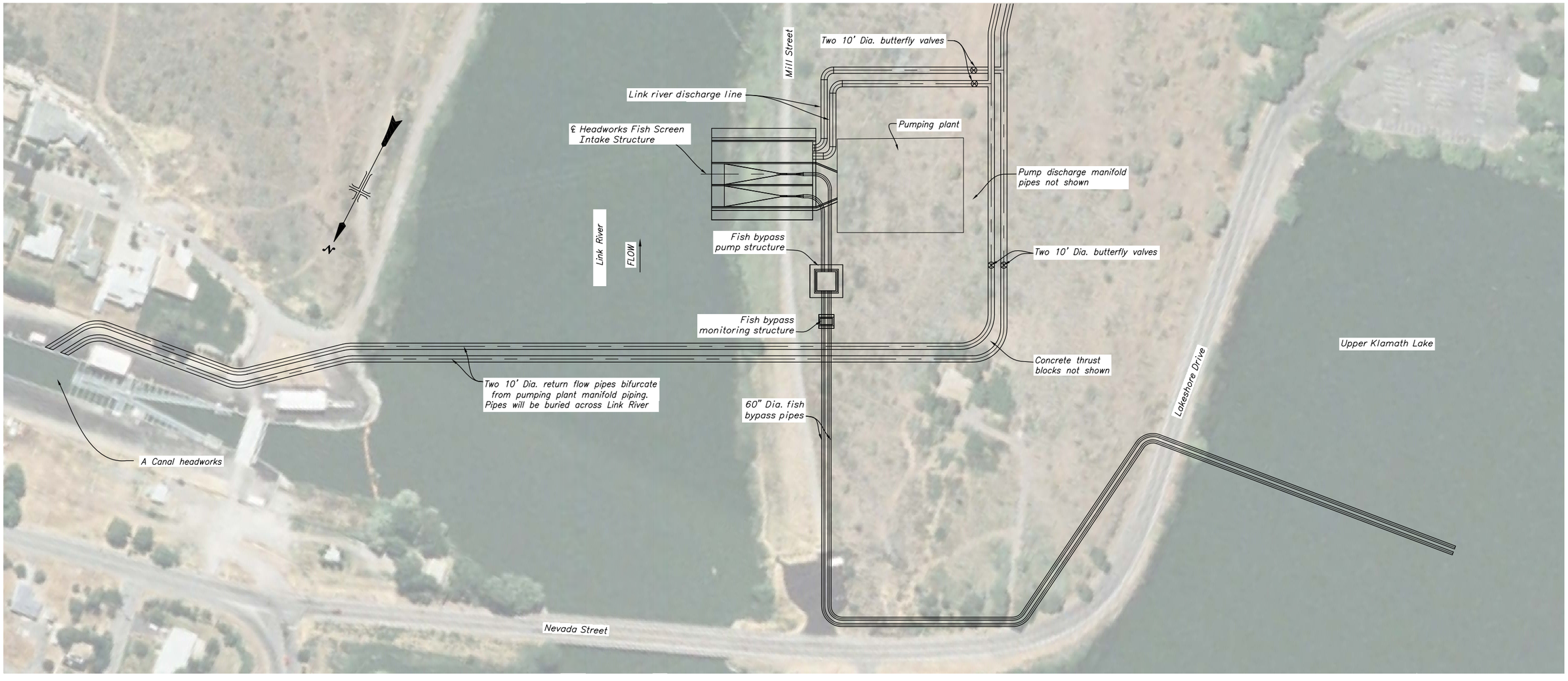
AT 5 FS 1000 CFS APPRAISAL V2 12-31-08.DWG

RECLAMATION
Managing Water in the West



PLAN

80 0 80 160 240
SCALE OF FEET

NOTE
Discharge pipes transition into tunnel location to be determined at a later design stage.

PRELIMINARY

NOT TO BE USED FOR CONSTRUCTION

February 26, 2009

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KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING LEVEL
TUNNEL HEADWORKS FISH SCREEN INTAKE STRUCTURE
1,000 CFS ALTERNATIVE 5
PUMPING PLANT OPTION A
PLAN

DESIGNED _ CHOU CHA
REVIEWED BY _____
Water Conveyance Group

DENVER, COLORADO
SHEET 1 OF 1

Figure B28 (Final Draft)

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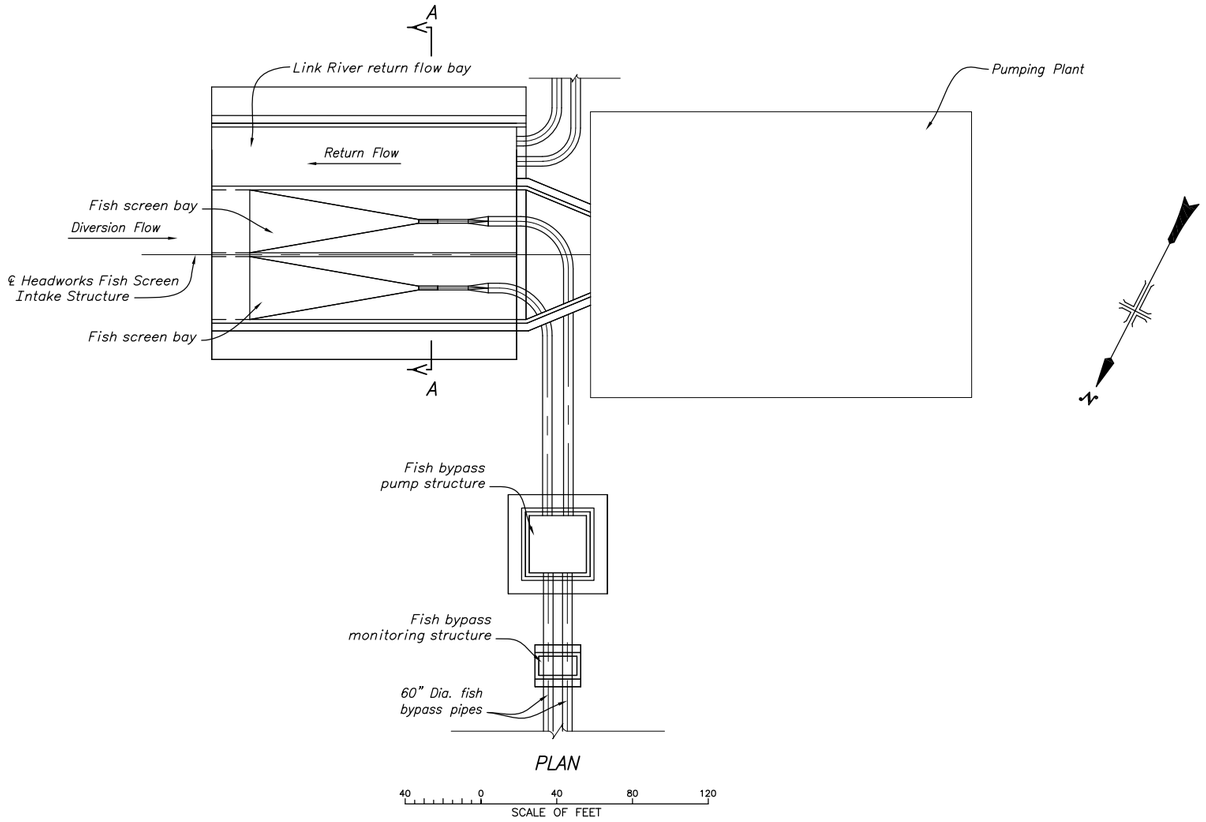
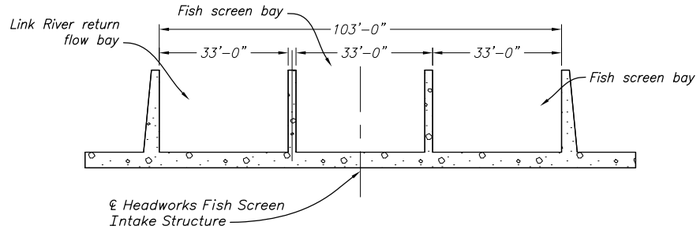
AT 5 FS 1000 CFS APPRAISAL V2 12-31-08.DWG

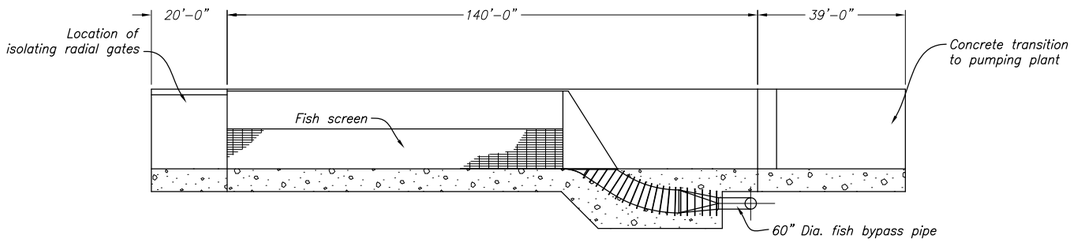
RECLAMATION
Managing Water in the West



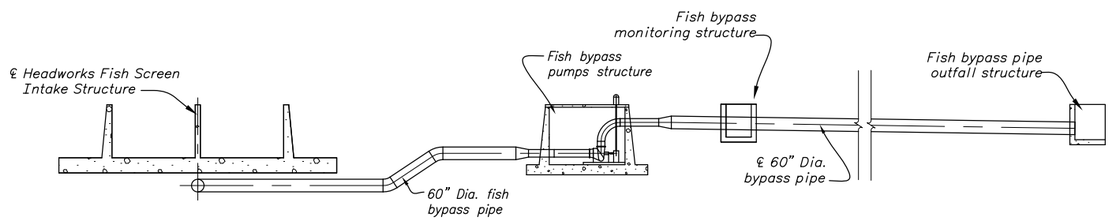
PLAN



SECTION A–A
(FISHSCREENS NOT SHOWN)
NO SCALE



PROFILE ALONG HEADWORKS FISH SCREEN INTAKE STRUCTURE



PROFILE ALONG FISH BYPASS PIPE SYSTEM

PRELIMINARY

NOT TO BE USED FOR CONSTRUCTION

February 26, 2009

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BUREAU OF RECLAMATION
KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING LEVEL
TUNNEL HEADWORKS FISH SCREEN INTAKE STRUCTURE
1000 CFS ALTERNATIVE 5
PUMPING PLANT OPTION
PLAN, PROFILES, AND SECTION

DESIGNED – CHDU CHA
REVIEWED BY – Water Conveyance Group

DENVER, COLORADO
SHEET 1 OF 1

Figure B29 (Final Draft)

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JANUARY 8, 2009 13:44
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CCHA

CAD SYSTEM
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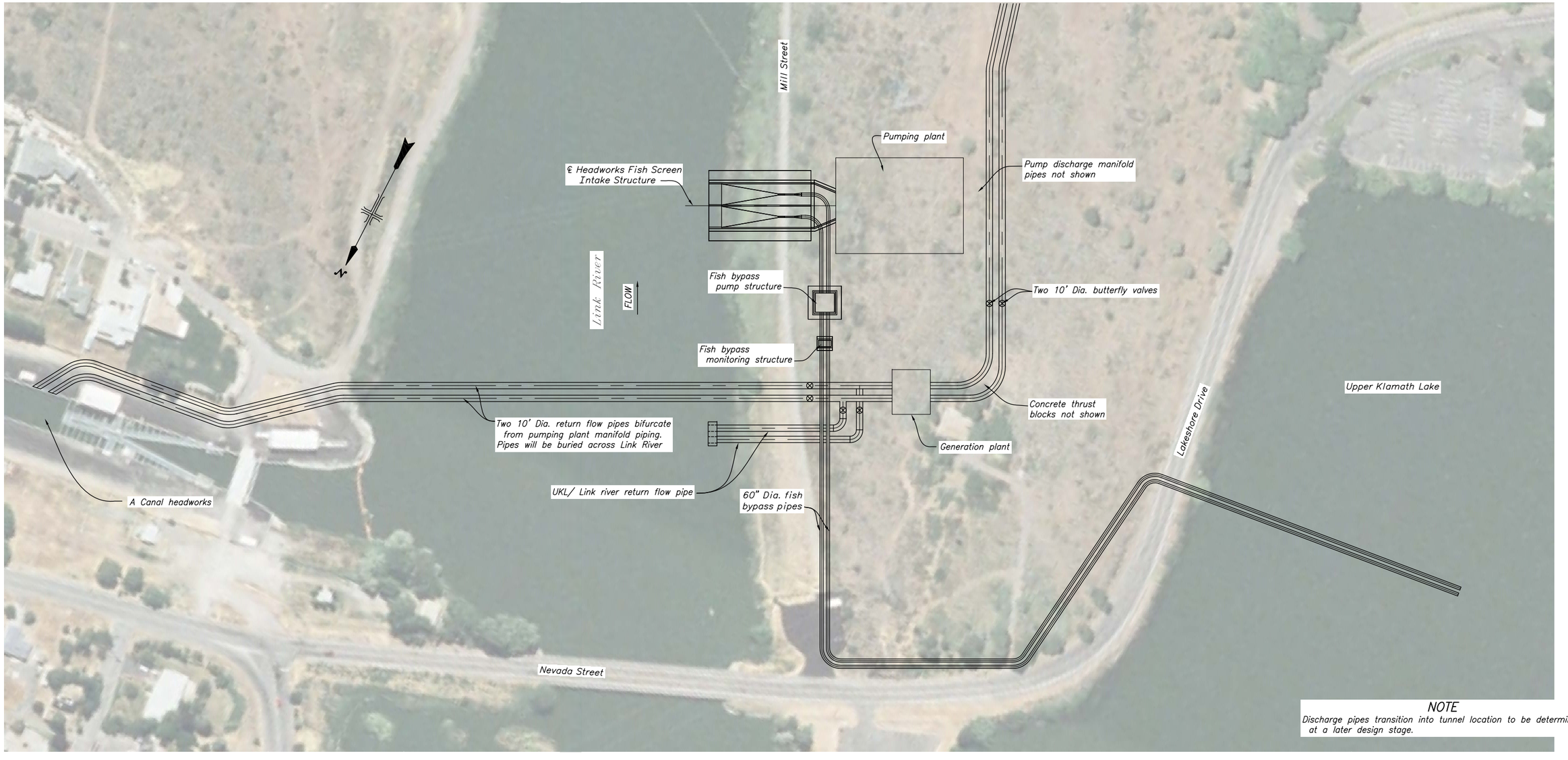
AT 5 FS 1000 CFS APPRAISAL V2 12-31-08.DWG

RECLAMATION
Managing Water in the West



NOTE
Discharge pipes transition into tunnel location to be determined at a later design stage.

PLAN

80 0 80 160 240
SCALE OF FEET

PRELIMINARY

NOT TO BE USED FOR CONSTRUCTION

February 26, 2009

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KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING LEVEL
TUNNEL HEADWORKS FISH SCREEN INTAKE STRUCTURE
1,000 CFS ALTERNATIVE 5
PUMPING AND GENERATING PLANT OPTION C
PLAN

DESIGNED _ CHOU CHA _____
REVIEWED BY _____
Water Conveyance Group

DENVER, COLORADO
SHEET 1 OF 1

Figure B30 (Final Draft)

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CAD SYSTEM
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CAD FILENAME
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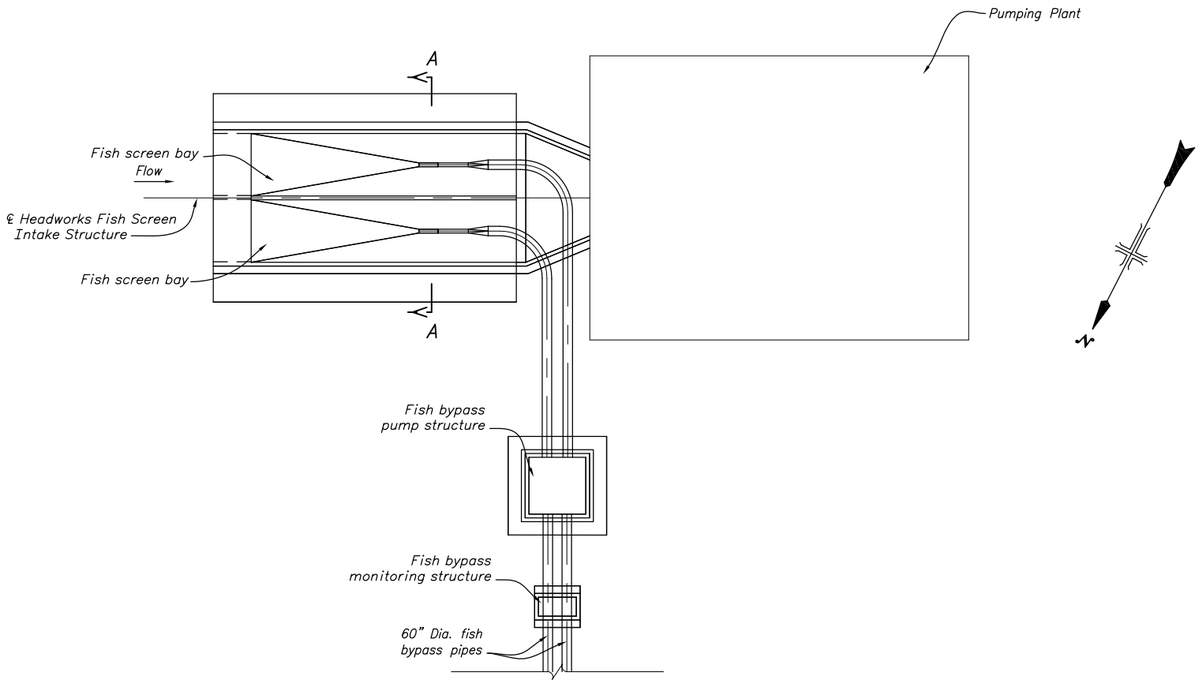
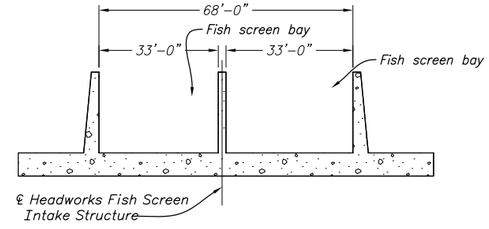
RECLAMATION
Managing Water in the West

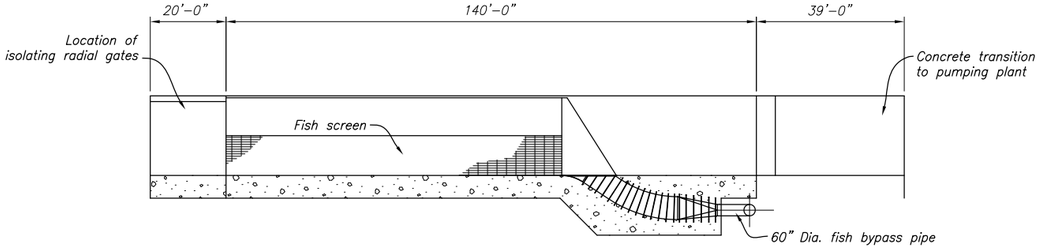


PLAN

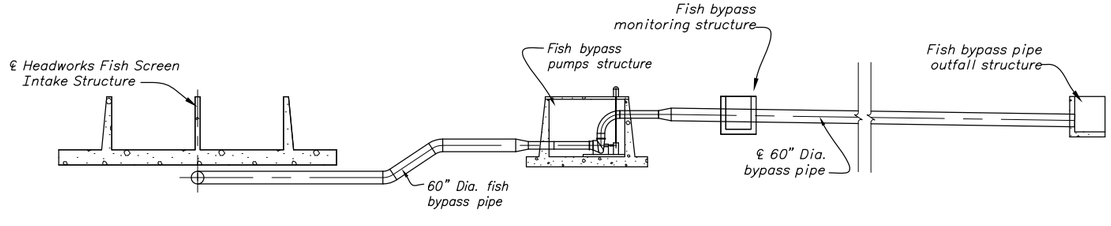
40 0 40 80 120
SCALE OF FEET



SECTION A–A
(FISH SCREEN NOT SHOWN)



PROFILE ALONG HEADWORKS FISH SCREEN INTAKE STRUCTURE



PROFILE ALONG FISH BYPASS PIPE SYSTEM

PRELIMINARY

NOT TO BE USED FOR CONSTRUCTION

February 26, 2009

UNCHECKED

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING LEVEL
TUNNEL HEADWORKS FISH SCREEN INTAKE STRUCTURE
1,000 CFS ALTERNATIVE 5
PUMPING AND GENERATING PLANT OPTION C
PLAN, PROFILES, AND SECTION

DESIGNED – CHOU CHA
REVIEWED BY – Water Conveyance Group

DENVER, COLORADO
SHEET 1 OF 1

Figure B 31 (Final Draft)

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CCHA

CAD SYSTEM
AutoCAD Rel. 17.1s
CAD FILENAME
AT 5 FS 1000 CFS APPRAISAL V2 12-31-08.DWG

RECLAMATION
Managing Water in the West



PLAN

200 0 200 400 600
SCALE OF FEET

PRELIMINARY

NOT TO BE USED FOR CONSTRUCTION

February 26, 2009

UNCHECKED

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING STUDY
CONVEYANCE CANAL HEADWORKS FISH SCREEN STRUCTURE
2000 CFS ALTERNATIVES 1, 2, AND 4
PLAN

DESIGNED _ CHOU CHA
REVIEWED BY _ Water Conveyance Group

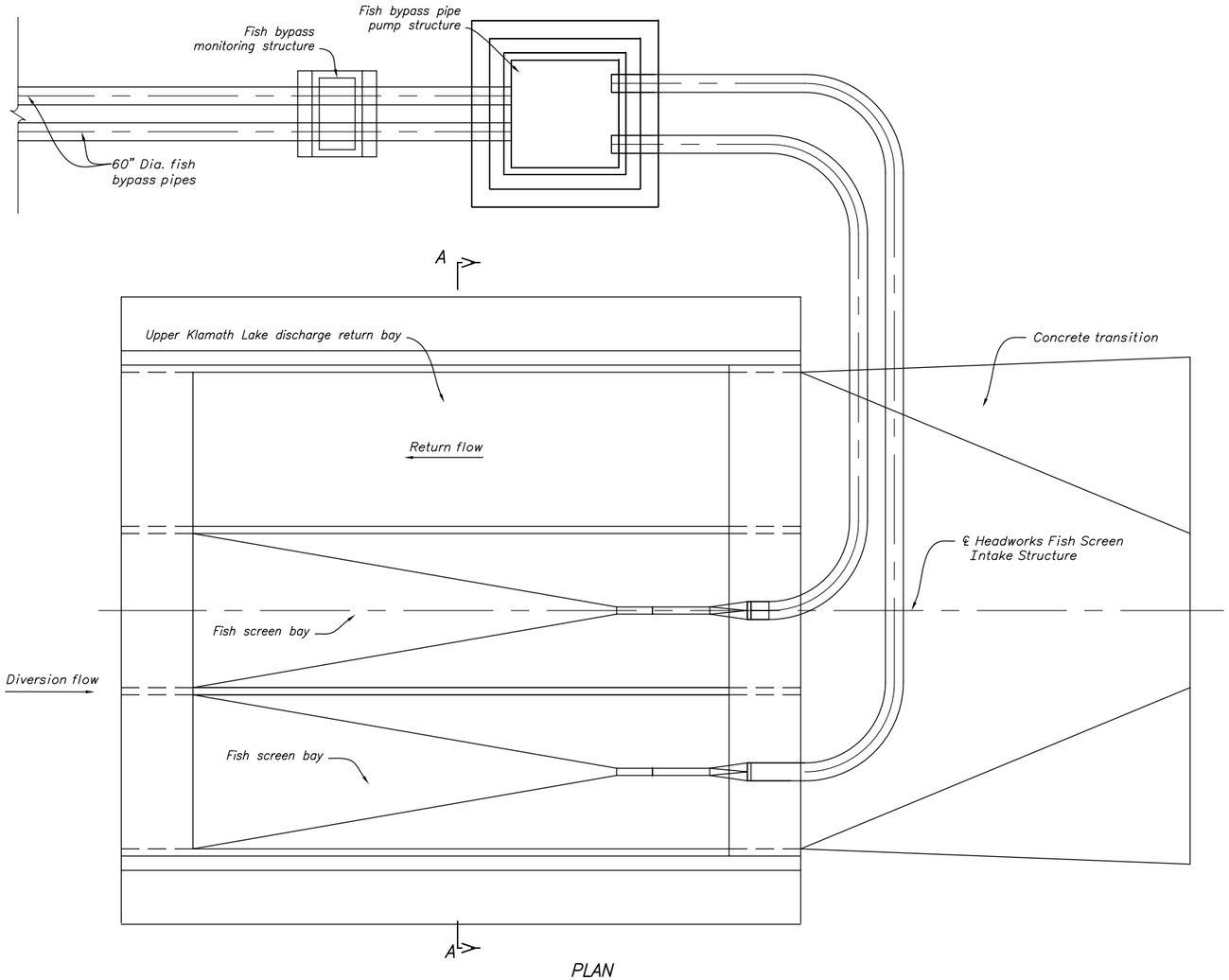
DENVER, COLORADO
SHEET 1 OF 1

Figure B32 (Final Draft)

DATE AND TIME PLOTTED
JANUARY 8, 2009 16:58
PLOTTED BY
CCHA

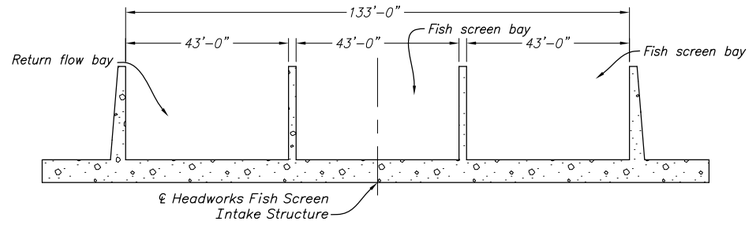
CAD SYSTEM
AutoCAD Rel. 17.1s
CAD FILENAME
ALT 1_2_4 FS 2000 CFS APPRAISAL CONCEPT V1.DWG

RECLAMATION
Managing Water in the West

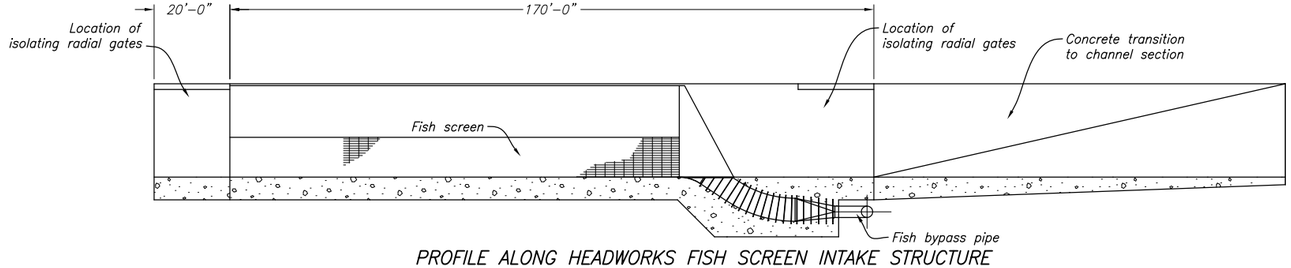


PLAN

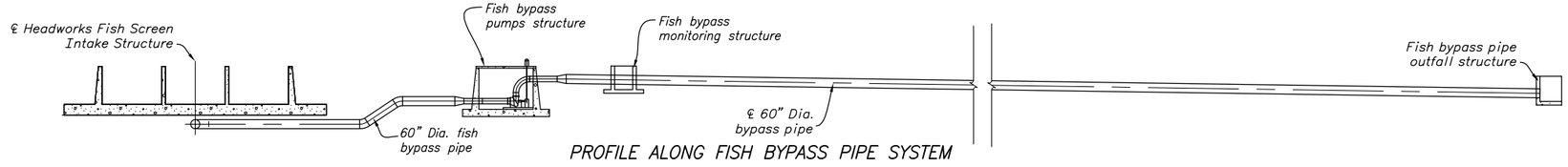
20 0 20 40 60
SCALE OF FEET



SECTION A–A
(FISH SCREEN NOT SHOWN)



PROFILE ALONG HEADWORKS FISH SCREEN INTAKE STRUCTURE



PROFILE ALONG FISH BYPASS PIPE SYSTEM

PRELIMINARY

NOT TO BE USED FOR CONSTRUCTION

February 26, 2009

NOTE
Pumping plant not shown.

UNCHECKED

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING LEVEL
CONVEYANCE CANAL HEADWORKS FISH SCREEN STRUCTURE
2000 CFS ALTERNATIVES 1, 2, AND 4
PLAN, PROFILES, AND SECTION

DESIGNED – CHOU CHA
REVIEWED BY – Water Conveyance Group

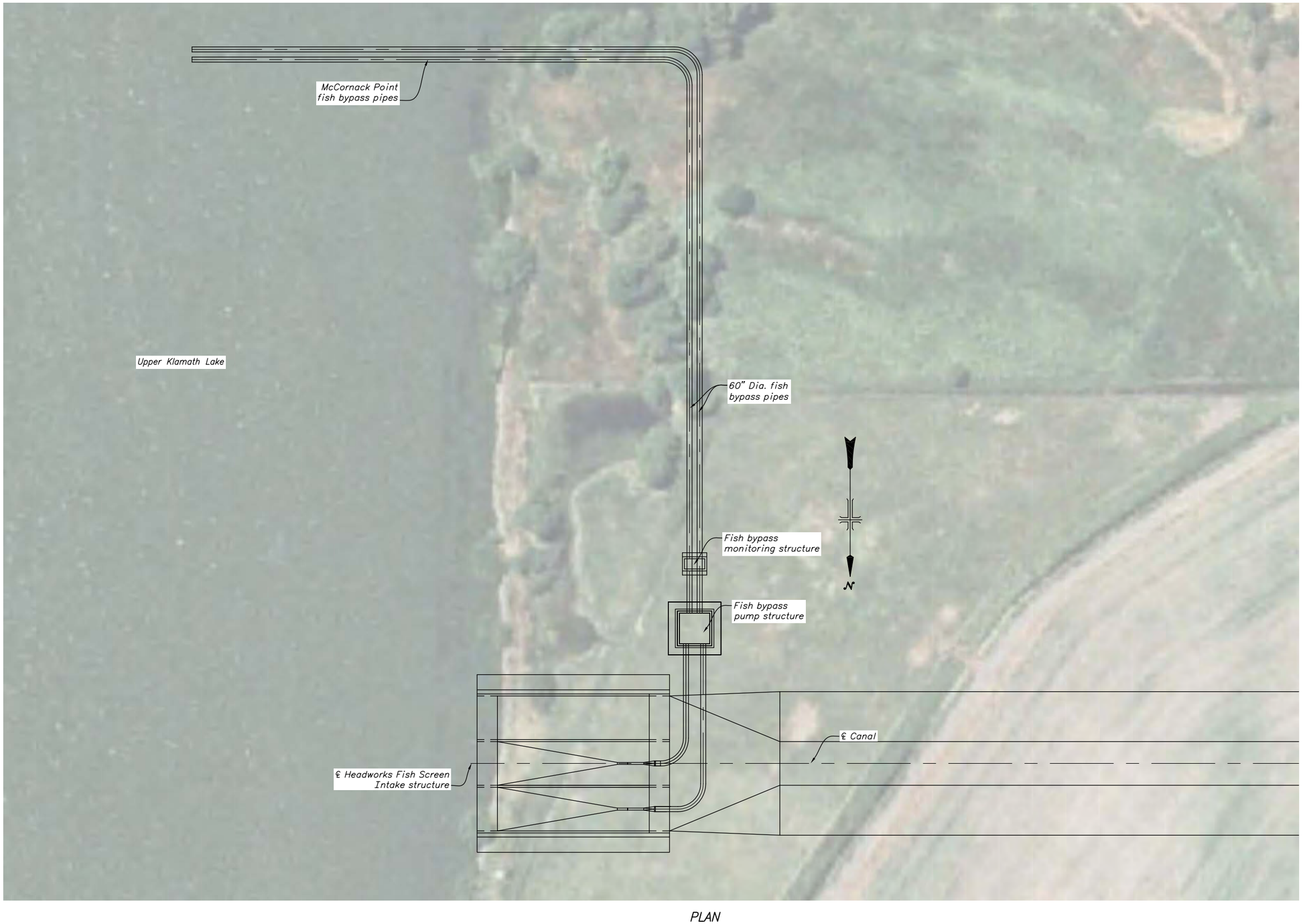
DENVER, COLORADO
SHEET 1 OF 1

Figure B33 (Final Draft)

DATE AND TIME PLOTTED
JANUARY 8, 2009 16:58
PLOTTED BY
CCHA

CAD SYSTEM
AutoCAD R14 17.1s
CAD FILENAME
ALT 1_2_4 FS 2000 CFS APPRAISAL CONCEPT V1.DWG

RECLAMATION
Managing Water in the West



PLAN

50 0 50 100 150
SCALE OF FEET

PRELIMINARY

NOT TO BE USED FOR CONSTRUCTION

February 26, 2009

NOTE
Pumping plant not shown.

UNCHECKED

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KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING LEVEL
CONVEYANCE CANAL HEADWORKS FISH SCREEN STRUCTURE
2,000 CFS ALTERNATIVE 3
FOR OPTIONS B, D, AND E
PLAN

DESIGNED _ CHOU CHA
REVIEWED BY _ Water Conveyance Group

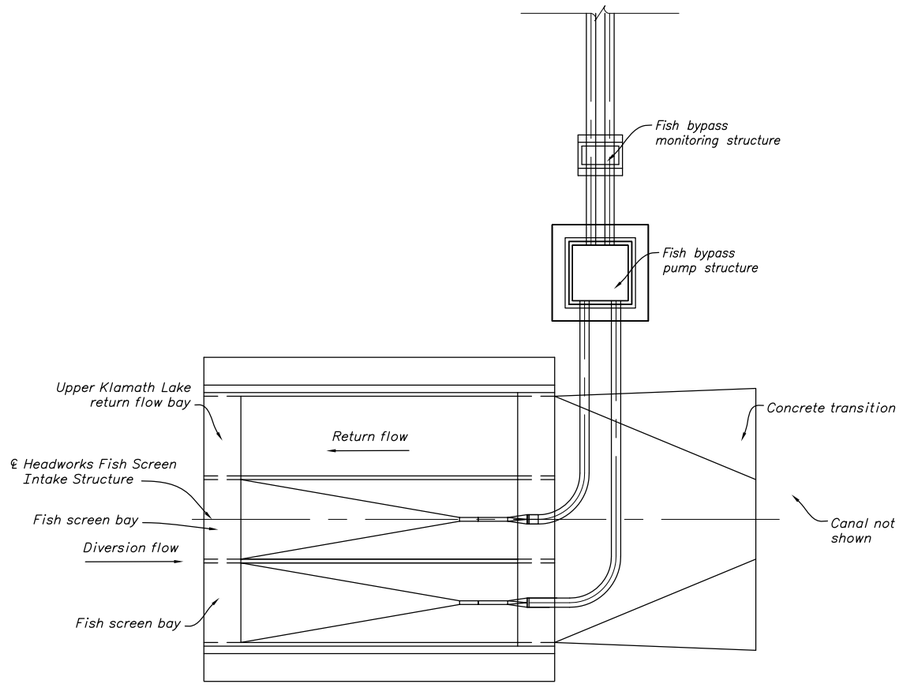
DENVER, COLORADO
SHEET 1 OF 1

Figure B34 (Final Draft)

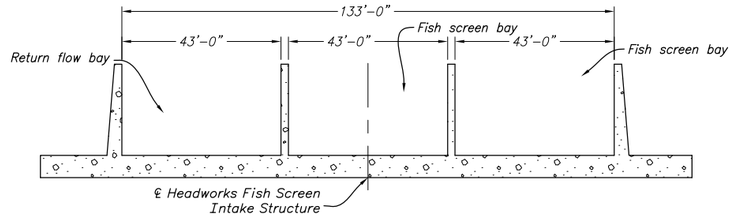
DATE AND TIME PLOTTED
JANUARY 8, 2009 13:50
PLOTTED BY
CCHA

CAD SYSTEM
AutoCAD R14 17.1s
CAD FILENAME
ALT 3 FS 2000 CFS APPRAISAL CONCEPT.DWG

RECLAMATION
Managing Water in the West



PLAN



SECTION A–A
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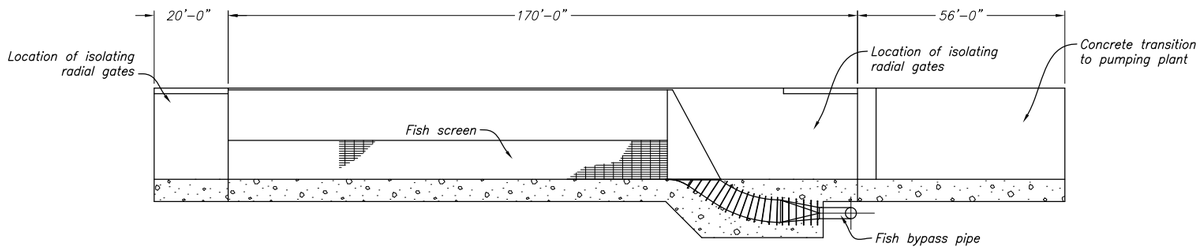
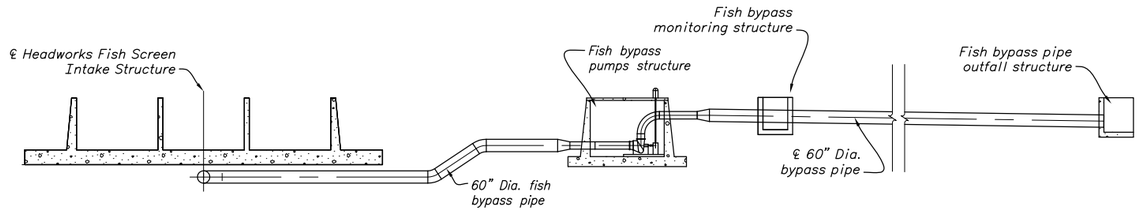


PROFILE ALONG HEADWORKS FISH SCREEN INTAKE STRUCTURE



PROFILE ALONG FISH BYPASS PIPE SYSTEM

PRELIMINARY

NOT TO BE USED FOR CONSTRUCTION

February 26, 2009

NOTE
Pumping plant not shown.

UNCHECKED

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U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING LEVEL
CONVEYANCE CANAL HEADWORKS FISH SCREEN STRUCTURE
2,000 CFS ALTERNATIVE 3
FOR OPTIONS B, D, AND E
PLAN, PROFILES, AND SECTION

DESIGNED CHOU CHA
REVIEWED BY
Water Conveyance Group

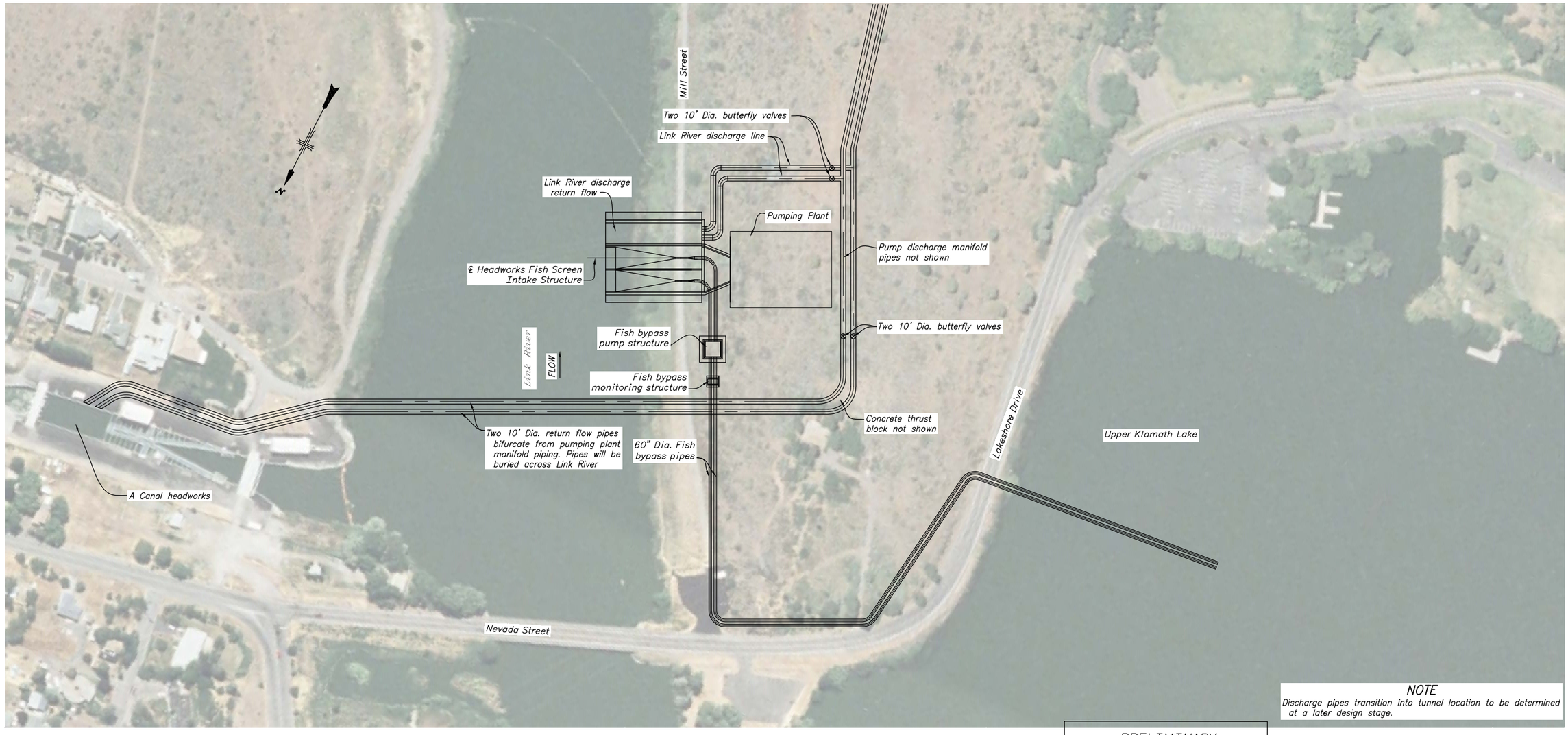
DENVER, COLORADO
SHEET 1 OF 1

Figure B35 (Final Draft)

DATE AND TIME PLOTTED JANUARY 8, 2009 13:50
PLOTTED BY CCHA

CAD SYSTEM AutoCAD Rel. 17.1s
CAD FILENAME ALT 3 FS 2000 CFS APPRAISAL CONCEPT.DWG

RECLAMATION
Managing Water in the West



NOTE
Discharge pipes transition into tunnel location to be determined at a later design stage.

PLAN

100 0 100 200 300
SCALE OF FEET

PRELIMINARY

NOT TO BE USED FOR CONSTRUCTION

February 26, 2009

UNCHECKED

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING LEVEL
TUNNEL HEADWORKS FISH SCREEN INTAKE STRUCTURE
2,000 CFS ALTERNATIVE 5
PUMPING ONLY OPTION B
PLAN

DESIGNED – CHOU CHA
REVIEWED BY
Water Conveyance Group

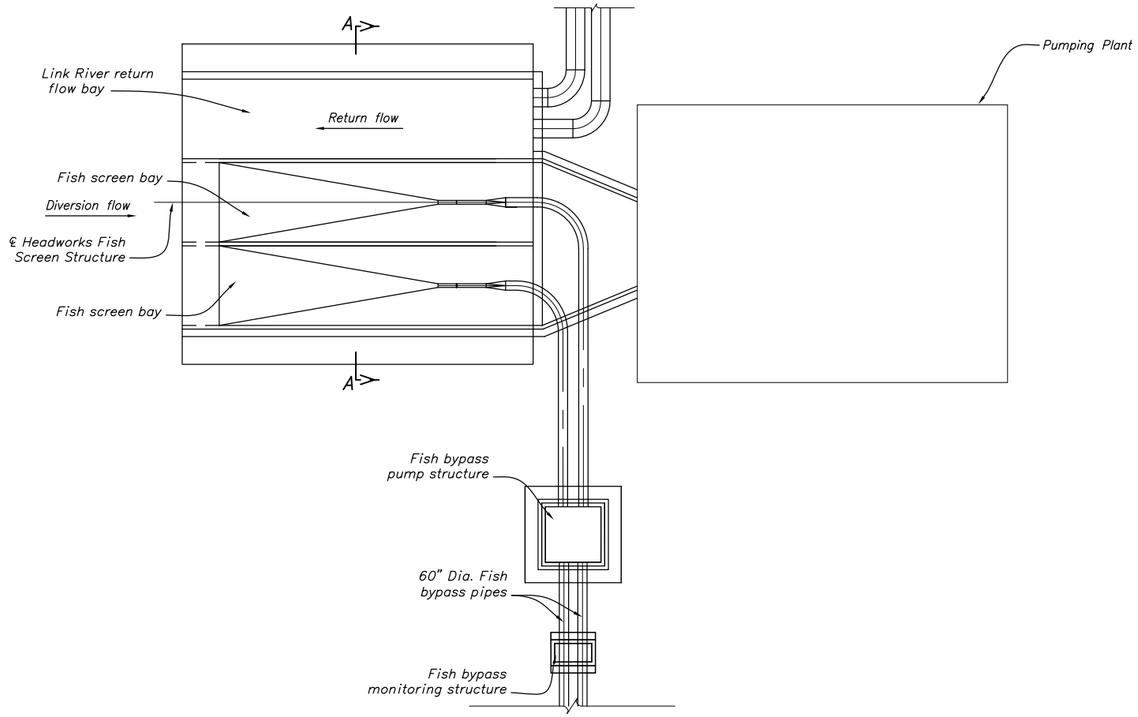
DENVER, COLORADO
SHEET 1 OF 1

Figure B36 (Final Draft)

DATE AND TIME PLOTTED
OCTOBER 21, 2008 11:19
PLOTTED BY
CCHA

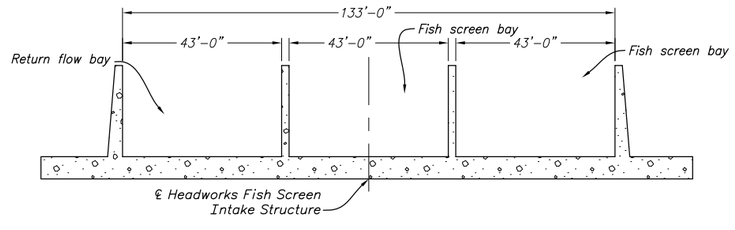
CAD SYSTEM
AutoCAD Rel. 17.1s
CAD FILENAME
ALT 5 FS 2000 CFS APPRAISAL CONCEPT V1.DWG

RECLAMATION
Managing Water in the West



PLAN

40 0 40 80 120
SCALE OF FEET



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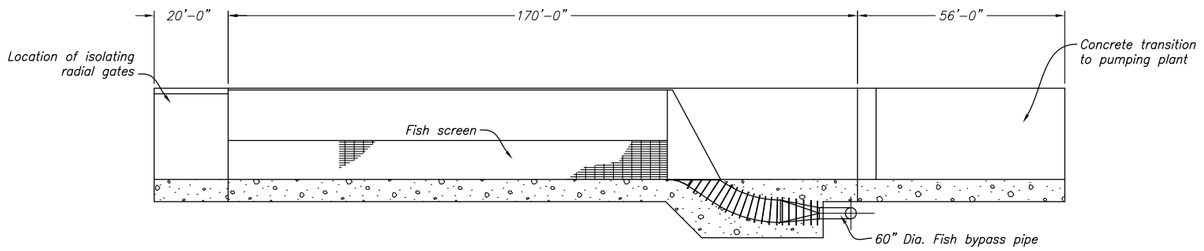
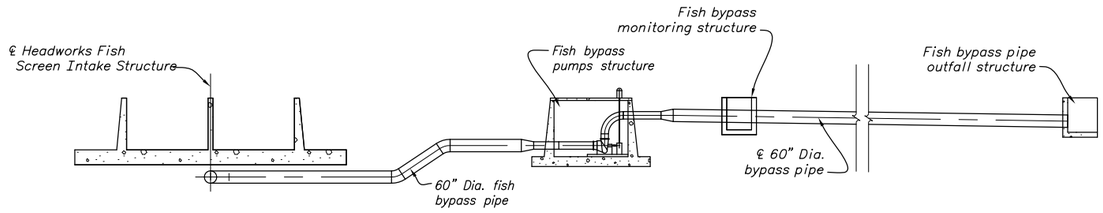


PROFILE ALONG HEADWORKS FISH SCREEN INTAKE STRUCTURE



PROFILE ALONG FISH BYPASS PIPE SYSTEM

PRELIMINARY

NOT TO BE USED FOR CONSTRUCTION

February 26, 2009

UNCHECKED

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U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING LEVEL
TUNNEL HEADWORKS FISH SCREEN INTAKE STRUCTURE
2,000 CFS ALTERNATIVE 5
PUMPING ONLY OPTION B
PLAN, PROFILES, AND SECTION

DESIGNED _ CHOU CHA _____
REVIEWED BY _____
Water Conveyance Group

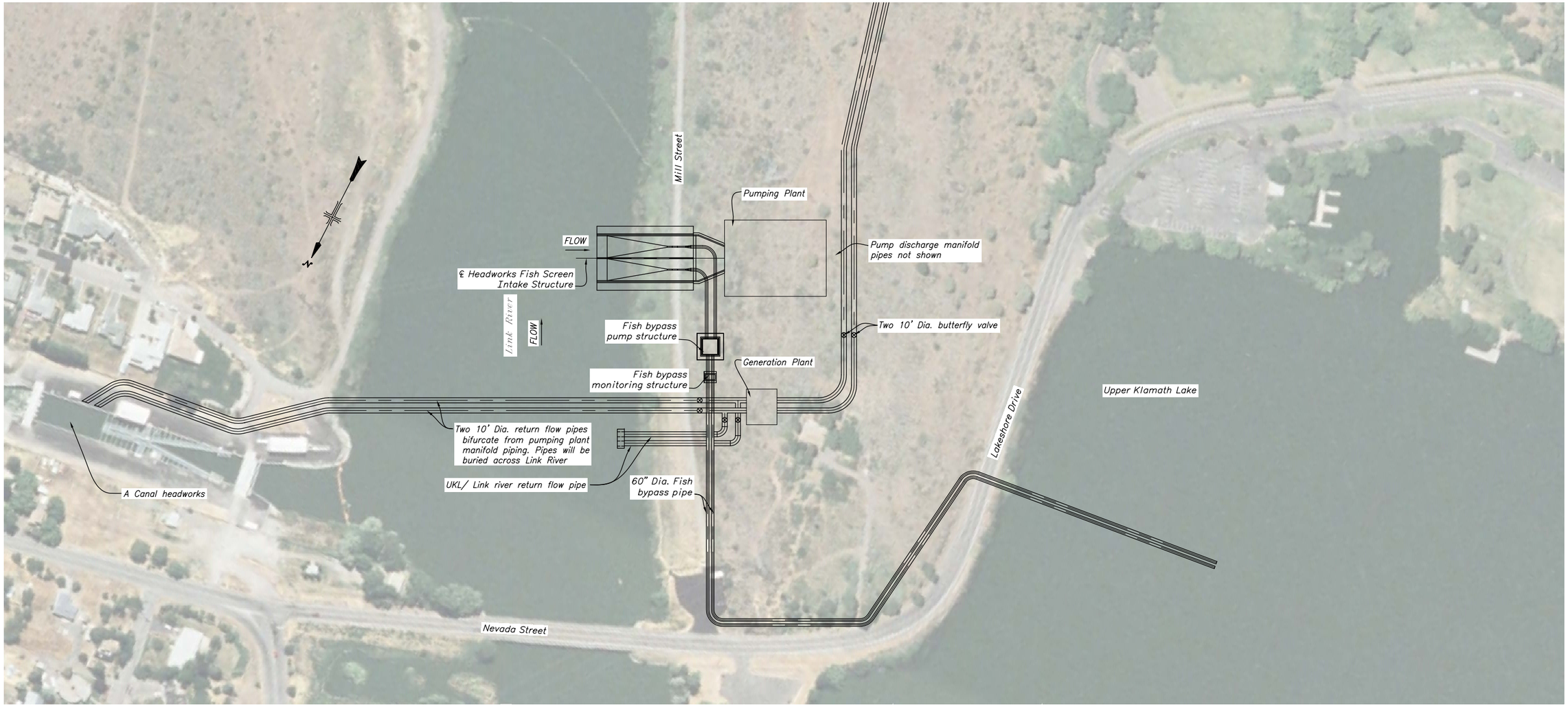
DENVER, COLORADO
SHEET 1 OF 1

Figure B37 (Final Draft)

DATE AND TIME PLOTTED
OCTOBER 21, 2008 11:19
PLOTTED BY
CCHA

CAD SYSTEM
AutoCAD Rel. 17.1s
CAD FILENAME
ALT 5 FS 2000 CFS APPRAISAL CONCEPT V1.DWG

RECLAMATION
Managing Water in the West



PLAN

100 0 100 200 300
SCALE OF FEET

PRELIMINARY

NOT TO BE USED FOR CONSTRUCTION

February 26, 2009

NOTE

Discharge pipes transition into tunnel location to be determined at a later design stage.

UNCHECKED

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING LEVEL
TUNNEL HEADWORKS FISH SCREEN INTAKE STRUCTURE
2,000 CFS ALTERNATIVE 5
PUMPING AND GENERATING OPTION D
PLAN

DESIGNED _ CHOU CKM _____
REVIEWED BY _____
Water Conveyance Group

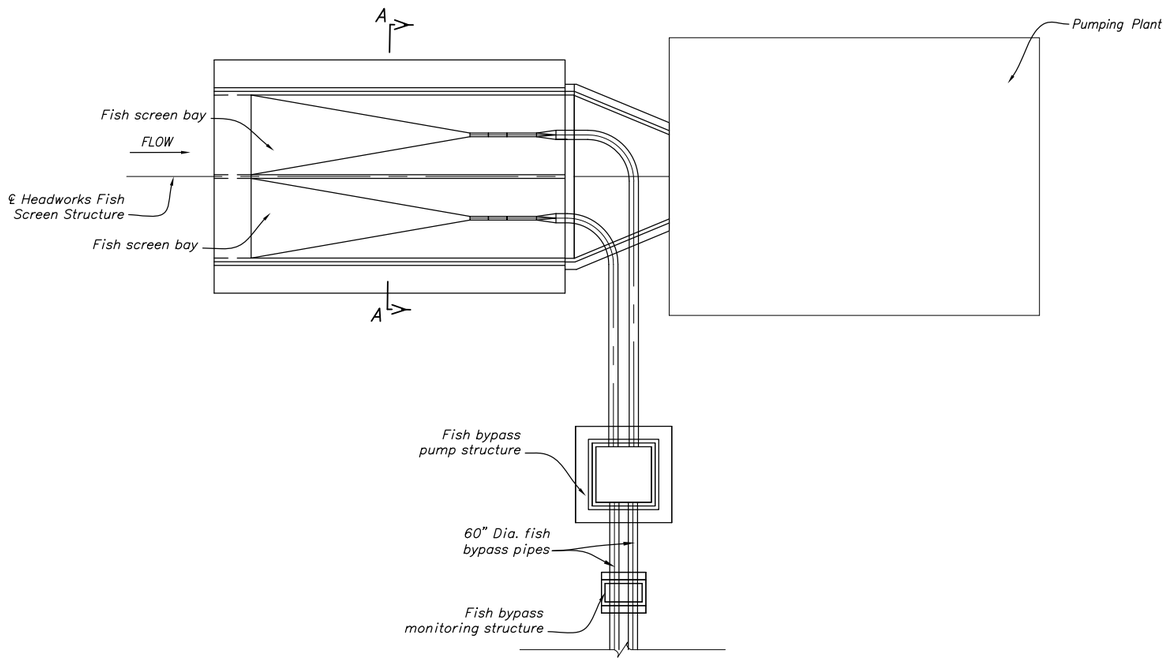
DENVER, COLORADO
SHEET 1 OF 1

Figure B38 (Final Draft)

DATE AND TIME PLOTTED
OCTOBER 21, 2008 11:21
PLOTTED BY
CCHA

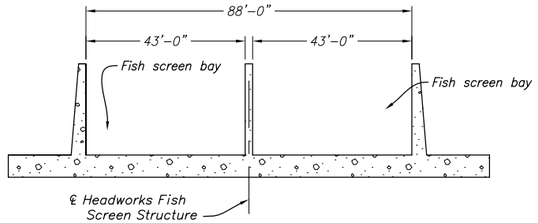
CAD SYSTEM
AutoCAD Rel. 17.1s
CAD FILENAME
ALT 5 FS 2000 CFS APPRAISAL CONCEPT V1.DWG

RECLAMATION
Managing Water in the West



PLAN

40 0 40 80 120
SCALE OF FEET



SECTION A–A
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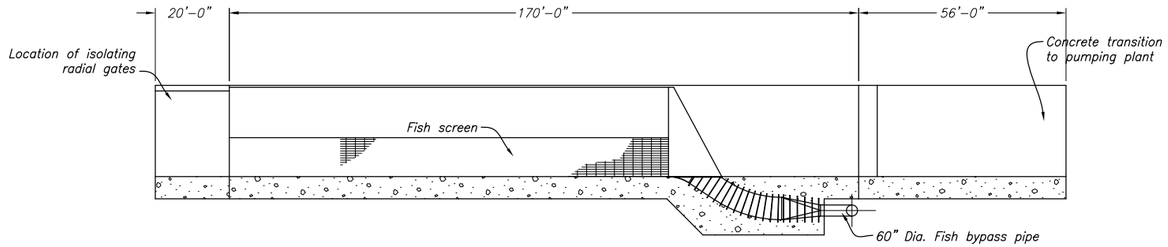
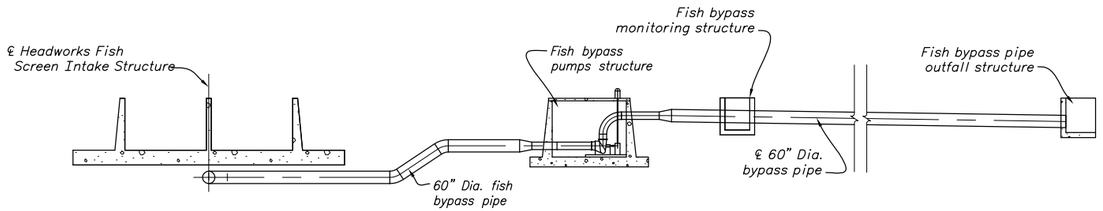


PROFILE ALONG HEADWORKS FISH SCREEN INTAKE STRUCTURE



PROFILE ALONG FISH BYPASS PIPE SYSTEM

PRELIMINARY

NOT TO BE USED FOR CONSTRUCTION

February 26, 2009

UNCHECKED

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U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING LEVEL
TUNNEL HEADWORKS FISH SCREEN INTAKE STRUCTURE
2,000 CFS ALTERNATIVE 5
PUMPING AND GENERATING OPTION D
PLAN, PROFILES, AND SECTION

DESIGNED CHOU CHA
REVIEWED BY
Water Conveyance Group

DENVER, COLORADO
SHEET 1 OF 1

Figure B39 (Final Draft)

DATE AND TIME PLOTTED OCTOBER 21, 2008 11:21
PLOTTED BY CCHA

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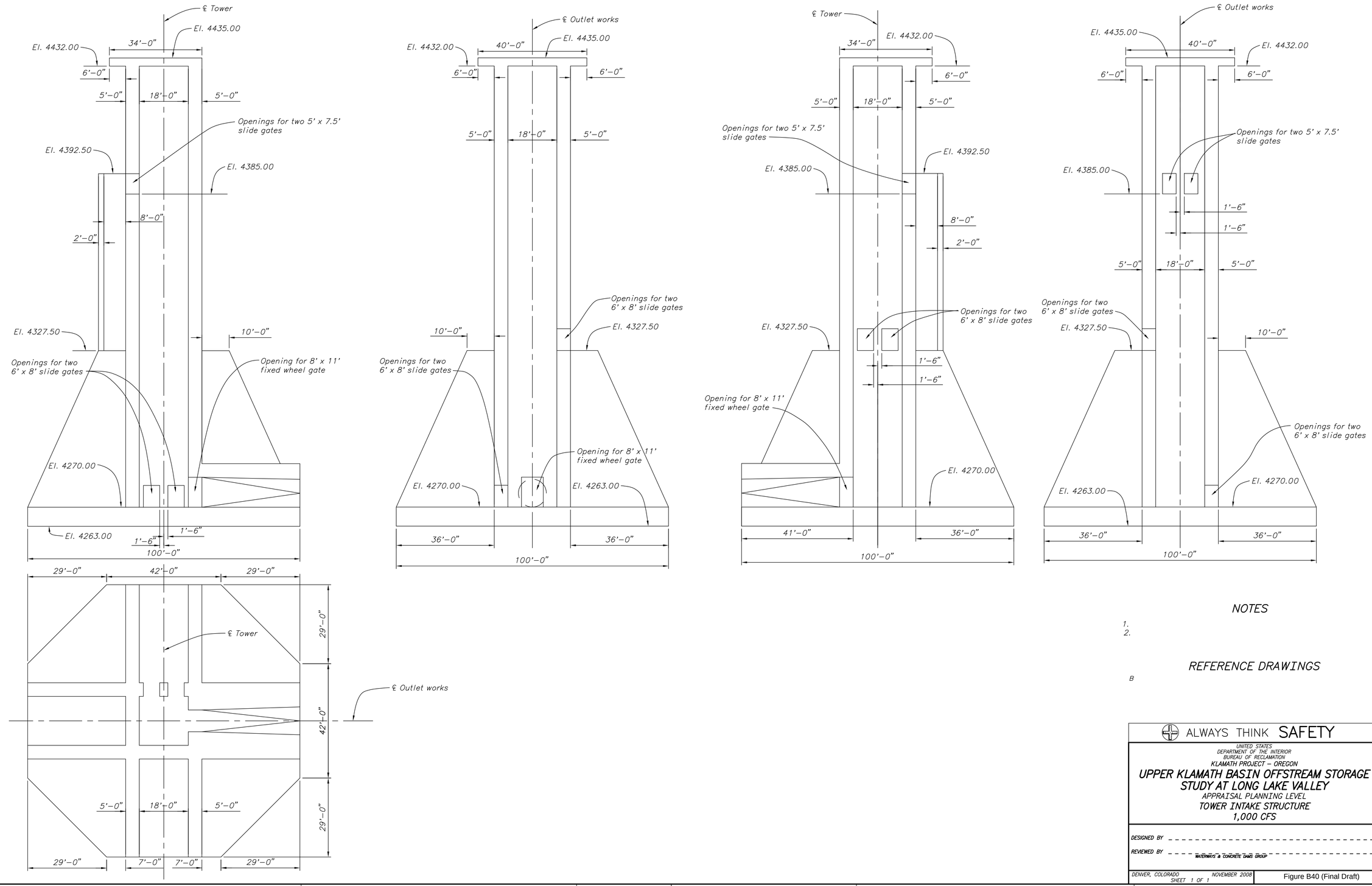

NOTES

1.
2.

REFERENCE DRAWINGS

B

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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
KLAMATH PROJECT – OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING LEVEL

TOWER INTAKE STRUCTURE

1,000 CFS

DESIGNED BY

REVIEWED BY

WATERWAYS & CONCRETE DAMS GROUP

DENVER, COLORADO NOVEMBER 2008
SHEET 1 OF 1

Figure B40 (Final Draft)

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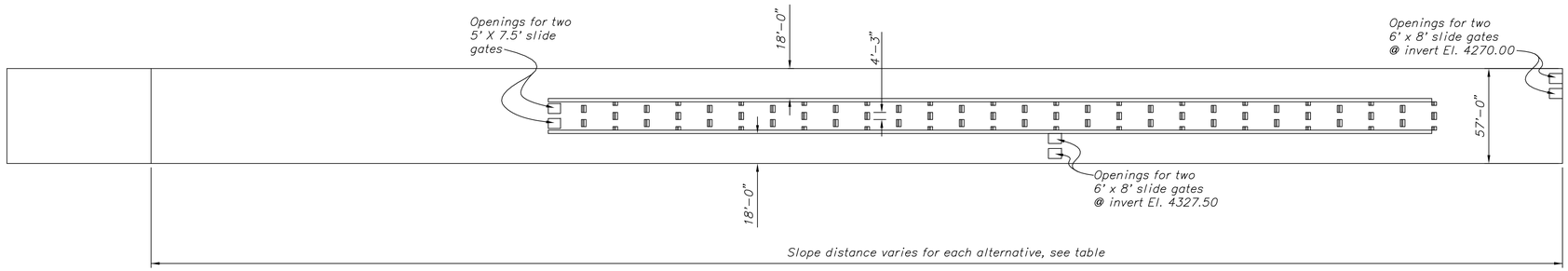
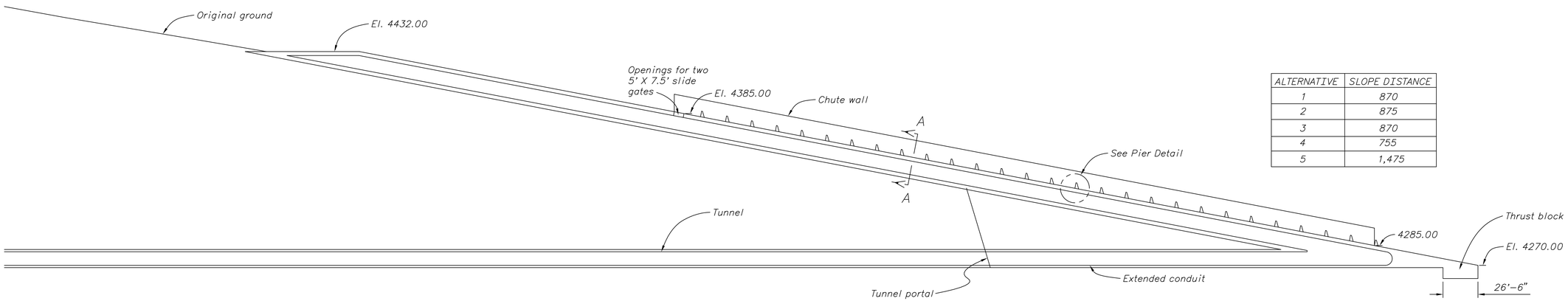
CAD FILENAME INTAKESTRUCTURES1000.DWG
DATE AND TIME PLOTTED NOVEMBER 6, 2008 09:31
PLOTTED BY RBENIK

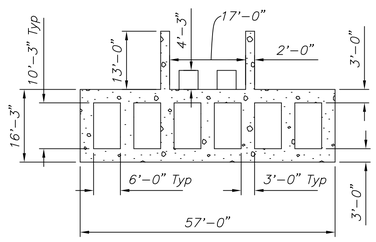


PLAN

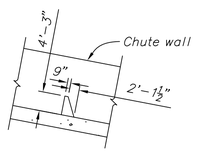


PROFILE

ALTERNATIVE	SLOPE DISTANCE
1	870
2	875
3	870
4	755
5	1,475



SECTION A–A



PIER DETAIL

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UNITED STATES
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BUREAU OF RECLAMATION
KLAMATH PROJECT – OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING LEVEL
SLOPING INTAKE STRUCTURE
1,000 CFS

DESIGNED BY
REVIEWED BY WATERWAYS & CONCRETE DAMS GROUP

DENVER, COLORADO NOVEMBER 2008
SHEET 1 OF 1

Figure B41 (Final Draft)

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DATE AND TIME PLOTTED
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NOVEMBER 6, 2008 09:28
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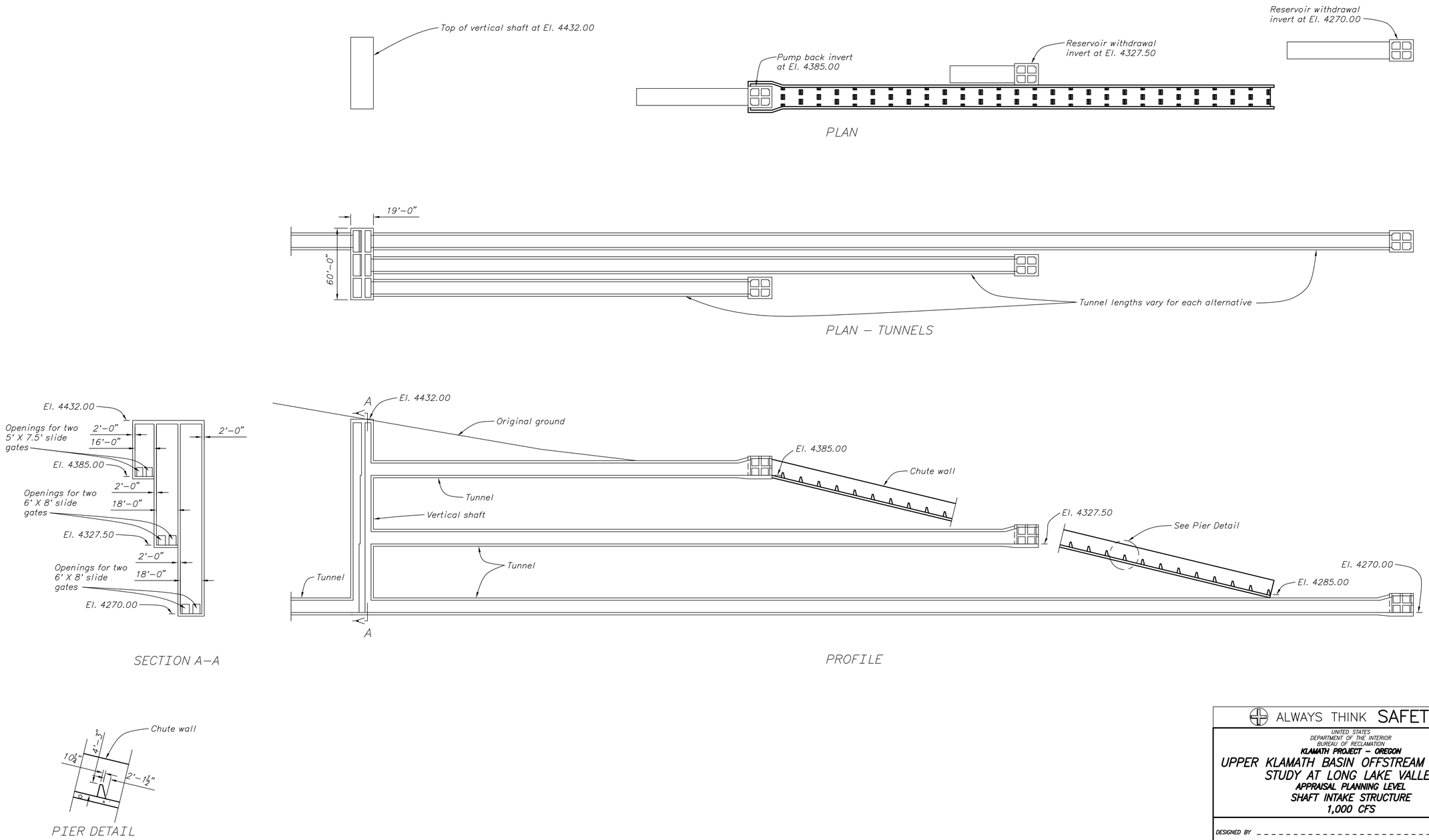

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UNITED STATES
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KLAMATH PROJECT – OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING LEVEL
SHAFT INTAKE STRUCTURE
1,000 CFS

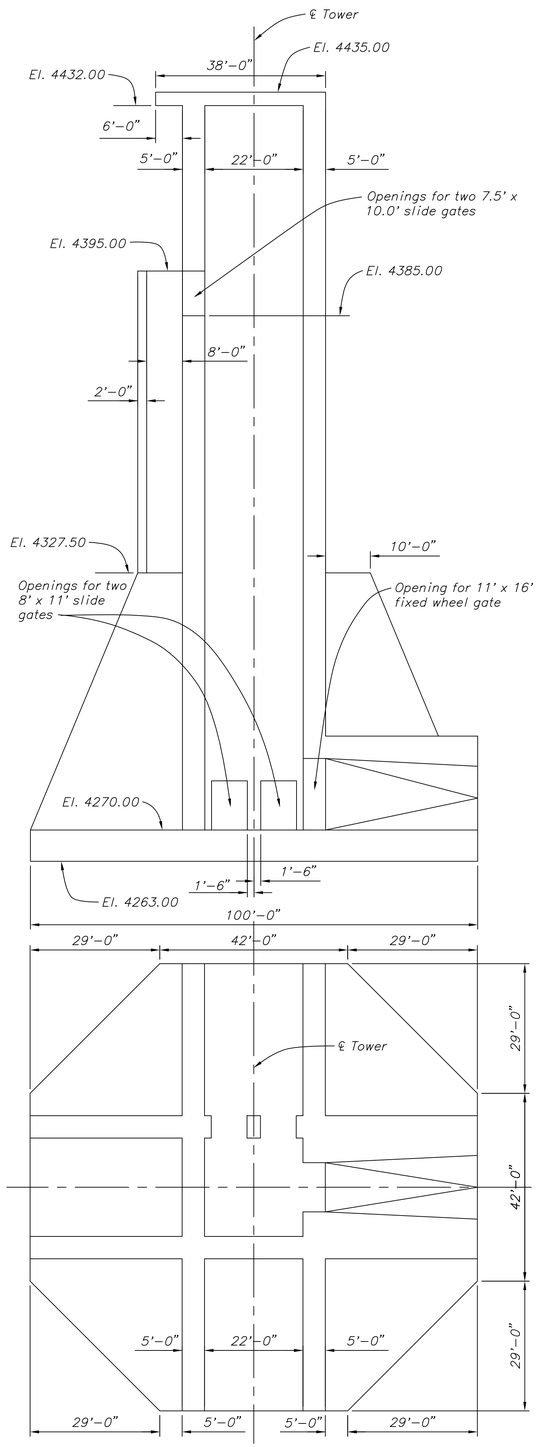
DESIGNED BY
REVIEWED BY
WATERWAYS & CONCRETE DAMS GROUP

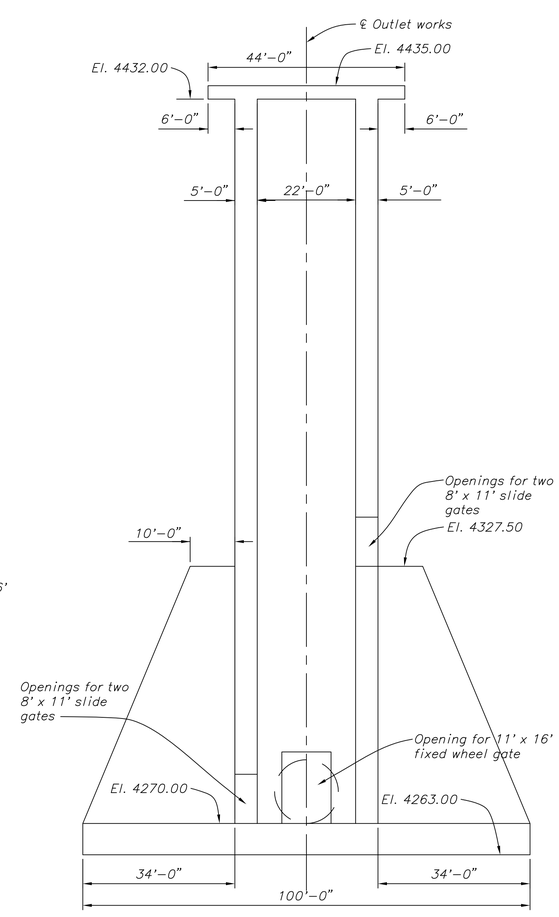
DENVER, COLORADO NOVEMBER 2008
SHEET 1 OF 1

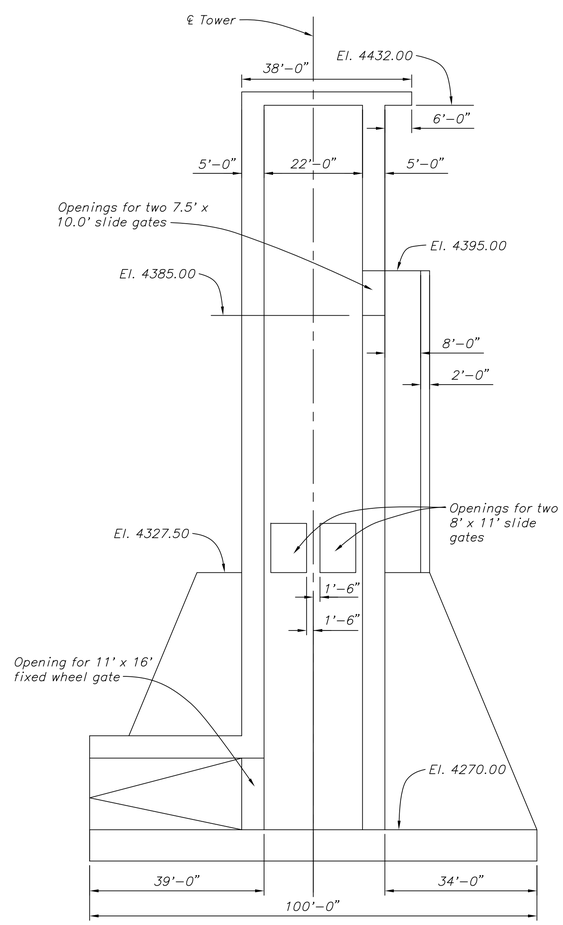
Figure B42 (Final Draft)

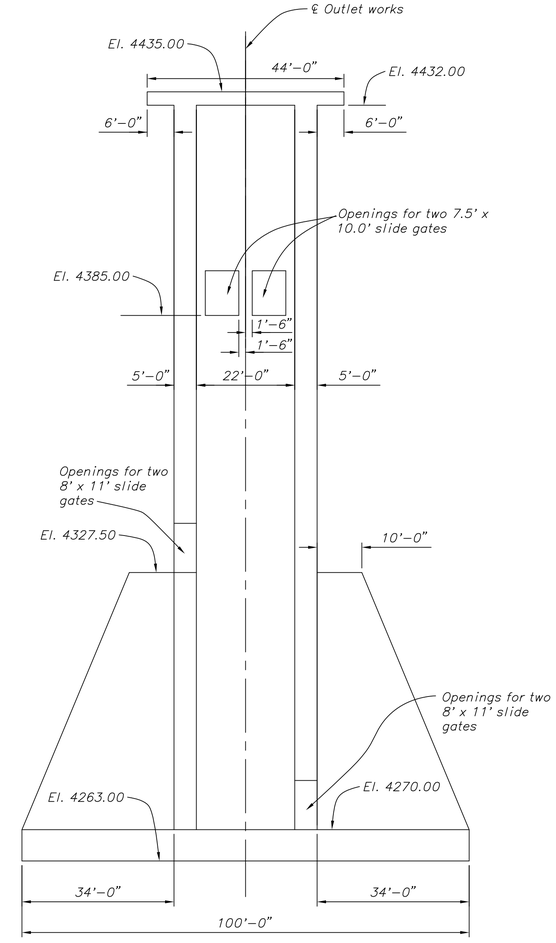
NOVEMBER 6, 2008 09:24
RBENK

CAD SYSTEM
CAD FILENAME
DATE AND TIME PLOTTED
AutoCAD Rel. 17.1s
PLOTTED BY
INTAKESTRUCTURES1000.DWG









NOTES

1.
2.

REFERENCE DRAWINGS

B

ALWAYS THINK **SAFETY**

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
KLAMATH PROJECT – OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING LEVEL

TOWER INTAKE STRUCTURE

2,000 CFS

DESIGNED BY

REVIEWED BY

WATERWAYS & CONCRETE DAMS GROUP

DENVER, COLORADO NOVEMBER 2008
SHEET 1 OF 1

Figure B43 (Final Draft)

CAD SYSTEM
AutoCAD Rel. 17.1s
CAD FILENAME
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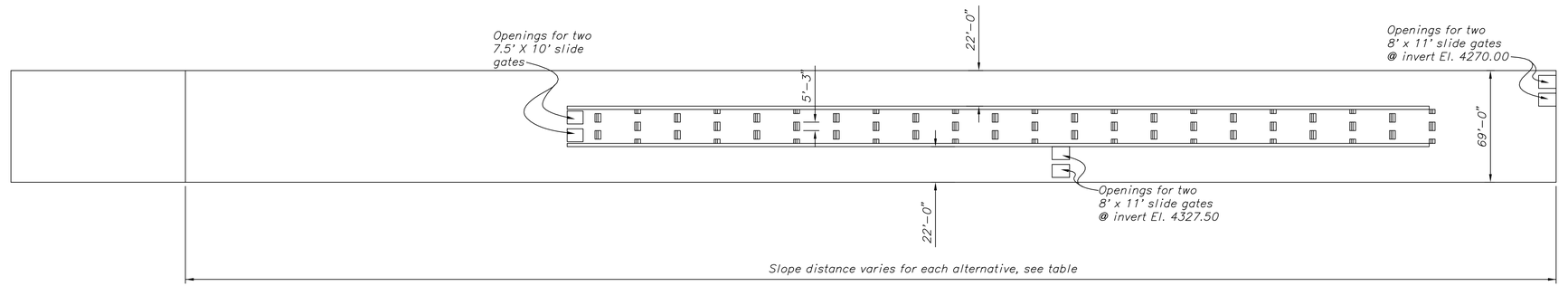
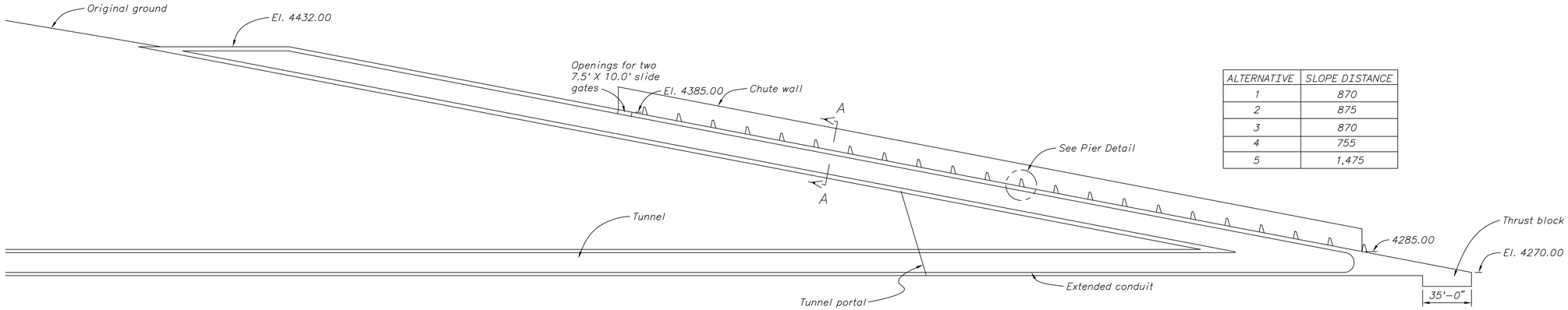
DATE AND TIME PLOTTED
NOVEMBER 6, 2008 09:33
PLOTTED BY
RBENK

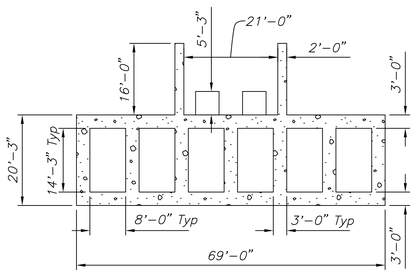


PLAN

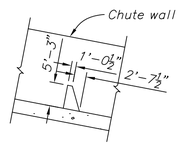


PROFILE

ALTERNATIVE	SLOPE DISTANCE
1	870
2	875
3	870
4	755
5	1,475



SECTION A–A



PIER DETAIL

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
KLAMATH PROJECT – OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING LEVEL
SLOPING INTAKE STRUCTURE
2,000 CFS

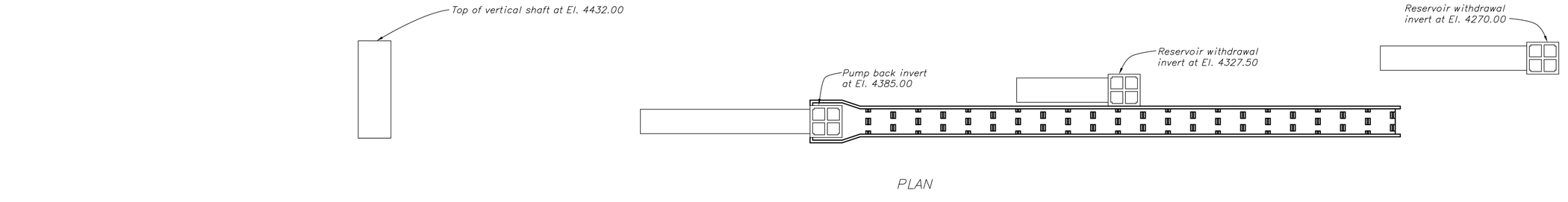
DESIGNED BY
REVIEWED BY WATERWAYS & CONCRETE DAMS GROUP

DENVER, COLORADO NOVEMBER 2008
SHEET 1 OF 1

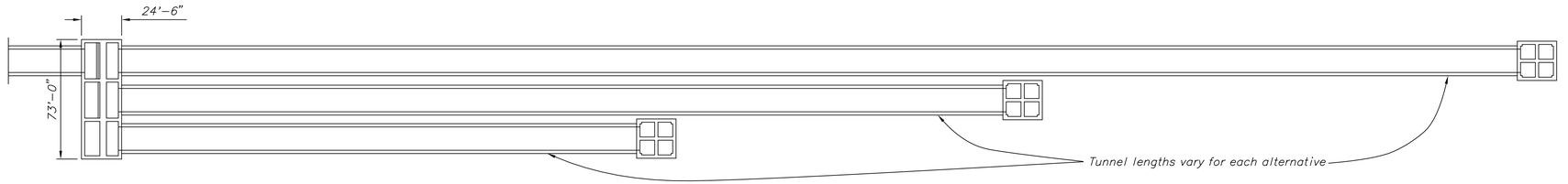
Figure B44 (Final Draft)

For Internal Discussion Only
Not For Distribution

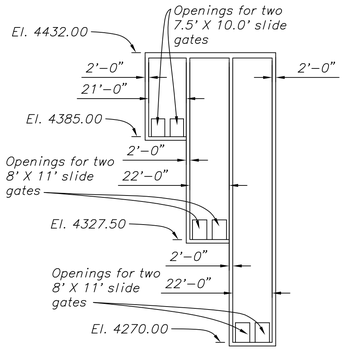
CAD SYSTEM
CAD FILENAME
DATE AND TIME PLOTTED
PLOTTED BY
INTAKESTRUCTURES2000LONG
AutoCAD Rel. 17.1s
NOVEMBER 4, 2008 08:12
RBENK



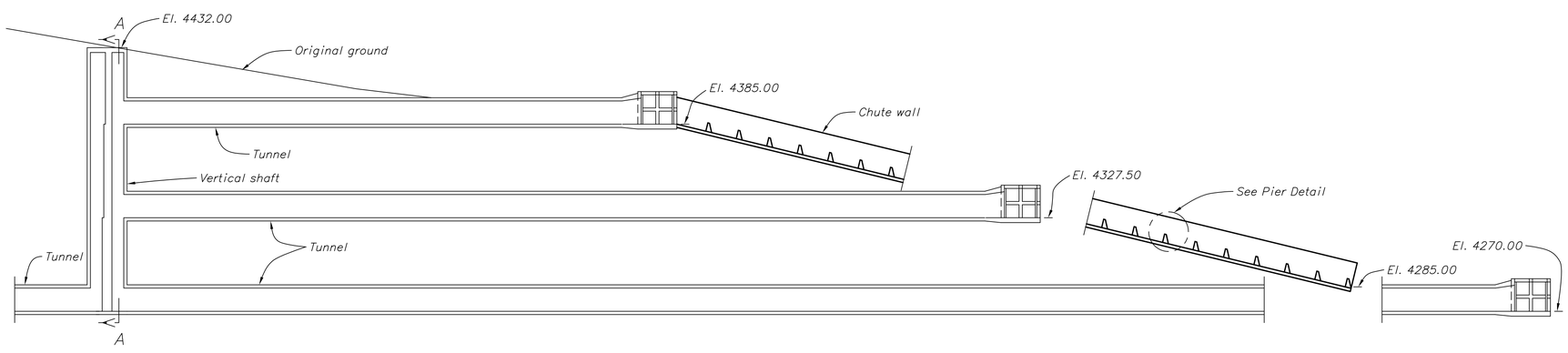
PLAN



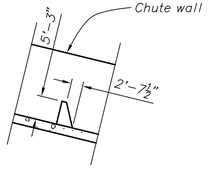
PLAN – TUNNELS



SECTION A-A



PROFILE



PIER DETAIL

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KLAMATH PROJECT – OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING LEVEL

SHAFT INTAKE STRUCTURE 2,000 CFS

DESIGNED BY

REVIEWED BY WATERWAYS & CONCRETE DAMS GROUP

DENVER, COLORADO NOVEMBER 2008
SHEET 1 OF 1

Figure B45 (Final Draft)

CAD SYSTEM
CAD FILENAME
DATE AND TIME PLOTTED
AutoCAD Rel. 17.1s
PLOTTED BY
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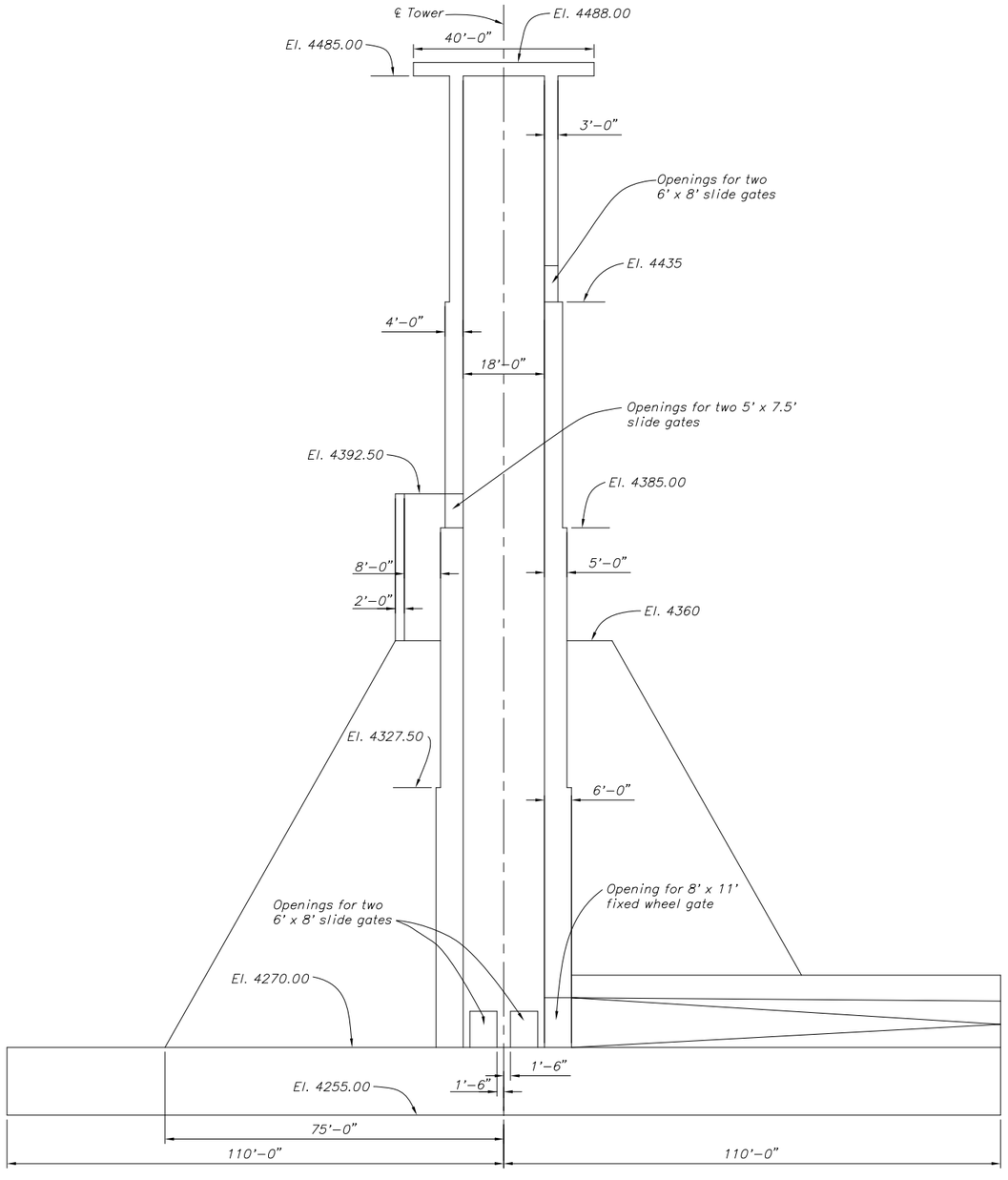
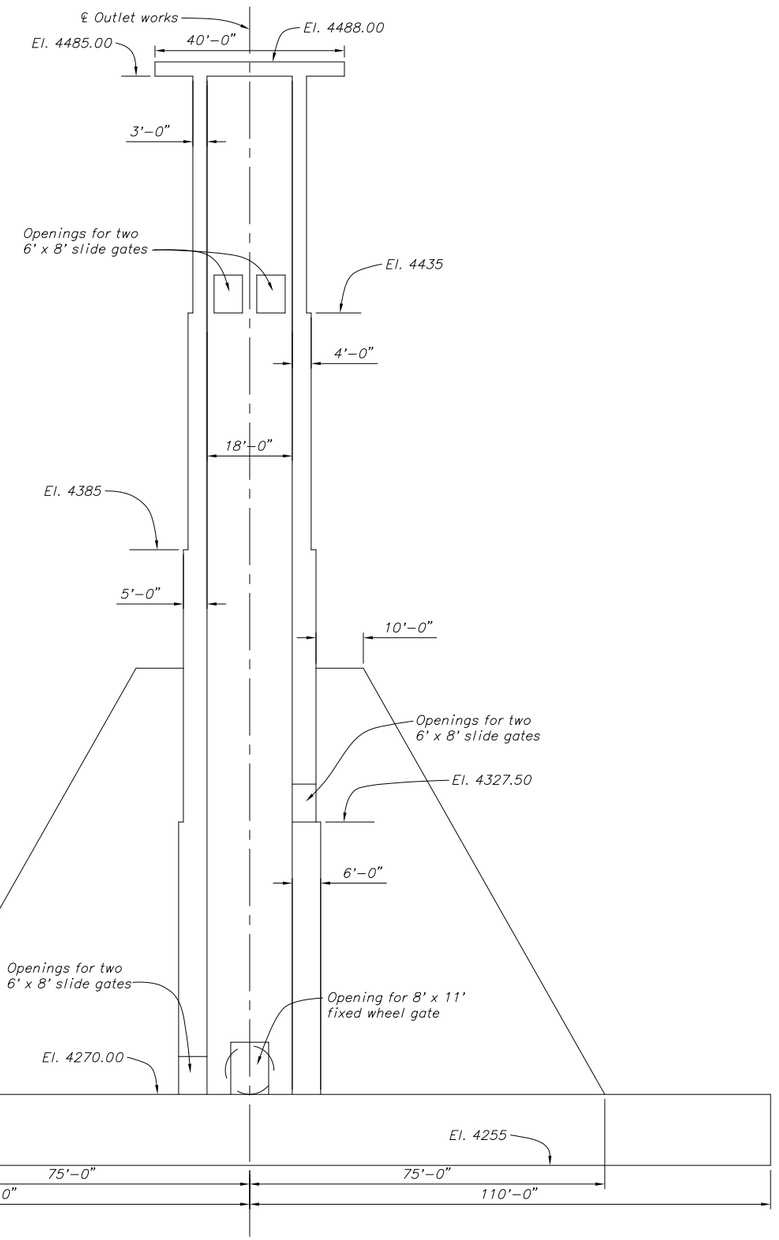
RBENIK





16 0 16 32
SCALE OF FEET

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KLAMATH PROJECT – OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING LEVEL

TOWER INTAKE STRUCTURE
1,000 CFS, 500,000 AC–FT RESERVOIR

DENVER, COLORADO MARCH 2009
SHEET 1 OF 3

Figure B46 (Final Draft)

CAD SYSTEM
AutoCAD Rel. 17.1s
CAD FILENAME
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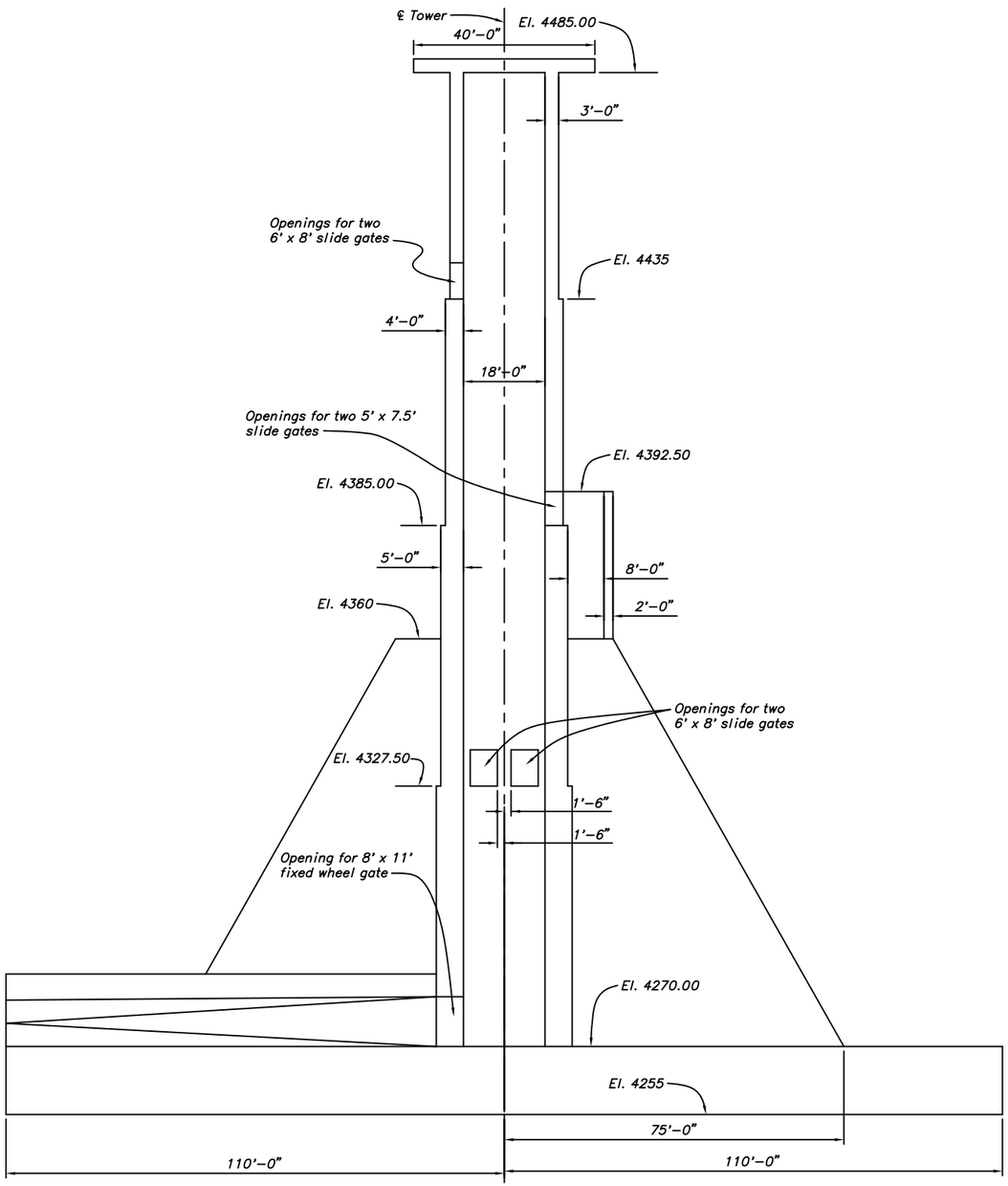
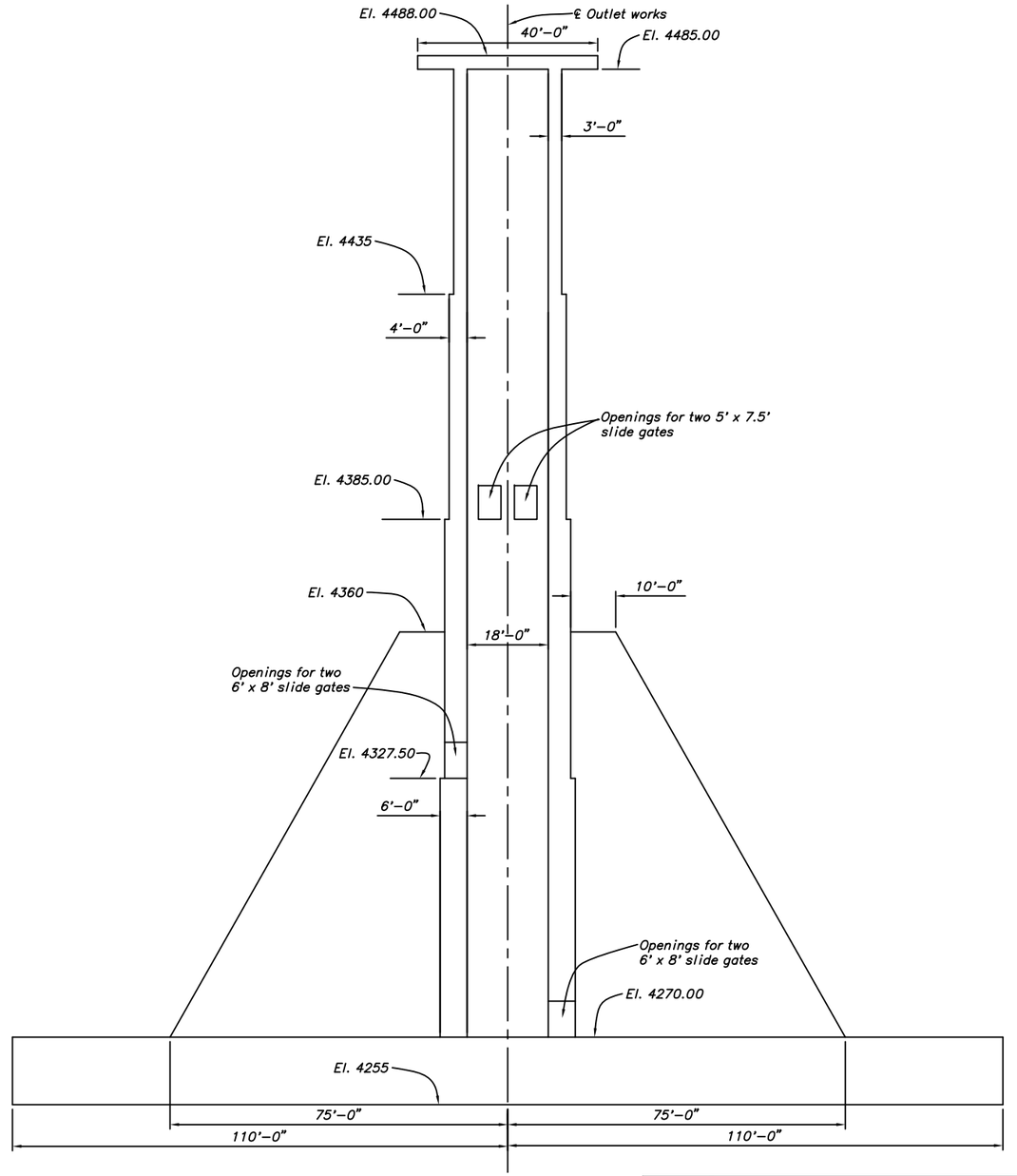
DATE AND TIME PLOTTED
MARCH 3, 2009 08:14
PLOTTED BY
RBENK





16 0 16 32
SCALE OF FEET

CAD SYSTEM
AutoCAD Rel. 17.1s
CAD FILENAME
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DATE AND TIME PLOTTED
MARCH 12, 2009 09:22
PLOTTED BY
RSENK

ALWAYS THINK **SAFETY**

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KLAMATH PROJECT – OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

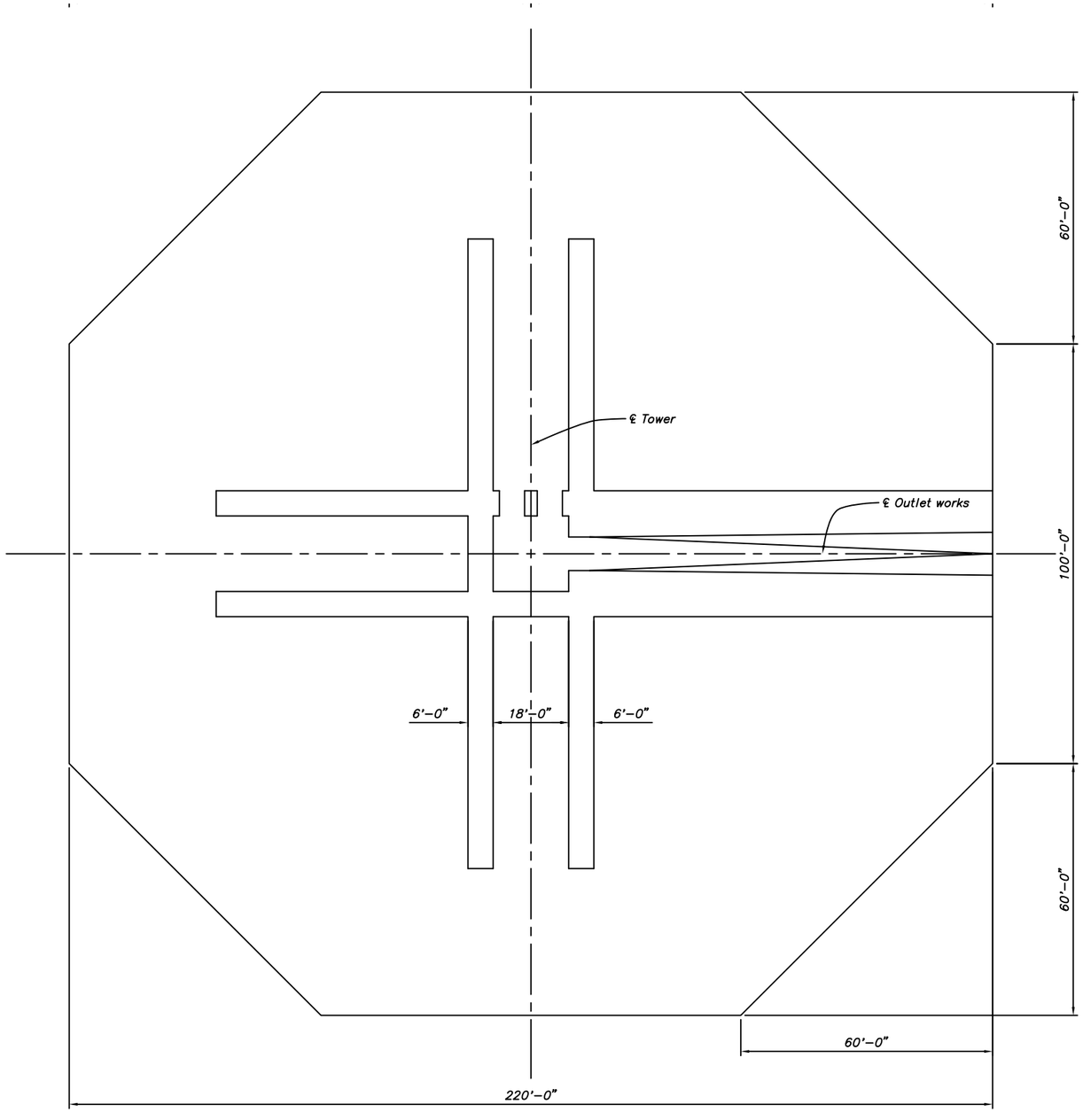
APPRAISAL PLANNING LEVEL

TOWER INTAKE STRUCTURE

1,000 CFS, 500,000 AC–FT RESERVOIR

DENVER, COLORADO MARCH 2009
SHEET 2 OF 3

Figure B47 (Final Draft)



16 0 16 32
SCALE OF FEET

ALWAYS THINK **SAFETY**

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KLAMATH PROJECT – OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING LEVEL

TOWER INTAKE STRUCTURE

1,000 CFS, 500,000 AC–FT RESERVOIR

DENVER, COLORADO MARCH 2009
SHEET 3 OF 3

Figure B48 (Final Draft)

CAD SYSTEM
AutoCAD R14 17.1s
CAD FILENAME
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DATE AND TIME PLOTTED
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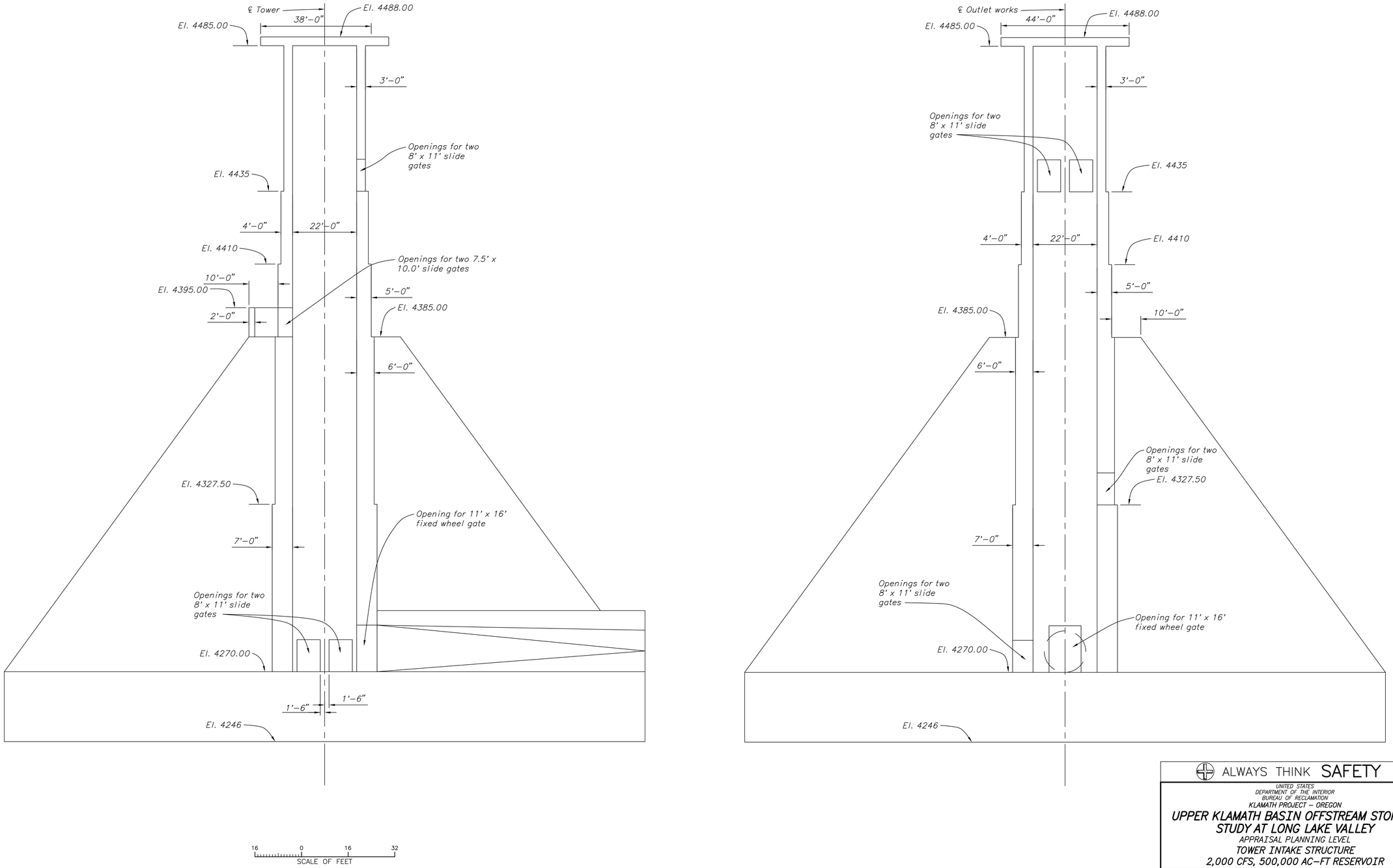

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KLAMATH PROJECT – OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING LEVEL

TOWER INTAKE STRUCTURE

2,000 CFS, 500,000 AC-FT RESERVOIR

DENVER, COLORADO March 2009
SHEET 1 OF 3

Figure B49 (Final Draft)

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DATE AND TIME PLOTTED MARCH 12, 2009 09:26
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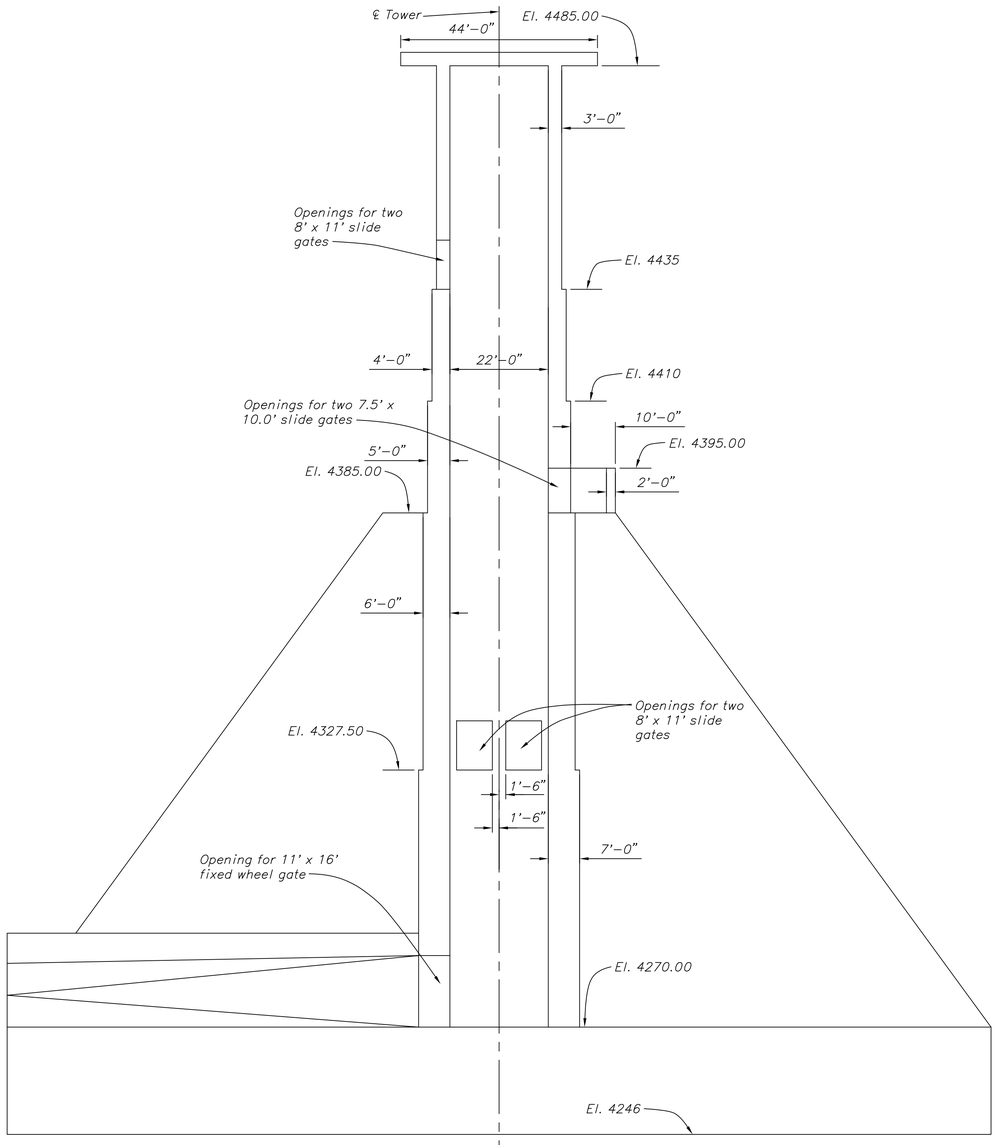

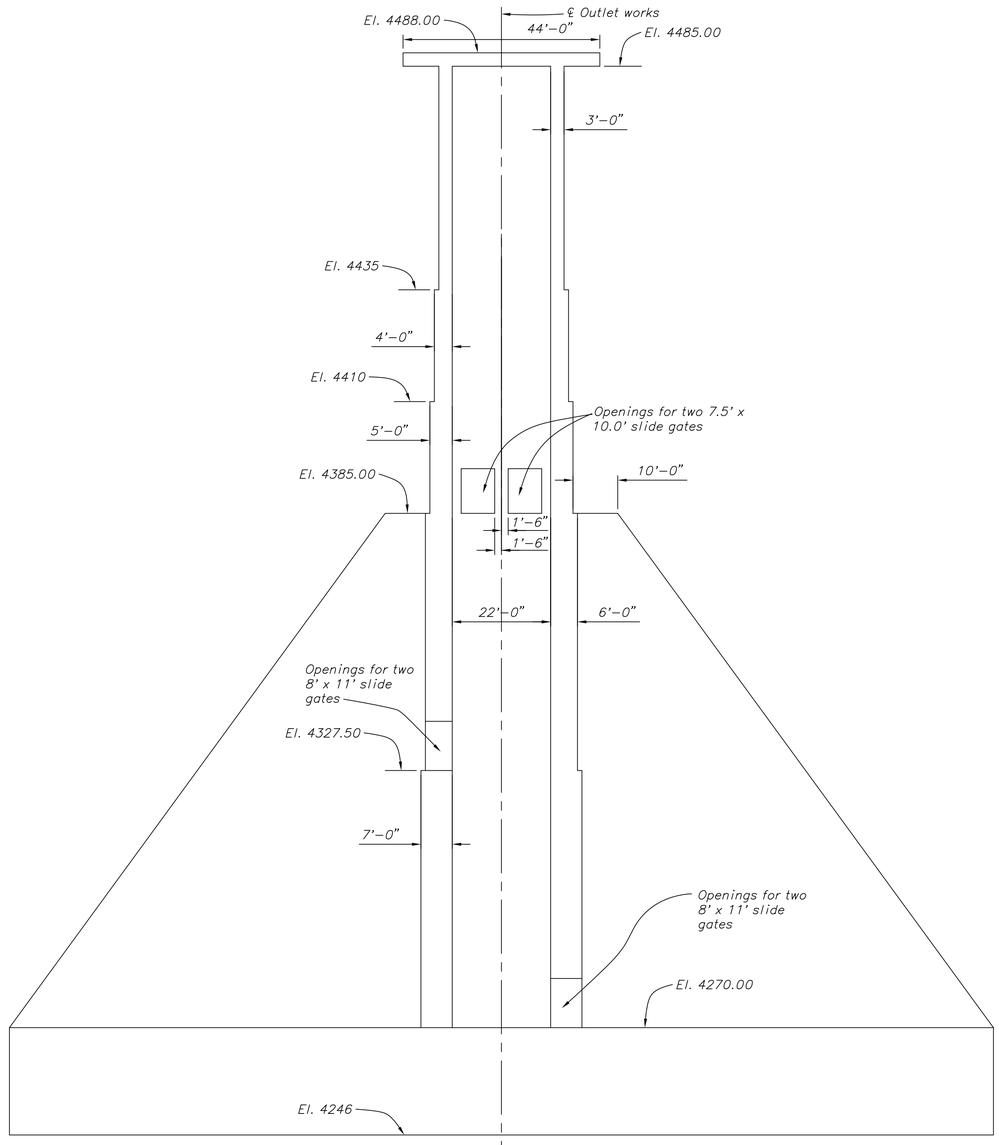

16 0 16 32
SCALE OF FEET

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KLAMATH PROJECT – OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING LEVEL

TOWER INTAKE STRUCTURE

2,000 CFS, 500,000 AC–FT RESERVOIR

DENVER, COLORADO March 2009
SHEET 2 OF 3

Figure B50 (Final Draft)

CAD SYSTEM
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CAD FILENAME
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DATE AND TIME PLOTTED
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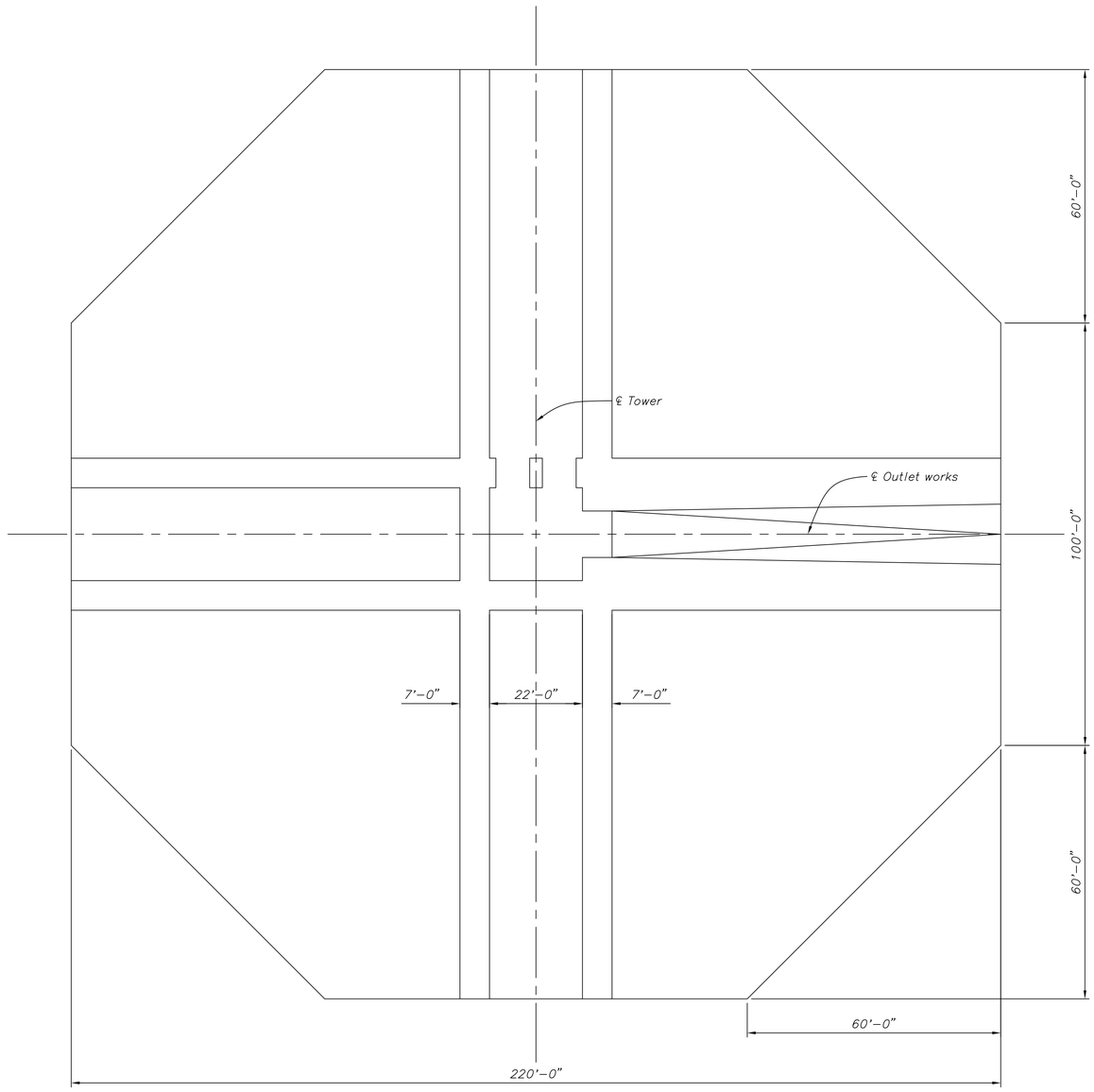

16 0 16 32
SCALE OF FEET

ALWAYS THINK SAFETY

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KLAMATH PROJECT – OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING LEVEL

TOWER INTAKE STRUCTURE
2,000 CFS, 500,000 AC–FT RESERVOIR

DENVER, COLORADO March 2009
SHEET 3 OF 3

Figure B51 (Final Draft)

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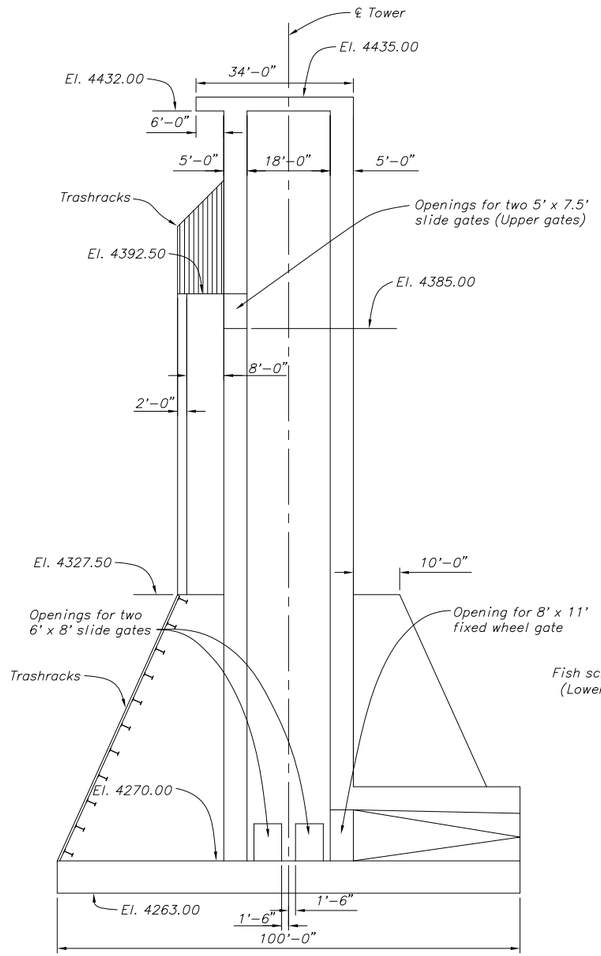
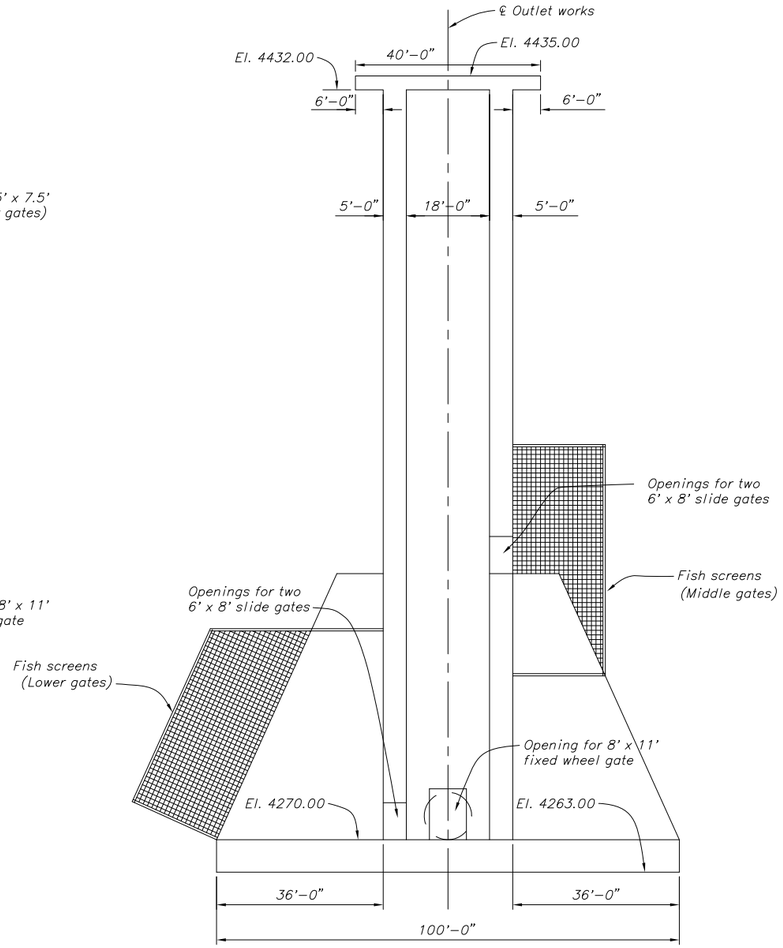
DATE AND TIME PLOTTED
MARCH 12, 2009 09:30
PLOTTED BY
RSENK



TRASHRACKS FOR UPPER GATES



SCREENS AT MIDDLE AND LOWER GATES

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UNITED STATES
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BUREAU OF RECLAMATION

KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL LEVEL ESTIMATE

TOWER INTAKE STRUCTURE WITH SCREENS 1,000 CFS

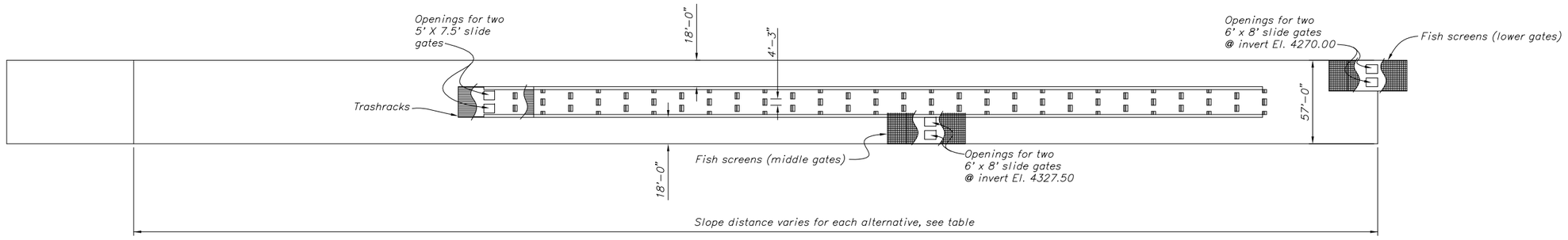
DESIGNED

REVIEWED BY
WATERWAYS & CONCRETE DAMS GROUP

DENVER, COLORADO DECEMBER 2008
SHEET 1 OF 1

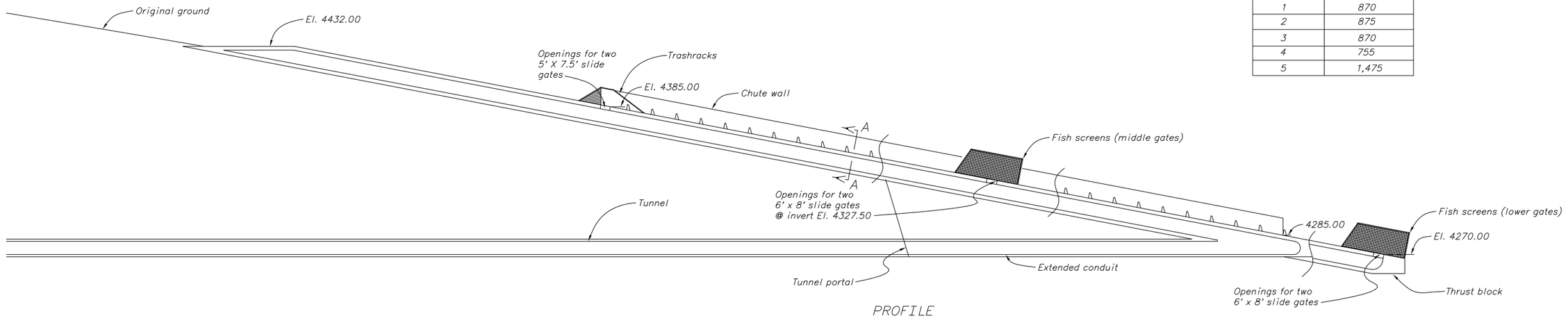
Figure 52 (Final Draft)

CAD SYSTEM
CAD FILENAME
DATE AND TIME PLOTTED
AutoCAD Rel. 17.0
PLOTTED BY
INTAKESTRUCTURES1.DWG
DECEMBER 18, 2008 14:15
RCHRISTENSEN

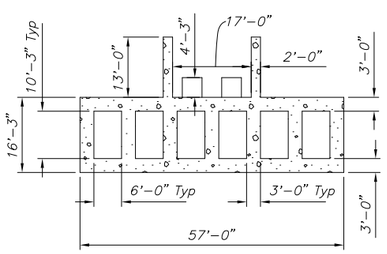


PLAN

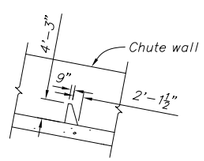
ALTERNATIVE	SLOPE DISTANCE
1	870
2	875
3	870
4	755
5	1,475



PROFILE



SECTION A–A



PIER DETAIL

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KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL LEVEL ESTIMATE

SLOPING INTAKE STRUCTURE WITH SCREENS 1,000 CFS

DESIGNED

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WATERWAYS & CONCRETE DAMS GROUP

DENVER, COLORADO DECEMBER 2008
SHEET 1 OF 1

Figure B53 (Final Draft)

CAD SYSTEM
CAD FILENAME
DATE AND TIME PLOTTED
AutoCAD Rel. 17.0
PLOTTED BY
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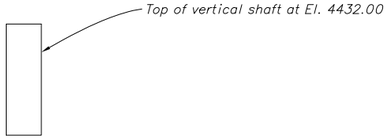
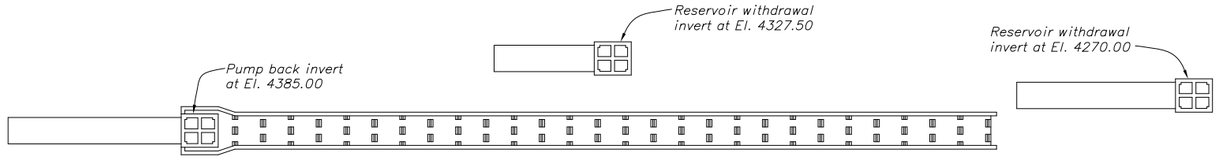
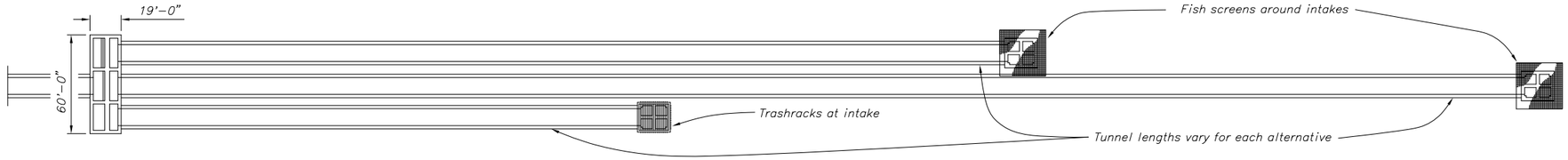
RCHRISTENSEN

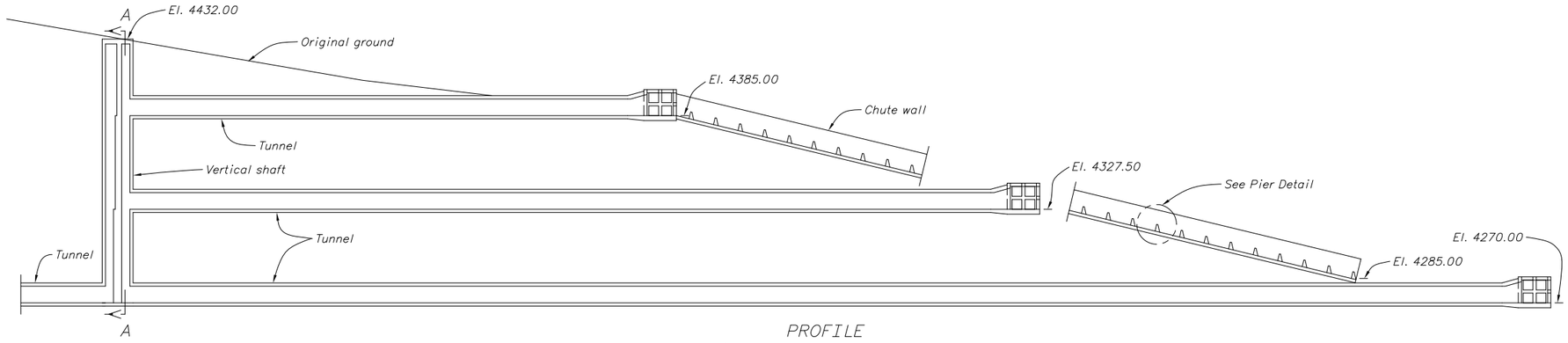




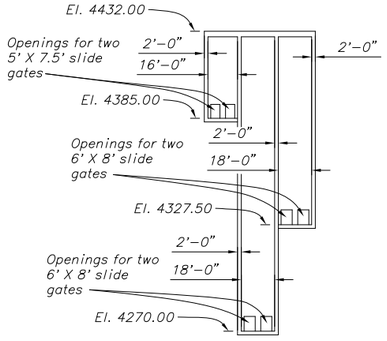
PLAN
(TRASHRACKS AND SCREENS NOT SHOWN)



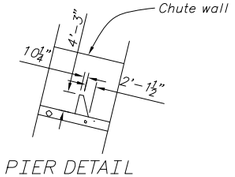
PLAN – TUNNELS



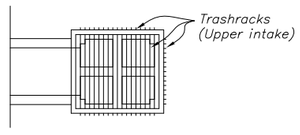
PROFILE
(TRASHRACKS AND SCREENS NOT SHOWN)



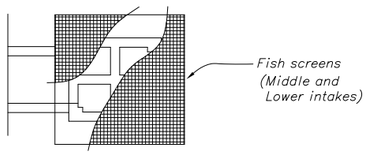
SECTION A–A



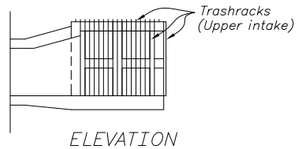
PIER DETAIL



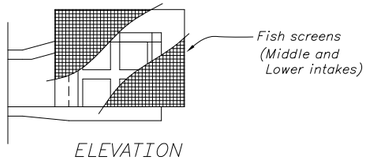
PLAN



PLAN



ELEVATION
INTAKE WITH TRASHRACKS



ELEVATION
INTAKES WITH SCREENS

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BUREAU OF RECLAMATION

KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING LEVEL

SHAFT INTAKE STRUCTURE WITH SCREENS 1,000 CFS

DESIGNED BY

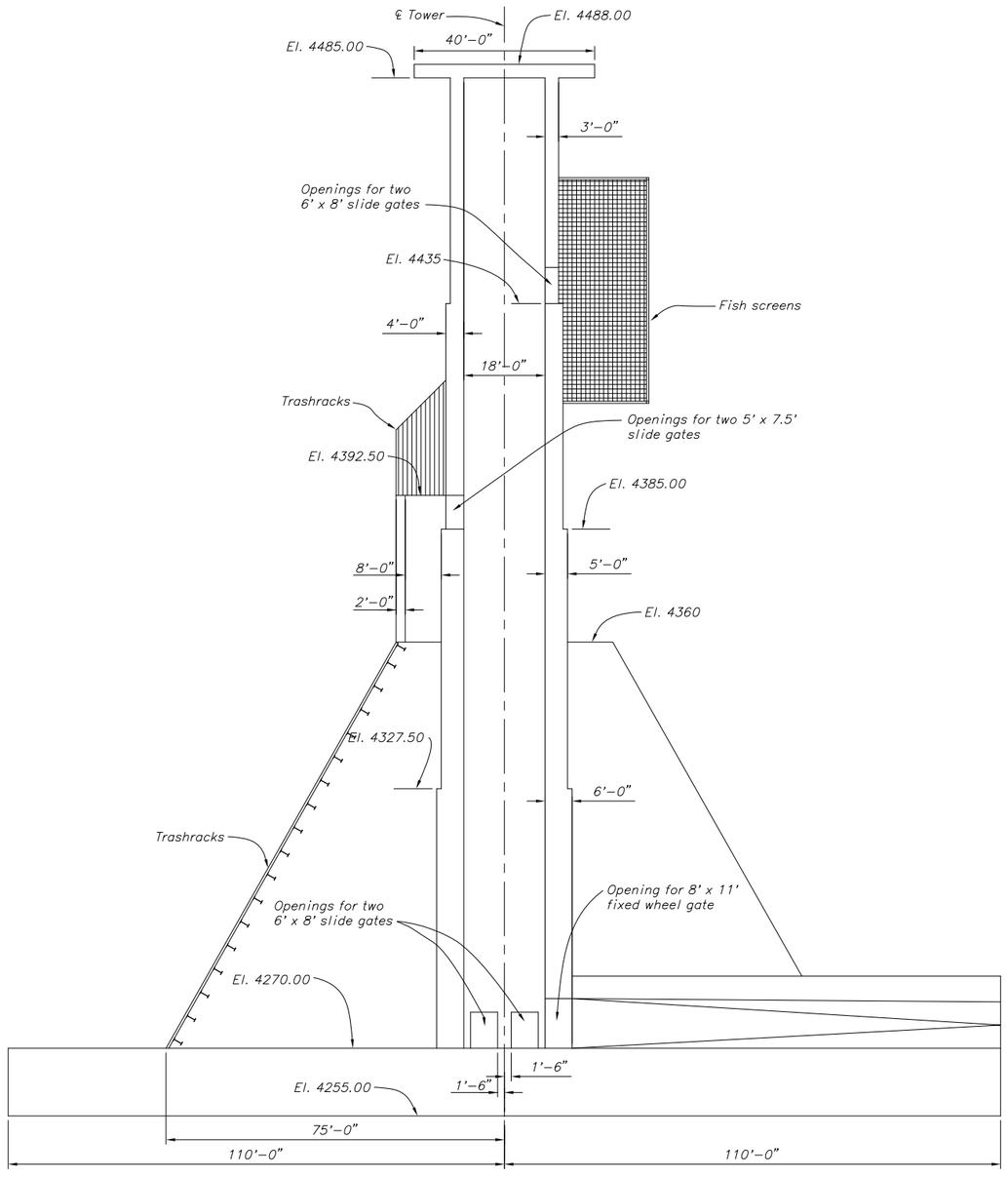
REVIEWED BY
WATERWAYS & CONCRETE DAMS GROUP

DENVER, COLORADO DECEMBER 2008
SHEET 1 OF 1

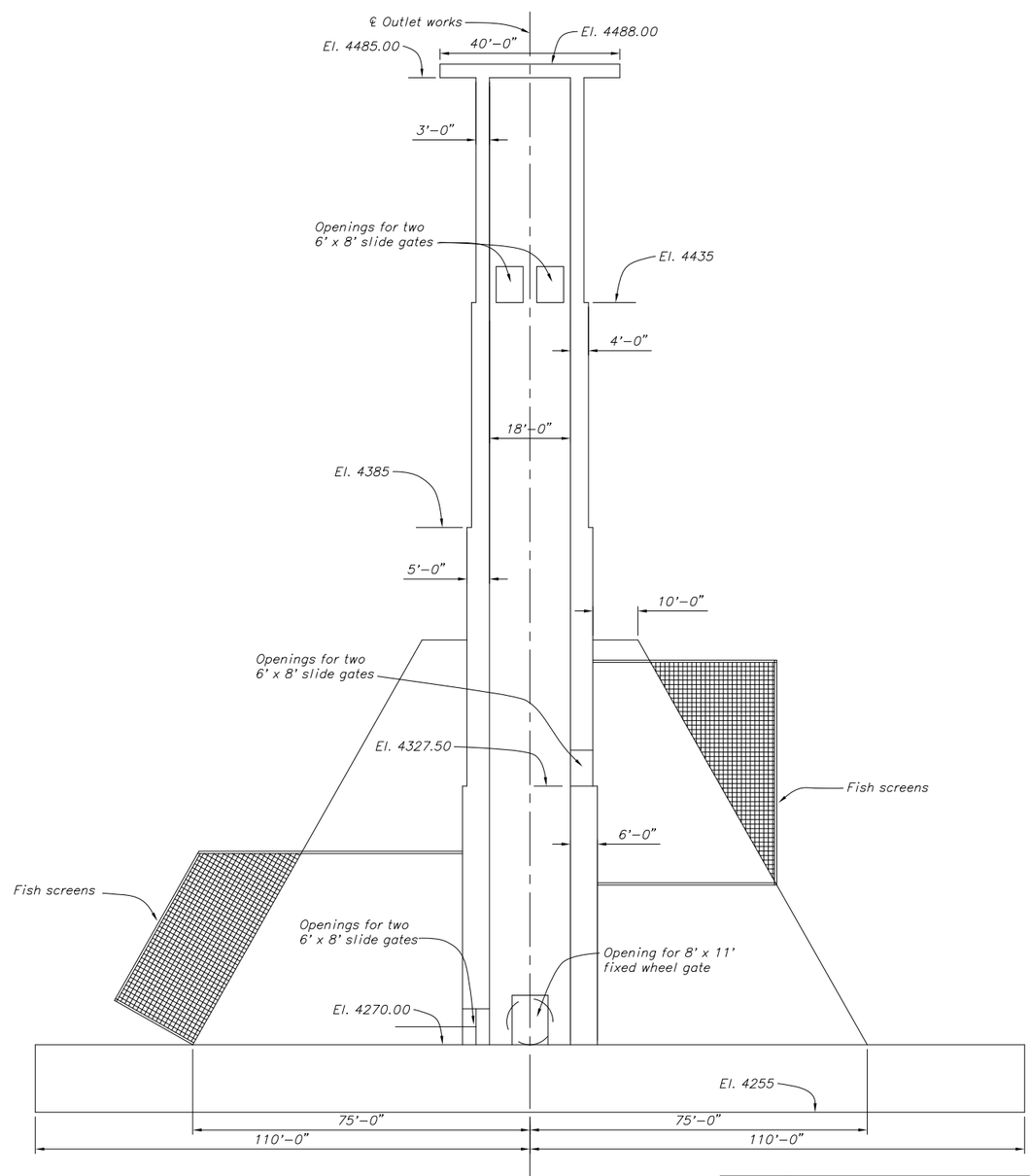
Figure B54 (Final Draft)

CAD SYSTEM
CAD FILENAME
DATE AND TIME PLOTTED
AutoCAD Rel. 17.1s
PLOTTED BY
INTAKESTRUCTURESHAFT1000SCREEN.DWG

DECEMBER 18, 2008 13:56
RCHRISTENSEN



SCREENS FOR UPPER GATES & TRASHRACKS FOR PUMP FLOW GATES



SCREENS AT THE TWO LOWER ELEVATION GATES

16 0 16 32
SCALE OF FEET

ALWAYS THINK SAFETY

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DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
KLAMATH PROJECT – OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL PLANNING LEVEL

TOWER INTAKE STRUCTURE WITH SCREENS
1,000 CFS, 500,000 AC–FT RESERVOIR

DESIGNED BY

REVIEWED BY
WATERWAYS & CONCRETE DAMS GROUP

DENVER, COLORADO MARCH 2009
SHEET 1 OF 1

Figure B55 (Final Draft)

CAD SYSTEM
CAD FILENAME
DATE AND TIME PLOTTED
AutoCAD Rel. 17.1s
PLOTTED BY
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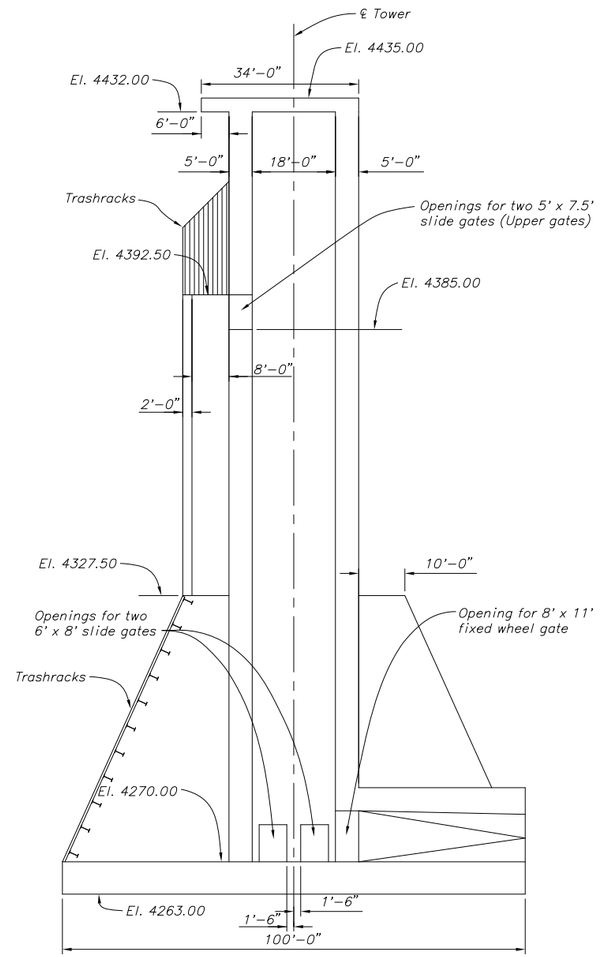
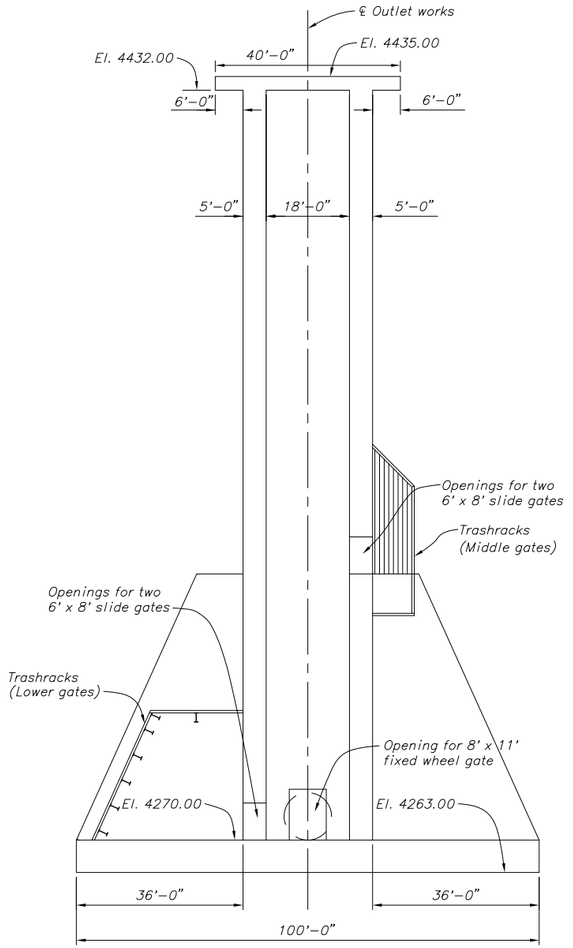
RCHRISTENSEN



TRASHRACKS FOR UPPER GATES



TRASHRACKS AT MIDDLE AND LOWER GATES

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KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL LEVEL ESTIMATE

TOWER INTAKE STRUCTURE WITH TRASHRACKS 1,000 CFS

DESIGNED

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WATERWAYS & CONCRETE DAMS GROUP

DENVER, COLORADO DECEMBER 2008
SHEET 1 OF 1

Figure B56 (Final Draft)

CAD SYSTEM
CAD FILENAME
DATE AND TIME PLOTTED
AutoCAD Rel. 17.1s
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DECEMBER 18, 2008 14:18
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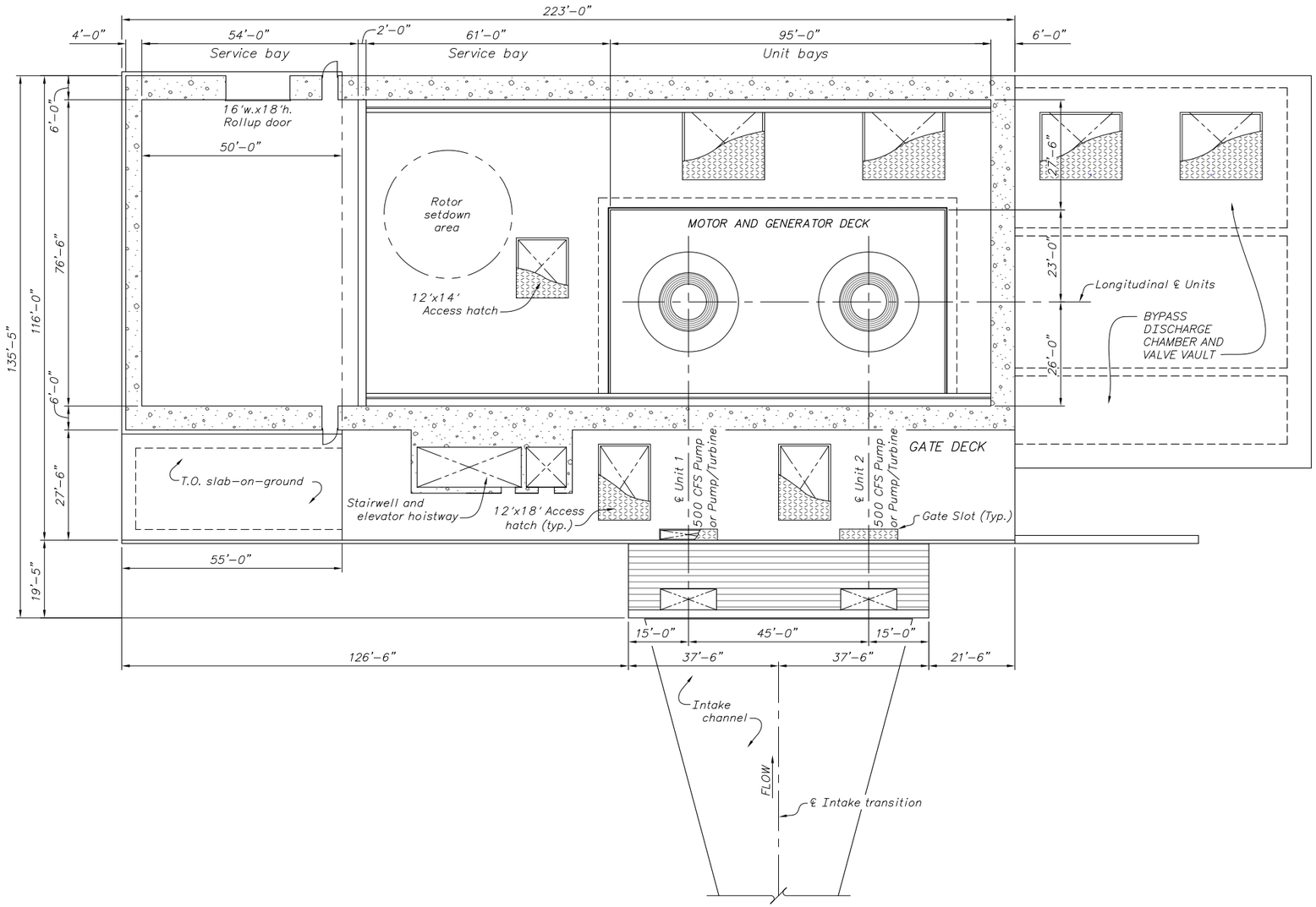
RECLAMATION
Managing Water in the West



PLAN – SERVICE BAY, GATE DECK & MOTOR DECK
1000 CFS PUMPING PLANT AND 1000 CFS PUMP/TURBINE PLANT

16 0 16 32
SCALE OF FEET

NOTES

1. *For transverse section through unit, see Figure ?.*

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL LEVEL ESTIMATE

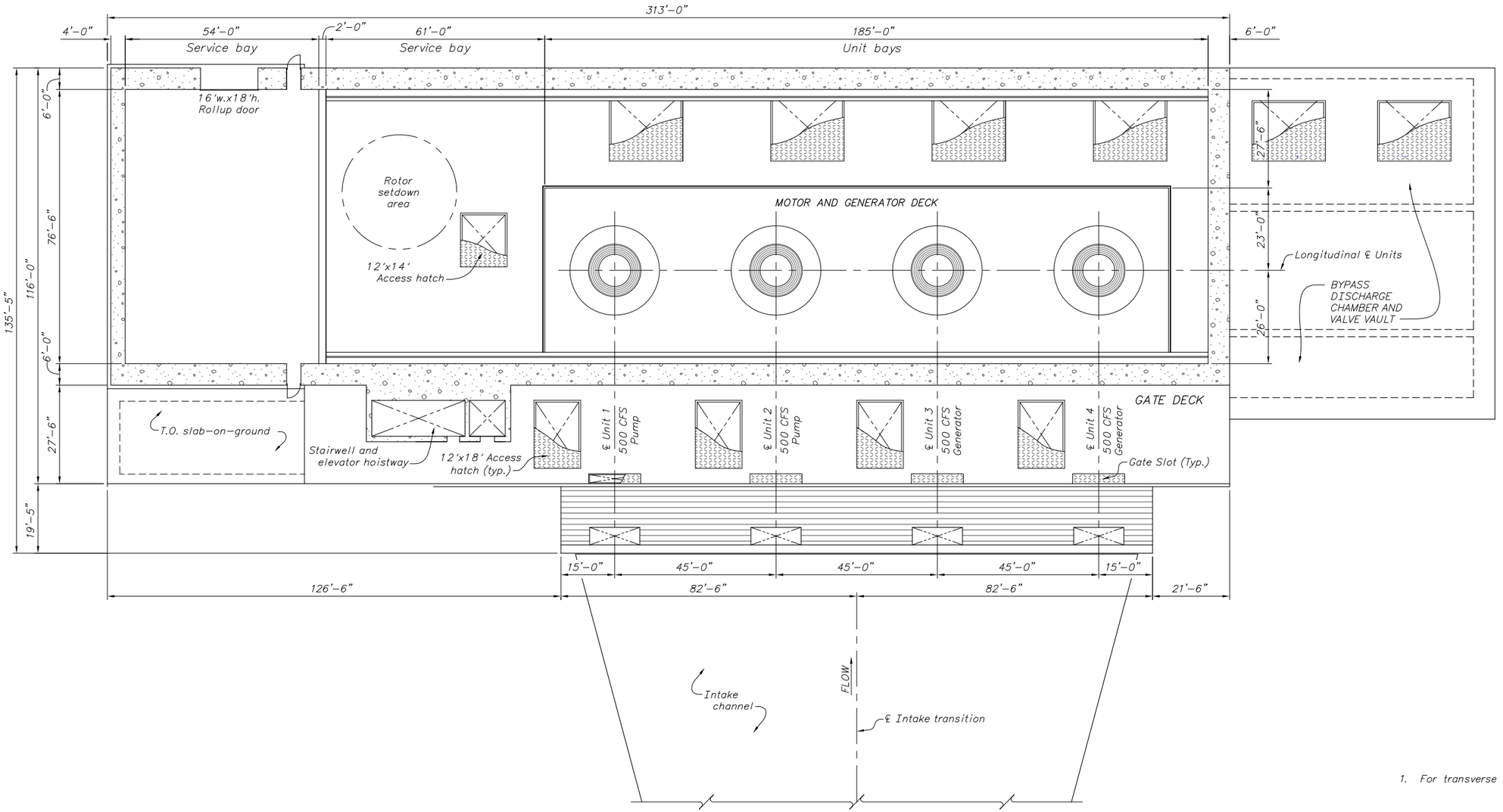
1000 CFS PUMPING PLANT AND
1000 CFS PUMP/TURBINE PLANT
PLAN – MOTOR DECK

DESIGNED BY	
REVIEWED BY (PLANT STRUCTURES GROUP)	
CADD SYSTEM	CADD FILENAME
DENVER, COLORADO	JULY 31, 2008

Figure B57 (Final Draft)

PLOTTED BY: AUTOCAD UNKNOWN
Not Plotted Not Plotted

RECLAMATION
Managing Water in the West



PLAN – SERVICE BAY, GATE DECK & MOTOR DECK
1000 CFS PUMPING AND GENERATOR PLANT

16 0 16 32
SCALE OF FEET

NOTES

1. For transverse section through unit, see Figure ?.

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL LEVEL ESTIMATE

1000 CFS PUMPING AND GENERATOR PLANT
PLAN – MOTOR DECK

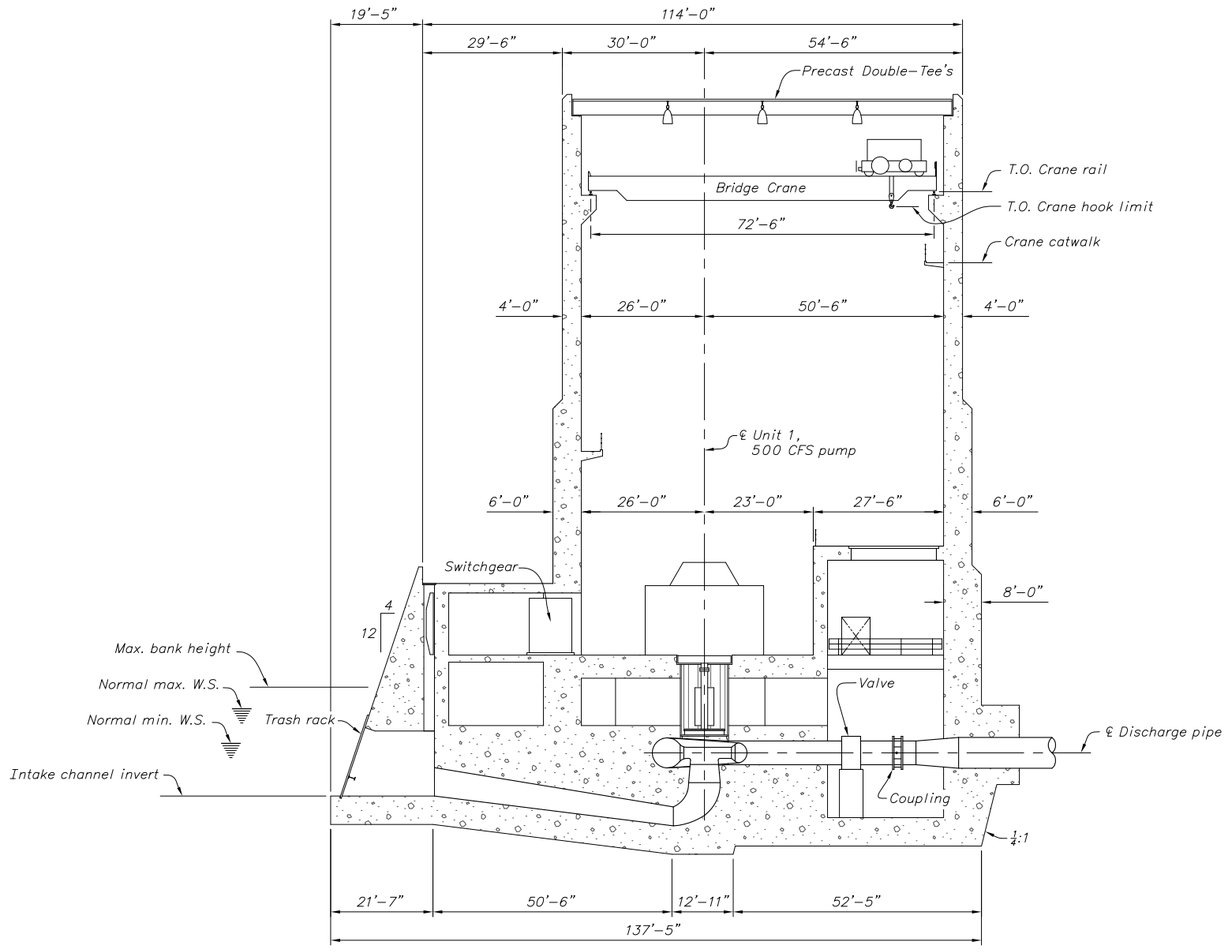
DESIGNED BY

REVIEWED BY
PLANT STRUCTURES GROUP

CADD SYSTEM	CADD FILENAME
DENVER, COLORADO	JULY 31, 2008

Figure B58 (Final Draft)

PLOTTED BY: AUTOCAD UNKNOWN
Not Plotted Not Plotted



TRANSVERSE SECTION THRU ℄ 500 CFS UNIT

(FOR 1000 CFS PUMPING PLANT, 1000 CFS PUMPING AND GENERATION PLANT, AND 1000 CFS PUMPING/TURBINE PLANT)

16 0 16 32
SCALE OF FEET

NOTE

1. Transverse Section of plant is similar for all 1000 cfs options.

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

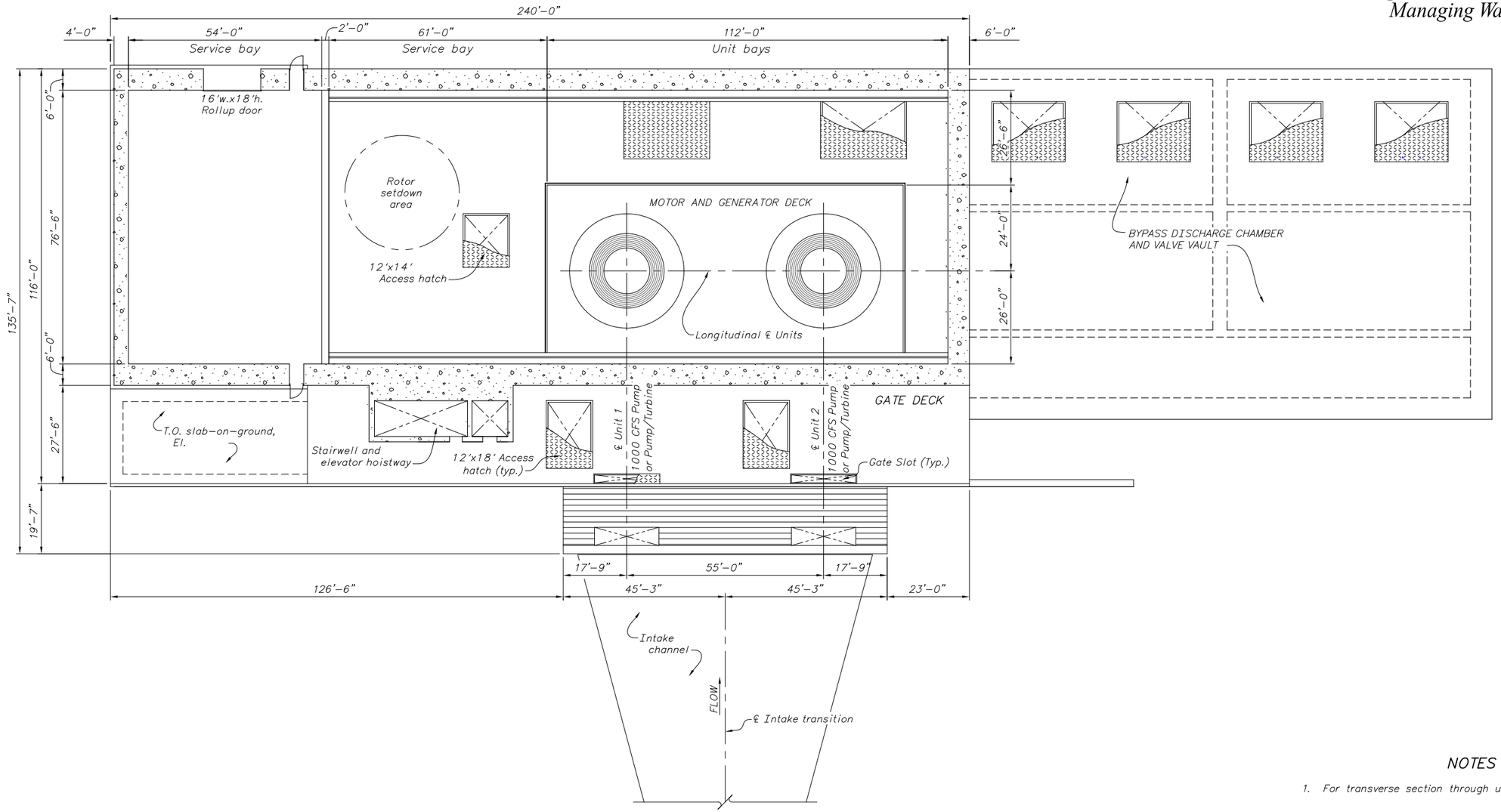
1000 CFS PLANTS

TRANSVERSE SECTION THRU 500 CFS UNIT

DESIGNED BY	
REVIEWED BY PLANT STRUCTURES GROUP	
CADD SYSTEM	CADD FILENAME
DENVER, COLORADO JULY 31, 2008	Figure B59 (Final Draft)

PLOTTED BY: AUTOCAD UNKNOWN
Not Plotted Not Plotted

RECLAMATION
Managing Water in the West



PLAN – SERVICE BAY, GATE DECK & MOTOR DECK
2000 CFS PUMPING PLANT AND 2000 CFS PUMP/TURBINE PLANT

16 0 16 32
SCALE OF FEET

NOTES

1. *For transverse section through unit, see Figure ?.*

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
KLAMATH PROJECT – KLAMATH COUNTY, OREGON

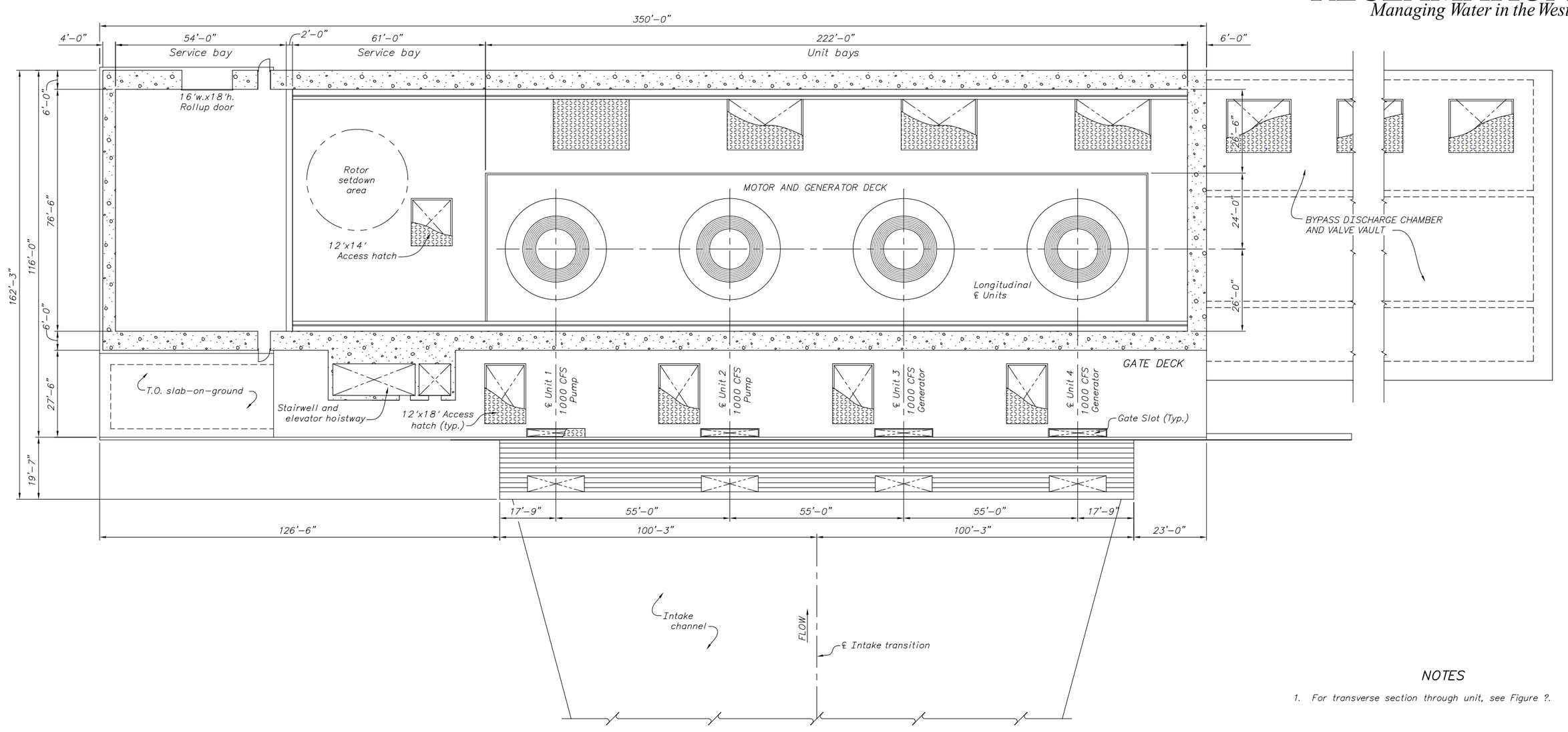
UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL LEVEL ESTIMATE
2000 CFS PUMPING PLANT AND
2000 CFS PUMP/TURBINE PLANT
PLAN – MOTOR DECK

DESIGNED BY
REVIEWED BY PLANT STRUCTURES GROUP
CADD SYSTEM
CADD FILENAME
DENVER, COLORADO SHEET 1 OF 2 JULY 31, 2008
Figure B60 (Final Draft)

PLOTTED BY: AUTOCAD UNKNOWN
Not Plotted Not Plotted

RECLAMATION
Managing Water in the West



NOTES

1. For transverse section through unit, see Figure ?.

PLAN – SERVICE BAY, GATE DECK & MOTOR AND GENERATOR DECK
2000 CFS PUMPING AND GENERATING PLANT

16 0 16 32
SCALE OF FEET

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

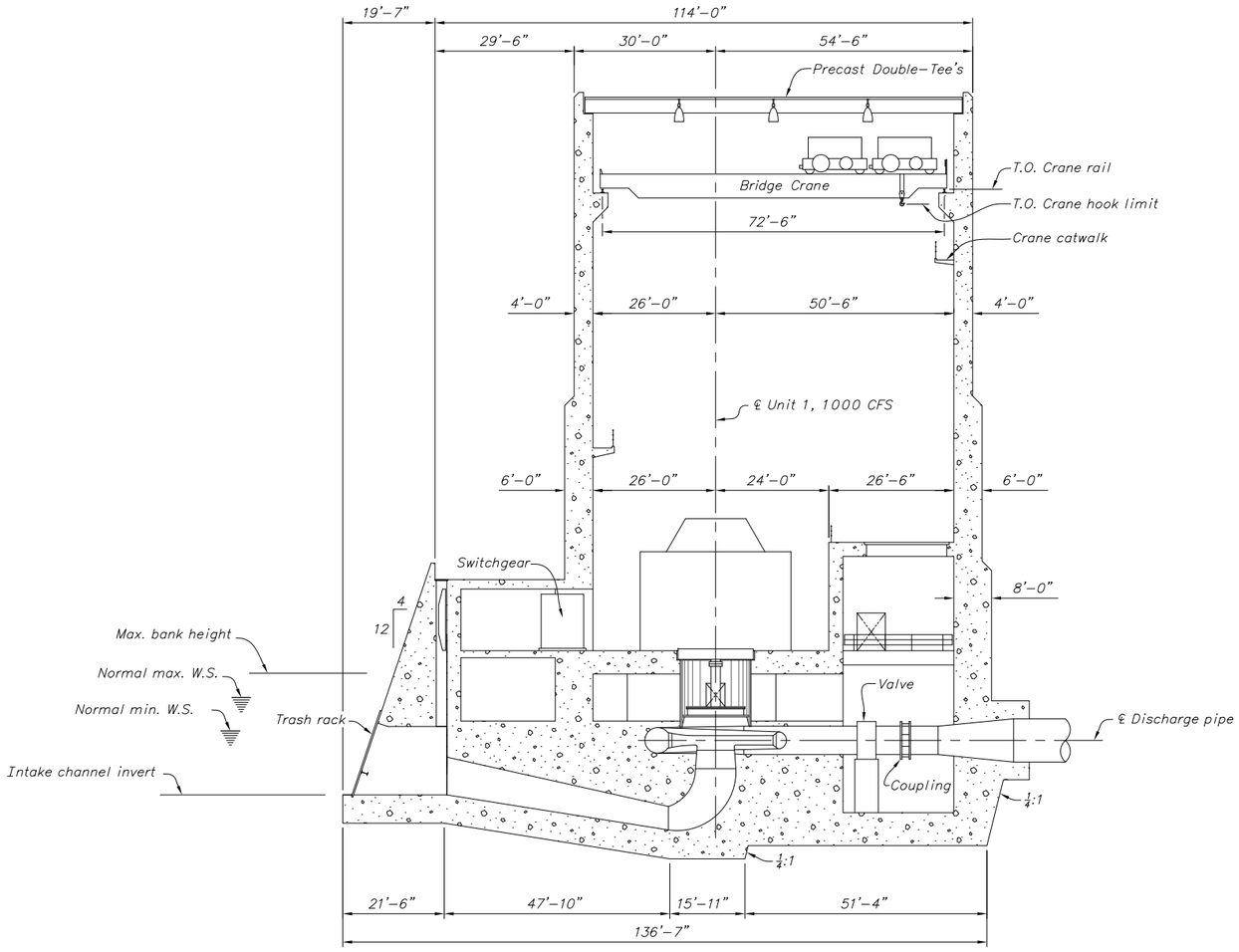
APPRAISAL LEVEL ESTIMATE

2000 CFS PUMPING AND GENERATOR PLANT
PLAN – MOTOR DECK

DESIGNED BY	
REVIEWED BY (PLANT STRUCTURES GROUP)	
CADD SYSTEM	CADD FILENAME
DENVER, COLORADO	JULY 31, 2008

Figure B61 (Final Draft)

PLOTTED BY: AUTOCAD UNKNOWN
Not Plotted Not Plotted



TRANSVERSE SECTION THRU ℄ 1000 CFS UNIT

(FOR 2000 CFS PUMPING PLANT, 2000 CFS PUMPING AND GENERATION PLANT, AND 2000 CFS PUMPING/TURBINE PLANT)

16 0 16 32
SCALE OF FEET

NOTE

1. Transverse Section of plant is similar for all 2000 cfs options.

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

KLAMATH PROJECT – KLAMATH COUNTY, OREGON

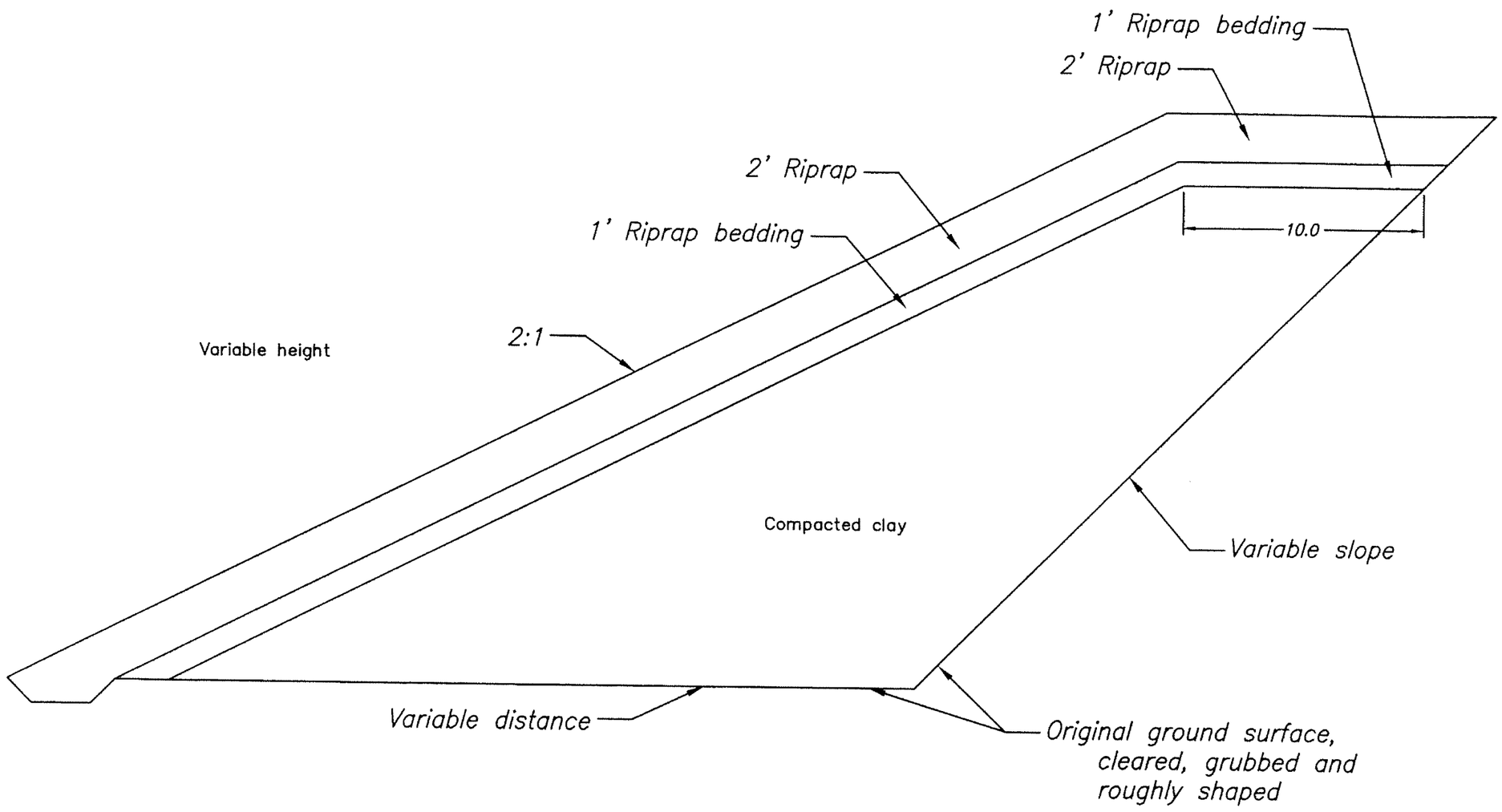
UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY
2000 CFS PLANTS
TRANSVERSE SECTION THRU 1000 CFS UNIT

DESIGNED BY B.K. GOPLEN
REVIEWED BY A.I. BERNSTEIN
PLANT STRUCTURES GROUP

CADD SYSTEM | CADD FILENAME

DENVER, COLORADO SHEET 1 OF 1 JULY 31, 2008 | Figure B62 (Final Draft)

PLOTTED BY: AUTOCAD UNKNOWN
Not Plotted Not Plotted



ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL LEVEL ESTIMATE

RESERVOIR LINER
CROSS SECTION

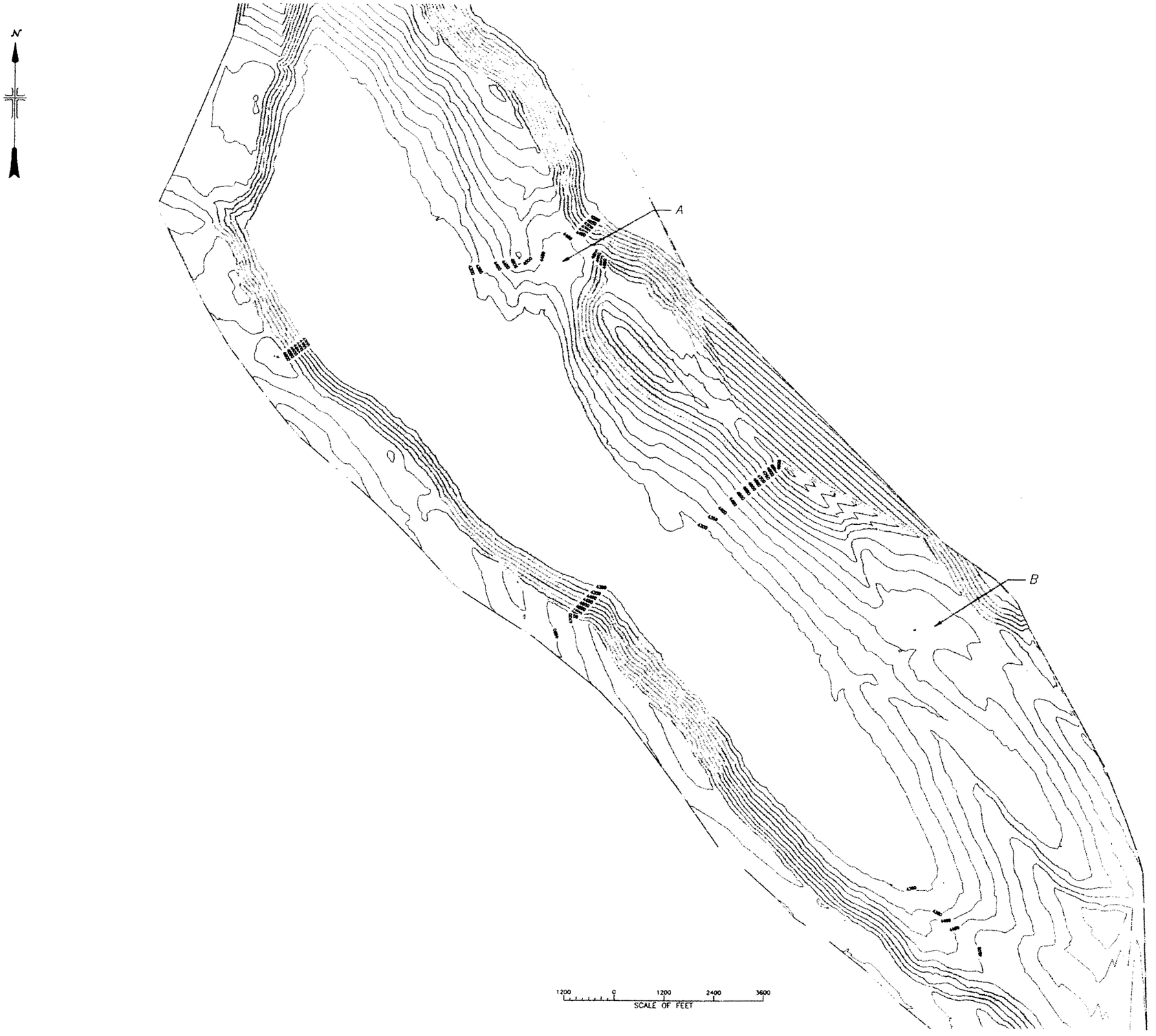
DESIGNED

REVIEWED BY

DENVER, COLORADO March 12, 2009
SHEET 1 OF 1

Figure B63 (Final Draft)

CAD SYSTEM AutoCAD Rel 17.1s
CAD FILENAME LLV CANAL SECTIONS_RECOVER NEW2.DWG
DATE AND TIME PLOTTED OCTOBER 17, 2008 09:44
PLOTTED BY ARETNOLDS



ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

KLAMATH PROJECT – KLAMATH COUNTY, OREGON

UPPER KLAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRAISAL LEVEL ESTIMATE

LONG LAKE VALLEY TOPOGRAPHY

DESIGNED

REVIEWED BY

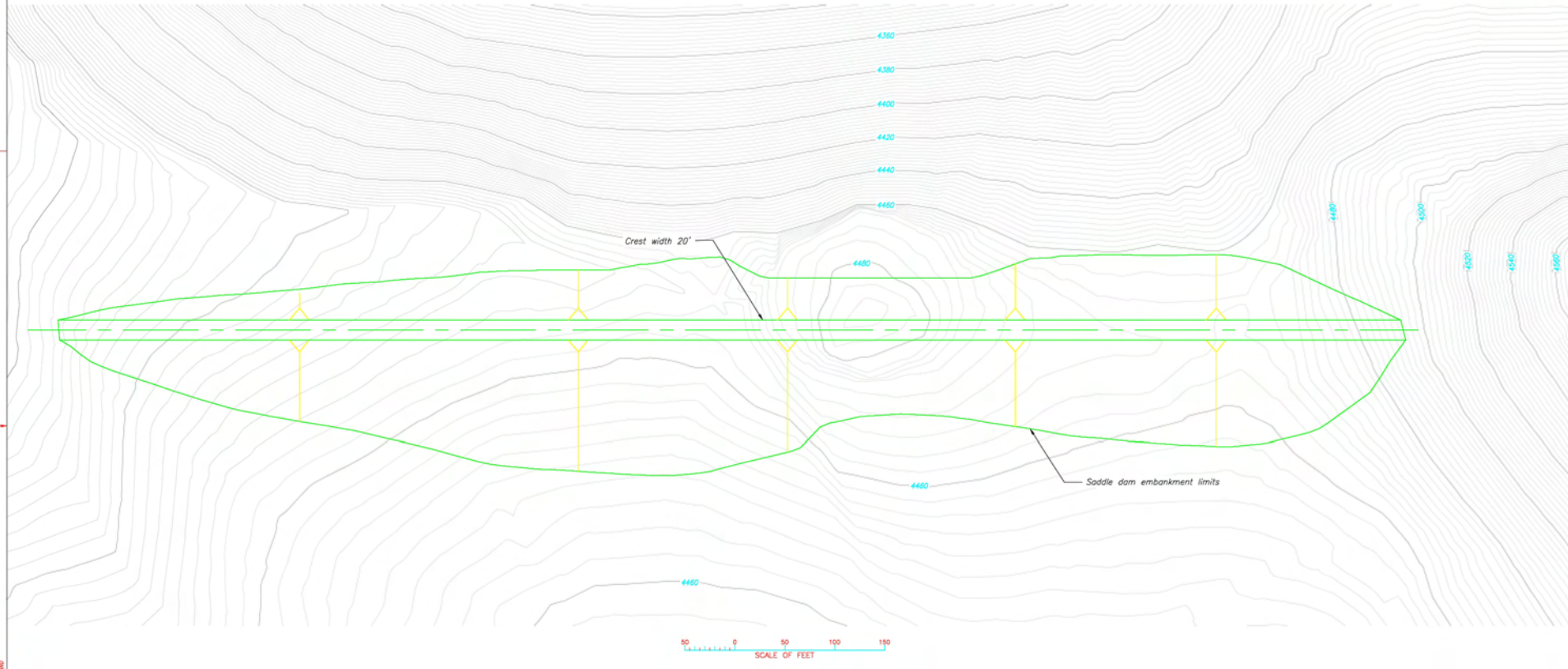
DENVER, COLORADO March 12, 2009

SHEET 1 OF 1

Figure B64 (Final Draft)

DATE AND TIME PLOTTED
OCTOBER 17, 2008 09:44
PLOTTED BY
KREYNOLDS

CAD SYSTEM
AutoCAD Rel 17.1s
CAD FILENAME
LLV CANAL SECTIONS_RECOVERY NEW2.DWG



RECLAMATION
Managing Water in the West

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U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

KALAMATH PROJECT – KALAMATH COUNTY, OREGON

UPPER KALAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRASAL LEVEL ESTIMATE

SADDLE DAM – 500,000 ACRE–FOOT RESERVOIR PLAN

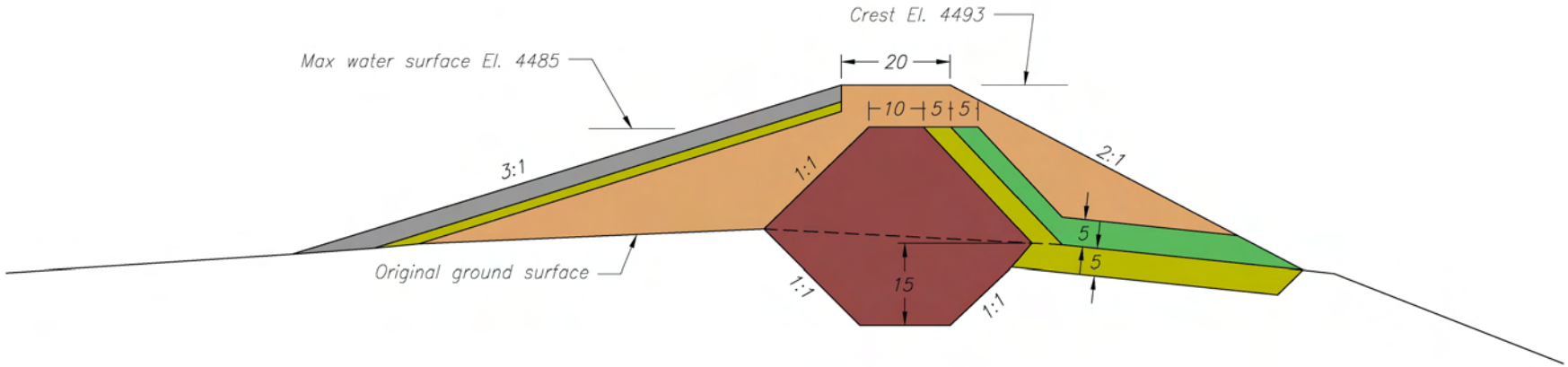
DESIGNED _____ CHECKED _____
DRAWN _____ TECH. APPR. _____ NAME – TITLE
APPROVED _____ ADMINISTRATIVE APPROVAL – NAME – TITLE

DENVER 2009-04-1[illegible]
SHEET 1 OF 1

DATE AND TIME PLOTTED APRIL 10, 2009 12:09
PLOTTED BY CSTROKLAND

CAD SYSTEM AutoCAD Rel. 17.1s
CAD FILENAME SADDLE DAM PLAN.DWG

Figure B65 (Final Draft)



RECLAMATION
Managing Water in the West

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

KALAMATH PROJECT – KALAMATH COUNTY, OREGON

UPPER KALAMATH BASIN OFFSTREAM STORAGE STUDY AT LONG LAKE VALLEY

APPRASAL LEVEL ESTIMATE

SADDLE DAM – 500,000 ACRE-FOOT RESERVOIR
EMBANKMENT SECTION

DESIGNED _____ CHECKED _____
DRAWN _____ TECH. APPR. _____
APPROVED _____ NAME – TITLE
ADMINISTRATIVE APPROVAL – NAME – TITLE

DENVER 2009-04-10
SHEET 1 OF 1

Figure B66 (Final Draft)

ATTACHMENT C
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
350,000 Acre-foot Reservoir Construction Costs

Includes Long Lake Intake Tower Structure with Fish Screens, Under Link River Discharge,
Fish Bypass Pipe Extensions, & Water Treatment with liner options. ***Does not include Life Cycle Costs***

Alternative - Option	No Liner	Half Height Liner	NE Side Only Full Liner	Full Liner
Alt1-OptA-PO-1000cfs-Earthen Lined Canal	$718,000,000.00	$958,000,000.00	$1,158,000,000.00	$1,268,000,000.00
Alt1-OptB-PO-2000cfs-Earthen Lined Canal	$958,000,000.00	$1,198,000,000.00	$1,398,000,000.00	$1,508,000,000.00
Alt1-OptC-PG-1000cfs-Earthen Lined Canal	$808,000,000.00	$1,048,000,000.00	$1,248,000,000.00	$1,358,000,000.00
Alt1-OptD-PG-2000cfs-Earthen Lined Canal	$1,068,000,000.00	$1,308,000,000.00	$1,508,000,000.00	$1,618,000,000.00
Alt1-OptE-PT-2000cfs-Earthen Lined Canal	$948,000,000.00	$1,188,000,000.00	$1,388,000,000.00	$1,498,000,000.00
Alt1-OptF-PT-1000cfs-Earthen Lined Canal	$728,000,000.00	$968,000,000.00	$1,168,000,000.00	$1,278,000,000.00
Alt2-OptA-PO-1000cfs-Short Tunnel	$548,000,000.00	$788,000,000.00	$988,000,000.00	$1,098,000,000.00
Alt2-OptB-PO-2000cfs-Short Tunnel	$818,000,000.00	$1,058,000,000.00	$1,258,000,000.00	$1,368,000,000.00
Alt2-OptC-PG-1000cfs-Short Tunnel	$648,000,000.00	$888,000,000.00	$1,088,000,000.00	$1,198,000,000.00
Alt2-OptD-PG-2000cfs-Short Tunnel	$958,000,000.00	$1,198,000,000.00	$1,398,000,000.00	$1,508,000,000.00
Alt2-OptE-PT-2000cfs-Short Tunnel	$808,000,000.00	$1,048,000,000.00	$1,248,000,000.00	$1,358,000,000.00
Alt2-OptF-PT-1000cfs-Short Tunnel	$548,000,000.00	$788,000,000.00	$988,000,000.00	$1,098,000,000.00
Alt3-OptA-PO-1000cfs-Earthen Lined Canal	$708,000,000.00	$948,000,000.00	$1,148,000,000.00	$1,258,000,000.00
Alt3-OptB-PO-2000cfs-Earthen Lined Canal	$928,000,000.00	$1,168,000,000.00	$1,368,000,000.00	$1,478,000,000.00
Alt3-OptC-PG-1000cfs-Earthen Lined Canal	$798,000,000.00	$1,038,000,000.00	$1,238,000,000.00	$1,348,000,000.00
Alt3-OptD-PG-2000cfs-Earthen Lined Canal	$1,068,000,000.00	$1,308,000,000.00	$1,508,000,000.00	$1,618,000,000.00
Alt3-OptE-PT-2000cfs-Earthen Lined Canal	$928,000,000.00	$1,168,000,000.00	$1,368,000,000.00	$1,478,000,000.00
Alt3-OptF-PT-1000cfs-Earthen Lined Canal	$708,000,000.00	$948,000,000.00	$1,148,000,000.00	$1,258,000,000.00
Alt4-OptA-PO-1000cfs-Earthen Lined Canal	$618,000,000.00	$858,000,000.00	$1,058,000,000.00	$1,168,000,000.00
Alt4-OptB-PO-2000cfs-Earthen Lined Canal	$848,000,000.00	$1,088,000,000.00	$1,288,000,000.00	$1,398,000,000.00
Alt4-OptC-PG-1000cfs-Earthen Lined Canal	$708,000,000.00	$948,000,000.00	$1,148,000,000.00	$1,258,000,000.00
Alt4-OptD-PG-2000cfs-Earthen Lined Canal	$968,000,000.00	$1,208,000,000.00	$1,408,000,000.00	$1,518,000,000.00
Alt4-OptE-PT-2000cfs-Earthen Lined Canal	$828,000,000.00	$1,068,000,000.00	$1,268,000,000.00	$1,378,000,000.00
Alt4-OptF-PT-1000cfs-Earthen Lined Canal	$628,000,000.00	$868,000,000.00	$1,068,000,000.00	$1,178,000,000.00
Alt5-OptA-PO-1000cfs-Long Tunnel	$768,000,000.00	$1,008,000,000.00	$1,208,000,000.00	$1,318,000,000.00
Alt5-OptB-PO-2000cfs-Long Tunnel	$1,118,000,000.00	$1,358,000,000.00	$1,558,000,000.00	$1,668,000,000.00
Alt5-OptC-PG-1000cfs-Long Tunnel	$858,000,000.00	$1,098,000,000.00	$1,298,000,000.00	$1,408,000,000.00
Alt5-OptD-PG-2000cfs-Long Tunnel	$1,268,000,000.00	$1,508,000,000.00	$1,708,000,000.00	$1,818,000,000.00
Alt5-OptE-PT-2000cfs-Long Tunnel	*N/A*	*N/A*	*N/A*	*N/A*
Alt5-OptF-PT-1000cfs-Long Tunnel	*N/A*	*N/A*	*N/A*	*N/A*

ATTACHMENT C
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
500,000 Acre-foot Reservoir Construction Costs

Includes Long Lake Intake Tower Structure with Fish Screens, Under Link River Discharge,
Fish Bypass Pipe Extensions, & Water Treatment with liner options. **Does not include Life Cycle Costs**

Alternative - Option	No Liner	Half Height Liner	NE Side Only Full Liner	Full Liner
5Alt1-OptA-PO-1000cfs-Earthen Lined Canal	$801,000,000.00	$1,151,000,000.00	$1,401,000,000.00	$1,641,000,000.00
5Alt1-OptB-PO-2000cfs-Earthen Lined Canal	$1,071,000,000.00	$1,421,000,000.00	$1,671,000,000.00	$1,911,000,000.00
5Alt1-OptC-PG-1000cfs-Earthen Lined Canal	$901,000,000.00	$1,251,000,000.00	$1,501,000,000.00	$1,741,000,000.00
5Alt1-OptD-PG-2000cfs-Earthen Lined Canal	$1,221,000,000.00	$1,571,000,000.00	$1,821,000,000.00	$2,061,000,000.00
5Alt1-OptE-PT-2000cfs-Earthen Lined Canal	$1,071,000,000.00	$1,421,000,000.00	$1,671,000,000.00	$1,911,000,000.00
5Alt1-OptF-PT-1000cfs-Earthen Lined Canal	$811,000,000.00	$1,161,000,000.00	$1,411,000,000.00	$1,651,000,000.00
5Alt2-OptA-PO-1000cfs-Short Tunnel	$631,000,000.00	$981,000,000.00	$1,231,000,000.00	$1,471,000,000.00
5Alt2-OptB-PO-2000cfs-Short Tunnel	$971,000,000.00	$1,321,000,000.00	$1,571,000,000.00	$1,811,000,000.00
5Alt2-OptC-PG-1000cfs-Short Tunnel	$731,000,000.00	$1,081,000,000.00	$1,331,000,000.00	$1,571,000,000.00
5Alt2-OptD-PG-2000cfs-Short Tunnel	$1,121,000,000.00	$1,471,000,000.00	$1,721,000,000.00	$1,961,000,000.00
5Alt2-OptE-PT-2000cfs-Short Tunnel	$961,000,000.00	$1,311,000,000.00	$1,561,000,000.00	$1,801,000,000.00
5Alt2-OptF-PT-1000cfs-Short Tunnel	$631,000,000.00	$981,000,000.00	$1,231,000,000.00	$1,471,000,000.00
5Alt3-OptA-PO-1000cfs-Earthen Lined Canal	$781,000,000.00	$1,131,000,000.00	$1,381,000,000.00	$1,621,000,000.00
5Alt3-OptB-PO-2000cfs-Earthen Lined Canal	$1,071,000,000.00	$1,421,000,000.00	$1,671,000,000.00	$1,911,000,000.00
5Alt3-OptC-PG-1000cfs-Earthen Lined Canal	$871,000,000.00	$1,221,000,000.00	$1,471,000,000.00	$1,711,000,000.00
5Alt3-OptD-PG-2000cfs-Earthen Lined Canal	$1,221,000,000.00	$1,571,000,000.00	$1,821,000,000.00	$2,061,000,000.00
5Alt3-OptE-PT-2000cfs-Earthen Lined Canal	$1,071,000,000.00	$1,421,000,000.00	$1,671,000,000.00	$1,911,000,000.00
5Alt3-OptF-PT-1000cfs-Earthen Lined Canal	$781,000,000.00	$1,131,000,000.00	$1,381,000,000.00	$1,621,000,000.00
5Alt4-OptA-PO-1000cfs-Earthen Lined Canal	$701,000,000.00	$1,051,000,000.00	$1,301,000,000.00	$1,541,000,000.00
5Alt4-OptB-PO-2000cfs-Earthen Lined Canal	$971,000,000.00	$1,321,000,000.00	$1,571,000,000.00	$1,811,000,000.00
5Alt4-OptC-PG-1000cfs-Earthen Lined Canal	$801,000,000.00	$1,151,000,000.00	$1,401,000,000.00	$1,641,000,000.00
5Alt4-OptD-PG-2000cfs-Earthen Lined Canal	$1,121,000,000.00	$1,471,000,000.00	$1,721,000,000.00	$1,961,000,000.00
5Alt4-OptE-PT-2000cfs-Earthen Lined Canal	$971,000,000.00	$1,321,000,000.00	$1,571,000,000.00	$1,811,000,000.00
5Alt4-OptF-PT-1000cfs-Earthen Lined Canal	$711,000,000.00	$1,061,000,000.00	$1,311,000,000.00	$1,551,000,000.00
5Alt5-OptA-PO-1000cfs-Long Tunnel	$871,000,000.00	$1,221,000,000.00	$1,471,000,000.00	$1,711,000,000.00
5Alt5-OptB-PO-2000cfs-Long Tunnel	$1,321,000,000.00	$1,671,000,000.00	$1,921,000,000.00	$2,161,000,000.00
5Alt5-OptC-PG-1000cfs-Long Tunnel	$971,000,000.00	$1,321,000,000.00	$1,571,000,000.00	$1,811,000,000.00
5Alt5-OptD-PG-2000cfs-Long Tunnel	$1,471,000,000.00	$1,821,000,000.00	$2,071,000,000.00	$2,311,000,000.00
5Alt5-OptE-PT-2000cfs-Long Tunnel	N/A	N/A	N/A	N/A
5Alt5-OptF-PT-1000cfs-Long Tunnel	N/A	N/A	N/A	N/A

ATTACHMENT D
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
350,000 Acre-foot Reservoir Life Cycle Costs

Alternative - Option	No Liner	Half Height Liner	NE Side Only Full Liner	Full Liner
Alt1-OptA-PO-1000cfs-Earthen Lined Canal	$870,000,000.00	$1,100,000,000.00	$1,300,000,000.00	$1,400,000,000.00
Alt1-OptB-PO-2000cfs-Earthen Lined Canal	$1,150,000,000.00	$1,400,000,000.00	$1,600,000,000.00	$1,700,000,000.00
Alt1-OptC-PG-1000cfs-Earthen Lined Canal	$990,000,000.00	$1,250,000,000.00	$1,450,000,000.00	$1,550,000,000.00
Alt1-OptD-PG-2000cfs-Earthen Lined Canal	$1,300,000,000.00	$1,550,000,000.00	$1,750,000,000.00	$1,850,000,000.00
Alt1-OptE-PT-2000cfs-Earthen Lined Canal	$1,150,000,000.00	$1,350,000,000.00	$1,550,000,000.00	$1,700,000,000.00
Alt1-OptF-PT-1000cfs-Earthen Lined Canal	$880,000,000.00	$1,100,000,000.00	$1,300,000,000.00	$1,450,000,000.00
Alt2-OptA-PO-1000cfs-Short Tunnel	$740,000,000.00	$970,000,000.00	$1,150,000,000.00	$1,300,000,000.00
Alt2-OptB-PO-2000cfs-Short Tunnel	$1,050,000,000.00	$1,300,000,000.00	$1,500,000,000.00	$1,600,000,000.00
Alt2-OptC-PG-1000cfs-Short Tunnel	$860,000,000.00	$1,100,000,000.00	$1,300,000,000.00	$1,400,000,000.00
Alt2-OptD-PG-2000cfs-Short Tunnel	$1,250,000,000.00	$1,450,000,000.00	$1,650,000,000.00	$1,800,000,000.00
Alt2-OptE-PT-2000cfs-Short Tunnel	$1,050,000,000.00	$1,250,000,000.00	$1,450,000,000.00	$1,600,000,000.00
Alt2-OptF-PT-1000cfs-Short Tunnel	$740,000,000.00	$970,000,000.00	$1,150,000,000.00	$1,300,000,000.00
Alt3-OptA-PO-1000cfs-Earthen Lined Canal	$860,000,000.00	$1,100,000,000.00	$1,300,000,000.00	$1,400,000,000.00
Alt3-OptB-PO-2000cfs-Earthen Lined Canal	$1,100,000,000.00	$1,350,000,000.00	$1,550,000,000.00	$1,650,000,000.00
Alt3-OptC-PG-1000cfs-Earthen Lined Canal	$980,000,000.00	$1,200,000,000.00	$1,400,000,000.00	$1,550,000,000.00
Alt3-OptD-PG-2000cfs-Earthen Lined Canal	$1,300,000,000.00	$1,550,000,000.00	$1,750,000,000.00	$1,850,000,000.00
Alt3-OptE-PT-2000cfs-Earthen Lined Canal	$1,100,000,000.00	$1,350,000,000.00	$1,550,000,000.00	$1,650,000,000.00
Alt3-OptF-PT-1000cfs-Earthen Lined Canal	$860,000,000.00	$1,100,000,000.00	$1,300,000,000.00	$1,400,000,000.00
Alt4-OptA-PO-1000cfs-Earthen Lined Canal	$770,000,000.00	$1,000,000,000.00	$1,200,000,000.00	$1,300,000,000.00
Alt4-OptB-PO-2000cfs-Earthen Lined Canal	$1,050,000,000.00	$1,250,000,000.00	$1,450,000,000.00	$1,600,000,000.00
Alt4-OptC-PG-1000cfs-Earthen Lined Canal	$890,000,000.00	$1,150,000,000.00	$1,300,000,000.00	$1,450,000,000.00
Alt4-OptD-PG-2000cfs-Earthen Lined Canal	$1,200,000,000.00	$1,450,000,000.00	$1,650,000,000.00	$1,750,000,000.00
Alt4-OptE-PT-2000cfs-Earthen Lined Canal	$1,000,000,000.00	$1,250,000,000.00	$1,450,000,000.00	$1,550,000,000.00
Alt4-OptF-PT-1000cfs-Earthen Lined Canal	$780,000,000.00	$1,000,000,000.00	$1,200,000,000.00	$1,350,000,000.00
Alt5-OptA-PO-1000cfs-Long Tunnel	$1,000,000,000.00	$1,250,000,000.00	$1,450,000,000.00	$1,550,000,000.00
Alt5-OptB-PO-2000cfs-Long Tunnel	$1,400,000,000.00	$1,650,000,000.00	$1,850,000,000.00	$1,950,000,000.00
Alt5-OptC-PG-1000cfs-Long Tunnel	$1,150,000,000.00	$1,350,000,000.00	$1,550,000,000.00	$1,700,000,000.00
Alt5-OptD-PG-2000cfs-Long Tunnel	$1,600,000,000.00	$1,850,000,000.00	$2,050,000,000.00	$2,150,000,000.00
Alt5-OptE-PT-2000cfs-Long Tunnel	N/A	N/A	N/A	N/A
Alt5-OptF-PT-1000cfs-Long Tunnel	N/A	N/A	N/A	N/A

ATTACHMENT D
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
500,000 Acre-foot Reservoir Life Cycle Costs

Alternative - Option	No Liner	Half Height Liner	NE Side Only Full Liner	Full Liner
Alt1-OptA-PO-1000cfs-Earthen Lined Canal	$970,000,000.00	$1,300,000,000.00	$1,550,000,000.00	$1,800,000,000.00
Alt1-OptB-PO-2000cfs-Earthen Lined Canal	$1,250,000,000.00	$1,600,000,000.00	$1,850,000,000.00	$2,100,000,000.00
Alt1-OptC-PG-1000cfs-Earthen Lined Canal	$1,100,000,000.00	$1,450,000,000.00	$1,700,000,000.00	$1,900,000,000.00
Alt1-OptD-PG-2000cfs-Earthen Lined Canal	$1,450,000,000.00	$1,800,000,000.00	$2,100,000,000.00	$2,300,000,000.00
Alt1-OptE-PT-2000cfs-Earthen Lined Canal	$1,250,000,000.00	$1,600,000,000.00	$1,850,000,000.00	$2,100,000,000.00
Alt1-OptF-PT-1000cfs-Earthen Lined Canal	$980,000,000.00	$1,300,000,000.00	$1,550,000,000.00	$1,800,000,000.00
Alt2-OptA-PO-1000cfs-Short Tunnel	$830,000,000.00	$1,150,000,000.00	$1,400,000,000.00	$1,650,000,000.00
Alt2-OptB-PO-2000cfs-Short Tunnel	$1,200,000,000.00	$1,550,000,000.00	$1,800,000,000.00	$2,000,000,000.00
Alt2-OptC-PG-1000cfs-Short Tunnel	$960,000,000.00	$1,300,000,000.00	$1,550,000,000.00	$1,800,000,000.00
Alt2-OptD-PG-2000cfs-Short Tunnel	$1,400,000,000.00	$1,750,000,000.00	$2,000,000,000.00	$2,200,000,000.00
Alt2-OptE-PT-2000cfs-Short Tunnel	$1,200,000,000.00	$1,550,000,000.00	$1,800,000,000.00	$2,000,000,000.00
Alt2-OptF-PT-1000cfs-Short Tunnel	$830,000,000.00	$1,150,000,000.00	$1,400,000,000.00	$1,650,000,000.00
Alt3-OptA-PO-1000cfs-Earthen Lined Canal	$950,000,000.00	$1,300,000,000.00	$1,550,000,000.00	$1,800,000,000.00
Alt3-OptB-PO-2000cfs-Earthen Lined Canal	$1,250,000,000.00	$1,600,000,000.00	$1,850,000,000.00	$2,100,000,000.00
Alt3-OptC-PG-1000cfs-Earthen Lined Canal	$1,050,000,000.00	$1,400,000,000.00	$1,650,000,000.00	$1,900,000,000.00
Alt3-OptD-PG-2000cfs-Earthen Lined Canal	$1,450,000,000.00	$1,800,000,000.00	$2,100,000,000.00	$2,300,000,000.00
Alt3-OptE-PT-2000cfs-Earthen Lined Canal	$1,250,000,000.00	$1,600,000,000.00	$1,850,000,000.00	$2,100,000,000.00
Alt3-OptF-PT-1000cfs-Earthen Lined Canal	$950,000,000.00	$1,300,000,000.00	$1,550,000,000.00	$1,750,000,000.00
Alt4-OptA-PO-1000cfs-Earthen Lined Canal	$870,000,000.00	$1,200,000,000.00	$1,450,000,000.00	$1,700,000,000.00
Alt4-OptB-PO-2000cfs-Earthen Lined Canal	$1,150,000,000.00	$1,500,000,000.00	$1,750,000,000.00	$2,000,000,000.00
Alt4-OptC-PG-1000cfs-Earthen Lined Canal	$1,000,000,000.00	$1,350,000,000.00	$1,600,000,000.00	$1,850,000,000.00
Alt4-OptD-PG-2000cfs-Earthen Lined Canal	$1,350,000,000.00	$1,700,000,000.00	$1,950,000,000.00	$2,200,000,000.00
Alt4-OptE-PT-2000cfs-Earthen Lined Canal	$1,150,000,000.00	$1,500,000,000.00	$1,750,000,000.00	$2,000,000,000.00
Alt4-OptF-PT-1000cfs-Earthen Lined Canal	$880,000,000.00	$1,200,000,000.00	$1,450,000,000.00	$1,700,000,000.00
Alt5-OptA-PO-1000cfs-Long Tunnel	$1,150,000,000.00	$1,450,000,000.00	$1,700,000,000.00	$1,950,000,000.00
Alt5-OptB-PO-2000cfs-Long Tunnel	$1,650,000,000.00	$1,950,000,000.00	$2,200,000,000.00	$2,500,000,000.00
Alt5-OptC-PG-1000cfs-Long Tunnel	$1,250,000,000.00	$1,600,000,000.00	$1,850,000,000.00	$2,100,000,000.00
Alt5-OptD-PG-2000cfs-Long Tunnel	$1,850,000,000.00	$2,200,000,000.00	$2,400,000,000.00	$2,700,000,000.00
Alt5-OptE-PT-2000cfs-Long Tunnel	N/A	N/A	N/A	N/A
Alt5-OptF-PT-1000cfs-Long Tunnel	N/A	N/A	N/A	N/A

Long Lake Valley - Life Cycle Cost Assumptions

Estimate Level: Preliminary

Price Level: Jan-2008

This example is for pump only plant at 1,000 CFS.

		Detailed Estimated Costs	Estimated Costs
Periodic Costs			
5-Year Periodic Costs			**$108,100**
4	**UKL Intake Hydraulic Equipment**		
	Remove and replace fish screen bypass pump bearings and wear rings	$108,100	
10-Year Periodic Costs			**$112,800**
4	**UKL Intake Hydraulic Equipment**		
	Remove and replace fish screen bypass pump bearings and wear rings	$108,100	
8	**UKL Plant Structure**		
	Asphalt Crack Repair for road and parking lot	$4,700	
15-Year Periodic Costs			**$1,222,000**
3	**UKL Intake Fish Screen Equipment**		
	Remove and Replace AC Unit	$47,265	
4	**UKL Intake Hydraulic Equipment**		
	Remove and replace fish screen bypass pump internal parts	$903,749	
9	**UKL Plant Mechanical Equipment**		
	Remove and Replace AC Unit	$270,986	
20-Year Periodic Costs			**$131,600**
4	**UKL Intake Hydraulic Equipment**		
	Remove and replace fish screen bypass pump bearings and wear rings	$108,100	
8	**UKL Plant Structure**		
	Asphalt Crack Repair for road and parking lot	$4,700	
	Pavement Overlay for road and parking lot	$18,800	
25-Year Periodic Costs			**$31,020,000**
2	**Tunnels**		
	Remove and replace interior coating of the tunnel	$8,640,590	
3	**UKL Intake Fish Screen Equipment**		
	Remove and replace trashracks	$965,850	
	Remove and replace trash rake	$1,057,914	
	Remove and replace stoplogs, lifting beam, seats and guide replacement	$1,205,600	
	Remove and replace fish screens	$3,481,170	
	Remove and replace barrier panels	$1,356,807	
	Remove and replace baffles	$3,189,360	
	Remove and replace fish screen cleaners	$478,774	
	Remove and replace water level measuring system	$123,300	
	Remove and replace sump pump	$28,386	
	Remove and replace FRP 500 gallon tanks	$34,935	
	Remove and replace coating on radial gates	$99,583	
4	**UKL Intake Hydraulic Equipment**		
	Remove and replace fish screen bypass pump bearings and wear rings	$108,100	
5	**UKL Intake Fish Screen Pipe**		
	Remove and replace interior coating of the pipe	$172,620	
	Remove and replace exterior coating of the pipe	$139,329	
9	**UKL Plant Mechanical Equipment**		
	Remove and replace trashracks	$386,340	
	Remove and replace stoplogs, lifting beam, seats and guide replacement	$376,750	
11	**UKL Plant Pipe**		
	Remove and replace interior coating of the pipe	$1,712,500	
	Remove and replace exterior coating of the pipe	$1,644,000	
14	**Plant Penstock**		
	Remove and replace interior coating of the pipe	$1,767,300	
	Remove and replace exterior coating of the pipe	$1,413,840	

Long Lake Valley - Life Cycle Cost Assumptions

Estimate Level: Preliminary

16	**Long Lake Intake Mechanical Equipment**		
	Remove and replace trashracks	$2,173,163	
	Remove and replace screen cleaning system	$374,969	
17	**Long Lake Intake Hydraulic Equipment**		
	Remove and replace coating of slide and fixed-wheel gates	$88,820	
30-Year Periodic Costs			**$2,632,000**
3	**UKL Intake Fish Screen Equipment**		
	Remove and Replace AC Unit	$47,265	
4	**UKL Intake Hydraulic Equipment**		
	Remove and replace motors	$569,920	
	Remove and replace gear drive	$835,380	
	Remove and replace fish screen bypass pump internal parts	$903,749	
8	**UKL Plant Structure**		
	Asphalt Crack Repair for road and parking lot	$4,700	
9	**UKL Plant Mechanical Equipment**		
	Remove and Replace AC Unit	$270,986	
35-Year Periodic Costs			**$15,040,000**
4	**UKL Intake Hydraulic Equipment**		
	Remove and replace VFD	$1,318,625	
	Remove and replace fish screen bypass pump bearings and wear rings	$108,100	
10	**UKL Plant Hydraulic Equipment**		
	Vertical Turbine Pump Unit Overhaul #1	$6,466,743	
12	**UKL Plant Electrical**		
	Rewind Motor for Pumping Unit 1	$7,146,533	
40-Year Periodic Costs			**$17,390,000**
4	**UKL Intake Hydraulic Equipment**		
	Remove and replace fish screen bypass pump bearings and wear rings	$108,100	
8	**UKL Plant Structure**		
	Asphalt Crack Repair for road and parking lot	$4,700	
	Pavement Overlay for road and parking lot	$131,600	
10	**UKL Plant Hydraulic Equipment**		
	Vertical Turbine Pump Unit Overhaul #2	$6,466,743	
12	**UKL Plant Electrical**		
	Rewind Motor for Pumping Unit 2	$7,146,533	
13	**Switchyard & Transmission Line**		
	Replacement of power transformer #1 30 MVA 115 kV: 13.8 kV Oil Filled	$3,532,324	
45-Year Periodic Costs			**$1,222,000**
3	**UKL Intake Fish Screen Equipment**		
	Remove and Replace AC Unit	$47,265	
4	**UKL Intake Hydraulic Equipment**		
	Remove and replace fish screen bypass pump internal parts	$903,749	
9	**UKL Plant Mechanical Equipment**		
	Remove and Replace AC Unit	$270,986	
Maintenance Annual Costs			**$2,162,000**
1	**Canals**		
	Mowing on either side of the canal within the Right-of-Way 2 times/yr - performed by one mower operator and a laborer	$12,103	
	Tree and Shrub removal on either side of the canal within the Right-of-Way for an equivalent of 5 days/year - performed by two laborers	$7,935	
	Weed Control performed once a year by dragging a steel net between two tractors - peformed by two tractor operators	$16,061	
	Rodent Control performed for an equivalent of 2 days/month by one laborer	$17,185	
	Road Maintenance	$34,095	

Long Lake Valley - Life Cycle Cost Assumptions

Estimate Level: Preliminary

	Blade Roads an equivalent of 5 days/year by one operator	$9,447
	Fix Potholes / Washout assuming 20 CY of commercial clay material installed by a crew	$15,578
	Dust control on roads monthly	$9,069
	Fence Maintenance performed for an equivalent of 5 days/year by 2 laborers	$8,130
	Inspection conducted by plant operator and 2 consultants once every three years, but converted to an annual cost	$7,136
2	**Tunnels**	
	Assume 2% of the interior coating of the tunnel is repaired every year	$320,103
	Inspection conducted by plant operator and 2 consultants once every three years, but converted to an annual cost (includes ventilation system)	$39,345
3	**UKL Intake Fish Screen Equipment**	
	10% of the Plug Costs detailed below in general notes about maintenance costs	$30,500
	Spot repair 5% of coating on radial gates every year	$19,552
4	**UKL Intake Hydraulic Equipment**	
	10% of the Plug Costs detailed below in general notes about maintenance costs	$20,333
5	**UKL Intake Fish Screen Pipe**	
	Inspection conducted by plant operator and 2 consultants once every three years, but converted to an annual cost (includes ventilation system)	$1,701
	Assume 3% of the exterior coating of the pipe is repaired every year	$70,368
	Assume 2% of the interior coating of the pipe is repaired every year	$58,109
6	**UKL Intake Fish Screen Structure**	
	10% of the Plug Costs detailed below in general notes about maintenance costs	$11,296
8	**UKL Plant Structure**	
	Plug Costs detailed below in general notes about maintenance costs	$112,963
	Assume 3% of the gravel surface is repaired every year	$2,020
	Assume herbicide is sprayed on the plant site every other year	$6,422
	Inspection conducted by plant operator and 2 consultants once every three years, but converted to an annual cost (includes ventilation system)	$5,974
9	**UKL Plant Mechanical Equipment**	
	Plug Costs detailed below in general notes about maintenance costs	$304,999
10	**UKL Plant Hydraulic Equipment**	
	Plug Costs detailed below in general notes about maintenance costs	$203,333
11	**UKL Plant Pipe**	
	Inspection conducted by plant operator and 2 consultants once every three years, but converted to an annual cost (includes ventilation system)	$7,580
	Assume 3% of the exterior coating of the pipe is repaired every year	$7,388
	Assume 2% of the interior coating of the pipe is repaired every year	$8,854
12	**UKL Plant Electrical**	
	Plug Costs detailed below in general notes about maintenance costs	$508,332
14	**Plant Penstock**	
	Assume 3% of the exterior coating of the pipe is repaired every year	$72,631
	Assume 2% of the interior coating of the pipe is repaired every year	$59,172
	Inspection conducted by plant operator and 2 consultants once every three years, but converted to an annual cost (includes ventilation system)	$14,335
15	**Long Lake Intake Tower Structure**	
	5% of the Plug Costs detailed below in general notes about maintenance costs	$5,648
	Inspection conducted by plant operator and 2 consultants once every three years, but converted to an annual cost (includes ventilation system)	$5,974
16	**Long Lake Intake Mechanical Equipment**	
	5% of the Plug Costs detailed below in general notes about maintenance costs	$15,250
17	**Long Lake Intake Hydraulic Equipment**	
	5% of the Plug Costs detailed below in general notes about maintenance costs	$10,167
	Assume 3% of the exterior coating of the pipe is repaired every year	$10,089
18	**Non-Plant Electrical**	
	10% of the UKL Maintenance Plug Costs and 5% of the LLV Maintenance Plug Costs detailed below in general notes about maintenance costs	$92,824

Operations Annual Costs **$1,739,000**

3	**UKL Intake Fish Screen Equipment**	
	10% of the Plug Costs detailed below in general notes about maintenance costs	$10,193
4	**UKL Intake Hydraulic Equipment**	
	10% of the Plug Costs detailed below in general notes about maintenance costs	$6,705
	Annual Electrical Cost for the Pumps	$89,375
	Assume 200 hp pumps run 24/7 for 200 days/year at $0.045/kW-hr for 2 pumps	
6	**UKL Intake Fish Screen Structure**	

Long Lake Valley - Life Cycle Cost Assumptions

Estimate Level: Preliminary

	10% of the Plug Costs detailed below in general notes about maintenance costs	$3,725	
8	**UKL Plant Structure**		
	Plant Operator with a pickup truck for the entire year, 8 hrs/day	$163,200	
	Plug Costs detailed below in general notes about maintenance costs	$37,248	
9	**UKL Plant Mechanical Equipment**		
	Plug Costs detailed below in general notes about maintenance costs	$100,569	
10	**UKL Plant Hydraulic Equipment**		
	Plug Costs detailed below in general notes about maintenance costs	$67,046	
	Annual Electrical Cost for the Pumps Assume 17,000 hp pumps run 24/7 for 28 days/year at $0.045/kW-hr for 2 pumps - pump 50,000 acre-feet/year	$1,058,750	
12	**UKL Plant Electrical**		
	Plug Costs detailed below in general notes about maintenance costs	$167,616	
	Annual Electrical Cost for the fish by-pass Pumps to backflush	$743	
15	**Long Lake Intake Tower Structure**		
	5% of the Plug Costs detailed below in general notes about maintenance costs	$1,862	
16	**Long Lake Intake Mechanical Equipment**		
	5% of the Plug Costs detailed below in general notes about maintenance costs	$5,028	
17	**Long Lake Intake Hydraulic Equipment**		
	5% of the Plug Costs detailed below in general notes about maintenance costs	$3,352	
18	**Non-Plant Electrical**		
	10% of the UKL Maintenance Plug Costs and 5% of the LLV Maintenance Plug Costs detailed below in general notes about maintenance costs	$23,588	

Other Annual O&M Costs — $573,400

Maintenance Misc Costs for Small Items not Detailed Above		
+/-15% of the Maintenance Costs Listed Above	$313,700	
+/-15% of the Operations Costs Listed Above	$259,700	

Other Costs (Evaporated Water) — $93,816

Other Costs (Water Seepage) — $46,983

General Notes for Maintenance and Operations Costs

Plant Maintenance (75% of total = $48000/MW) and Operation (25% of total = $16000/MW) costs are based on Boysen Power Plant 2004 costs ($64,000/MW) found on dataweb site which is approximately the same size as the LLV PO plant (21,755 SF) as per John Brooks in the Oct 2008 Draft Report for this project.

Indexing from BOR-CCT Powerplants 1-2005 (267) to 10-2008 (322) ==> $64000/MW * 388/267 = $64,000/MW * 1.206 = $77,185/MW.

$77,185/MW * 15MW Boysen generation capacity = $1,157,775 Annual Operation Costs for the 1000 cfs pump only plant.

Subtracting out 1 full time operator at GS10, Step 5 total compensation & support costs for net plant maintenance and operations costs $1,157,775 - $74,200 = $1,083,575.

Dividing by the plant SF (21,755) results in a $/SF operation cost which I will use for all Alternatives and Options.

$1,083,575 / 21755 SF = $49.81/SF for Annual Plant Maintenance and Operations Costs.
We will use $50.00/SF for all plants in this study and calculate the total for each plant by the respect plant SF to account for the large plant sizes.

1000 cfs PO Plants (21,755 SF). Use $1,083,575 for annual maintenance and operations costs.
2000 cfs PO Plants (25,540 SF). Use $1,277,000 for annual maintenance and operations costs.

Assume 10% of the each Plant Maintenance and Plant Operation Costs are attributed to the plant structure itself, with 45% of the total attributed to each of the electrical and mechanical equipment. Assume the mechanical equipment maintenance and operations is attributed to 60% mechanical and 40% hydraulic equipment.

Assume that the UKL Fishscreen structure maintenance and operations costs are 10% of the the plant maintenance and operations costs with the same subordinate breakouts.

Long Lake Valley - Life Cycle Cost Assumptions

Estimate Level: Preliminary

Assume that the LLV Structure maintenance and operations costs are 5% of the
the plant maintenance and operations costs with the same subordinate breakouts.

For 1000 cfs PO Option Maintenance Costs

Total Plant Maintenance Costs: 75% * $1,083,575 = $812,681.25

Plant Maintenance Costs: 10% * $812,681.25 = $81,268.13

Mechanical Maintenance Costs: 45% * $812,681.25 = $365,706.56

Mechanical Equipment Maintenance Costs: 60% * $365,706.56 = $219,423.94

Hydraulic Equipment Maintenance Costs: 40% * $365,706.56 = $146,282.63

Electrical Equipment Maintenance Costs: 45% * $812,681.25 = $365,706.56

Total UKL FS Intake Maintenance Costs: (10% * $812,681.25) = $81,268.13

UKL FS Intake Structure Maintenance Costs: 10% * $81,268.13 = $8,126.81

UKL FS Intake Maintenance Costs: 45% * $81,268.13 = $36,570.66

UKL FS Intake Mechanical Equipment Maintenance Costs: 60% * $36,999.28 = $21,942.39

UKL FS Intake Hydraulic Equipment Maintenance Costs: 40% * $36,999.28 = $14,628.26

UKL FS Intake Electrical Equipment Maintenance Costs: 45% * $81,268.13 = $36,570.66

Total LLV Intake Maintenance Costs: (5% * $812,681.25) = $40,634.06

LLV Intake Structure Maintenance Costs: 10% * $41,110.31 = $4,063.41

LLV Intake Maintenance Costs: 45% * $41,110.31 = $18,285.33

LLV Intake Mechanical Equipment Maintenance Costs: 60% * $18,499.64 = $10,971.20

LLV Intake Hydraulic Equipment Maintenance Costs: 40% * $18,499.64 = $7,314.13

LLV Intake Electrical Equipment Maintenance Costs: 45% * $41,110.31 = $18,285.33

For 1000 cfs PO Option Operations Costs

Total Plant Operations Costs: 25% * $1,083,575 = $270,893.75

Plant Operations Costs: 10% * $270,893.75 = $27,089.38

Mechanical Operations Costs: 45% * $270,893.75 = $121,902.19

Mechanical Equipment Operations Costs: 60% * $121,902.19 = $73,141.31

Hydraulic Equipment Operations Costs: 40% * $121,902.19 = $48,760.88

Electrical Equipment Operations Costs: 45% * $270,893.75 = $121,902.19

Total UKL FS Intake Operations Costs: (10% * $270,893.75) = $27,089.38

UKL FS Intake Structure Operations Costs: 10% * $27,089.38 = $2,708.94

UKL FS Intake Mechanical Operations Costs: 45% * $27,089.38 = $12,190.22

UKL FS Intake Mechanical Equipment Operations Costs: 60% * $12,333.09 = $7,314.13

UKL FS Intake Hydraulic Equipment Operations Costs: 40% * $12,333.09 = $4,876.09

UKL FS Intake Electrical Equipment Operations Costs: 45% * $27,089.38 = $12,190.22

Total LLV Intake Operations Costs: (5% * $270,893.75) = $13,544.69

LLV Intake Structure Operations Costs: 10% * $13,703.44 = $1,354.47

LLV Intake Mechanical Operations Costs: 45% * $13,703.44 = $6,095.11

LLV Intake Mechanical Equipment Operations Costs: 60% * $6,166.55 = $3,657.01

LLV Intake Hydraulic Equipment Operations Costs: 40% * $6,166.55 = $2,438.04

LLV Intake Electrical Equipment Operations Costs: 45% * $13,703.44 = $6,095.11

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
350,000 Acre-foot Reservoir - Full Liner
Benefit Cost Analysis

ALTERNATIVE 1

350,000 Acre-Foot Reservoir			Alternative 1 - Option A 1000 CFS Pump Only		Alternative 1 - Option B 2000 CFS Pump Only		Alternative 1 - Option C 1000 CFS Pump & Generator		Alternative 1 - Option D 2000 CFS Pump & Generator		Alternative 1 - Option E 2000 CFS Pump-Turbine		Alternative 1 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$700,000,000		$940,000,000		$790,000,000		$1,050,000,000		$930,000,000		$710,000,000
Full Liner Construction Costs				$550,000,000		$550,000,000		$550,000,000		$550,000,000		$550,000,000		$550,000,000
Water Treatment Construction Costs				$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000
Subtotal 1				**$1,268,000,000**		**$1,508,000,000**		**$1,358,000,000**		**$1,618,000,000**		**$1,498,000,000**		**$1,278,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946	$190,000	$76,922	$185,000	$74,897
Year 25	PW Factor	0.32293	$54,000,000	$17,438,220	$70,000,000	$22,605,100	$56,000,000	$18,084,080	$74,000,000	$23,896,820	$71,000,000	$22,928,030	$54,000,000	$17,438,220
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$16,500,000	$3,390,255	$34,000,000	$6,985,980	$31,000,000	$6,369,570	$67,000,000	$13,766,490	$34,000,000	$6,985,980	$16,500,000	$3,390,255
Year 40	PW Factor	0.16390	$18,500,000	$3,032,150	$41,000,000	$6,719,900	$33,000,000	$5,408,700	$73,000,000	$11,964,700	$41,000,000	$6,719,900	$18,500,000	$3,032,150
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$25,709,016**		**$38,193,309**		**$31,834,266**		**$51,691,537**		**$38,516,239**		**$25,709,015**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$2,800,000	$54,227,012	$3,200,000	$61,973,728	$3,600,000	$69,720,444	$4,300,000	$83,277,197	$3,200,000	$61,973,728	$2,800,000	$54,227,012
Operations Costs	PWA Factor	19.36679	$2,900,000	$56,163,691	$3,200,000	$61,973,728	$3,100,000	$60,037,049	$3,500,000	$67,783,765	$3,200,000	$61,973,728	$2,900,000	$56,163,691
Other Annual O&M	PWA Factor	19.36679	$600,000	$11,620,074	$730,000	$14,137,757	$760,000	$14,718,760	$940,000	$18,204,783	$730,000	$14,137,757	$610,000	$11,813,742
Other Costs	PWA Factor	19.36679	$93,816	$1,816,915	$128,918	$2,496,728	$93,816	$1,816,915	$128,918	$2,496,728	$128,918	$2,496,728	$93,816	$1,816,915
Subtotal 3				**$123,827,692**		**$140,581,941**		**$146,293,168**		**$171,762,473**		**$140,581,941**		**$124,021,360**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,417,536,708**		**$1,686,775,250**		**$1,536,127,434**		**$1,841,454,010**		**$1,677,098,180**		**$1,427,730,375**
Total Present Worth Costs Rounded				**$1,400,000,000**		**$1,700,000,000**		**$1,550,000,000**		**$1,850,000,000**		**$1,700,000,000**		**$1,450,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

BY: Lonnie Zlomke (86-68170)	CHECKED: D.McKelvie 04/07/2009
DATE PREPARED: 04/06/2009	PEER REVIEW: D.Donaldson 4/8/2009

Preliminary Interest During Construction	**157,787,339**		**179,828,055**		**218,769,917**		**232,950,523**		**178,704,242**		**158,927,709**	
Preliminary Total Project Costs =	**1,557,787,339**		**1,879,828,055**		**1,768,769,917**		**2,082,950,523**		**1,878,704,242**		**1,608,927,709**	
Preliminary Total Project Costs =	**$1,560,000,000**		**$1,880,000,000**		**$1,770,000,000**		**$2,080,000,000**		**$1,880,000,000**		**$1,610,000,000**	

Preliminary Project Benefit Summary

0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power	**$0**	**$0**	**$0**	**$0**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**
Preliminary Total Project Benefits = A	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**
Preliminary Total Project Benefits = A	**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**

Preliminary Benefit Cost Calculation	**0.02**	**0.01**	**0.02**	**0.02**	**0.02**	**0.02**

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
350,000 Acre-foot Reservoir - Full Liner
Benefit Cost Analysis

ALTERNATIVE 2

350,000 Acre-Foot Reservoir			Alternative 2 - Option A 1000 CFS Pump Only		Alternative 2 - Option B 2000 CFS Pump Only		Alternative 2 - Option C 1000 CFS Pump & Generator		Alternative 2 - Option D 2000 CFS Pump & Generator		Alternative 2 - Option E 2000 CFS Pump-Turbine		Alternative 2 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$530,000,000		$800,000,000		$630,000,000		$940,000,000		$790,000,000		$530,000,000
Full Liner Construction Costs				$550,000,000		$550,000,000		$550,000,000		$550,000,000		$550,000,000		$550,000,000
Water Treatment Construction Costs				$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000
Subtotal 1				**$1,098,000,000**		**$1,368,000,000**		**$1,198,000,000**		**$1,508,000,000**		**$1,358,000,000**		**$1,098,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$194,000	$78,541	$189,000	$76,517	$185,000	$74,897
Year 25	PW Factor	0.32293	$77,000,000	$24,865,610	$105,000,000	$33,907,650	$79,000,000	$25,511,470	$110,000,000	$35,522,300	$105,000,000	$33,907,650	$77,000,000	$24,865,610
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$16,500,000	$3,390,255	$34,000,000	$6,985,980	$31,000,000	$6,369,570	$67,000,000	$13,766,490	$34,000,000	$6,985,980	$16,500,000	$3,390,255
Year 40	PW Factor	0.16390	$18,500,000	$3,032,150	$41,000,000	$6,719,900	$33,000,000	$5,408,700	$73,000,000	$11,964,700	$41,000,000	$6,719,900	$18,500,000	$3,032,150
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$33,136,405**		**$49,495,859**		**$39,261,656**		**$63,316,612**		**$49,495,454**		**$33,136,405**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$3,900,000	$75,530,481	$4,800,000	$92,960,592	$4,600,000	$89,087,234	$5,900,000	$114,264,061	$4,800,000	$92,960,592	$3,900,000	$75,530,481
Operations Costs	PWA Factor	19.36679	$2,900,000	$56,163,691	$3,200,000	$61,973,728	$3,100,000	$60,037,049	$3,500,000	$67,783,765	$3,200,000	$61,973,728	$2,900,000	$56,163,691
Other Annual O&M	PWA Factor	19.36679	$770,000	$14,912,428	$960,000	$18,592,118	$920,000	$17,817,447	$1,150,000	$22,271,809	$965,000	$18,688,952	$768,000	$14,873,695
Other Costs	PWA Factor	19.36679	$93,816	$1,816,915	$128,918	$2,496,728	$93,816	$1,816,915	$128,918	$2,496,728	$128,918	$2,496,728	$93,816	$1,816,915
Subtotal 3				**$148,423,515**		**$176,023,166**		**$168,758,645**		**$206,816,363**		**$176,120,000**		**$148,384,782**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,279,559,920**		**$1,593,519,025**		**$1,406,020,301**		**$1,778,132,975**		**$1,583,615,454**		**$1,279,521,187**
Total Present Worth Costs Rounded				**$1,300,000,000**		**$1,600,000,000**		**$1,400,000,000**		**$1,800,000,000**		**$1,600,000,000**		**$1,300,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

BY: Lonnie Zlomke (86-68170)	CHECKED: D.McKelvie 04/07/2009
DATE PREPARED: 04/06/2009	PEER REVIEW: D.Donaldson 4/8/2009

Preliminary Interest During Construction	**143,595,484**		**165,597,495**		**204,686,065**		**218,977,051**		**164,463,629**		**144,094,562**	
Preliminary Total Project Costs =	**1,443,595,484**		**1,765,597,495**		**1,604,686,065**		**2,018,977,051**		**1,764,463,629**		**1,444,094,562**	
Preliminary Total Project Costs =	**$1,440,000,000**		**$1,770,000,000**		**$1,600,000,000**		**$2,020,000,000**		**$1,760,000,000**		**$1,440,000,000**	

Preliminary Project Benefit Summary

0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power	**$0**	**$0**	**$0**	**$0**	**$720,000**	**$13,944,087**	**$720,000**	**$13,944,087**	**$720,000**	**$13,944,087**	**$720,000**	**$13,944,087**
Preliminary Total Project Benefits = A	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,946,560**	**$37,698,620**	**$1,946,560**	**$37,698,620**	**$1,946,560**	**$37,698,620**	**$1,946,560**	**$37,698,620**
Preliminary Total Project Benefits = A	**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$1,950,000**	**$37,700,000**	**$1,950,000**	**$37,700,000**	**$1,950,000**	**$37,700,000**	**$1,950,000**	**$37,700,000**

Preliminary Benefit Cost Calculation	**0.02**	**0.01**	**0.02**	**0.02**	**0.02**	**0.03**

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
350,000 Acre-foot Reservoir - Full Liner
Benefit Cost Analysis

ALTERNATIVE 3

350,000 Acre-Foot Reservoir			Alternative 3 - Option A 1000 CFS Pump Only		Alternative 3 - Option B 2000 CFS Pump Only		Alternative 3 - Option C 1000 CFS Pump & Generator		Alternative 3 - Option D 2000 CFS Pump & Generator		Alternative 3 - Option E 2000 CFS Pump-Turbine		Alternative 3 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$690,000,000		$910,000,000		$780,000,000		$1,050,000,000		$910,000,000		$690,000,000
Full Liner Construction Costs				$550,000,000		$550,000,000		$550,000,000		$550,000,000		$550,000,000		$550,000,000
Water Treatment Construction Costs				$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000
Subtotal 1				**$1,258,000,000**		**$1,478,000,000**		**$1,348,000,000**		**$1,618,000,000**		**$1,478,000,000**		**$1,258,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946	$190,000	$76,922	$185,000	$74,897
Year 25	PW Factor	0.32293	$54,000,000	$17,438,220	$70,000,000	$22,605,100	$56,000,000	$18,084,080	$74,000,000	$23,896,820	$71,000,000	$22,928,030	$54,000,000	$17,438,220
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$16,500,000	$3,390,255	$34,000,000	$6,985,980	$31,000,000	$6,369,570	$67,000,000	$13,766,490	$34,000,000	$6,985,980	$16,500,000	$3,390,255
Year 40	PW Factor	0.16390	$18,500,000	$3,032,150	$41,000,000	$6,719,900	$33,000,000	$5,408,700	$73,000,000	$11,964,700	$41,000,000	$6,719,900	$18,500,000	$3,032,150
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$25,709,015**		**$38,193,309**		**$31,834,266**		**$51,691,537**		**$38,516,239**		**$25,709,015**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$2,800,000	$54,227,012	$3,200,000	$61,973,728	$3,600,000	$69,720,444	$4,300,000	$83,277,197	$3,200,000	$61,973,728	$2,800,000	$54,227,012
Operations Costs	PWA Factor	19.36679	$2,900,000	$56,163,691	$3,200,000	$61,973,728	$3,100,000	$60,037,049	$3,500,000	$67,783,765	$3,200,000	$61,973,728	$2,900,000	$56,163,691
Other Annual O&M	PWA Factor	19.36679	$610,000	$11,813,742	$730,000	$14,137,757	$760,000	$14,718,760	$940,000	$18,204,783	$730,000	$14,137,757	$610,000	$11,813,742
Other Costs	PWA Factor	19.36679	$93,816	$1,816,915	$128,918	$2,496,728	$93,816	$1,816,915	$128,918	$2,496,728	$128,918	$2,496,728	$93,816	$1,816,915
Subtotal 3				**$124,021,360**		**$140,581,941**		**$146,293,168**		**$171,762,473**		**$140,581,941**		**$124,021,360**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,407,730,375**		**$1,656,775,250**		**$1,526,127,434**		**$1,841,454,010**		**$1,657,098,180**		**$1,407,730,375**
Total Present Worth Costs Rounded				**$1,400,000,000**		**$1,650,000,000**		**$1,550,000,000**		**$1,850,000,000**		**$1,650,000,000**		**$1,400,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

BY: Lonnie Zlomke (86-68170)	CHECKED: D.McKelvie 04/07/2009
DATE PREPARED: 04/06/2009	PEER REVIEW: D.Donaldson 4/8/2009

Preliminary Interest During Construction	**156,700,413**		**176,696,401**		**217,415,255**		**232,950,523**		**176,618,191**		**156,752,362**
Preliminary Total Project Costs =	**1,556,700,413**		**1,826,696,401**		**1,767,415,255**		**2,082,950,523**		**1,826,618,191**		**1,556,752,362**
Preliminary Total Project Costs =	**$1,560,000,000**		**$1,830,000,000**		**$1,770,000,000**		**$2,080,000,000**		**$1,830,000,000**		**$1,560,000,000**

Preliminary Project Benefit Summary

0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power	**$0**	**$0**	**$0**	**$0**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**
Preliminary Total Project Benefits = A	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**
Preliminary Total Project Benefits = A	**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**

Preliminary Benefit Cost Calculation	**0.02**	**0.01**	**0.02**	**0.02**	**0.02**	**0.03**

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
350,000 Acre-foot Reservoir - Full Liner
Benefit Cost Analysis

ALTERNATIVE 4

350,000 Acre-Foot Reservoir			Alternative 4 - Option A 1000 CFS Pump Only		Alternative 4 - Option B 2000 CFS Pump Only		Alternative 4 - Option C 1000 CFS Pump & Generator		Alternative 4 - Option D 2000 CFS Pump & Generator		Alternative 4 - Option E 2000 CFS Pump-Turbine		Alternative 4 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$600,000,000		$830,000,000		$690,000,000		$950,000,000		$810,000,000		$610,000,000
Full Liner Construction Costs				$550,000,000		$550,000,000		$550,000,000		$550,000,000		$550,000,000		$550,000,000
Water Treatment Construction Costs				$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000
Subtotal 1				**$1,168,000,000**		**$1,398,000,000**		**$1,258,000,000**		**$1,518,000,000**		**$1,378,000,000**		**$1,178,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946	$190,000	$76,922	$185,000	$74,897
Year 25	PW Factor	0.32293	$54,000,000	$17,438,220	$71,000,000	$22,928,030	$56,000,000	$18,084,080	$74,000,000	$23,896,820	$71,000,000	$22,928,030	$54,000,000	$17,438,220
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$16,500,000	$3,390,255	$34,000,000	$6,985,980	$31,000,000	$6,369,570	$67,000,000	$13,766,490	$34,000,000	$6,985,980	$16,500,000	$3,390,255
Year 40	PW Factor	0.16390	$18,500,000	$3,032,150	$41,000,000	$6,719,900	$33,000,000	$5,408,700	$73,000,000	$11,964,700	$41,000,000	$6,719,900	$18,500,000	$3,032,150
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$25,709,015**		**$38,516,239**		**$31,834,266**		**$51,691,537**		**$38,516,239**		**$25,709,015**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$2,700,000	$52,290,333	$3,200,000	$61,973,728	$3,500,000	$67,783,765	$4,300,000	$83,277,197	$3,200,000	$61,973,728	$2,700,000	$52,290,333
Operations Costs	PWA Factor	19.36679	$2,900,000	$56,163,691	$3,200,000	$61,973,728	$3,100,000	$60,037,049	$3,500,000	$67,783,765	$3,200,000	$61,973,728	$2,900,000	$56,163,691
Other Annual O&M	PWA Factor	19.36679	$600,000	$11,620,074	$720,000	$13,944,089	$760,000	$14,718,760	$930,000	$18,011,115	$720,000	$13,944,089	$600,000	$11,620,074
Other Costs	PWA Factor	19.36679	$93,816	$1,816,915	$128,918	$2,496,728	$93,816	$1,816,915	$128,918	$2,496,728	$128,918	$2,496,728	$93,816	$1,816,915
Subtotal 3				**$121,891,013**		**$140,388,273**		**$144,356,489**		**$171,568,805**		**$140,388,273**		**$121,891,013**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,315,600,028**		**$1,576,904,512**		**$1,434,190,755**		**$1,741,260,342**		**$1,556,904,512**		**$1,325,600,028**
Total Present Worth Costs Rounded				**$1,300,000,000**		**$1,600,000,000**		**$1,450,000,000**		**$1,750,000,000**		**$1,550,000,000**		**$1,350,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

BY: Lonnie Zlomke (86-68170)	CHECKED: D.McKelvie 04/07/2009
DATE PREPARED: 04/06/2009	PEER REVIEW: D.Donaldson 4/8/2009

Preliminary Interest During Construction		**144,880,517**		**166,138,016**		**204,687,680**		**216,526,237**		**163,767,032**		**146,020,936**		
Preliminary Total Project Costs =		**1,444,880,517**		**1,766,138,016**		**1,654,687,680**		**1,966,526,237**		**1,713,767,032**		**1,496,020,936**		
Preliminary Total Project Costs =		**$1,440,000,000**		**$1,770,000,000**		**$1,650,000,000**		**$1,970,000,000**		**$1,710,000,000**		**$1,500,000,000**		

Preliminary Project Benefit Summary

	0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power		**$0**	**$0**	**$0**	**$0**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**
Preliminary Total Project Benefits = A		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**
Preliminary Total Project Benefits = A		**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**

Preliminary Benefit Cost Calculation	**0.02**	**0.01**	**0.02**	**0.02**	**0.02**	**0.03**

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
350,000 Acre-foot Reservoir - Full Liner
Benefit Cost Analysis

ALTERNATIVE 5

350,000 Acre-Foot Reservoir			Alternative 5 - Option A 1000 CFS Pump Only		Alternative 5 - Option B 2000 CFS Pump Only		Alternative 5 - Option C 1000 CFS Pump & Generator		Alternative 5 - Option D 2000 CFS Pump & Generator	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs										
Initial Construction and Other Costs										
Construction Costs Rev1 - July 2008				$750,000,000		$1,100,000,000		$840,000,000		$1,250,000,000
Full Liner Construction Costs				$550,000,000		$550,000,000		$550,000,000		$550,000,000
Water Treatment Construction Costs				$18,000,000		$18,000,000		$18,000,000		$18,000,000
Subtotal 1				**$1,318,000,000**		**$1,668,000,000**		**$1,408,000,000**		**$1,818,000,000**
Periodic Costs		P/F								
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946
Year 25	PW Factor	0.32293	$118,000,000	$38,105,740	$150,000,000	$48,439,500	$120,000,000	$38,751,600	$154,000,000	$49,731,220
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529
Year 35	PW Factor	0.20547	$16,500,000	$3,390,255	$34,000,000	$6,985,980	$31,000,000	$6,369,570	$67,000,000	$13,766,490
Year 40	PW Factor	0.16390	$18,500,000	$3,032,150	$41,000,000	$6,719,900	$33,000,000	$5,408,700	$73,000,000	$11,964,700
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647
Subtotal 2				**$46,376,535**		**$64,027,709**		**$52,501,786**		**$77,525,937**
Annual Costs		P/A								
Maintenance	PWA Factor	19.36679	$5,900,000	$114,264,061	$7,300,000	$141,377,567	$6,700,000	$129,757,493	$8,300,000	$160,744,357
Operations Costs	PWA Factor	19.36679	$2,900,000	$56,163,691	$3,200,000	$61,973,728	$3,100,000	$60,037,049	$3,500,000	$67,783,765
Other Annual O&M	PWA Factor	19.36679	$1,000,000	$19,366,790	$1,250,000	$24,208,488	$1,200,000	$23,240,148	$1,500,000	$29,050,185
Other Costs	PWA Factor	19.36679	$93,816	$1,816,915	$128,918	$2,496,728	$93,816	$1,816,915	$128,918	$2,496,728
Subtotal 3				**$191,611,457**		**$230,056,511**		**$214,851,605**		**$260,075,035**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,555,987,992**		**$1,962,084,220**		**$1,675,353,391**		**$2,155,600,972**
Total Present Worth Costs Rounded				**$1,550,000,000**		**$1,950,000,000**		**$1,700,000,000**		**$2,150,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

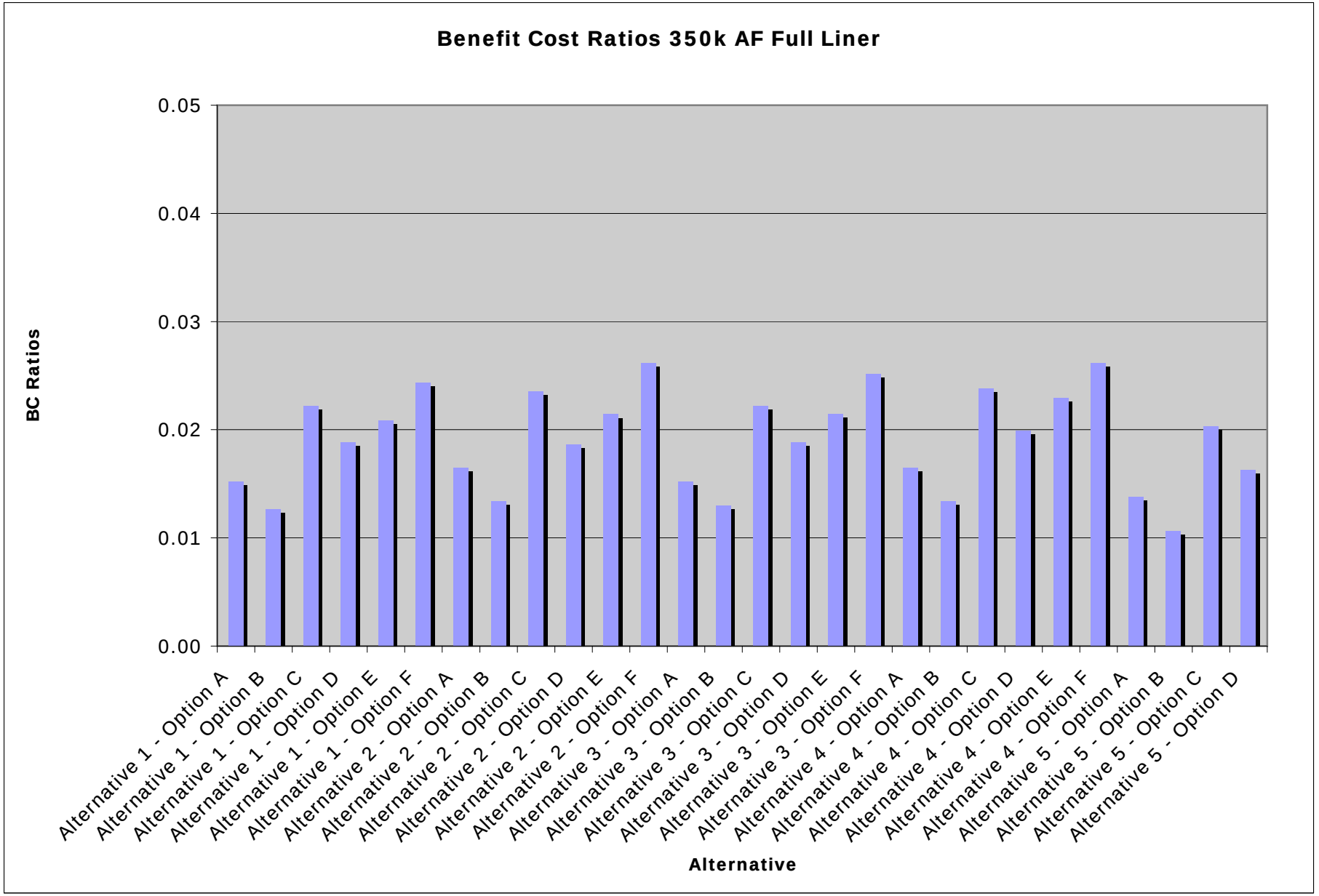
BY: Lonnie Zlomke (86-68170)	CHECKED: D.McKelvie 04/07/2009
DATE PREPARED: 04/06/2009	PEER REVIEW: D.Donaldson 4/8/2009

Preliminary Interest During Construction	**169,906,322**		**277,719,642**		**231,426,071**		**262,203,500**	
Preliminary Total Project Costs =	**1,719,906,322**		**2,227,719,642**		**1,931,426,071**		**2,412,203,500**	
Preliminary Total Project Costs =	**$1,720,000,000**		**$2,230,000,000**		**$1,930,000,000**		**$2,410,000,000**	

Preliminary Project Benefit Summary

0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power	**$0**	**$0**	**$0**	**$0**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**
Preliminary Total Project Benefits = A	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**
Preliminary Total Project Benefits = A	**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**

Preliminary Benefit Cost Calculation	**0.01**	**0.01**	**0.02**	**0.02**


Benefit Cost Ratios 350k AF Full Liner
BC Ratios
0.05
0.04
0.03
0.02
0.01
0.00
Alternative 1 - Option A
Alternative 1 - Option B
Alternative 1 - Option C
Alternative 1 - Option D
Alternative 1 - Option E
Alternative 1 - Option F
Alternative 2 - Option A
Alternative 2 - Option B
Alternative 2 - Option C
Alternative 2 - Option D
Alternative 2 - Option E
Alternative 2 - Option F
Alternative 3 - Option A
Alternative 3 - Option B
Alternative 3 - Option C
Alternative 3 - Option D
Alternative 3 - Option E
Alternative 3 - Option F
Alternative 4 - Option A
Alternative 4 - Option B
Alternative 4 - Option C
Alternative 4 - Option D
Alternative 4 - Option E
Alternative 4 - Option F
Alternative 5 - Option A
Alternative 5 - Option B
Alternative 5 - Option C
Alternative 5 - Option D
Alternative

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
350,000 Acre-foot Reservoir - Half Liner
Benefit Cost Analysis

ALTERNATIVE 1

350,000 Acre-Foot Reservoir			Alternative 1 - Option A 1000 CFS Pump Only		Alternative 1 - Option B 2000 CFS Pump Only		Alternative 1 - Option C 1000 CFS Pump & Generator		Alternative 1 - Option D 2000 CFS Pump & Generator		Alternative 1 - Option E 2000 CFS Pump-Turbine		Alternative 1 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$700,000,000		$940,000,000		$790,000,000		$1,050,000,000		$930,000,000		$710,000,000
Half Liner Construction Costs				$240,000,000		$240,000,000		$240,000,000		$240,000,000		$240,000,000		$240,000,000
Water Treatment Construction Costs				$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000
Subtotal 1				**$958,000,000**		**$1,198,000,000**		**$1,048,000,000**		**$1,308,000,000**		**$1,188,000,000**		**$968,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946	$190,000	$76,922	$185,000	$74,897
Year 25	PW Factor	0.32293	$54,000,000	$17,438,220	$70,000,000	$22,605,100	$56,000,000	$18,084,080	$74,000,000	$23,896,820	$71,000,000	$22,928,030	$54,000,000	$17,438,220
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$16,500,000	$3,390,255	$34,000,000	$6,985,980	$31,000,000	$6,369,570	$67,000,000	$13,766,490	$34,000,000	$6,985,980	$16,500,000	$3,390,255
Year 40	PW Factor	0.16390	$18,500,000	$3,032,150	$41,000,000	$6,719,900	$33,000,000	$5,408,700	$73,000,000	$11,964,700	$41,000,000	$6,719,900	$18,500,000	$3,032,150
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$25,709,016**		**$38,193,309**		**$31,834,266**		**$51,691,537**		**$38,516,239**		**$25,709,015**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$2,800,000	$54,227,012	$3,200,000	$61,973,728	$3,600,000	$69,720,444	$4,300,000	$83,277,197	$3,200,000	$61,973,728	$2,800,000	$54,227,012
Operations Costs	PWA Factor	19.36679	$2,900,000	$56,163,691	$3,200,000	$61,973,728	$3,100,000	$60,037,049	$3,500,000	$67,783,765	$3,200,000	$61,973,728	$2,900,000	$56,163,691
Other Annual O&M	PWA Factor	19.36679	$600,000	$11,620,074	$730,000	$14,137,757	$760,000	$14,718,760	$940,000	$18,204,783	$730,000	$14,137,757	$610,000	$11,813,742
Other Costs	PWA Factor	19.36679	$93,816	$1,816,915	$128,918	$2,496,728	$93,816	$1,816,915	$128,918	$2,496,728	$128,918	$2,496,728	$93,816	$1,816,915
Other Costs (Water	PWA Factor	19.36679	$46,983	$909,910	$56,379	$1,091,880	$46,983	$909,910	$56,379	$1,091,880	$56,379	$1,091,880	$46,983	$909,910
Subtotal 3				**$124,737,602**		**$141,673,821**		**$147,203,078**		**$172,854,353**		**$141,673,821**		**$124,931,270**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,108,446,618**		**$1,377,867,130**		**$1,227,037,344**		**$1,532,545,890**		**$1,368,190,060**		**$1,118,640,285**
Total Present Worth Costs Rounded				**$1,100,000,000**		**$1,400,000,000**		**$1,250,000,000**		**$1,550,000,000**		**$1,350,000,000**		**$1,100,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

BY: Lonnie Zlomke (86-68170)	CHECKED: D.McKelvie 04/07/2009
DATE PREPARED: 6-Apr-09	PEER REVIEW: D.Donaldson 4/8/2009

Preliminary Interest During Construction	**110,071,969**	**132,112,685**	**154,510,211**	**168,690,817**	**130,988,872**	**111,212,339**
Preliminary Total Project Costs =	**1,210,071,969**	**1,532,112,685**	**1,404,510,211**	**1,718,690,817**	**1,480,988,872**	**1,211,212,339**
Preliminary Total Project Costs =	**$1,210,000,000**	**$1,530,000,000**	**$1,400,000,000**	**$1,720,000,000**	**$1,480,000,000**	**$1,210,000,000**

Preliminary Project Benefit Summary

0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power	**$0**	**$0**	**$0**	**$0**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**
Preliminary Total Project Benefits = A	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**
Preliminary Total Project Benefits = A	**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**

Preliminary Benefit Cost Calculation	**0.02**	**0.02**	**0.03**	**0.02**	**0.03**	**0.03**

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
350,000 Acre-foot Reservoir - Half Liner
Benefit Cost Analysis

ALTERNATIVE 2

350,000 Acre-Foot Reservoir			Alternative 2 - Option A 1000 CFS Pump Only		Alternative 2 - Option B 2000 CFS Pump Only		Alternative 2 - Option C 1000 CFS Pump & Generator		Alternative 2 - Option D 2000 CFS Pump & Generator		Alternative 2 - Option E 2000 CFS Pump-Turbine		Alternative 2 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$530,000,000		$800,000,000		$630,000,000		$940,000,000		$790,000,000		$530,000,000
Half Liner Construction Costs				$240,000,000		$240,000,000		$240,000,000		$240,000,000		$240,000,000		$240,000,000
Water Treatment Construction Costs				$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000
Subtotal 1				**$788,000,000**		**$1,058,000,000**		**$888,000,000**		**$1,198,000,000**		**$1,048,000,000**		**$788,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$194,000	$78,541	$189,000	$76,517	$185,000	$74,897
Year 25	PW Factor	0.32293	$77,000,000	$24,865,610	$105,000,000	$33,907,650	$79,000,000	$25,511,470	$110,000,000	$35,522,300	$105,000,000	$33,907,650	$77,000,000	$24,865,610
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$16,500,000	$3,390,255	$34,000,000	$6,985,980	$31,000,000	$6,369,570	$67,000,000	$13,766,490	$34,000,000	$6,985,980	$16,500,000	$3,390,255
Year 40	PW Factor	0.16390	$18,500,000	$3,032,150	$41,000,000	$6,719,900	$33,000,000	$5,408,700	$73,000,000	$11,964,700	$41,000,000	$6,719,900	$18,500,000	$3,032,150
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$33,136,405**		**$49,495,859**		**$39,261,656**		**$63,316,612**		**$49,495,454**		**$33,136,405**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$3,900,000	$75,530,481	$4,800,000	$92,960,592	$4,600,000	$89,087,234	$5,900,000	$114,264,061	$4,800,000	$92,960,592	$3,900,000	$75,530,481
Operations Costs	PWA Factor	19.36679	$2,900,000	$56,163,691	$3,200,000	$61,973,728	$3,100,000	$60,037,049	$3,500,000	$67,783,765	$3,200,000	$61,973,728	$2,900,000	$56,163,691
Other Annual O&M	PWA Factor	19.36679	$770,000	$14,912,428	$960,000	$18,592,118	$920,000	$17,817,447	$1,150,000	$22,271,809	$965,000	$18,688,952	$768,000	$14,873,695
Other Costs	PWA Factor	19.36679	$93,816	$1,816,915	$128,918	$2,496,728	$93,816	$1,816,915	$128,918	$2,496,728	$128,918	$2,496,728	$93,816	$1,816,915
Other Costs (Water	PWA Factor	19.36679	$46,983	$909,910	$56,379	$1,091,880	$46,983	$909,910	$56,379	$1,091,880	$56,379	$1,091,880	$46,983	$909,910
Subtotal 3				**$149,333,425**		**$177,115,046**		**$169,668,555**		**$207,908,243**		**$177,211,880**		**$149,294,692**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$970,469,830**		**$1,284,610,905**		**$1,096,930,211**		**$1,469,224,855**		**$1,274,707,334**		**$970,431,097**
Total Present Worth Costs Rounded				**$970,000,000**		**$1,300,000,000**		**$1,100,000,000**		**$1,450,000,000**		**$1,250,000,000**		**$970,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

BY: Lonnie Zlomke (86-68170)	CHECKED: D.McKelvie 04/07/2009
DATE PREPARED: 6-Apr-09	PEER REVIEW: D.Donaldson 4/8/2009

Preliminary Interest During Construction	**95,880,114**		**117,882,125**		**140,426,359**		**154,717,345**		**116,748,258**		**96,379,192**	
Preliminary Total Project Costs =	**1,065,880,114**		**1,417,882,125**		**1,240,426,359**		**1,604,717,345**		**1,366,748,258**		**1,066,379,192**	
Preliminary Total Project Costs =	**$1,070,000,000**		**$1,420,000,000**		**$1,240,000,000**		**$1,600,000,000**		**$1,370,000,000**		**$1,070,000,000**	

Preliminary Project Benefit Summary

0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power	**$0**	**$0**	**$0**	**$0**	**$720,000**	**$13,944,087**	**$720,000**	**$13,944,087**	**$720,000**	**$13,944,087**	**$720,000**	**$13,944,087**
Preliminary Total Project Benefits = A	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,946,560**	**$37,698,620**	**$1,946,560**	**$37,698,620**	**$1,946,560**	**$37,698,620**	**$1,946,560**	**$37,698,620**
Preliminary Total Project Benefits = A	**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$1,950,000**	**$37,700,000**	**$1,950,000**	**$37,700,000**	**$1,950,000**	**$37,700,000**	**$1,950,000**	**$37,700,000**

Preliminary Benefit Cost Calculation	**0.02**	**0.02**	**0.03**	**0.02**	**0.03**	**0.04**

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
350,000 Acre-foot Reservoir - Half Liner
Benefit Cost Analysis

ALTERNATIVE 3

350,000 Acre-Foot Reservoir			Alternative 3 - Option A 1000 CFS Pump Only		Alternative 3 - Option B 2000 CFS Pump Only		Alternative 3 - Option C 1000 CFS Pump & Generator		Alternative 3 - Option D 2000 CFS Pump & Generator		Alternative 3 - Option E 2000 CFS Pump-Turbine		Alternative 3 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$690,000,000		$910,000,000		$780,000,000		$1,050,000,000		$910,000,000		$690,000,000
Half Liner Construction Costs				$240,000,000		$240,000,000		$240,000,000		$240,000,000		$240,000,000		$240,000,000
Water Treatment Construction Costs				$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000
Subtotal 1				**$948,000,000**		**$1,168,000,000**		**$1,038,000,000**		**$1,308,000,000**		**$1,168,000,000**		**$948,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946	$190,000	$76,922	$185,000	$74,897
Year 25	PW Factor	0.32293	$54,000,000	$17,438,220	$70,000,000	$22,605,100	$56,000,000	$18,084,080	$74,000,000	$23,896,820	$71,000,000	$22,928,030	$54,000,000	$17,438,220
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$16,500,000	$3,390,255	$34,000,000	$6,985,980	$31,000,000	$6,369,570	$67,000,000	$13,766,490	$34,000,000	$6,985,980	$16,500,000	$3,390,255
Year 40	PW Factor	0.16390	$18,500,000	$3,032,150	$41,000,000	$6,719,900	$33,000,000	$5,408,700	$73,000,000	$11,964,700	$41,000,000	$6,719,900	$18,500,000	$3,032,150
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$25,709,015**		**$38,193,309**		**$31,834,266**		**$51,691,537**		**$38,516,239**		**$25,709,015**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$2,800,000	$54,227,012	$3,200,000	$61,973,728	$3,600,000	$69,720,444	$4,300,000	$83,277,197	$3,200,000	$61,973,728	$2,800,000	$54,227,012
Operations Costs	PWA Factor	19.36679	$2,900,000	$56,163,691	$3,200,000	$61,973,728	$3,100,000	$60,037,049	$3,500,000	$67,783,765	$3,200,000	$61,973,728	$2,900,000	$56,163,691
Other Annual O&M	PWA Factor	19.36679	$610,000	$11,813,742	$730,000	$14,137,757	$760,000	$14,718,760	$940,000	$18,204,783	$730,000	$14,137,757	$610,000	$11,813,742
Other Costs	PWA Factor	19.36679	$93,816	$1,816,915	$128,918	$2,496,728	$93,816	$1,816,915	$128,918	$2,496,728	$128,918	$2,496,728	$93,816	$1,816,915
Other Costs (Water	PWA Factor	19.36679	$46,983	$909,910	$56,379	$1,091,880	$46,983	$909,910	$56,379	$1,091,880	$56,379	$1,091,880	$46,983	$909,910
Subtotal 3				**$124,931,270**		**$141,673,821**		**$147,203,078**		**$172,854,353**		**$141,673,821**		**$124,931,270**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,098,640,285**		**$1,347,867,130**		**$1,217,037,344**		**$1,532,545,890**		**$1,348,190,060**		**$1,098,640,285**
Total Present Worth Costs Rounded				**$1,100,000,000**		**$1,350,000,000**		**$1,200,000,000**		**$1,550,000,000**		**$1,350,000,000**		**$1,100,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

BY: Lonnie Zlomke (86-68170)	CHECKED: D.McKelvie 04/07/2009
DATE PREPARED: 6-Apr-09	PEER REVIEW: D.Donaldson 4/8/2009

Preliminary Interest During Construction	**108,985,042**		**128,981,030**		**153,155,549**		**168,690,817**		**128,902,821**		**109,036,992**	
Preliminary Total Project Costs =	**1,208,985,042**		**1,478,981,030**		**1,353,155,549**		**1,718,690,817**		**1,478,902,821**		**1,209,036,992**	
Preliminary Total Project Costs =	**$1,210,000,000**		**$1,480,000,000**		**$1,350,000,000**		**$1,720,000,000**		**$1,480,000,000**		**$1,210,000,000**	

Preliminary Project Benefit Summary

	0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power		**$0**	**$0**	**$0**	**$0**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**
Preliminary Total Project Benefits = A		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**
Preliminary Total Project Benefits = A		**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**

Preliminary Benefit Cost Calculation	**0.02**	**0.02**	**0.03**	**0.02**	**0.03**	**0.03**

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
350,000 Acre-foot Reservoir - Half Liner
Benefit Cost Analysis

ALTERNATIVE 4

350,000 Acre-Foot Reservoir			Alternative 4 - Option A 1000 CFS Pump Only		Alternative 4 - Option B 2000 CFS Pump Only		Alternative 4 - Option C 1000 CFS Pump & Generator		Alternative 4 - Option D 2000 CFS Pump & Generator		Alternative 4 - Option E 2000 CFS Pump-Turbine		Alternative 4 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$600,000,000		$830,000,000		$690,000,000		$950,000,000		$810,000,000		$610,000,000
Half Liner Construction Costs				$240,000,000		$240,000,000		$240,000,000		$240,000,000		$240,000,000		$240,000,000
Water Treatment Construction Costs				$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000
Subtotal 1				**$858,000,000**		**$1,088,000,000**		**$948,000,000**		**$1,208,000,000**		**$1,068,000,000**		**$868,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946	$190,000	$76,922	$185,000	$74,897
Year 25	PW Factor	0.32293	$54,000,000	$17,438,220	$71,000,000	$22,928,030	$56,000,000	$18,084,080	$74,000,000	$23,896,820	$71,000,000	$22,928,030	$54,000,000	$17,438,220
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$16,500,000	$3,390,255	$34,000,000	$6,985,980	$31,000,000	$6,369,570	$67,000,000	$13,766,490	$34,000,000	$6,985,980	$16,500,000	$3,390,255
Year 40	PW Factor	0.16390	$18,500,000	$3,032,150	$41,000,000	$6,719,900	$33,000,000	$5,408,700	$73,000,000	$11,964,700	$41,000,000	$6,719,900	$18,500,000	$3,032,150
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$25,709,015**		**$38,516,239**		**$31,834,266**		**$51,691,537**		**$38,516,239**		**$25,709,015**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$2,700,000	$52,290,333	$3,200,000	$61,973,728	$3,500,000	$67,783,765	$4,300,000	$83,277,197	$3,200,000	$61,973,728	$2,700,000	$52,290,333
Operations Costs	PWA Factor	19.36679	$2,900,000	$56,163,691	$3,200,000	$61,973,728	$3,100,000	$60,037,049	$3,500,000	$67,783,765	$3,200,000	$61,973,728	$2,900,000	$56,163,691
Other Annual O&M	PWA Factor	19.36679	$600,000	$11,620,074	$720,000	$13,944,089	$760,000	$14,718,760	$930,000	$18,011,115	$720,000	$13,944,089	$600,000	$11,620,074
Other Costs	PWA Factor	19.36679	$93,816	$1,816,915	$128,918	$2,496,728	$93,816	$1,816,915	$128,918	$2,496,728	$128,918	$2,496,728	$93,816	$1,816,915
Other Costs (Water	PWA Factor	19.36679	$46,983	$909,910	$56,379	$1,091,880	$46,983	$909,910	$56,379	$1,091,880	$56,379	$1,091,880	$46,983	$909,910
Subtotal 3				**$122,800,923**		**$141,480,153**		**$145,266,399**		**$172,660,685**		**$141,480,153**		**$122,800,923**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,006,509,938**		**$1,267,996,392**		**$1,125,100,665**		**$1,432,352,222**		**$1,247,996,392**		**$1,016,509,938**
Total Present Worth Costs Rounded				**$1,000,000,000**		**$1,250,000,000**		**$1,150,000,000**		**$1,450,000,000**		**$1,250,000,000**		**$1,000,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

BY: Lonnie Zlomke (86-68170)	CHECKED: D.McKelvie 04/07/2009
DATE PREPARED: 6-Apr-09	PEER REVIEW: D.Donaldson 4/8/2009

Preliminary Interest During Construction	**97,165,147**		**118,422,646**		**140,427,974**		**152,266,531**		**116,051,662**		**98,305,565**	
Preliminary Total Project Costs =	**1,097,165,147**		**1,368,422,646**		**1,290,427,974**		**1,602,266,531**		**1,366,051,662**		**1,098,305,565**	
Preliminary Total Project Costs =	**$1,100,000,000**		**$1,370,000,000**		**$1,290,000,000**		**$1,600,000,000**		**$1,370,000,000**		**$1,100,000,000**	

Preliminary Project Benefit Summary

	0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power		**$0**	**$0**	**$0**	**$0**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**
Preliminary Total Project Benefits = A		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**
Preliminary Total Project Benefits = A		**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**

Preliminary Benefit Cost Calculation	**0.02**	**0.02**	**0.03**	**0.02**	**0.03**	**0.04**

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
350,000 Acre-foot Reservoir - Half Liner
Benefit Cost Analysis

ALTERNATIVE 5

350,000 Acre-Foot Reservoir			Alternative 5 - Option A 1000 CFS Pump Only		Alternative 5 - Option B 2000 CFS Pump Only		Alternative 5 - Option C 1000 CFS Pump & Generator		Alternative 5 - Option D 2000 CFS Pump & Generator	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs										
Initial Construction and Other Costs										
Construction Costs Rev1 - July 2008				$750,000,000		$1,100,000,000		$840,000,000		$1,250,000,000
Half Liner Construction Costs				$240,000,000		$240,000,000		$240,000,000		$240,000,000
Water Treatment Construction Costs				$18,000,000		$18,000,000		$18,000,000		$18,000,000
Subtotal 1				**$1,008,000,000**		**$1,358,000,000**		**$1,098,000,000**		**$1,508,000,000**
Periodic Costs		P/F								
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946
Year 25	PW Factor	0.32293	$118,000,000	$38,105,740	$150,000,000	$48,439,500	$120,000,000	$38,751,600	$154,000,000	$49,731,220
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529
Year 35	PW Factor	0.20547	$16,500,000	$3,390,255	$34,000,000	$6,985,980	$31,000,000	$6,369,570	$67,000,000	$13,766,490
Year 40	PW Factor	0.16390	$18,500,000	$3,032,150	$41,000,000	$6,719,900	$33,000,000	$5,408,700	$73,000,000	$11,964,700
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647
Subtotal 2				**$46,376,535**		**$64,027,709**		**$52,501,786**		**$77,525,937**
Annual Costs		P/A								
Maintenance	PWA Factor	19.36679	$5,900,000	$114,264,061	$7,300,000	$141,377,567	$6,700,000	$129,757,493	$8,300,000	$160,744,357
Operations Costs	PWA Factor	19.36679	$2,900,000	$56,163,691	$3,200,000	$61,973,728	$3,100,000	$60,037,049	$3,500,000	$67,783,765
Other Annual O&M	PWA Factor	19.36679	$1,000,000	$19,366,790	$1,250,000	$24,208,488	$1,200,000	$23,240,148	$1,500,000	$29,050,185
Other Costs	PWA Factor	19.36679	$93,816	$1,816,915	$128,918	$2,496,728	$93,816	$1,816,915	$128,918	$2,496,728
Other Costs (Water	PWA Factor	19.36679	$46,983	$909,910	$56,379	$1,091,880	$46,983	$909,910	$56,379	$1,091,880
Subtotal 3				**$192,521,367**		**$231,148,391**		**$215,761,515**		**$261,166,915**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,246,897,902**		**$1,653,176,100**		**$1,366,263,301**		**$1,846,692,852**
Total Present Worth Costs Rounded				**$1,250,000,000**		**$1,650,000,000**		**$1,350,000,000**		**$1,850,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

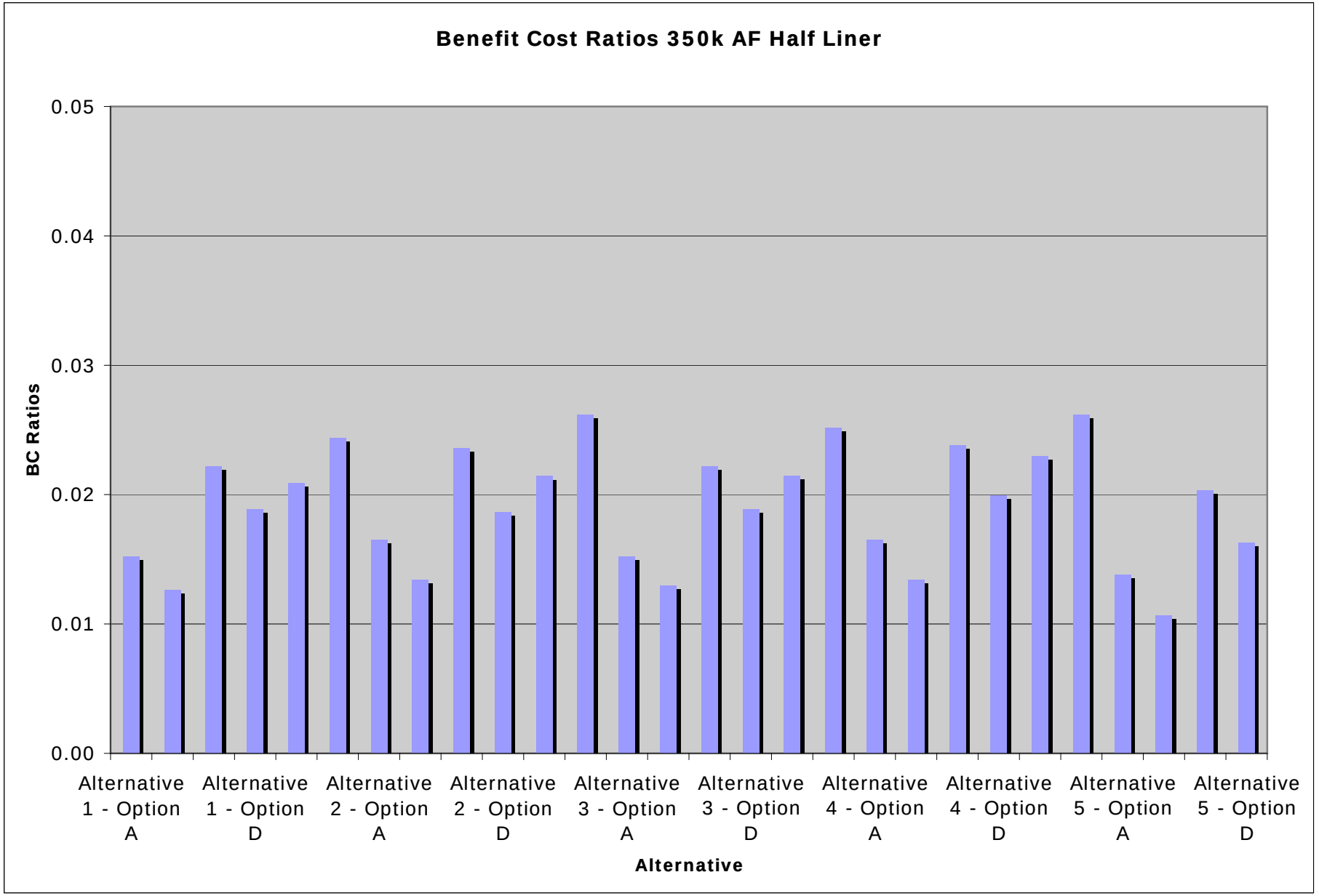
BY: Lonnie Zlomke (86-68170)	CHECKED: D.McKelvie 04/07/2009
DATE PREPARED: 6-Apr-09	PEER REVIEW: D.Donaldson 4/8/2009

Preliminary Interest During Construction	**122,190,952**		**213,459,936**		**167,166,365**		**197,943,794**	
Preliminary Total Project Costs =	**1,372,190,952**		**1,863,459,936**		**1,517,166,365**		**2,047,943,794**	
Preliminary Total Project Costs =	**$1,370,000,000**		**$1,860,000,000**		**$1,520,000,000**		**$2,050,000,000**	

Preliminary Project Benefit Summary

0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power	**$0**	**$0**	**$0**	**$0**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**
Preliminary Total Project Benefits = A	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**
Preliminary Total Project Benefits = A	**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**

Preliminary Benefit Cost Calculation	**0.02**	**0.01**	**0.03**	**0.02**


Benefit Cost Ratios 350k AF Half Liner
BC Ratios
0.05
0.04
0.03
0.02
0.01
0.00
Alternative 1 - Option A
Alternative 1 - Option D
Alternative 2 - Option A
Alternative 2 - Option D
Alternative 3 - Option A
Alternative 3 - Option D
Alternative 4 - Option A
Alternative 4 - Option D
Alternative 5 - Option A
Alternative 5 - Option D
Alternative

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
350,000 Acre-foot Reservoir - NE Side Only Full Liner
Benefit Cost Analysis

ALTERNATIVE 1

350,000 Acre-Foot Reservoir			Alternative 1 - Option A 1000 CFS Pump Only		Alternative 1 - Option B 2000 CFS Pump Only		Alternative 1 - Option C 1000 CFS Pump & Generator		Alternative 1 - Option D 2000 CFS Pump & Generator		Alternative 1 - Option E 2000 CFS Pump-Turbine		Alternative 1 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$700,000,000		$940,000,000		$790,000,000		$1,050,000,000		$930,000,000		$710,000,000
NE Side Only Full Liner				$440,000,000		$440,000,000		$440,000,000		$440,000,000		$440,000,000		$440,000,000
Water Treatment Construction Costs				$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000
Subtotal 1				**$1,158,000,000**		**$1,398,000,000**		**$1,248,000,000**		**$1,508,000,000**		**$1,388,000,000**		**$1,168,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946	$190,000	$76,922	$185,000	$74,897
Year 25	PW Factor	0.32293	$54,000,000	$17,438,220	$70,000,000	$22,605,100	$56,000,000	$18,084,080	$74,000,000	$23,896,820	$71,000,000	$22,928,030	$54,000,000	$17,438,220
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$16,500,000	$3,390,255	$34,000,000	$6,985,980	$31,000,000	$6,369,570	$67,000,000	$13,766,490	$34,000,000	$6,985,980	$16,500,000	$3,390,255
Year 40	PW Factor	0.16390	$18,500,000	$3,032,150	$41,000,000	$6,719,900	$33,000,000	$5,408,700	$73,000,000	$11,964,700	$41,000,000	$6,719,900	$18,500,000	$3,032,150
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$25,709,016**		**$38,193,309**		**$31,834,266**		**$51,691,537**		**$38,516,239**		**$25,709,015**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$2,800,000	$54,227,012	$3,200,000	$61,973,728	$3,600,000	$69,720,444	$4,300,000	$83,277,197	$3,200,000	$61,973,728	$2,800,000	$54,227,012
Operations Costs	PWA Factor	19.36679	$2,900,000	$56,163,691	$3,200,000	$61,973,728	$3,100,000	$60,037,049	$3,500,000	$67,783,765	$3,200,000	$61,973,728	$2,900,000	$56,163,691
Other Annual O&M	PWA Factor	19.36679	$600,000	$11,620,074	$730,000	$14,137,757	$760,000	$14,718,760	$940,000	$18,204,783	$730,000	$14,137,757	$610,000	$11,813,742
Other Costs	PWA Factor	19.36679	$93,816	$1,816,915	$128,918	$2,496,728	$93,816	$1,816,915	$128,918	$2,496,728	$128,918	$2,496,728	$93,816	$1,816,915
Other Costs (Water	PWA Factor	19.36679	$21,681	$419,891	$26,017	$503,866	$21,681	$419,891	$26,017	$503,866	$26,017	$503,866	$21,681	$419,891
Subtotal 3				**$124,247,583**		**$141,085,807**		**$146,713,059**		**$172,266,339**		**$141,085,807**		**$124,441,251**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,307,956,599**		**$1,577,279,116**		**$1,426,547,325**		**$1,731,957,876**		**$1,567,602,046**		**$1,318,150,266**
Total Present Worth Costs Rounded				**$1,300,000,000**		**$1,600,000,000**		**$1,450,000,000**		**$1,750,000,000**		**$1,550,000,000**		**$1,300,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

BY: Lonnie Zlomke (86-68170)	CHECKED: D.McKelvie 04/07/2009
DATE PREPARED: 6-Apr-09	PEER REVIEW: D.Donaldson 4/8/2009

Preliminary Interest During Construction	**125,763,451**	**147,804,167**	**180,177,424**	**194,358,030**	**146,680,354**	**126,903,821**
Preliminary Total Project Costs =	**1,425,763,451**	**1,747,804,167**	**1,630,177,424**	**1,944,358,030**	**1,696,680,354**	**1,426,903,821**
Preliminary Total Project Costs =	**$1,430,000,000**	**$1,750,000,000**	**$1,630,000,000**	**$1,940,000,000**	**$1,700,000,000**	**$1,430,000,000**

Preliminary Project Benefit Summary

0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power	**$0**	**$0**	**$0**	**$0**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**
Preliminary Total Project Benefits = A	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**
Preliminary Total Project Benefits = A	**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**

Preliminary Benefit Cost Calculation	**0.02**	**0.01**	**0.02**	**0.02**	**0.02**	**0.03**

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
350,000 Acre-foot Reservoir - NE Side Only Full Liner
Benefit Cost Analysis

ALTERNATIVE 2

350,000 Acre-Foot Reservoir			Alternative 2 - Option A 1000 CFS Pump Only		Alternative 2 - Option B 2000 CFS Pump Only		Alternative 2 - Option C 1000 CFS Pump & Generator		Alternative 2 - Option D 2000 CFS Pump & Generator		Alternative 2 - Option E 2000 CFS Pump-Turbine		Alternative 2 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$530,000,000		$800,000,000		$630,000,000		$940,000,000		$790,000,000		$530,000,000
NE Side Only Full Liner				$440,000,000		$440,000,000		$440,000,000		$440,000,000		$440,000,000		$440,000,000
Water Treatment Construction Costs				$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000
Subtotal 1				**$988,000,000**		**$1,258,000,000**		**$1,088,000,000**		**$1,398,000,000**		**$1,248,000,000**		**$988,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$194,000	$78,541	$189,000	$76,517	$185,000	$74,897
Year 25	PW Factor	0.32293	$77,000,000	$24,865,610	$105,000,000	$33,907,650	$79,000,000	$25,511,470	$110,000,000	$35,522,300	$105,000,000	$33,907,650	$77,000,000	$24,865,610
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$16,500,000	$3,390,255	$34,000,000	$6,985,980	$31,000,000	$6,369,570	$67,000,000	$13,766,490	$34,000,000	$6,985,980	$16,500,000	$3,390,255
Year 40	PW Factor	0.16390	$18,500,000	$3,032,150	$41,000,000	$6,719,900	$33,000,000	$5,408,700	$73,000,000	$11,964,700	$41,000,000	$6,719,900	$18,500,000	$3,032,150
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$33,136,405**		**$49,495,859**		**$39,261,656**		**$63,316,612**		**$49,495,454**		**$33,136,405**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$3,900,000	$75,530,481	$4,800,000	$92,960,592	$4,600,000	$89,087,234	$5,900,000	$114,264,061	$4,800,000	$92,960,592	$3,900,000	$75,530,481
Operations Costs	PWA Factor	19.36679	$2,900,000	$56,163,691	$3,200,000	$61,973,728	$3,100,000	$60,037,049	$3,500,000	$67,783,765	$3,200,000	$61,973,728	$2,900,000	$56,163,691
Other Annual O&M	PWA Factor	19.36679	$770,000	$14,912,428	$960,000	$18,592,118	$920,000	$17,817,447	$1,150,000	$22,271,809	$965,000	$18,688,952	$768,000	$14,873,695
Other Costs	PWA Factor	19.36679	$93,816	$1,816,915	$128,918	$2,496,728	$93,816	$1,816,915	$128,918	$2,496,728	$128,918	$2,496,728	$93,816	$1,816,915
Other Costs (Water	PWA Factor	19.36679	$21,681	$419,891	$26,017	$503,866	$21,681	$419,891	$26,017	$503,866	$26,017	$503,866	$21,681	$419,891
Subtotal 3				**$148,843,406**		**$176,527,032**		**$169,178,536**		**$207,320,229**		**$176,623,866**		**$148,804,673**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,169,979,811**		**$1,484,022,891**		**$1,296,440,192**		**$1,668,636,841**		**$1,474,119,320**		**$1,169,941,078**
Total Present Worth Costs Rounded				**$1,150,000,000**		**$1,500,000,000**		**$1,300,000,000**		**$1,650,000,000**		**$1,450,000,000**		**$1,150,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

BY: Lonnie Zlomke (86-68170)	CHECKED: D.McKelvie 04/07/2009
DATE PREPARED: 6-Apr-09	PEER REVIEW: D.Donaldson 4/8/2009

Preliminary Interest During Construction	**111,571,596**		**133,573,607**		**166,093,572**		**180,384,558**		**132,439,741**		**112,070,674**
Preliminary Total Project Costs =	**1,261,571,596**		**1,633,573,607**		**1,466,093,572**		**1,830,384,558**		**1,582,439,741**		**1,262,070,674**
Preliminary Total Project Costs =	**$1,260,000,000**		**$1,630,000,000**		**$1,470,000,000**		**$1,830,000,000**		**$1,580,000,000**		**$1,260,000,000**

Preliminary Project Benefit Summary

0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power	**$0**	**$0**	**$0**	**$0**	**$720,000**	**$13,944,087**	**$720,000**	**$13,944,087**	**$720,000**	**$13,944,087**	**$720,000**	**$13,944,087**
Preliminary Total Project Benefits = A	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,946,560**	**$37,698,620**	**$1,946,560**	**$37,698,620**	**$1,946,560**	**$37,698,620**	**$1,946,560**	**$37,698,620**
Preliminary Total Project Benefits = A	**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$1,950,000**	**$37,700,000**	**$1,950,000**	**$37,700,000**	**$1,950,000**	**$37,700,000**	**$1,950,000**	**$37,700,000**

Preliminary Benefit Cost Calculation	**0.02**	**0.01**	**0.03**	**0.02**	**0.02**	**0.03**

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
350,000 Acre-foot Reservoir - NE Side Only Full Liner
Benefit Cost Analysis

ALTERNATIVE 3

350,000 Acre-Foot Reservoir			Alternative 3 - Option A 1000 CFS Pump Only		Alternative 3 - Option B 2000 CFS Pump Only		Alternative 3 - Option C 1000 CFS Pump & Generator		Alternative 3 - Option D 2000 CFS Pump & Generator		Alternative 3 - Option E 2000 CFS Pump-Turbine		Alternative 3 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$690,000,000		$910,000,000		$780,000,000		$1,050,000,000		$910,000,000		$690,000,000
NE Side Only Full Liner				$440,000,000		$440,000,000		$440,000,000		$440,000,000		$440,000,000		$440,000,000
Water Treatment Construction Costs				$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000
Subtotal 1				**$1,148,000,000**		**$1,368,000,000**		**$1,238,000,000**		**$1,508,000,000**		**$1,368,000,000**		**$1,148,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946	$190,000	$76,922	$185,000	$74,897
Year 25	PW Factor	0.32293	$54,000,000	$17,438,220	$70,000,000	$22,605,100	$56,000,000	$18,084,080	$74,000,000	$23,896,820	$71,000,000	$22,928,030	$54,000,000	$17,438,220
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$16,500,000	$3,390,255	$34,000,000	$6,985,980	$31,000,000	$6,369,570	$67,000,000	$13,766,490	$34,000,000	$6,985,980	$16,500,000	$3,390,255
Year 40	PW Factor	0.16390	$18,500,000	$3,032,150	$41,000,000	$6,719,900	$33,000,000	$5,408,700	$73,000,000	$11,964,700	$41,000,000	$6,719,900	$18,500,000	$3,032,150
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$25,709,015**		**$38,193,309**		**$31,834,266**		**$51,691,537**		**$38,516,239**		**$25,709,015**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$2,800,000	$54,227,012	$3,200,000	$61,973,728	$3,600,000	$69,720,444	$4,300,000	$83,277,197	$3,200,000	$61,973,728	$2,800,000	$54,227,012
Operations Costs	PWA Factor	19.36679	$2,900,000	$56,163,691	$3,200,000	$61,973,728	$3,100,000	$60,037,049	$3,500,000	$67,783,765	$3,200,000	$61,973,728	$2,900,000	$56,163,691
Other Annual O&M	PWA Factor	19.36679	$610,000	$11,813,742	$730,000	$14,137,757	$760,000	$14,718,760	$940,000	$18,204,783	$730,000	$14,137,757	$610,000	$11,813,742
Other Costs	PWA Factor	19.36679	$93,816	$1,816,915	$128,918	$2,496,728	$93,816	$1,816,915	$128,918	$2,496,728	$128,918	$2,496,728	$93,816	$1,816,915
Other Costs (Water	PWA Factor	19.36679	$21,681	$419,891	$26,017	$503,866	$21,681	$419,891	$26,017	$503,866	$26,017	$503,866	$21,681	$419,891
Subtotal 3				**$124,441,251**		**$141,085,807**		**$146,713,059**		**$172,266,339**		**$141,085,807**		**$124,441,251**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,298,150,266**		**$1,547,279,116**		**$1,416,547,325**		**$1,731,957,876**		**$1,547,602,046**		**$1,298,150,266**
Total Present Worth Costs Rounded				**$1,300,000,000**		**$1,550,000,000**		**$1,400,000,000**		**$1,750,000,000**		**$1,550,000,000**		**$1,300,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

BY: Lonnie Zlomke (86-68170)	CHECKED: D.McKelvie 04/07/2009
DATE PREPARED: 6-Apr-09	PEER REVIEW: D.Donaldson 4/8/2009

Preliminary Interest During Construction	**124,676,525**		**144,672,512**		**178,822,762**		**194,358,030**		**144,594,303**		**124,728,474**
Preliminary Total Project Costs =	**1,424,676,525**		**1,694,672,512**		**1,578,822,762**		**1,944,358,030**		**1,694,594,303**		**1,424,728,474**
Preliminary Total Project Costs =	**$1,420,000,000**		**$1,690,000,000**		**$1,580,000,000**		**$1,940,000,000**		**$1,690,000,000**		**$1,420,000,000**

Preliminary Project Benefit Summary

	0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power		**$0**	**$0**	**$0**	**$0**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**
Preliminary Total Project Benefits = A		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**
Preliminary Total Project Benefits = A		**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**

Preliminary Benefit Cost Calculation	**0.02**	**0.01**	**0.02**	**0.02**	**0.02**	**0.03**

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
350,000 Acre-foot Reservoir - NE Side Only Full Liner
Benefit Cost Analysis

ALTERNATIVE 4

350,000 Acre-Foot Reservoir			Alternative 4 - Option A 1000 CFS Pump Only		Alternative 4 - Option B 2000 CFS Pump Only		Alternative 4 - Option C 1000 CFS Pump & Generator		Alternative 4 - Option D 2000 CFS Pump & Generator		Alternative 4 - Option E 2000 CFS Pump-Turbine		Alternative 4 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$600,000,000		$830,000,000		$690,000,000		$950,000,000		$810,000,000		$610,000,000
NE Side Only Full Liner				$440,000,000		$440,000,000		$440,000,000		$440,000,000		$440,000,000		$440,000,000
Water Treatment Construction Costs				$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000
Subtotal 1				**$1,058,000,000**		**$1,288,000,000**		**$1,148,000,000**		**$1,408,000,000**		**$1,268,000,000**		**$1,068,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946	$190,000	$76,922	$185,000	$74,897
Year 25	PW Factor	0.32293	$54,000,000	$17,438,220	$71,000,000	$22,928,030	$56,000,000	$18,084,080	$74,000,000	$23,896,820	$71,000,000	$22,928,030	$54,000,000	$17,438,220
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$16,500,000	$3,390,255	$34,000,000	$6,985,980	$31,000,000	$6,369,570	$67,000,000	$13,766,490	$34,000,000	$6,985,980	$16,500,000	$3,390,255
Year 40	PW Factor	0.16390	$18,500,000	$3,032,150	$41,000,000	$6,719,900	$33,000,000	$5,408,700	$73,000,000	$11,964,700	$41,000,000	$6,719,900	$18,500,000	$3,032,150
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$25,709,015**		**$38,516,239**		**$31,834,266**		**$51,691,537**		**$38,516,239**		**$25,709,015**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$2,700,000	$52,290,333	$3,200,000	$61,973,728	$3,500,000	$67,783,765	$4,300,000	$83,277,197	$3,200,000	$61,973,728	$2,700,000	$52,290,333
Operations Costs	PWA Factor	19.36679	$2,900,000	$56,163,691	$3,200,000	$61,973,728	$3,100,000	$60,037,049	$3,500,000	$67,783,765	$3,200,000	$61,973,728	$2,900,000	$56,163,691
Other Annual O&M	PWA Factor	19.36679	$600,000	$11,620,074	$720,000	$13,944,089	$760,000	$14,718,760	$930,000	$18,011,115	$720,000	$13,944,089	$600,000	$11,620,074
Other Costs	PWA Factor	19.36679	$93,816	$1,816,915	$128,918	$2,496,728	$93,816	$1,816,915	$128,918	$2,496,728	$128,918	$2,496,728	$93,816	$1,816,915
Other Costs (Water	PWA Factor	19.36679	$21,681	$419,891	$26,017	$503,866	$21,681	$419,891	$26,017	$503,866	$26,017	$503,866	$21,681	$419,891
Subtotal 3				**$122,310,904**		**$140,892,139**		**$144,776,380**		**$172,072,671**		**$140,892,139**		**$122,310,904**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,206,019,919**		**$1,467,408,378**		**$1,324,610,646**		**$1,631,764,208**		**$1,447,408,378**		**$1,216,019,919**
Total Present Worth Costs Rounded				**$1,200,000,000**		**$1,450,000,000**		**$1,300,000,000**		**$1,650,000,000**		**$1,450,000,000**		**$1,200,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

BY: Lonnie Zlomke (86-68170)	CHECKED: D.McKelvie 04/07/2009
DATE PREPARED: 6-Apr-09	PEER REVIEW: D.Donaldson 4/8/2009

Preliminary Interest During Construction	**112,856,629**		**134,114,128**		**166,095,187**		**177,933,744**		**131,743,144**		**113,997,048**
Preliminary Total Project Costs =	**1,312,856,629**		**1,584,114,128**		**1,466,095,187**		**1,827,933,744**		**1,581,743,144**		**1,313,997,048**
Preliminary Total Project Costs =	**$1,310,000,000**		**$1,580,000,000**		**$1,470,000,000**		**$1,830,000,000**		**$1,580,000,000**		**$1,310,000,000**

Preliminary Project Benefit Summary

0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power	**$0**	**$0**	**$0**	**$0**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**
Preliminary Total Project Benefits = A	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**
Preliminary Total Project Benefits = A	**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**

Preliminary Benefit Cost Calculation	**0.02**	**0.02**	**0.03**	**0.02**	**0.02**	**0.03**

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
350,000 Acre-foot Reservoir - NE Side Only Full Liner
Benefit Cost Analysis

ALTERNATIVE 5

350,000 Acre-Foot Reservoir			Alternative 5 - Option A 1000 CFS Pump Only		Alternative 5 - Option B 2000 CFS Pump Only		Alternative 5 - Option C 1000 CFS Pump & Generator		Alternative 5 - Option D 2000 CFS Pump & Generator	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs										
Initial Construction and Other Costs										
Construction Costs Rev1 - July 2008				$750,000,000		$1,100,000,000		$840,000,000		$1,250,000,000
NE Side Only Full Liner				$440,000,000		$440,000,000		$440,000,000		$440,000,000
Water Treatment Construction Costs				$18,000,000		$18,000,000		$18,000,000		$18,000,000
Subtotal 1				**$1,208,000,000**		**$1,558,000,000**		**$1,298,000,000**		**$1,708,000,000**
Periodic Costs		P/F								
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946
Year 25	PW Factor	0.32293	$118,000,000	$38,105,740	$150,000,000	$48,439,500	$120,000,000	$38,751,600	$154,000,000	$49,731,220
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529
Year 35	PW Factor	0.20547	$16,500,000	$3,390,255	$34,000,000	$6,985,980	$31,000,000	$6,369,570	$67,000,000	$13,766,490
Year 40	PW Factor	0.16390	$18,500,000	$3,032,150	$41,000,000	$6,719,900	$33,000,000	$5,408,700	$73,000,000	$11,964,700
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647
Subtotal 2				**$46,376,535**		**$64,027,709**		**$52,501,786**		**$77,525,937**
Annual Costs		P/A								
Maintenance	PWA Factor	19.36679	$5,900,000	$114,264,061	$7,300,000	$141,377,567	$6,700,000	$129,757,493	$8,300,000	$160,744,357
Operations Costs	PWA Factor	19.36679	$2,900,000	$56,163,691	$3,200,000	$61,973,728	$3,100,000	$60,037,049	$3,500,000	$67,783,765
Other Annual O&M	PWA Factor	19.36679	$1,000,000	$19,366,790	$1,250,000	$24,208,488	$1,200,000	$23,240,148	$1,500,000	$29,050,185
Other Costs	PWA Factor	19.36679	$93,816	$1,816,915	$128,918	$2,496,728	$93,816	$1,816,915	$128,918	$2,496,728
Other Costs (Water	PWA Factor	19.36679	$21,681	$419,891	$26,017	$503,866	$21,681	$419,891	$26,017	$503,866
Subtotal 3				**$192,031,348**		**$230,560,377**		**$215,271,496**		**$260,578,901**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,446,407,883**		**$1,852,588,086**		**$1,565,773,282**		**$2,046,104,838**
Total Present Worth Costs Rounded				**$1,450,000,000**		**$1,850,000,000**		**$1,550,000,000**		**$2,050,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

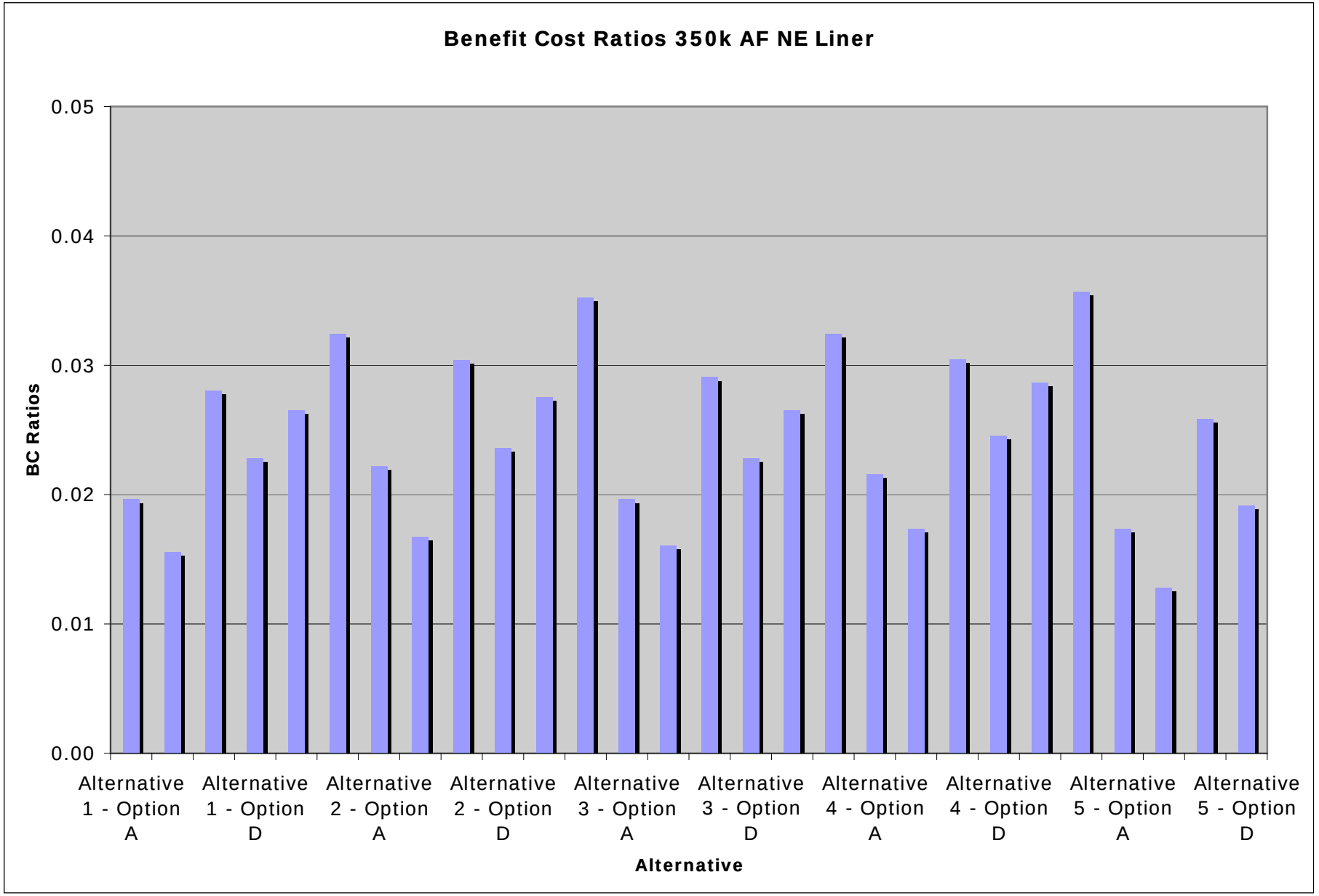
BY: Lonnie Zlomke (86-68170)	CHECKED: D.McKelvie 04/07/2009
DATE PREPARED: 6-Apr-09	PEER REVIEW: D.Donaldson 4/8/2009

Preliminary Interest During Construction	**137,882,434**		**239,127,150**		**192,833,578**		**223,611,007**	
Preliminary Total Project Costs =	**1,587,882,434**		**2,089,127,150**		**1,742,833,578**		**2,273,611,007**	
Preliminary Total Project Costs =	**$1,590,000,000**		**$2,090,000,000**		**$1,740,000,000**		**$2,270,000,000**	

Preliminary Project Benefit Summary

0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power	**$0**	**$0**	**$0**	**$0**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**
Preliminary Total Project Benefits = A	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**
Preliminary Total Project Benefits = A	**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**

Preliminary Benefit Cost Calculation	**0.01**	**0.01**	**0.02**	**0.02**


Benefit Cost Ratios 350k AF NE Liner
BC Ratios
0.05
0.04
0.03
0.02
0.01
0.00
Alternative 1 - Option A
Alternative 1 - Option D
Alternative 2 - Option A
Alternative 2 - Option D
Alternative 3 - Option A
Alternative 3 - Option D
Alternative 4 - Option A
Alternative 4 - Option D
Alternative 5 - Option A
Alternative 5 - Option D
Alternative

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
500,000 Acre-foot Reservoir - Full Liner
Benefit Cost Analysis

ALTERNATIVE 1

500,000 Acre-Foot Resevoir			Alternative 1 - Option A 1000 CFS Pump Only		Alternative 1 - Option B 2000 CFS Pump Only		Alternative 1 - Option C 1000 CFS Pump & Generator		Alternative 1 - Option D 2000 CFS Pump & Generator		Alternative 1 - Option E 2000 CFS Pump-Turbine		Alternative 1 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$780,000,000		$1,050,000,000		$880,000,000		$1,200,000,000		$1,050,000,000		$790,000,000
Full Liner Construction Costs				$840,000,000		$840,000,000		$840,000,000		$840,000,000		$840,000,000		$840,000,000
Water Treatment Construction Costs				$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000
Subtotal 1				**$1,641,000,000**		**$1,911,000,000**		**$1,741,000,000**		**$2,061,000,000**		**$1,911,000,000**		**$1,651,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946	$190,000	$76,922	$185,000	$74,897
Year 25	PW Factor	0.32293	$57,000,000	$18,407,010	$74,000,000	$23,896,820	$59,000,000	$19,052,870	$77,000,000	$24,865,610	$74,000,000	$23,896,820	$57,000,000	$18,407,010
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$17,500,000	$3,595,725	$37,000,000	$7,602,390	$33,000,000	$6,780,510	$70,000,000	$14,382,900	$39,000,000	$8,013,330	$18,000,000	$3,698,460
Year 40	PW Factor	0.16390	$20,000,000	$3,278,000	$43,000,000	$7,047,700	$36,000,000	$5,900,400	$76,000,000	$12,456,400	$45,000,000	$7,375,500	$21,000,000	$3,441,900
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$27,129,126**		**$40,429,239**		**$33,705,696**		**$53,768,437**		**$41,167,979**		**$27,395,760**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$2,900,000	$56,163,691	$3,300,000	$63,910,407	$3,600,000	$69,720,444	$4,400,000	$85,213,876	$3,300,000	$63,910,407	$2,900,000	$56,163,691
Operations Costs	PWA Factor	19.36679	$3,000,000	$58,100,370	$3,400,000	$65,847,086	$3,300,000	$63,910,407	$3,700,000	$71,657,123	$3,400,000	$65,847,086	$3,000,000	$58,100,370
Other Annual O&M	PWA Factor	19.36679	$610,000	$11,813,742	$730,000	$14,137,757	$760,000	$14,718,760	$940,000	$18,204,783	$730,000	$14,137,757	$610,000	$11,813,742
Other Costs	PWA Factor	19.36679	$125	$2,421	$166	$3,215	$125	$2,421	$166	$3,215	$166	$3,215	$125	$2,421
Subtotal 3				**$126,080,224**		**$143,898,465**		**$148,352,032**		**$175,078,997**		**$143,898,465**		**$126,080,224**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,794,209,350**		**$2,095,327,704**		**$1,923,057,728**		**$2,289,847,434**		**$2,096,066,444**		**$1,804,475,984**
Total Present Worth Costs Rounded				**$1,800,000,000**		**$2,100,000,000**		**$1,900,000,000**		**$2,300,000,000**		**$2,100,000,000**		**$1,800,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

BY: Jeff Morris (86-68170)	CHECKED: LLZlomke 03/31/09
DATE PREPARED: 26-Mar-09	PEER REVIEW: D. Maag 3/31/09

Preliminary Interest During Construction			**209,181,938**		**234,010,026**		**121,469,321**		**140,772,098**		**110,748,574**		**87,157,126**	
Preliminary Total Project Costs =			**2,009,181,938**		**2,334,010,026**		**2,021,469,321**		**2,440,772,098**		**2,210,748,574**		**1,887,157,126**	
Preliminary Total Project Costs =			**$2,010,000,000**		**$2,330,000,000**		**$2,020,000,000**		**$2,440,000,000**		**$2,210,000,000**		**$1,890,000,000**	

Preliminary Project Benefit Summary

	0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power		**$0**	**$0**	**$0**	**$0**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**
Preliminary Total Project Benefits = A		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**
Preliminary Total Project Benefits = A		**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**

Preliminary Benefit Cost Calculation	**0.01**	**0.01**	**0.02**	**0.02**	**0.02**	**0.02**

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
500,000 Acre-foot Reservoir - Full Liner
Benefit Cost Analysis

ALTERNATIVE 2

500,000 Acre-Foot Resevoir			Alternative 2 - Option A 1000 CFS Pump Only		Alternative 2 - Option B 2000 CFS Pump Only		Alternative 2 - Option C 1000 CFS Pump & Generator		Alternative 2 - Option D 2000 CFS Pump & Generator		Alternative 2 - Option E 2000 CFS Pump-Turbine		Alternative 2 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$610,000,000		$950,000,000		$710,000,000		$1,100,000,000		$940,000,000		$610,000,000
Full Liner Construction Costs				$840,000,000		$840,000,000		$840,000,000		$840,000,000		$840,000,000		$840,000,000
Water Treatment Construction Costs				$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000
Subtotal 1				**$1,471,000,000**		**$1,811,000,000**		**$1,571,000,000**		**$1,961,000,000**		**$1,801,000,000**		**$1,471,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$190,000	$76,922	$190,000	$76,922	$185,000	$74,897
Year 25	PW Factor	0.32293	$81,000,000	$26,157,330	$110,000,000	$35,522,300	$83,000,000	$26,803,190	$110,000,000	$35,522,300	$110,000,000	$35,522,300	$81,000,000	$26,157,330
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$17,500,000	$3,595,725	$37,000,000	$7,602,390	$33,000,000	$6,780,510	$70,000,000	$14,382,900	$39,000,000	$8,013,330	$19,500,000	$4,006,665
Year 40	PW Factor	0.16390	$20,000,000	$3,278,000	$43,000,000	$7,047,700	$36,000,000	$5,900,400	$76,000,000	$12,456,400	$45,000,000	$7,375,500	$21,000,000	$3,441,900
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$34,879,445**		**$52,054,719**		**$41,456,016**		**$64,423,103**		**$52,793,459**		**$35,454,285**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$3,900,000	$75,530,481	$4,900,000	$94,897,271	$4,700,000	$91,023,913	$5,900,000	$114,264,061	$4,900,000	$94,897,271	$3,900,000	$75,530,481
Operations Costs	PWA Factor	19.36679	$3,000,000	$58,100,370	$3,400,000	$65,847,086	$3,300,000	$63,910,407	$3,700,000	$71,657,123	$3,400,000	$65,847,086	$3,000,000	$58,100,370
Other Annual O&M	PWA Factor	19.36679	$770,000	$14,912,428	$960,000	$18,592,118	$920,000	$17,817,447	$1,150,000	$22,271,809	$965,000	$18,688,952	$770,000	$14,912,428
Other Costs	PWA Factor	19.36679	$125	$2,421	$166	$3,215	$125	$2,421	$166	$3,215	$166	$3,215	$125	$2,421
Subtotal 3				**$148,545,700**		**$179,339,690**		**$172,754,188**		**$208,196,208**		**$179,436,524**		**$148,545,700**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,654,425,145**		**$2,042,394,409**		**$1,785,210,204**		**$2,233,619,311**		**$2,033,229,983**		**$1,654,999,985**
Total Present Worth Costs Rounded				**$1,650,000,000**		**$2,000,000,000**		**$1,800,000,000**		**$2,200,000,000**		**$2,000,000,000**		**$1,650,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

BY: Jeff Morris (86-68170)	CHECKED: LLZlomke 03/31/09
DATE PREPARED: 26-Mar-09	PEER REVIEW: D. Maag 3/31/09

Preliminary Interest During Construction	**72,465,792**		**100,855,762**		**106,393,541**		**127,735,633**		**148,763,362**		**73,040,202**	
Preliminary Total Project Costs =	**1,722,465,792**		**2,100,855,762**		**1,906,393,541**		**2,327,735,633**		**2,148,763,362**		**1,723,040,202**	
Preliminary Total Project Costs =	**$1,720,000,000**		**$2,100,000,000**		**$1,910,000,000**		**$2,330,000,000**		**$2,150,000,000**		**$1,720,000,000**	

Preliminary Project Benefit Summary

0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power	**$0**	**$0**	**$0**	**$0**	**$840,000**	**$16,268,101**	**$840,000**	**$16,268,101**	**$840,000**	**$16,268,101**	**$840,000**	**$16,268,101**
Preliminary Total Project Benefits = A	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,066,560**	**$40,022,635**	**$2,066,560**	**$40,022,635**	**$2,066,560**	**$40,022,635**	**$2,066,560**	**$40,022,635**
Preliminary Total Project Benefits = A	**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,070,000**	**$40,020,000**	**$2,070,000**	**$40,020,000**	**$2,070,000**	**$40,020,000**	**$2,070,000**	**$40,020,000**

Preliminary Benefit Cost Calculation	**0.01**	**0.01**	**0.02**	**0.02**	**0.02**	**0.02**

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
500,000 Acre-foot Reservoir - Full Liner
Benefit Cost Analysis

ALTERNATIVE 3

500,000 Acre-Foot Resevoir			Alternative 3 - Option A 1000 CFS Pump Only		Alternative 3 - Option B 2000 CFS Pump Only		Alternative 3 - Option C 1000 CFS Pump & Generator		Alternative 3 - Option D 2000 CFS Pump & Generator		Alternative 3 - Option E 2000 CFS Pump-Turbine		Alternative 3 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$760,000,000		$1,050,000,000		$850,000,000		$1,200,000,000		$1,050,000,000		$760,000,000
Full Liner Construction Costs				$840,000,000		$840,000,000		$840,000,000		$840,000,000		$840,000,000		$840,000,000
Water Treatment Construction Costs				$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000
Subtotal 1				**$1,621,000,000**		**$1,911,000,000**		**$1,711,000,000**		**$2,061,000,000**		**$1,911,000,000**		**$1,621,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946	$190,000	$76,922	$185,000	$74,897
Year 25	PW Factor	0.32293	$57,000,000	$18,407,010	$74,000,000	$23,896,820	$59,000,000	$19,052,870	$77,000,000	$24,865,610	$74,000,000	$23,896,820	$57,000,000	$18,407,010
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$17,500,000	$3,595,725	$37,000,000	$7,602,390	$33,000,000	$6,780,510	$73,000,000	$14,999,310	$39,000,000	$8,013,330	$18,500,000	$3,801,195
Year 40	PW Factor	0.16390	$20,000,000	$3,278,000	$43,000,000	$7,047,700	$36,000,000	$5,900,400	$74,000,000	$12,128,600	$45,000,000	$7,375,500	$21,000,000	$3,441,900
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$27,129,125**		**$40,429,239**		**$33,705,696**		**$54,057,047**		**$41,167,979**		**$27,498,495**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$2,900,000	$56,163,691	$3,300,000	$63,910,407	$3,600,000	$69,720,444	$4,400,000	$85,213,876	$3,300,000	$63,910,407	$2,900,000	$56,163,691
Operations Costs	PWA Factor	19.36679	$3,000,000	$58,100,370	$3,400,000	$65,847,086	$3,300,000	$63,910,407	$3,700,000	$71,657,123	$3,400,000	$65,847,086	$3,000,000	$58,100,370
Other Annual O&M	PWA Factor	19.36679	$610,000	$11,813,742	$730,000	$14,137,757	$760,000	$14,718,760	$940,000	$18,204,783	$730,000	$14,137,757	$610,000	$11,813,742
Other Costs	PWA Factor	19.36679	$125	$2,421	$166	$3,215	$125	$2,421	$166	$3,215	$166	$3,215	$125	$2,421
Subtotal 3				**$126,080,224**		**$143,898,465**		**$148,352,032**		**$175,078,997**		**$143,898,465**		**$126,080,224**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,774,209,349**		**$2,095,327,704**		**$1,893,057,728**		**$2,290,136,044**		**$2,096,066,444**		**$1,774,578,719**
Total Present Worth Costs Rounded				**$1,750,000,000**		**$2,100,000,000**		**$1,900,000,000**		**$2,300,000,000**		**$2,100,000,000**		**$1,950,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

BY: Jeff Morris (86-68170)	CHECKED: LLZlomke 03/31/09
DATE PREPARED: 26-Mar-09	PEER REVIEW: D. Maag 3/31/09

Preliminary Interest During Construction	**83,836,926**		**234,010,026**		**285,123,216**		**308,489,977**		**233,919,785**		**207,065,316**	
Preliminary Total Project Costs =	**1,833,836,926**		**2,334,010,026**		**2,185,123,216**		**2,608,489,977**		**2,333,919,785**		**1,957,065,316**	
Preliminary Total Project Costs =	**$1,830,000,000**		**$2,330,000,000**		**$2,190,000,000**		**$2,610,000,000**		**$2,330,000,000**		**$1,960,000,000**	

Preliminary Project Benefit Summary

0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power	**$0**	**$0**	**$0**	**$0**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**
Preliminary Total Project Benefits = A	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**
Preliminary Total Project Benefits = A	**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**

Preliminary Benefit Cost Calculation	**0.01**	**0.01**	**0.02**	**0.02**	**0.02**	**0.02**

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
500,000 Acre-foot Reservoir - Full Liner
Benefit Cost Analysis

ALTERNATIVE 4

500,000 Acre-Foot Resevoir			Alternative 4 - Option A 1000 CFS Pump Only		Alternative 4 - Option B 2000 CFS Pump Only		Alternative 4 - Option C 1000 CFS Pump & Generator		Alternative 4 - Option D 2000 CFS Pump & Generator		Alternative 4 - Option E 2000 CFS Pump-Turbine		Alternative 4 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$680,000,000		$950,000,000		$780,000,000		$1,100,000,000		$950,000,000		$690,000,000
Full Liner Construction Costs				$840,000,000		$840,000,000		$840,000,000		$840,000,000		$840,000,000		$840,000,000
Water Treatment Construction Costs				$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000
Subtotal 1				**$1,541,000,000**		**$1,811,000,000**		**$1,641,000,000**		**$1,961,000,000**		**$1,811,000,000**		**$1,551,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946	$190,000	$76,922	$185,000	$74,897
Year 25	PW Factor	0.32293	$57,000,000	$18,407,010	$75,000,000	$24,219,750	$59,000,000	$19,052,870	$78,000,000	$25,188,540	$74,000,000	$23,896,820	$57,000,000	$18,407,010
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$17,500,000	$3,595,725	$37,000,000	$7,602,390	$33,000,000	$6,780,510	$70,000,000	$14,382,900	$39,000,000	$8,013,330	$18,000,000	$3,698,460
Year 40	PW Factor	0.16390	$20,000,000	$3,278,000	$43,000,000	$7,047,700	$36,000,000	$5,900,400	$76,000,000	$12,456,400	$45,000,000	$7,375,500	$21,000,000	$3,441,900
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$27,129,125**		**$40,752,169**		**$33,705,696**		**$54,091,367**		**$41,167,979**		**$27,395,760**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$2,800,000	$54,227,012	$3,300,000	$63,910,407	$3,600,000	$69,720,444	$4,400,000	$85,213,876	$3,300,000	$63,910,407	$2,800,000	$54,227,012
Operations Costs	PWA Factor	19.36679	$3,000,000	$58,100,370	$3,400,000	$65,847,086	$3,300,000	$63,910,407	$3,700,000	$71,657,123	$3,400,000	$65,847,086	$3,000,000	$58,100,370
Other Annual O&M	PWA Factor	19.36679	$600,000	$11,620,074	$720,000	$13,944,089	$760,000	$14,718,760	$930,000	$18,011,115	$720,000	$13,944,089	$600,000	$11,620,074
Other Costs	PWA Factor	19.36679	$125	$2,421	$166	$3,215	$125	$2,421	$166	$3,215	$166	$3,215	$125	$2,421
Subtotal 3				**$123,949,877**		**$143,704,797**		**$148,352,032**		**$174,885,329**		**$143,704,797**		**$123,949,877**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,692,079,002**		**$1,995,456,966**		**$1,823,057,728**		**$2,189,976,696**		**$1,995,872,776**		**$1,702,345,637**
Total Present Worth Costs Rounded				**$1,700,000,000**		**$2,000,000,000**		**$1,800,000,000**		**$2,200,000,000**		**$2,000,000,000**		**$1,700,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

BY: Jeff Morris (86-68170)	CHECKED: LLZlomke 03/31/09
DATE PREPARED: 26-Mar-09	PEER REVIEW: D. Maag 3/31/09

Preliminary Interest During Construction	**196,003,441**		**221,044,743**		**275,035,101**		**291,294,841**		**220,650,198**		**197,155,318**
Preliminary Total Project Costs =	**1,896,003,441**		**2,221,044,743**		**2,075,035,101**		**2,491,294,841**		**2,220,650,198**		**1,897,155,318**
Preliminary Total Project Costs =	**$1,900,000,000**		**$2,220,000,000**		**$2,080,000,000**		**$2,490,000,000**		**$2,220,000,000**		**$1,900,000,000**

Preliminary Project Benefit Summary

0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power	**$0**	**$0**	**$0**	**$0**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**
Preliminary Total Project Benefits = A	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**
Preliminary Total Project Benefits = A	**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**

Preliminary Benefit Cost Calculation	**0.01**	**0.01**	**0.02**	**0.02**	**0.02**	**0.02**

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
500,000 Acre-foot Reservoir - Full Liner
Benefit Cost Analysis

ALTERNATIVE 5

500,000 Acre-Foot Resevoir			Alternative 5 - Option A 1000 CFS Pump Only		Alternative 5 - Option B 2000 CFS Pump Only		Alternative 5 - Option C 1000 CFS Pump & Generator		Alternative 5 - Option D 2000 CFS Pump & Generator	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs										
Initial Construction and Other Costs										
Construction Costs Rev1 - July 2008				$850,000,000		$1,300,000,000		$950,000,000		$1,450,000,000
Full Liner Construction Costs				$840,000,000		$840,000,000		$840,000,000		$840,000,000
Water Treatment Construction Costs				$21,000,000		$21,000,000		$21,000,000		$21,000,000
Subtotal 1				**$1,711,000,000**		**$2,161,000,000**		**$1,811,000,000**		**$2,311,000,000**
Periodic Costs		P/F								
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946
Year 25	PW Factor	0.32293	$120,000,000	$38,751,600	$155,000,000	$50,054,150	$125,000,000	$40,366,250	$160,000,000	$51,668,800
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529
Year 35	PW Factor	0.20547	$17,500,000	$3,595,725	$37,000,000	$7,602,390	$33,000,000	$6,780,510	$70,000,000	$14,382,900
Year 40	PW Factor	0.16390	$20,000,000	$3,278,000	$43,000,000	$7,047,700	$36,000,000	$5,900,400	$76,000,000	$12,456,400
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647
Subtotal 2				**$47,473,715**		**$66,586,569**		**$55,019,076**		**$80,571,627**
Annual Costs		P/A								
Maintenance	PWA Factor	19.36679	$6,000,000	$116,200,740	$7,300,000	$141,377,567	$6,800,000	$131,694,172	$8,400,000	$162,681,036
Operations Costs	PWA Factor	19.36679	$3,000,000	$58,100,370	$3,400,000	$65,847,086	$3,300,000	$63,910,407	$3,700,000	$71,657,123
Other Annual O&M	PWA Factor	19.36679	$1,000,000	$19,366,790	$1,250,000	$24,208,488	$1,200,000	$23,240,148	$1,500,000	$29,050,185
Other Costs	PWA Factor	19.36679	$125	$2,421	$166	$3,215	$125	$2,421	$166	$3,215
Subtotal 3				**$193,670,321**		**$231,436,356**		**$218,847,148**		**$263,391,559**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,952,144,036**		**$2,459,022,925**		**$2,084,866,224**		**$2,654,963,186**
Total Present Worth Costs Rounded				**$1,950,000,000**		**$2,500,000,000**		**$2,100,000,000**		**$2,700,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

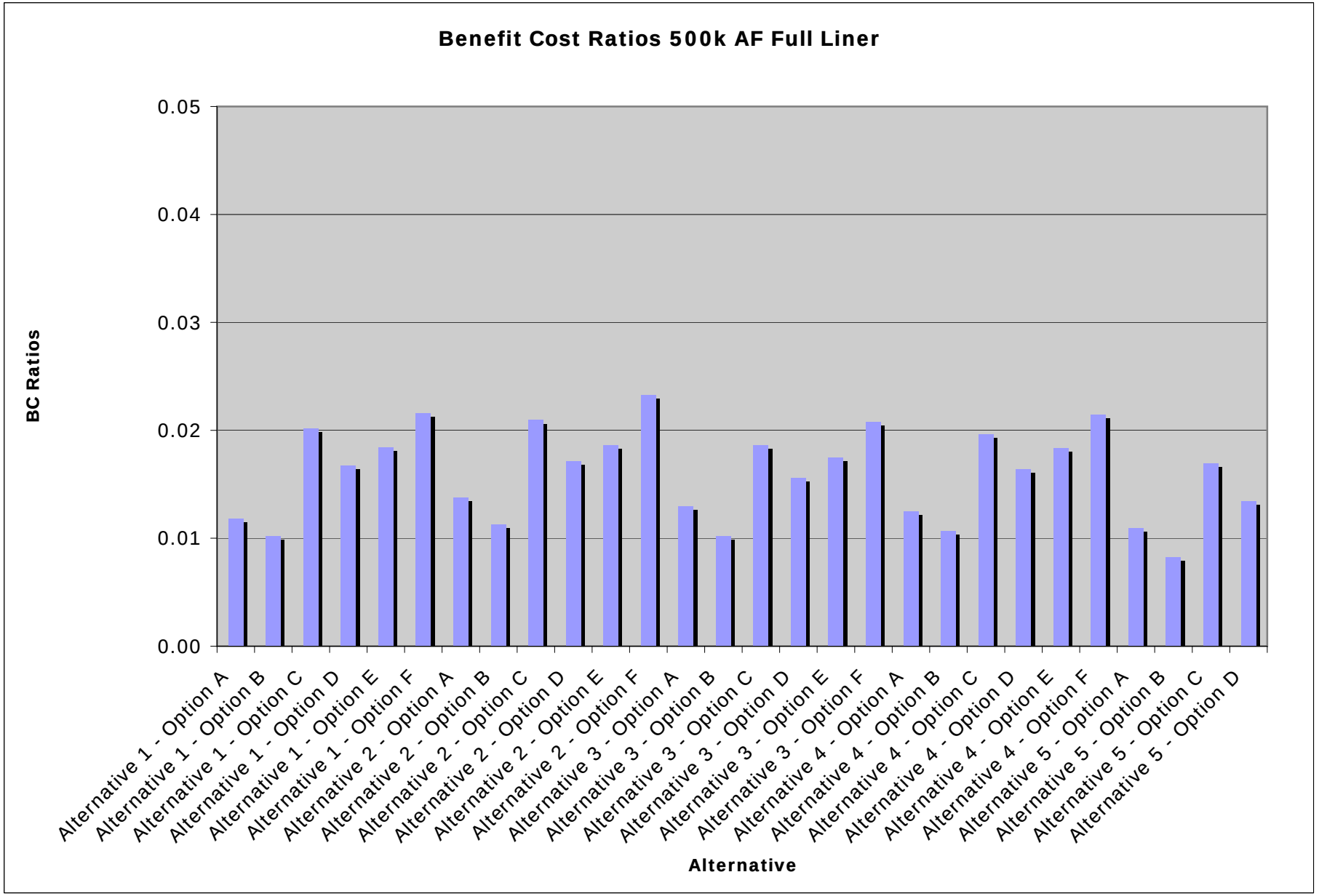
BY: Jeff Morris (86-68170)	CHECKED: LLZlomke 03/31/09
DATE PREPARED: 26-Mar-09	PEER REVIEW: D. Maag 3/31/09

Preliminary Interest During Construction	**224,366,019**		**366,120,971**		**305,323,051**		**344,501,083**	
Preliminary Total Project Costs =	**2,174,366,019**		**2,866,120,971**		**2,405,323,051**		**3,044,501,083**	
Preliminary Total Project Costs =	**$2,170,000,000**		**$2,870,000,000**		**$2,410,000,000**		**$3,040,000,000**	

Preliminary Project Benefit Summary

0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power	**$0**	**$0**	**$0**	**$0**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**
Preliminary Total Project Benefits = A	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**
Preliminary Total Project Benefits = A	**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**

Preliminary Benefit Cost Calculation	**0.01**	**0.01**	**0.02**	**0.01**


Benefit Cost Ratios 500k AF Full Liner
BC Ratios
0.05
0.04
0.03
0.02
0.01
0.00
Alternative 1 - Option A
Alternative 1 - Option B
Alternative 1 - Option C
Alternative 1 - Option D
Alternative 1 - Option E
Alternative 1 - Option F
Alternative 2 - Option A
Alternative 2 - Option B
Alternative 2 - Option C
Alternative 2 - Option D
Alternative 2 - Option E
Alternative 2 - Option F
Alternative 3 - Option A
Alternative 3 - Option B
Alternative 3 - Option C
Alternative 3 - Option D
Alternative 3 - Option E
Alternative 3 - Option F
Alternative 4 - Option A
Alternative 4 - Option B
Alternative 4 - Option C
Alternative 4 - Option D
Alternative 4 - Option E
Alternative 4 - Option F
Alternative 5 - Option A
Alternative 5 - Option B
Alternative 5 - Option C
Alternative 5 - Option D
Alternative

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
500,000 Acre-foot Reservoir - Half Liner
Benefit Cost Analysis

ALTERNATIVE 1

500,000 Acre-Foot Reservoir			Alternative 1 - Option A 1000 CFS Pump Only		Alternative 1 - Option B 2000 CFS Pump Only		Alternative 1 - Option C 1000 CFS Pump & Generator		Alternative 1 - Option D 2000 CFS Pump & Generator		Alternative 1 - Option E 2000 CFS Pump-Turbine		Alternative 1 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$780,000,000		$1,050,000,000		$880,000,000		$1,200,000,000		$1,050,000,000		$790,000,000
Half Liner Construction Costs				$350,000,000		$350,000,000		$350,000,000		$350,000,000		$350,000,000		$350,000,000
Water Treatment Construction Costs				$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000
Subtotal 1				**$1,151,000,000**		**$1,421,000,000**		**$1,251,000,000**		**$1,571,000,000**		**$1,421,000,000**		**$1,161,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946	$190,000	$76,922	$185,000	$74,897
Year 25	PW Factor	0.32293	$57,000,000	$18,407,010	$74,000,000	$23,896,820	$59,000,000	$19,052,870	$77,000,000	$24,865,610	$74,000,000	$23,896,820	$57,000,000	$18,407,010
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$17,500,000	$3,595,725	$37,000,000	$7,602,390	$33,000,000	$6,780,510	$70,000,000	$14,382,900	$39,000,000	$8,013,330	$18,000,000	$3,698,460
Year 40	PW Factor	0.16390	$20,000,000	$3,278,000	$43,000,000	$7,047,700	$36,000,000	$5,900,400	$76,000,000	$12,456,400	$45,000,000	$7,375,500	$21,000,000	$3,441,900
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$27,129,126**		**$40,429,239**		**$33,705,696**		**$53,768,437**		**$41,167,979**		**$27,395,760**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$2,900,000	$56,163,691	$3,300,000	$63,910,407	$3,600,000	$69,720,444	$4,400,000	$85,213,876	$3,300,000	$63,910,407	$2,900,000	$56,163,691
Operations Costs	PWA Factor	19.36679	$3,000,000	$58,100,370	$3,400,000	$65,847,086	$3,300,000	$63,910,407	$3,700,000	$71,657,123	$3,400,000	$65,847,086	$3,000,000	$58,100,370
Other Annual O&M	PWA Factor	19.36679	$610,000	$11,813,742	$730,000	$14,137,757	$760,000	$14,718,760	$940,000	$18,204,783	$730,000	$14,137,757	$610,000	$11,813,742
Other Costs	PWA Factor	19.36679	$125	$2,425	$166	$3,215	$125	$2,425	$166	$3,215	$166	$3,215	$125	$2,425
Other Costs (Water	PWA Factor	19.36679	$105,232	$2,038,006	$121,176	$2,346,790	$105,232	$2,038,006	$121,176	$2,346,790	$121,176	$2,346,790	$105,232	$2,038,006
Subtotal 3				**$128,118,234**		**$146,245,255**		**$150,390,042**		**$177,425,787**		**$146,245,255**		**$128,118,234**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,306,247,360**		**$1,607,674,494**		**$1,435,095,738**		**$1,802,194,224**		**$1,608,413,234**		**$1,316,513,994**
Total Present Worth Costs Rounded				**$1,300,000,000**		**$1,600,000,000**		**$1,450,000,000**		**$1,800,000,000**		**$1,600,000,000**		**$1,300,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

BY: Jeff Morris (86-68170)	CHECKED: D. McKekvie 3/31/09
DATE PREPARED: 26-Mar-09	PEER REVIEW: D. Maag 3/31/09

Preliminary Interest During Construction			**134,037,211**		**158,865,300**		**121,469,321**		**140,772,098**		**110,748,574**		**87,157,126**	
Preliminary Total Project Costs =			**1,434,037,211**		**1,758,865,300**		**1,571,469,321**		**1,940,772,098**		**1,710,748,574**		**1,387,157,126**	
Preliminary Total Project Costs =			**$1,430,000,000**		**$1,760,000,000**		**$1,570,000,000**		**$1,940,000,000**		**$1,710,000,000**		**$1,390,000,000**	

Preliminary Project Benefit Summary

	0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power		**$0**	**$0**	**$0**	**$0**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**
Preliminary Total Project Benefits = A		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**
Preliminary Total Project Benefits = A		**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**

Preliminary Benefit Cost Calculation	**0.02**	**0.01**	**0.03**	**0.02**	**0.02**	**0.03**

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
500,000 Acre-foot Reservoir - Half Liner
Benefit Cost Analysis

ALTERNATIVE 2

500,000 Acre-Foot Reservoir			Alternative 2 - Option A 1000 CFS Pump Only		Alternative 2 - Option B 2000 CFS Pump Only		Alternative 2 - Option C 1000 CFS Pump & Generator		Alternative 2 - Option D 2000 CFS Pump & Generator		Alternative 2 - Option E 2000 CFS Pump-Turbine		Alternative 2 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$610,000,000		$950,000,000		$710,000,000		$1,100,000,000		$940,000,000		$610,000,000
Half Liner Construction Costs				$350,000,000		$350,000,000		$350,000,000		$350,000,000		$350,000,000		$350,000,000
Water Treatment Construction Costs				$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000
Subtotal 1				**$981,000,000**		**$1,321,000,000**		**$1,081,000,000**		**$1,471,000,000**		**$1,311,000,000**		**$981,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$190,000	$76,922	$190,000	$76,922	$185,000	$74,897
Year 25	PW Factor	0.32293	$81,000,000	$26,157,330	$110,000,000	$35,522,300	$83,000,000	$26,803,190	$110,000,000	$35,522,300	$110,000,000	$35,522,300	$81,000,000	$26,157,330
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$17,500,000	$3,595,725	$37,000,000	$7,602,390	$33,000,000	$6,780,510	$70,000,000	$14,382,900	$39,000,000	$8,013,330	$19,500,000	$4,006,665
Year 40	PW Factor	0.16390	$20,000,000	$3,278,000	$43,000,000	$7,047,700	$36,000,000	$5,900,400	$76,000,000	$12,456,400	$45,000,000	$7,375,500	$21,000,000	$3,441,900
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$34,879,445**		**$52,054,719**		**$41,456,016**		**$64,423,103**		**$52,793,459**		**$35,454,285**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$3,900,000	$75,530,481	$4,900,000	$94,897,271	$4,700,000	$91,023,913	$5,900,000	$114,264,061	$4,900,000	$94,897,271	$3,900,000	$75,530,481
Operations Costs	PWA Factor	19.36679	$3,000,000	$58,100,370	$3,400,000	$65,847,086	$3,300,000	$63,910,407	$3,700,000	$71,657,123	$3,400,000	$65,847,086	$3,000,000	$58,100,370
Other Annual O&M	PWA Factor	19.36679	$770,000	$14,912,428	$960,000	$18,592,118	$920,000	$17,817,447	$1,150,000	$22,271,809	$965,000	$18,688,952	$770,000	$14,912,428
Other Costs	PWA Factor	19.36679	$125	$2,425	$166	$3,215	$125	$2,425	$166	$3,215	$166	$3,215	$125	$2,425
Other Costs (Water	PWA Factor	19.36679	$105,232	$2,038,006	$121,176	$2,346,790	$105,232	$2,038,006	$121,176	$2,346,790	$121,176	$2,346,790	$105,232	$2,038,006
Subtotal 3				**$150,583,710**		**$181,686,480**		**$174,792,198**		**$210,542,998**		**$181,783,314**		**$150,583,710**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,166,463,155**		**$1,554,741,199**		**$1,297,248,214**		**$1,745,966,101**		**$1,545,576,773**		**$1,167,037,995**
Total Present Worth Costs Rounded				**$1,150,000,000**		**$1,550,000,000**		**$1,300,000,000**		**$1,750,000,000**		**$1,550,000,000**		**$1,150,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

BY: Jeff Morris (86-68170)	CHECKED: D. McKekvie 3/31/09
DATE PREPARED: 26-Mar-09	PEER REVIEW: D. Maag 3/31/09

Preliminary Interest During Construction	**72,465,792**		**100,855,762**		**106,393,541**		**127,735,633**		**148,763,362**		**73,040,202**
Preliminary Total Project Costs =	**1,222,465,792**		**1,650,855,762**		**1,406,393,541**		**1,877,735,633**		**1,698,763,362**		**1,223,040,202**
Preliminary Total Project Costs =	**$1,220,000,000**		**$1,650,000,000**		**$1,410,000,000**		**$1,880,000,000**		**$1,700,000,000**		**$1,220,000,000**

Preliminary Project Benefit Summary

0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power	**$0**	**$0**	**$0**	**$0**	**$840,000**	**$16,268,101**	**$840,000**	**$16,268,101**	**$840,000**	**$16,268,101**	**$840,000**	**$16,268,101**
Preliminary Total Project Benefits = A	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,066,560**	**$40,022,635**	**$2,066,560**	**$40,022,635**	**$2,066,560**	**$40,022,635**	**$2,066,560**	**$40,022,635**
Preliminary Total Project Benefits = A	**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,070,000**	**$40,020,000**	**$2,070,000**	**$40,020,000**	**$2,070,000**	**$40,020,000**	**$2,070,000**	**$40,020,000**

Preliminary Benefit Cost Calculation	**0.02**	**0.01**	**0.03**	**0.02**	**0.02**	**0.03**

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
500,000 Acre-foot Reservoir - Half Liner
Benefit Cost Analysis

ALTERNATIVE 3

500,000 Acre-Foot Reservoir			Alternative 3 - Option A 1000 CFS Pump Only		Alternative 3 - Option B 2000 CFS Pump Only		Alternative 3 - Option C 1000 CFS Pump & Generator		Alternative 3 - Option D 2000 CFS Pump & Generator		Alternative 3 - Option E 2000 CFS Pump-Turbine		Alternative 3 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$760,000,000		$1,050,000,000		$850,000,000		$1,200,000,000		$1,050,000,000		$760,000,000
Half Liner Construction Costs				$350,000,000		$350,000,000		$350,000,000		$350,000,000		$350,000,000		$350,000,000
Water Treatment Construction Costs				$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000
Subtotal 1				**$1,131,000,000**		**$1,421,000,000**		**$1,221,000,000**		**$1,571,000,000**		**$1,421,000,000**		**$1,131,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946	$190,000	$76,922	$185,000	$74,897
Year 25	PW Factor	0.32293	$57,000,000	$18,407,010	$74,000,000	$23,896,820	$59,000,000	$19,052,870	$77,000,000	$24,865,610	$74,000,000	$23,896,820	$57,000,000	$18,407,010
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$17,500,000	$3,595,725	$37,000,000	$7,602,390	$33,000,000	$6,780,510	$73,000,000	$14,999,310	$39,000,000	$8,013,330	$18,500,000	$3,801,195
Year 40	PW Factor	0.16390	$20,000,000	$3,278,000	$43,000,000	$7,047,700	$36,000,000	$5,900,400	$74,000,000	$12,128,600	$45,000,000	$7,375,500	$21,000,000	$3,441,900
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$27,129,125**		**$40,429,239**		**$33,705,696**		**$54,057,047**		**$41,167,979**		**$27,498,495**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$2,900,000	$56,163,691	$3,300,000	$63,910,407	$3,600,000	$69,720,444	$4,400,000	$85,213,876	$3,300,000	$63,910,407	$2,900,000	$56,163,691
Operations Costs	PWA Factor	19.36679	$3,000,000	$58,100,370	$3,400,000	$65,847,086	$3,300,000	$63,910,407	$3,700,000	$71,657,123	$3,400,000	$65,847,086	$3,000,000	$58,100,370
Other Annual O&M	PWA Factor	19.36679	$610,000	$11,813,742	$730,000	$14,137,757	$760,000	$14,718,760	$940,000	$18,204,783	$730,000	$14,137,757	$610,000	$11,813,742
Other Costs	PWA Factor	19.36679	$125	$2,425	$166	$3,215	$125	$2,425	$166	$3,215	$166	$3,215	$125	$2,425
Other Costs (Water	PWA Factor	19.36679	$105,232	$2,038,006	$121,176	$2,346,790	$105,232	$2,038,006	$121,176	$2,346,790	$121,176	$2,346,790	$105,232	$2,038,006
Subtotal 3				**$128,118,234**		**$146,245,255**		**$150,390,042**		**$177,425,787**		**$146,245,255**		**$128,118,234**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,286,247,359**		**$1,607,674,494**		**$1,405,095,738**		**$1,802,482,834**		**$1,608,413,234**		**$1,286,616,729**
Total Present Worth Costs Rounded				**$1,300,000,000**		**$1,600,000,000**		**$1,400,000,000**		**$1,800,000,000**		**$1,600,000,000**		**$1,300,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

BY: Jeff Morris (86-68170)	CHECKED: D. McKekvie 3/31/09
DATE PREPARED: 26-Mar-09	PEER REVIEW: D. Maag 3/31/09

Preliminary Interest During Construction	**83,836,926**		**158,865,300**		**183,840,545**		**207,207,307**		**158,775,059**		**131,920,589**
Preliminary Total Project Costs =	**1,383,836,926**		**1,758,865,300**		**1,583,840,545**		**2,007,207,307**		**1,758,775,059**		**1,431,920,589**
Preliminary Total Project Costs =	**$1,380,000,000**		**$1,760,000,000**		**$1,580,000,000**		**$2,010,000,000**		**$1,760,000,000**		**$1,430,000,000**

Preliminary Project Benefit Summary

0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power	**$0**	**$0**	**$0**	**$0**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**
Preliminary Total Project Benefits = A	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**
Preliminary Total Project Benefits = A	**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**

Preliminary Benefit Cost Calculation	**0.02**	**0.01**	**0.03**	**0.02**	**0.02**	**0.03**

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
500,000 Acre-foot Reservoir - Half Liner
Benefit Cost Analysis

ALTERNATIVE 4

500,000 Acre-Foot Reservoir			Alternative 4 - Option A 1000 CFS Pump Only		Alternative 4 - Option B 2000 CFS Pump Only		Alternative 4 - Option C 1000 CFS Pump & Generator		Alternative 4 - Option D 2000 CFS Pump & Generator		Alternative 4 - Option E 2000 CFS Pump-Turbine		Alternative 4 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$680,000,000		$950,000,000		$780,000,000		$1,100,000,000		$950,000,000		$690,000,000
Half Liner Construction Costs				$350,000,000		$350,000,000		$350,000,000		$350,000,000		$350,000,000		$350,000,000
Water Treatment Construction Costs				$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000
Subtotal 1				**$1,051,000,000**		**$1,321,000,000**		**$1,151,000,000**		**$1,471,000,000**		**$1,321,000,000**		**$1,061,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946	$190,000	$76,922	$185,000	$74,897
Year 25	PW Factor	0.32293	$57,000,000	$18,407,010	$75,000,000	$24,219,750	$59,000,000	$19,052,870	$78,000,000	$25,188,540	$74,000,000	$23,896,820	$57,000,000	$18,407,010
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$17,500,000	$3,595,725	$37,000,000	$7,602,390	$33,000,000	$6,780,510	$70,000,000	$14,382,900	$39,000,000	$8,013,330	$18,000,000	$3,698,460
Year 40	PW Factor	0.16390	$20,000,000	$3,278,000	$43,000,000	$7,047,700	$36,000,000	$5,900,400	$76,000,000	$12,456,400	$45,000,000	$7,375,500	$21,000,000	$3,441,900
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$27,129,125**		**$40,752,169**		**$33,705,696**		**$54,091,367**		**$41,167,979**		**$27,395,760**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$2,800,000	$54,227,012	$3,300,000	$63,910,407	$3,600,000	$69,720,444	$4,400,000	$85,213,876	$3,300,000	$63,910,407	$2,800,000	$54,227,012
Operations Costs	PWA Factor	19.36679	$3,000,000	$58,100,370	$3,400,000	$65,847,086	$3,300,000	$63,910,407	$3,700,000	$71,657,123	$3,400,000	$65,847,086	$3,000,000	$58,100,370
Other Annual O&M	PWA Factor	19.36679	$600,000	$11,620,074	$720,000	$13,944,089	$760,000	$14,718,760	$930,000	$18,011,115	$720,000	$13,944,089	$600,000	$11,620,074
Other Costs	PWA Factor	19.36679	$125	$2,425	$166	$3,215	$125	$2,425	$166	$3,215	$166	$3,215	$125	$2,425
Other Costs (Water	PWA Factor	19.36679	$105,232	$2,038,006	$121,176	$2,346,790	$105,232	$2,038,006	$121,176	$2,346,790	$121,176	$2,346,790	$105,232	$2,038,006
Subtotal 3				**$125,987,887**		**$146,051,587**		**$150,390,042**		**$177,232,119**		**$146,051,587**		**$125,987,887**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,204,117,012**		**$1,507,803,756**		**$1,335,095,738**		**$1,702,323,486**		**$1,508,219,566**		**$1,214,383,647**
Total Present Worth Costs Rounded				**$1,200,000,000**		**$1,500,000,000**		**$1,350,000,000**		**$1,700,000,000**		**$1,500,000,000**		**$1,200,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

BY: Jeff Morris (86-68170)	CHECKED: D. McKekvie 3/31/09
DATE PREPARED: 26-Mar-09	PEER REVIEW: D. Maag 3/31/09

Preliminary Interest During Construction	**120,858,714**		**145,900,017**		**173,752,430**		**190,012,171**		**145,505,472**		**122,010,592**
Preliminary Total Project Costs =	**1,320,858,714**		**1,645,900,017**		**1,523,752,430**		**1,890,012,171**		**1,645,505,472**		**1,322,010,592**
Preliminary Total Project Costs =	**$1,320,000,000**		**$1,650,000,000**		**$1,520,000,000**		**$1,890,000,000**		**$1,650,000,000**		**$1,320,000,000**

Preliminary Project Benefit Summary

	0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power		**$0**	**$0**	**$0**	**$0**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**
Preliminary Total Project Benefits = A		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**
Preliminary Total Project Benefits = A		**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**

Preliminary Benefit Cost Calculation	**0.02**	**0.01**	**0.03**	**0.02**	**0.02**	**0.03**

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
500,000 Acre-foot Reservoir - Half Liner
Benefit Cost Analysis

ALTERNATIVE 5

500,000 Acre-Foot Reservoir			Alternative 5 - Option A 1000 CFS Pump Only		Alternative 5 - Option B 2000 CFS Pump Only		Alternative 5 - Option C 1000 CFS Pump & Generator		Alternative 5 - Option D 2000 CFS Pump & Generator	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs										
Initial Construction and Other Costs										
Construction Costs Rev1 - July 2008				$850,000,000		$1,300,000,000		$950,000,000		$1,450,000,000
Half Liner Construction Costs				$350,000,000		$350,000,000		$350,000,000		$350,000,000
Water Treatment Construction Costs				$21,000,000		$21,000,000		$21,000,000		$21,000,000
Subtotal 1				**$1,221,000,000**		**$1,671,000,000**		**$1,321,000,000**		**$1,821,000,000**
Periodic Costs		P/F								
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946
Year 25	PW Factor	0.32293	$120,000,000	$38,751,600	$155,000,000	$50,054,150	$125,000,000	$40,366,250	$160,000,000	$51,668,800
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529
Year 35	PW Factor	0.20547	$17,500,000	$3,595,725	$37,000,000	$7,602,390	$33,000,000	$6,780,510	$70,000,000	$14,382,900
Year 40	PW Factor	0.16390	$20,000,000	$3,278,000	$43,000,000	$7,047,700	$36,000,000	$5,900,400	$76,000,000	$12,456,400
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647
Subtotal 2				**$47,473,715**		**$66,586,569**		**$55,019,076**		**$80,571,627**
Annual Costs		P/A								
Maintenance	PWA Factor	19.36679	$6,000,000	$116,200,740	$7,300,000	$141,377,567	$6,800,000	$131,694,172	$8,400,000	$162,681,036
Operations Costs	PWA Factor	19.36679	$3,000,000	$58,100,370	$3,400,000	$65,847,086	$3,300,000	$63,910,407	$3,700,000	$71,657,123
Other Annual O&M	PWA Factor	19.36679	$1,000,000	$19,366,790	$1,250,000	$24,208,488	$1,200,000	$23,240,148	$1,500,000	$29,050,185
Other Costs	PWA Factor	19.36679	$125	$2,425	$166	$3,215	$125	$2,425	$166	$3,215
Other Costs (Water	PWA Factor	19.36679	$105,232	$2,038,006	$121,176	$2,346,790	$105,232	$2,038,006	$121,176	$2,346,790
Subtotal 3				**$195,708,331**		**$233,783,146**		**$220,885,158**		**$265,738,349**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,464,182,046**		**$1,971,369,715**		**$1,596,904,234**		**$2,167,309,976**
Total Present Worth Costs Rounded				**$1,450,000,000**		**$1,950,000,000**		**$1,600,000,000**		**$2,200,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

BY: Jeff Morris (86-68170)	CHECKED: D. McKekvie 3/31/09
DATE PREPARED: 26-Mar-09	PEER REVIEW: D. Maag 3/31/09

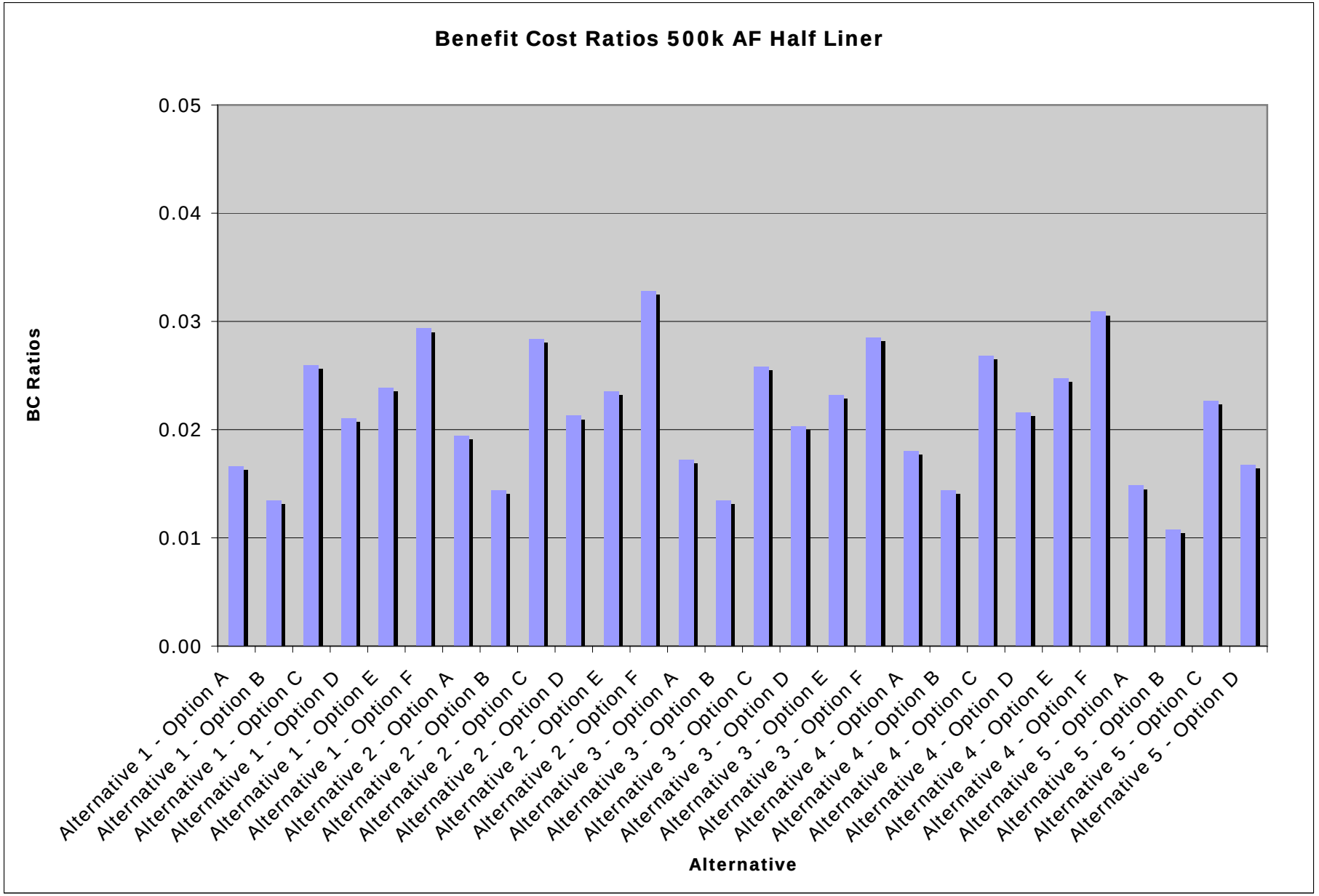
Preliminary Interest During Construction	**149,221,292**		**264,838,301**		**204,040,380**		**243,218,413**	

Preliminary Total Project Costs =	**1,599,221,292**		**2,214,838,301**		**1,804,040,380**		**2,443,218,413**
Preliminary Total Project Costs =	**$1,600,000,000**		**$2,210,000,000**		**$1,800,000,000**		**$2,440,000,000**

Preliminary Project Benefit Summary

0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power	**$0**	**$0**	**$0**	**$0**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**
Preliminary Total Project Benefits = A	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**
Preliminary Total Project Benefits = A	**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**

Preliminary Benefit Cost Calculation	**0.01**	**0.01**	**0.02**	**0.02**


Benefit Cost Ratios 500k AF Half Liner
BC Ratios
0.05
0.04
0.03
0.02
0.01
0.00
Alternative 1 - Option A
Alternative 1 - Option B
Alternative 1 - Option C
Alternative 1 - Option D
Alternative 1 - Option E
Alternative 1 - Option F
Alternative 2 - Option A
Alternative 2 - Option B
Alternative 2 - Option C
Alternative 2 - Option D
Alternative 2 - Option E
Alternative 2 - Option F
Alternative 3 - Option A
Alternative 3 - Option B
Alternative 3 - Option C
Alternative 3 - Option D
Alternative 3 - Option E
Alternative 3 - Option F
Alternative 4 - Option A
Alternative 4 - Option B
Alternative 4 - Option C
Alternative 4 - Option D
Alternative 4 - Option E
Alternative 4 - Option F
Alternative 5 - Option A
Alternative 5 - Option B
Alternative 5 - Option C
Alternative 5 - Option D
Alternative

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
500,000 Acre-foot Reservoir - NE Side Only Full Liner
Benefit Cost Analysis

ALTERNATIVE 1

500,000 Acre-Foot Reservoir			Alternative 1 - Option A 1000 CFS Pump Only		Alternative 1 - Option B 2000 CFS Pump Only		Alternative 1 - Option C 1000 CFS Pump & Generator		Alternative 1 - Option D 2000 CFS Pump & Generator		Alternative 1 - Option E 2000 CFS Pump-Turbine		Alternative 1 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$780,000,000		$1,050,000,000		$880,000,000		$1,200,000,000		$1,050,000,000		$790,000,000
NE Side Only Full Liner				$600,000,000		$600,000,000		$600,000,000		$600,000,000		$600,000,000		$600,000,000
Water Treatment Construction Costs				$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000
Subtotal 1				**$1,401,000,000**		**$1,671,000,000**		**$1,501,000,000**		**$1,821,000,000**		**$1,671,000,000**		**$1,411,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946	$190,000	$76,922	$185,000	$74,897
Year 25	PW Factor	0.32293	$57,000,000	$18,407,010	$74,000,000	$23,896,820	$59,000,000	$19,052,870	$77,000,000	$24,865,610	$74,000,000	$23,896,820	$57,000,000	$18,407,010
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$17,500,000	$3,595,725	$37,000,000	$7,602,390	$33,000,000	$6,780,510	$70,000,000	$14,382,900	$39,000,000	$8,013,330	$18,000,000	$3,698,460
Year 40	PW Factor	0.16390	$20,000,000	$3,278,000	$43,000,000	$7,047,700	$36,000,000	$5,900,400	$76,000,000	$12,456,400	$45,000,000	$7,375,500	$21,000,000	$3,441,900
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$27,129,126**		**$40,429,239**		**$33,705,696**		**$53,768,437**		**$41,167,979**		**$27,395,760**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$2,900,000	$56,163,691	$3,300,000	$63,910,407	$3,600,000	$69,720,444	$4,400,000	$85,213,876	$3,300,000	$63,910,407	$2,900,000	$56,163,691
Operations Costs	PWA Factor	19.36679	$3,000,000	$58,100,370	$3,400,000	$65,847,086	$3,300,000	$63,910,407	$3,700,000	$71,657,123	$3,400,000	$65,847,086	$3,000,000	$58,100,370
Other Annual O&M	PWA Factor	19.36679	$610,000	$11,813,742	$730,000	$14,137,757	$760,000	$14,718,760	$940,000	$18,204,783	$730,000	$14,137,757	$610,000	$11,813,742
Other Costs	PWA Factor	19.36679	$125	$2,421	$166	$3,215	$125	$2,421	$166	$3,215	$166	$3,215	$125	$2,421
Other Costs (Water	PWA Factor	19.36679	$74,816	$1,448,946	$86,151	$1,668,468	$74,816	$1,448,946	$86,151	$1,668,468	$86,151	$1,668,468	$74,816	$1,448,946
Subtotal 3				**$127,529,170**		**$145,566,933**		**$149,800,978**		**$176,747,465**		**$145,566,933**		**$127,529,170**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,555,658,296**		**$1,856,996,172**		**$1,684,506,674**		**$2,051,515,902**		**$1,857,734,912**		**$1,565,924,930**
Total Present Worth Costs Rounded				**$1,550,000,000**		**$1,850,000,000**		**$1,700,000,000**		**$2,100,000,000**		**$1,850,000,000**		**$1,550,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

BY: Jeff Morris (86-68170)	CHECKED: D. McKekvie 3/31/09
DATE PREPARED: 26-Mar-09	PEER REVIEW: D. Maag 3/31/09

Preliminary Interest During Construction			**152,316,084**		**177,144,173**		**121,469,321**		**140,772,098**		**110,748,574**		**87,157,126**	
Preliminary Total Project Costs =			**1,702,316,084**		**2,027,144,173**		**1,821,469,321**		**2,240,772,098**		**1,960,748,574**		**1,637,157,126**	
Preliminary Total Project Costs =			**$1,700,000,000**		**$2,030,000,000**		**$1,820,000,000**		**$2,240,000,000**		**$1,960,000,000**		**$1,640,000,000**	

Preliminary Project Benefit Summary

	0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power		**$0**	**$0**	**$0**	**$0**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**
Preliminary Total Project Benefits = A		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**
Preliminary Total Project Benefits = A		**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**

Preliminary Benefit Cost Calculation	**0.01**	**0.01**	**0.02**	**0.02**	**0.02**	**0.02**

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
500,000 Acre-foot Reservoir - NE Side Only Full Liner
Benefit Cost Analysis

ALTERNATIVE 2

500,000 Acre-Foot Reservoir			Alternative 2 - Option A 1000 CFS Pump Only		Alternative 2 - Option B 2000 CFS Pump Only		Alternative 2 - Option C 1000 CFS Pump & Generator		Alternative 2 - Option D 2000 CFS Pump & Generator		Alternative 2 - Option E 2000 CFS Pump-Turbine		Alternative 2 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$610,000,000		$950,000,000		$710,000,000		$1,100,000,000		$940,000,000		$610,000,000
NE Side Only Full Liner				$600,000,000		$600,000,000		$600,000,000		$600,000,000		$600,000,000		$600,000,000
Water Treatment Construction Costs				$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000
Subtotal 1				**$1,231,000,000**		**$1,571,000,000**		**$1,331,000,000**		**$1,721,000,000**		**$1,561,000,000**		**$1,231,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$190,000	$76,922	$190,000	$76,922	$185,000	$74,897
Year 25	PW Factor	0.32293	$81,000,000	$26,157,330	$110,000,000	$35,522,300	$83,000,000	$26,803,190	$110,000,000	$35,522,300	$110,000,000	$35,522,300	$81,000,000	$26,157,330
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$17,500,000	$3,595,725	$37,000,000	$7,602,390	$33,000,000	$6,780,510	$70,000,000	$14,382,900	$39,000,000	$8,013,330	$19,500,000	$4,006,665
Year 40	PW Factor	0.16390	$20,000,000	$3,278,000	$43,000,000	$7,047,700	$36,000,000	$5,900,400	$76,000,000	$12,456,400	$45,000,000	$7,375,500	$21,000,000	$3,441,900
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$34,879,445**		**$52,054,719**		**$41,456,016**		**$64,423,103**		**$52,793,459**		**$35,454,285**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$3,900,000	$75,530,481	$4,900,000	$94,897,271	$4,700,000	$91,023,913	$5,900,000	$114,264,061	$4,900,000	$94,897,271	$3,900,000	$75,530,481
Operations Costs	PWA Factor	19.36679	$3,000,000	$58,100,370	$3,400,000	$65,847,086	$3,300,000	$63,910,407	$3,700,000	$71,657,123	$3,400,000	$65,847,086	$3,000,000	$58,100,370
Other Annual O&M	PWA Factor	19.36679	$770,000	$14,912,428	$960,000	$18,592,118	$920,000	$17,817,447	$1,150,000	$22,271,809	$965,000	$18,688,952	$770,000	$14,912,428
Other Costs	PWA Factor	19.36679	$125	$2,421	$166	$3,215	$125	$2,421	$166	$3,215	$166	$3,215	$125	$2,421
Other Costs (Water	PWA Factor	19.36679	$74,816	$1,448,946	$86,151	$1,668,468	$74,816	$1,448,946	$86,151	$1,668,468	$86,151	$1,668,468	$74,816	$1,448,946
Subtotal 3				**$149,994,646**		**$181,008,158**		**$174,203,134**		**$209,864,676**		**$181,104,992**		**$149,994,646**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,415,874,091**		**$1,804,062,877**		**$1,546,659,150**		**$1,995,287,779**		**$1,794,898,451**		**$1,416,448,931**
Total Present Worth Costs Rounded				**$1,400,000,000**		**$1,800,000,000**		**$1,550,000,000**		**$2,000,000,000**		**$1,800,000,000**		**$1,400,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

BY: Jeff Morris (86-68170)	CHECKED: D. McKekvie 3/31/09
DATE PREPARED: 26-Mar-09	PEER REVIEW: D. Maag 3/31/09

Preliminary Interest During Construction	**72,465,792**		**100,855,762**		**106,393,541**		**127,735,633**		**148,763,362**		**73,040,202**
Preliminary Total Project Costs =	**1,472,465,792**		**1,900,855,762**		**1,656,393,541**		**2,127,735,633**		**1,948,763,362**		**1,473,040,202**
Preliminary Total Project Costs =	**$1,470,000,000**		**$1,900,000,000**		**$1,660,000,000**		**$2,130,000,000**		**$1,950,000,000**		**$1,470,000,000**

Preliminary Project Benefit Summary

	0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power		**$0**	**$0**	**$0**	**$0**	**$840,000**	**$16,268,101**	**$840,000**	**$16,268,101**	**$840,000**	**$16,268,101**	**$840,000**	**$16,268,101**
Preliminary Total Project Benefits = A		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,066,560**	**$40,022,635**	**$2,066,560**	**$40,022,635**	**$2,066,560**	**$40,022,635**	**$2,066,560**	**$40,022,635**
Preliminary Total Project Benefits = A		**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,070,000**	**$40,020,000**	**$2,070,000**	**$40,020,000**	**$2,070,000**	**$40,020,000**	**$2,070,000**	**$40,020,000**

Preliminary Benefit Cost Calculation	**0.02**	**0.01**	**0.02**	**0.02**	**0.02**	**0.03**

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
500,000 Acre-foot Reservoir - NE Side Only Full Liner
Benefit Cost Analysis

ALTERNATIVE 3

500,000 Acre-Foot Reservoir			Alternative 3 - Option A 1000 CFS Pump Only		Alternative 3 - Option B 2000 CFS Pump Only		Alternative 3 - Option C 1000 CFS Pump & Generator		Alternative 3 - Option D 2000 CFS Pump & Generator		Alternative 3 - Option E 2000 CFS Pump-Turbine		Alternative 3 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$760,000,000		$1,050,000,000		$850,000,000		$1,200,000,000		$1,050,000,000		$760,000,000
NE Side Only Full Liner				$600,000,000		$600,000,000		$600,000,000		$600,000,000		$600,000,000		$600,000,000
Water Treatment Construction Costs				$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000
Subtotal 1				**$1,381,000,000**		**$1,671,000,000**		**$1,471,000,000**		**$1,821,000,000**		**$1,671,000,000**		**$1,381,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946	$190,000	$76,922	$185,000	$74,897
Year 25	PW Factor	0.32293	$57,000,000	$18,407,010	$74,000,000	$23,896,820	$59,000,000	$19,052,870	$77,000,000	$24,865,610	$74,000,000	$23,896,820	$57,000,000	$18,407,010
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$17,500,000	$3,595,725	$37,000,000	$7,602,390	$33,000,000	$6,780,510	$73,000,000	$14,999,310	$39,000,000	$8,013,330	$18,500,000	$3,801,195
Year 40	PW Factor	0.16390	$20,000,000	$3,278,000	$43,000,000	$7,047,700	$36,000,000	$5,900,400	$74,000,000	$12,128,600	$45,000,000	$7,375,500	$21,000,000	$3,441,900
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$27,129,125**		**$40,429,239**		**$33,705,696**		**$54,057,047**		**$41,167,979**		**$27,498,495**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$2,900,000	$56,163,691	$3,300,000	$63,910,407	$3,600,000	$69,720,444	$4,400,000	$85,213,876	$3,300,000	$63,910,407	$2,900,000	$56,163,691
Operations Costs	PWA Factor	19.36679	$3,000,000	$58,100,370	$3,400,000	$65,847,086	$3,300,000	$63,910,407	$3,700,000	$71,657,123	$3,400,000	$65,847,086	$3,000,000	$58,100,370
Other Annual O&M	PWA Factor	19.36679	$610,000	$11,813,742	$730,000	$14,137,757	$760,000	$14,718,760	$940,000	$18,204,783	$730,000	$14,137,757	$610,000	$11,813,742
Other Costs	PWA Factor	19.36679	$125	$2,421	$166	$3,215	$125	$2,421	$166	$3,215	$166	$3,215	$125	$2,421
Other Costs (Water	PWA Factor	19.36679	$74,816	$1,448,946	$86,151	$1,668,468	$74,816	$1,448,946	$86,151	$1,668,468	$86,151	$1,668,468	$74,816	$1,448,946
Subtotal 3				**$127,529,170**		**$145,566,933**		**$149,800,978**		**$176,747,465**		**$145,566,933**		**$127,529,170**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,535,658,295**		**$1,856,996,172**		**$1,654,506,674**		**$2,051,804,512**		**$1,857,734,912**		**$1,536,027,665**
Total Present Worth Costs Rounded				**$1,550,000,000**		**$1,850,000,000**		**$1,650,000,000**		**$2,100,000,000**		**$1,850,000,000**		**$1,550,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

BY: Jeff Morris (86-68170)	CHECKED: D. McKekvie 3/31/09
DATE PREPARED: 26-Mar-09	PEER REVIEW: D. Maag 3/31/09

Preliminary Interest During Construction	**83,836,926**		**177,144,173**		**214,527,316**		**237,894,077**		**177,053,931**		**150,199,462**
Preliminary Total Project Costs =	**1,633,836,926**		**2,027,144,173**		**1,864,527,316**		**2,337,894,077**		**2,027,053,931**		**1,700,199,462**
Preliminary Total Project Costs =	**$1,630,000,000**		**$2,030,000,000**		**$1,860,000,000**		**$2,340,000,000**		**$2,030,000,000**		**$1,700,000,000**

Preliminary Project Benefit Summary

	0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power		**$0**	**$0**	**$0**	**$0**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**
Preliminary Total Project Benefits = A		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**
Preliminary Total Project Benefits = A		**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**

Preliminary Benefit Cost Calculation	**0.01**	**0.01**	**0.02**	**0.02**	**0.02**	**0.02**

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
500,000 Acre-foot Reservoir - NE Side Only Full Liner
Benefit Cost Analysis

ALTERNATIVE 4

500,000 Acre-Foot Reservoir			Alternative 4 - Option A 1000 CFS Pump Only		Alternative 4 - Option B 2000 CFS Pump Only		Alternative 4 - Option C 1000 CFS Pump & Generator		Alternative 4 - Option D 2000 CFS Pump & Generator		Alternative 4 - Option E 2000 CFS Pump-Turbine		Alternative 4 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$680,000,000		$950,000,000		$780,000,000		$1,100,000,000		$950,000,000		$690,000,000
NE Side Only Full Liner				$600,000,000		$600,000,000		$600,000,000		$600,000,000		$600,000,000		$600,000,000
Water Treatment Construction Costs				$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000
Subtotal 1				**$1,301,000,000**		**$1,571,000,000**		**$1,401,000,000**		**$1,721,000,000**		**$1,571,000,000**		**$1,311,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946	$190,000	$76,922	$185,000	$74,897
Year 25	PW Factor	0.32293	$57,000,000	$18,407,010	$75,000,000	$24,219,750	$59,000,000	$19,052,870	$78,000,000	$25,188,540	$74,000,000	$23,896,820	$57,000,000	$18,407,010
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$17,500,000	$3,595,725	$37,000,000	$7,602,390	$33,000,000	$6,780,510	$70,000,000	$14,382,900	$39,000,000	$8,013,330	$18,000,000	$3,698,460
Year 40	PW Factor	0.16390	$20,000,000	$3,278,000	$43,000,000	$7,047,700	$36,000,000	$5,900,400	$76,000,000	$12,456,400	$45,000,000	$7,375,500	$21,000,000	$3,441,900
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$27,129,125**		**$40,752,169**		**$33,705,696**		**$54,091,367**		**$41,167,979**		**$27,395,760**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$2,800,000	$54,227,012	$3,300,000	$63,910,407	$3,600,000	$69,720,444	$4,400,000	$85,213,876	$3,300,000	$63,910,407	$2,800,000	$54,227,012
Operations Costs	PWA Factor	19.36679	$3,000,000	$58,100,370	$3,400,000	$65,847,086	$3,300,000	$63,910,407	$3,700,000	$71,657,123	$3,400,000	$65,847,086	$3,000,000	$58,100,370
Other Annual O&M	PWA Factor	19.36679	$600,000	$11,620,074	$720,000	$13,944,089	$760,000	$14,718,760	$930,000	$18,011,115	$720,000	$13,944,089	$600,000	$11,620,074
Other Costs	PWA Factor	19.36679	$125	$2,421	$166	$3,215	$125	$2,421	$166	$3,215	$166	$3,215	$125	$2,421
Other Costs (Water	PWA Factor	19.36679	$74,816	$1,448,946	$86,151	$1,668,468	$74,816	$1,448,946	$86,151	$1,668,468	$86,151	$1,668,468	$74,816	$1,448,946
Subtotal 3				**$125,398,823**		**$145,373,265**		**$149,800,978**		**$176,553,797**		**$145,373,265**		**$125,398,823**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,453,527,948**		**$1,757,125,434**		**$1,584,506,674**		**$1,951,645,164**		**$1,757,541,244**		**$1,463,794,583**
Total Present Worth Costs Rounded				**$1,450,000,000**		**$1,750,000,000**		**$1,600,000,000**		**$1,950,000,000**		**$1,750,000,000**		**$1,450,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

BY: Jeff Morris (86-68170)	CHECKED: D. McKekvie 3/31/09
DATE PREPARED: 26-Mar-09	PEER REVIEW: D. Maag 3/31/09

Preliminary Interest During Construction	**139,137,587**		**164,178,890**		**204,439,201**		**220,698,941**		**163,784,344**		**140,289,465**
Preliminary Total Project Costs =	**1,589,137,587**		**1,914,178,890**		**1,804,439,201**		**2,170,698,941**		**1,913,784,344**		**1,590,289,465**
Preliminary Total Project Costs =	**$1,590,000,000**		**$1,910,000,000**		**$1,800,000,000**		**$2,170,000,000**		**$1,910,000,000**		**$1,590,000,000**

Preliminary Project Benefit Summary

	0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power		**$0**	**$0**	**$0**	**$0**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**
Preliminary Total Project Benefits = A		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**
Preliminary Total Project Benefits = A		**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**

Preliminary Benefit Cost Calculation	**0.01**	**0.01**	**0.02**	**0.02**	**0.02**	**0.03**

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
500,000 Acre-foot Reservoir - NE Side Only Full Liner
Benefit Cost Analysis

ALTERNATIVE 5

500,000 Acre-Foot Reservoir			Alternative 5 - Option A 1000 CFS Pump Only		Alternative 5 - Option B 2000 CFS Pump Only		Alternative 5 - Option C 1000 CFS Pump & Generator		Alternative 5 - Option D 2000 CFS Pump & Generator	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs										
Initial Construction and Other Costs										
Construction Costs Rev1 - July 2008				$850,000,000		$1,300,000,000		$950,000,000		$1,450,000,000
NE Side Only Full Liner				$600,000,000		$600,000,000		$600,000,000		$600,000,000
Water Treatment Construction Costs				$21,000,000		$21,000,000		$21,000,000		$21,000,000
Subtotal 1				**$1,471,000,000**		**$1,921,000,000**		**$1,571,000,000**		**$2,071,000,000**
Periodic Costs		P/F								
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946
Year 25	PW Factor	0.32293	$120,000,000	$38,751,600	$155,000,000	$50,054,150	$125,000,000	$40,366,250	$160,000,000	$51,668,800
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529
Year 35	PW Factor	0.20547	$17,500,000	$3,595,725	$37,000,000	$7,602,390	$33,000,000	$6,780,510	$70,000,000	$14,382,900
Year 40	PW Factor	0.16390	$20,000,000	$3,278,000	$43,000,000	$7,047,700	$36,000,000	$5,900,400	$76,000,000	$12,456,400
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647
Subtotal 2				**$47,473,715**		**$66,586,569**		**$55,019,076**		**$80,571,627**
Annual Costs		P/A								
Maintenance	PWA Factor	19.36679	$6,000,000	$116,200,740	$7,300,000	$141,377,567	$6,800,000	$131,694,172	$8,400,000	$162,681,036
Operations Costs	PWA Factor	19.36679	$3,000,000	$58,100,370	$3,400,000	$65,847,086	$3,300,000	$63,910,407	$3,700,000	$71,657,123
Other Annual O&M	PWA Factor	19.36679	$1,000,000	$19,366,790	$1,250,000	$24,208,488	$1,200,000	$23,240,148	$1,500,000	$29,050,185
Other Costs	PWA Factor	19.36679	$125	$2,421	$166	$3,215	$125	$2,421	$166	$3,215
Other Costs (Water	PWA Factor	19.36679	$74,816	$1,448,946	$86,151	$1,668,468	$74,816	$1,448,946	$86,151	$1,668,468
Subtotal 3				**$195,119,267**		**$233,104,824**		**$220,296,094**		**$265,060,027**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,713,592,982**		**$2,220,691,393**		**$1,846,315,170**		**$2,416,631,654**
Total Present Worth Costs Rounded				**$1,700,000,000**		**$2,200,000,000**		**$1,850,000,000**		**$2,400,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period
- FY2009 planning interest rate 4.625% per year for 50
- PW Factor = P/F = (1+ i)-n = Single Payment Present
- PWA Factor = P/A = ((1+i)n - 1)/(i*((1+i)n) = Uniform

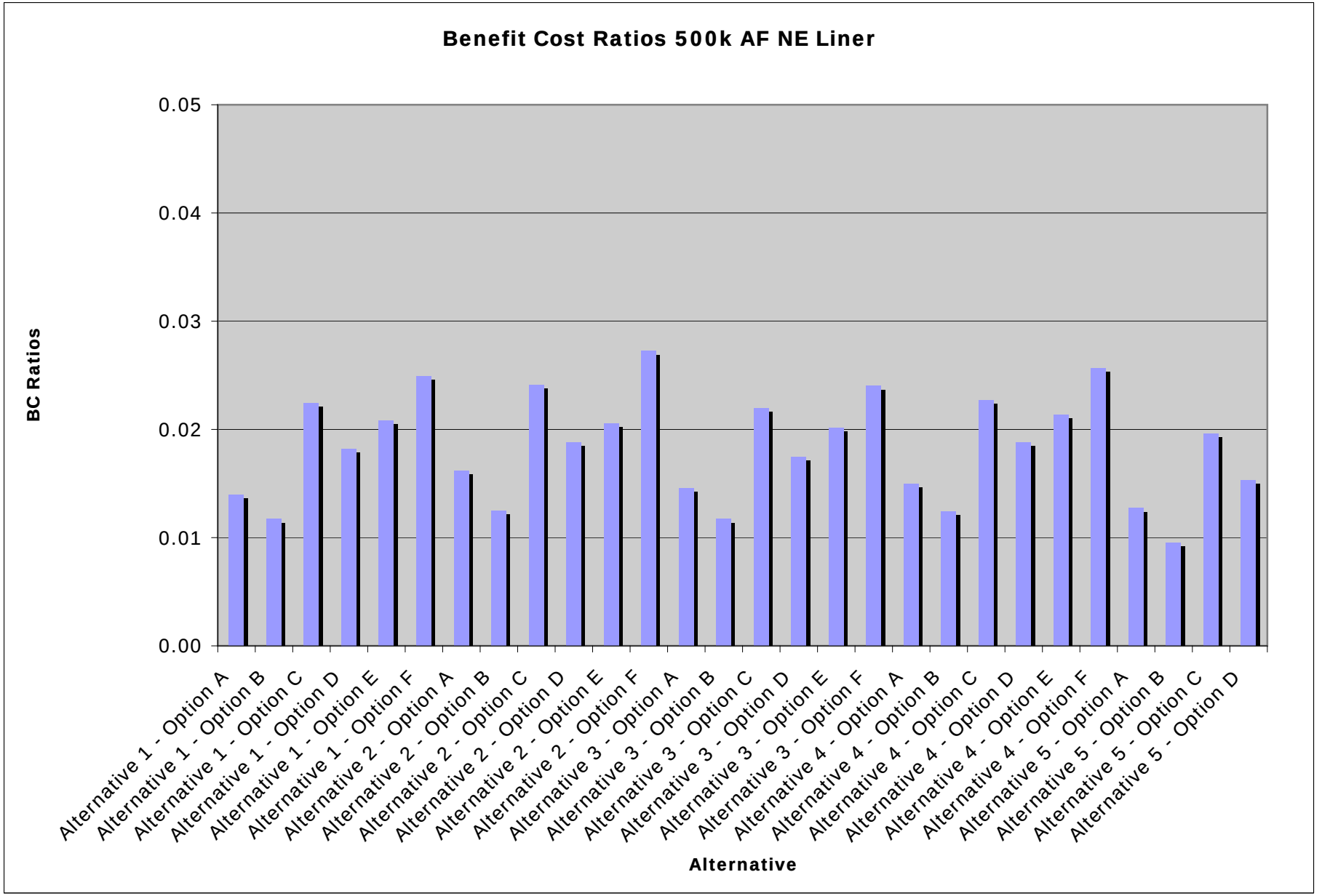
BY: Jeff Morris (86-68170)	CHECKED: D. McKekvie 3/31/09
DATE PREPARED: 26-Mar-09	PEER REVIEW: D. Maag 3/31/09

Preliminary Interest During Construction	**167,500,165**		**295,525,072**		**234,727,151**		**273,905,183**
Preliminary Total Project Costs =	**1,867,500,165**		**2,495,525,072**		**2,084,727,151**		**2,673,905,183**
Preliminary Total Project Costs =	**$1,870,000,000**		**$2,500,000,000**		**$2,080,000,000**		**$2,670,000,000**

Preliminary Project Benefit Summary

0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power	**$0**	**$0**	**$0**	**$0**	**$880,000**	**$17,042,772**	**$880,000**	**$17,042,772**
Preliminary Total Project Benefits = A	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,106,560**	**$40,797,306**	**$2,106,560**	**$40,797,306**
Preliminary Total Project Benefits = A	**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,110,000**	**$40,800,000**	**$2,110,000**	**$40,800,000**

Preliminary Benefit Cost Calculation	**0.01**	**0.01**	**0.02**	**0.02**


Benefit Cost Ratios 500k AF NE Liner
BC Ratios
0.05
0.04
0.03
0.02
0.01
0.00
Alternative 1 - Option A
Alternative 1 - Option B
Alternative 1 - Option C
Alternative 1 - Option D
Alternative 1 - Option E
Alternative 1 - Option F
Alternative 2 - Option A
Alternative 2 - Option B
Alternative 2 - Option C
Alternative 2 - Option D
Alternative 2 - Option E
Alternative 2 - Option F
Alternative 3 - Option A
Alternative 3 - Option B
Alternative 3 - Option C
Alternative 3 - Option D
Alternative 3 - Option E
Alternative 3 - Option F
Alternative 4 - Option A
Alternative 4 - Option B
Alternative 4 - Option C
Alternative 4 - Option D
Alternative 4 - Option E
Alternative 4 - Option F
Alternative 5 - Option A
Alternative 5 - Option B
Alternative 5 - Option C
Alternative 5 - Option D
Alternative

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
350,000 Acre-Foot Reservoir - No Liner
Benefit Cost Analysis

ALTERNATIVE 1

350,000 Acre-Foot Reservoir			Alternative 1 - Option A 1000 CFS Pump Only		Alternative 1 - Option B 2000 CFS Pump Only		Alternative 1 - Option C 1000 CFS Pump & Generator		Alternative 1 - Option D 2000 CFS Pump & Generator		Alternative 1 - Option E 2000 CFS Pump-Turbine		Alternative 1 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$700,000,000		$940,000,000		$790,000,000		$1,050,000,000		$930,000,000		$710,000,000
Water Treatment Construction Costs				$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000
Subtotal 1				**$718,000,000**		**$958,000,000**		**$808,000,000**		**$1,068,000,000**		**$948,000,000**		**$728,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946	$190,000	$76,922	$185,000	$74,897
Year 25	PW Factor	0.32293	$54,000,000	$17,438,220	$70,000,000	$22,605,100	$56,000,000	$18,084,080	$74,000,000	$23,896,820	$71,000,000	$22,928,030	$54,000,000	$17,438,220
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$16,500,000	$3,390,255	$34,000,000	$6,985,980	$31,000,000	$6,369,570	$67,000,000	$13,766,490	$34,000,000	$6,985,980	$16,500,000	$3,390,255
Year 40	PW Factor	0.16390	$18,500,000	$3,032,150	$41,000,000	$6,719,900	$33,000,000	$5,408,700	$73,000,000	$11,964,700	$41,000,000	$6,719,900	$18,500,000	$3,032,150
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$25,709,016**		**$38,193,309**		**$31,834,266**		**$51,691,537**		**$38,516,239**		**$25,709,015**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$2,800,000	$54,227,012	$3,200,000	$61,973,728	$3,600,000	$69,720,444	$4,300,000	$83,277,197	$3,200,000	$61,973,728	$2,800,000	$54,227,012
Operations Costs	PWA Factor	19.36679	$2,900,000	$56,163,691	$3,200,000	$61,973,728	$3,100,000	$60,037,049	$3,500,000	$67,783,765	$3,200,000	$61,973,728	$2,900,000	$56,163,691
Other Annual O&M Misc Costs (non-major equipment)	PWA Factor	19.36679	$600,000	$11,620,074	$730,000	$14,137,757	$760,000	$14,718,760	$940,000	$18,204,783	$730,000	$14,137,757	$610,000	$11,813,742
Other Costs (Evaporated Water)	PWA Factor	19.36679	$93,816	$1,816,915	$128,918	$2,496,728	$93,816	$1,816,915	$128,918	$2,496,728	$128,918	$2,496,728	$93,816	$1,816,915
Other Costs (Water Seepage)	PWA Factor	19.36679	$310,325	$6,009,999	$372,390	$7,211,999	$310,325	$6,009,999	$372,390	$7,211,999	$372,390	$7,211,999	$310,325	$6,009,999
Subtotal 3				**$129,837,691**		**$147,793,940**		**$152,303,167**		**$178,974,472**		**$147,793,940**		**$130,031,359**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$873,546,707**		**$1,143,987,249**		**$992,137,433**		**$1,298,666,009**		**$1,134,310,179**		**$883,740,374**
Total Present Worth Costs Rounded				**$870,000,000**		**$1,150,000,000**		**$990,000,000**		**$1,300,000,000**		**$1,150,000,000**		**$880,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period

- FY2009 planning interest rate 4.625% per year for 50 years.

- PW Factor = P/F = $(1+ i)^{-n}$ = Single Payment Present Worth (P/F, 4.625%, 50)
- PWA Factor = P/A = $((1+i)^n - 1)/(i*((1+i)^n)$ = Uniform Series Present Worth Factor (P/A, 4.625%, 50)

BY: Lonnie Zlomke (86-68170)	CHECKED: D.McKelvie 04/07/2009
DATE PREPARED: 6-Apr-09	PEER REVIEW: D.Donaldson 4/8/2009

Preliminary Interest During Construction Costs			**77,139,522**		**99,180,238**		**108,954,639**		**123,135,245**		**98,056,426**		**78,279,893**	
Preliminary Total Project Costs = Subtotal 1 + 2 + 3 + IDC			**947,139,522**		**1,249,180,238**		**1,098,954,639**		**1,423,135,245**		**1,248,056,426**		**958,279,893**	
Preliminary Total Project Costs = Subtotal 1+2+3+IDC			**$950,000,000**		**$1,250,000,000**		**$1,100,000,000**		**$1,420,000,000**		**$1,250,000,000**		**$960,000,000**	

Preliminary Project Benefit Summary

	0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power		**$0**	**$0**	**$0**	**$0**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**
Preliminary Total Project Benefits = A + B + C + D		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**
Preliminary Total Project Benefits = A + B + C + D Rounded		**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**

Preliminary Benefit Cost Calculation			**0.03**		**0.02**		**0.04**		**0.03**		**0.03**		**0.04**	

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
350,000 Acre-Foot Reservoir - No Liner
Benefit Cost Analysis

ALTERNATIVE 2

350,000 Acre-Foot Reservoir			Alternative 2 - Option A 1000 CFS Pump Only		Alternative 2 - Option B 2000 CFS Pump Only		Alternative 2 - Option C 1000 CFS Pump & Generator		Alternative 2 - Option D 2000 CFS Pump & Generator		Alternative 2 - Option E 2000 CFS Pump-Turbine		Alternative 2 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$530,000,000		$800,000,000		$630,000,000		$940,000,000		$790,000,000		$530,000,000
Water Treatment Construction Costs				$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000
Subtotal 1				**$548,000,000**		**$818,000,000**		**$648,000,000**		**$958,000,000**		**$808,000,000**		**$548,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$194,000	$78,541	$189,000	$76,517	$185,000	$74,897
Year 25	PW Factor	0.32293	$77,000,000	$24,865,610	$105,000,000	$33,907,650	$79,000,000	$25,511,470	$110,000,000	$35,522,300	$105,000,000	$33,907,650	$77,000,000	$24,865,610
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$16,500,000	$3,390,255	$34,000,000	$6,985,980	$31,000,000	$6,369,570	$67,000,000	$13,766,490	$34,000,000	$6,985,980	$16,500,000	$3,390,255
Year 40	PW Factor	0.16390	$18,500,000	$3,032,150	$41,000,000	$6,719,900	$33,000,000	$5,408,700	$73,000,000	$11,964,700	$41,000,000	$6,719,900	$18,500,000	$3,032,150
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$33,136,405**		**$49,495,859**		**$39,261,656**		**$63,316,612**		**$49,495,454**		**$33,136,405**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$3,900,000	$75,530,481	$4,800,000	$92,960,592	$4,600,000	$89,087,234	$5,900,000	$114,264,061	$4,800,000	$92,960,592	$3,900,000	$75,530,481
Operations Costs	PWA Factor	19.36679	$2,900,000	$56,163,691	$3,200,000	$61,973,728	$3,100,000	$60,037,049	$3,500,000	$67,783,765	$3,200,000	$61,973,728	$2,900,000	$56,163,691
Other Annual O&M Misc Costs (non-major equipment)	PWA Factor	19.36679	$770,000	$14,912,428	$960,000	$18,592,118	$920,000	$17,817,447	$1,150,000	$22,271,809	$965,000	$18,688,952	$768,000	$14,873,695
Other Costs (Evaporated Water)	PWA Factor	19.36679	$93,816	$1,816,915	$128,918	$2,496,728	$93,816	$1,816,915	$128,918	$2,496,728	$128,918	$2,496,728	$93,816	$1,816,915
Other Costs (Water Seepage)	PWA Factor	19.36679	$310,325	$6,009,999	$372,390	$7,211,999	$310,325	$6,009,999	$372,390	$7,211,999	$372,390	$7,211,999	$310,325	$6,009,999
Subtotal 3				**$154,433,514**		**$183,235,165**		**$174,768,644**		**$214,028,362**		**$183,331,999**		**$154,394,781**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$735,569,919**		**$1,050,731,024**		**$862,030,300**		**$1,235,344,974**		**$1,040,827,453**		**$735,531,186**
Total Present Worth Costs Rounded				**$740,000,000**		**$1,050,000,000**		**$860,000,000**		**$1,250,000,000**		**$1,050,000,000**		**$740,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period

- FY2009 planning interest rate 4.625% per year for 50 years.

- PW Factor = P/F = $(1+ i)^{-n}$ = Single Payment Present Worth (P/F, 4.625%, 50)
- PWA Factor = P/A = $((1+i)^n - 1)/(i*((1+i)^n)$ = Uniform Series Present Worth Factor (P/A, 4.625%, 50)

BY: Lonnie Zlomke (86-68170)	CHECKED: D.McKelvie 04/07/2009
DATE PREPARED: 6-Apr-09	PEER REVIEW: D.Donaldson 4/8/2009

Preliminary Interest During Construction Costs	**62,947,668**		**84,949,678**		**94,870,787**		**109,161,773**		**83,815,812**		**63,446,746**	
Preliminary Total Project Costs = Subtotal 1 + 2 + 3 + IDC	**802,947,668**		**1,134,949,678**		**954,870,787**		**1,359,161,773**		**1,133,815,812**		**803,446,746**	
Preliminary Total Project Costs = Subtotal 1+2+3+IDC	**$800,000,000**		**$1,130,000,000**		**$950,000,000**		**$1,360,000,000**		**$1,130,000,000**		**$800,000,000**	

Preliminary Project Benefit Summary

0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power	**$0**	**$0**	**$0**	**$0**	**$720,000**	**$13,944,087**	**$720,000**	**$13,944,087**	**$720,000**	**$13,944,087**	**$720,000**	**$13,944,087**
Preliminary Total Project Benefits = A + B + C + D	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,946,560**	**$37,698,620**	**$1,946,560**	**$37,698,620**	**$1,946,560**	**$37,698,620**	**$1,946,560**	**$37,698,620**
Preliminary Total Project Benefits = A + B + C + D Rounded	**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$1,950,000**	**$37,700,000**	**$1,950,000**	**$37,700,000**	**$1,950,000**	**$37,700,000**	**$1,950,000**	**$37,700,000**

Preliminary Benefit Cost Calculation	**0.03**		**0.02**		**0.04**		**0.03**		**0.03**		**0.05**	

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
350,000 Acre-Foot Reservoir - No Liner
Benefit Cost Analysis

ALTERNATIVE 3

350,000 Acre-Foot Reservoir			Alternative 3 - Option A 1000 CFS Pump Only		Alternative 3 - Option B 2000 CFS Pump Only		Alternative 3 - Option C 1000 CFS Pump & Generator		Alternative 3 - Option D 2000 CFS Pump & Generator		Alternative 3 - Option E 2000 CFS Pump-Turbine		Alternative 3 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$690,000,000		$910,000,000		$780,000,000		$1,050,000,000		$910,000,000		$690,000,000
Water Treatment Construction Costs				$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000
Subtotal 1				**$708,000,000**		**$928,000,000**		**$798,000,000**		**$1,068,000,000**		**$928,000,000**		**$708,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946	$190,000	$76,922	$185,000	$74,897
Year 25	PW Factor	0.32293	$54,000,000	$17,438,220	$70,000,000	$22,605,100	$56,000,000	$18,084,080	$74,000,000	$23,896,820	$71,000,000	$22,928,030	$54,000,000	$17,438,220
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$16,500,000	$3,390,255	$34,000,000	$6,985,980	$31,000,000	$6,369,570	$67,000,000	$13,766,490	$34,000,000	$6,985,980	$16,500,000	$3,390,255
Year 40	PW Factor	0.16390	$18,500,000	$3,032,150	$41,000,000	$6,719,900	$33,000,000	$5,408,700	$73,000,000	$11,964,700	$41,000,000	$6,719,900	$18,500,000	$3,032,150
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$25,709,015**		**$38,193,309**		**$31,834,266**		**$51,691,537**		**$38,516,239**		**$25,709,015**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$2,800,000	$54,227,012	$3,200,000	$61,973,728	$3,600,000	$69,720,444	$4,300,000	$83,277,197	$3,200,000	$61,973,728	$2,800,000	$54,227,012
Operations Costs	PWA Factor	19.36679	$2,900,000	$56,163,691	$3,200,000	$61,973,728	$3,100,000	$60,037,049	$3,500,000	$67,783,765	$3,200,000	$61,973,728	$2,900,000	$56,163,691
Other Annual O&M Misc Costs (non-major equipment)	PWA Factor	19.36679	$610,000	$11,813,742	$730,000	$14,137,757	$760,000	$14,718,760	$940,000	$18,204,783	$730,000	$14,137,757	$610,000	$11,813,742
Other Costs (Evaporated Water)	PWA Factor	19.36679	$93,816	$1,816,915	$128,918	$2,496,728	$93,816	$1,816,915	$128,918	$2,496,728	$128,918	$2,496,728	$93,816	$1,816,915
Other Costs (Water Seepage)	PWA Factor	19.36679	$310,325	$6,009,999	$372,390	$7,211,999	$310,325	$6,009,999	$372,390	$7,211,999	$372,390	$7,211,999	$310,325	$6,009,999
Subtotal 3				**$130,031,359**		**$147,793,940**		**$152,303,167**		**$178,974,472**		**$147,793,940**		**$130,031,359**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$863,740,374**		**$1,113,987,249**		**$982,137,433**		**$1,298,666,009**		**$1,114,310,179**		**$863,740,374**
Total Present Worth Costs Rounded				**$860,000,000**		**$1,100,000,000**		**$980,000,000**		**$1,300,000,000**		**$1,100,000,000**		**$860,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period

- FY2009 planning interest rate 4.625% per year for 50 years.

- PW Factor = P/F = $(1+ i)^{-n}$ = Single Payment Present Worth (P/F, 4.625%, 50)
- PWA Factor = P/A = $((1+i)^n - 1)/(i*((1+i)^n)$ = Uniform Series Present Worth Factor (P/A, 4.625%, 50)

BY: Lonnie Zlomke (86-68170)	CHECKED: D.McKelvie 04/07/2009
DATE PREPARED: 6-Apr-09	PEER REVIEW: D.Donaldson 4/8/2009

Preliminary Interest During Construction Costs	**76,052,596**		**96,048,584**		**107,599,977**		**123,135,245**		**95,970,375**		**76,104,546**	
Preliminary Total Project Costs = Subtotal 1 + 2 + 3 + IDC	**936,052,596**		**1,196,048,584**		**1,087,599,977**		**1,423,135,245**		**1,195,970,375**		**936,104,546**	
Preliminary Total Project Costs = Subtotal 1+2+3+IDC	**$940,000,000**		**$1,200,000,000**		**$1,090,000,000**		**$1,420,000,000**		**$1,200,000,000**		**$940,000,000**	

Preliminary Project Benefit Summary

0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power	**$0**	**$0**	**$0**	**$0**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**
Preliminary Total Project Benefits = A + B + C + D	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**
Preliminary Total Project Benefits = A + B + C + D Rounded	**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**

Preliminary Benefit Cost Calculation	**0.03**		**0.02**		**0.04**		**0.03**		**0.03**		**0.04**	

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
350,000 Acre-Foot Reservoir - No Liner
Benefit Cost Analysis

ALTERNATIVE 4

350,000 Acre-Foot Reservoir			Alternative 4 - Option A 1000 CFS Pump Only		Alternative 4 - Option B 2000 CFS Pump Only		Alternative 4 - Option C 1000 CFS Pump & Generator		Alternative 4 - Option D 2000 CFS Pump & Generator		Alternative 4 - Option E 2000 CFS Pump-Turbine		Alternative 4 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$600,000,000		$830,000,000		$690,000,000		$950,000,000		$810,000,000		$610,000,000
Water Treatment Construction Costs				$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000		$18,000,000
Subtotal 1				**$618,000,000**		**$848,000,000**		**$708,000,000**		**$968,000,000**		**$828,000,000**		**$628,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946	$190,000	$76,922	$185,000	$74,897
Year 25	PW Factor	0.32293	$54,000,000	$17,438,220	$71,000,000	$22,928,030	$56,000,000	$18,084,080	$74,000,000	$23,896,820	$71,000,000	$22,928,030	$54,000,000	$17,438,220
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$16,500,000	$3,390,255	$34,000,000	$6,985,980	$31,000,000	$6,369,570	$67,000,000	$13,766,490	$34,000,000	$6,985,980	$16,500,000	$3,390,255
Year 40	PW Factor	0.16390	$18,500,000	$3,032,150	$41,000,000	$6,719,900	$33,000,000	$5,408,700	$73,000,000	$11,964,700	$41,000,000	$6,719,900	$18,500,000	$3,032,150
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$25,709,015**		**$38,516,239**		**$31,834,266**		**$51,691,537**		**$38,516,239**		**$25,709,015**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$2,700,000	$52,290,333	$3,200,000	$61,973,728	$3,500,000	$67,783,765	$4,300,000	$83,277,197	$3,200,000	$61,973,728	$2,700,000	$52,290,333
Operations Costs	PWA Factor	19.36679	$2,900,000	$56,163,691	$3,200,000	$61,973,728	$3,100,000	$60,037,049	$3,500,000	$67,783,765	$3,200,000	$61,973,728	$2,900,000	$56,163,691
Other Annual O&M Misc Costs (non-major equipment)	PWA Factor	19.36679	$600,000	$11,620,074	$720,000	$13,944,089	$760,000	$14,718,760	$930,000	$18,011,115	$720,000	$13,944,089	$600,000	$11,620,074
Other Costs (Evaporated Water)	PWA Factor	19.36679	$93,816	$1,816,915	$128,918	$2,496,728	$93,816	$1,816,915	$128,918	$2,496,728	$128,918	$2,496,728	$93,816	$1,816,915
Other Costs (Water Seepage)	PWA Factor	19.36679	$310,325	$6,009,999	$372,390	$7,211,999	$310,325	$6,009,999	$372,390	$7,211,999	$372,390	$7,211,999	$310,325	$6,009,999
Subtotal 3				**$127,901,012**		**$147,600,272**		**$150,366,488**		**$178,780,804**		**$147,600,272**		**$127,901,012**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$771,610,027**		**$1,034,116,511**		**$890,200,754**		**$1,198,472,341**		**$1,014,116,511**		**$781,610,027**
Total Present Worth Costs Rounded				**$770,000,000**		**$1,050,000,000**		**$890,000,000**		**$1,200,000,000**		**$1,000,000,000**		**$780,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period

- FY2009 planning interest rate 4.625% per year for 50 years.

- PW Factor = P/F = $(1+ i)^{-n}$ = Single Payment Present Worth (P/F, 4.625%, 50)
- PWA Factor = P/A = $((1+i)^n - 1)/(i*((1+i)^n)$ = Uniform Series Present Worth Factor (P/A, 4.625%, 50)

BY: Lonnie Zlomke (86-68170)	CHECKED: D.McKelvie 04/07/2009
DATE PREPARED: 6-Apr-09	PEER REVIEW: D.Donaldson 4/8/2009

Preliminary Interest During Construction Costs	**64,232,701**		**85,490,199**		**94,872,402**		**106,710,959**		**83,119,216**		**65,373,119**	
Preliminary Total Project Costs = Subtotal 1 + 2 + 3 + IDC	**834,232,701**		**1,135,490,199**		**984,872,402**		**1,306,710,959**		**1,083,119,216**		**845,373,119**	
Preliminary Total Project Costs = Subtotal 1+2+3+IDC	**$830,000,000**		**$1,140,000,000**		**$980,000,000**		**$1,310,000,000**		**$1,080,000,000**		**$850,000,000**	

Preliminary Project Benefit Summary

0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power	**$0**	**$0**	**$0**	**$0**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**
Preliminary Total Project Benefits = A + B + C + D	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**
Preliminary Total Project Benefits = A + B + C + D Rounded	**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**

Preliminary Benefit Cost Calculation	**0.03**	**0.02**	**0.04**	**0.03**	**0.04**	**0.05**

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
350,000 Acre-Foot Reservoir - No Liner
Benefit Cost Analysis

ALTERNATIVE 5

350,000 Acre-Foot Reservoir			Alternative 5 - Option A 1000 CFS Pump Only		Alternative 5 - Option B 2000 CFS Pump Only		Alternative 5 - Option C 1000 CFS Pump & Generator		Alternative 5 - Option D 2000 CFS Pump & Generator	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs										
Initial Construction and Other Costs										
Construction Costs Rev1 - July 2008				$750,000,000		$1,100,000,000		$840,000,000		$1,250,000,000
Water Treatment Construction Costs				$18,000,000		$18,000,000		$18,000,000		$18,000,000
Subtotal 1				**$768,000,000**		**$1,118,000,000**		**$858,000,000**		**$1,268,000,000**
Periodic Costs		P/F								
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946
Year 25	PW Factor	0.32293	$118,000,000	$38,105,740	$150,000,000	$48,439,500	$120,000,000	$38,751,600	$154,000,000	$49,731,220
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529
Year 35	PW Factor	0.20547	$16,500,000	$3,390,255	$34,000,000	$6,985,980	$31,000,000	$6,369,570	$67,000,000	$13,766,490
Year 40	PW Factor	0.16390	$18,500,000	$3,032,150	$41,000,000	$6,719,900	$33,000,000	$5,408,700	$73,000,000	$11,964,700
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647
Subtotal 2				**$46,376,535**		**$64,027,709**		**$52,501,786**		**$77,525,937**
Annual Costs		P/A								
Maintenance	PWA Factor	19.36679	$5,900,000	$114,264,061	$7,300,000	$141,377,567	$6,700,000	$129,757,493	$8,300,000	$160,744,357
Operations Costs	PWA Factor	19.36679	$2,900,000	$56,163,691	$3,200,000	$61,973,728	$3,100,000	$60,037,049	$3,500,000	$67,783,765
Other Annual O&M Misc Costs (non-major equipment)	PWA Factor	19.36679	$1,000,000	$19,366,790	$1,250,000	$24,208,488	$1,200,000	$23,240,148	$1,500,000	$29,050,185
Other Costs (Evaporated Water)	PWA Factor	19.36679	$93,816	$1,816,915	$128,918	$2,496,728	$93,816	$1,816,915	$128,918	$2,496,728
Other Costs (Water Seepage)	PWA Factor	19.36679	$310,325	$6,009,999	$372,390	$7,211,999	$310,325	$6,009,999	$372,390	$7,211,999
Subtotal 3				**$197,621,456**		**$237,268,510**		**$220,861,604**		**$267,287,034**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,011,997,991**		**$1,419,296,219**		**$1,131,363,390**		**$1,612,812,971**
Total Present Worth Costs Rounded				**$1,000,000,000**		**$1,400,000,000**		**$1,150,000,000**		**$1,600,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period

- FY2009 planning interest rate 4.625% per year for 50 years.

- PW Factor = P/F = $(1+ i)^{-n}$ = Single Payment Present Worth (P/F, 4.625%, 50)
- PWA Factor = P/A = $((1+i)^n - 1)/(i*((1+i)^n)$ = Uniform Series Present Worth Factor (P/A, 4.625%, 50)

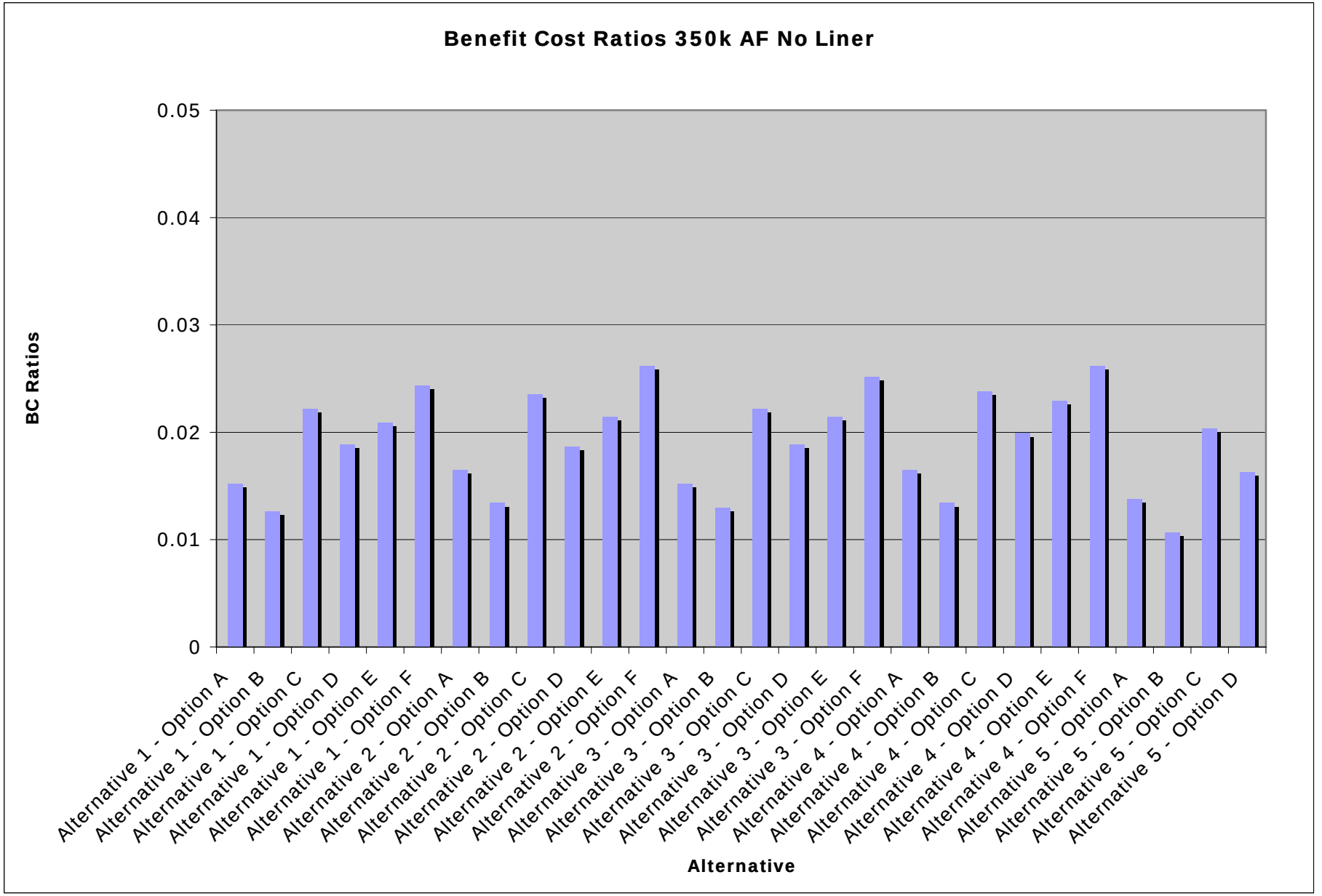
BY: Lonnie Zlomke (86-68170)	CHECKED: D.McKelvie 04/07/2009
DATE PREPARED: 6-Apr-09	PEER REVIEW: D.Donaldson 4/8/2009

Preliminary Interest During Construction Costs	**89,258,505**		**167,904,364**		**121,610,793**		**152,388,222**	
Preliminary Total Project Costs = Subtotal 1 + 2 + 3 + IDC	**1,089,258,505**		**1,567,904,364**		**1,271,610,793**		**1,752,388,222**	
Preliminary Total Project Costs = Subtotal 1+2+3+IDC	**$1,090,000,000**		**$1,570,000,000**		**$1,270,000,000**		**$1,750,000,000**	

Preliminary Project Benefit Summary

0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power	**$0**	**$0**	**$0**	**$0**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**
Preliminary Total Project Benefits = A + B + C + D	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**
Preliminary Total Project Benefits = A + B + C + D Rounded	**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**

Preliminary Benefit Cost Calculation	**0.02**	**0.02**	**0.03**	**0.02**


Benefit Cost Ratios 350k AF No Liner
BC Ratios
0.05
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Alternative 1 - Option A
Alternative 1 - Option B
Alternative 1 - Option C
Alternative 1 - Option D
Alternative 1 - Option E
Alternative 1 - Option F
Alternative 2 - Option A
Alternative 2 - Option B
Alternative 2 - Option C
Alternative 2 - Option D
Alternative 2 - Option E
Alternative 2 - Option F
Alternative 3 - Option A
Alternative 3 - Option B
Alternative 3 - Option C
Alternative 3 - Option D
Alternative 3 - Option E
Alternative 3 - Option F
Alternative 4 - Option A
Alternative 4 - Option B
Alternative 4 - Option C
Alternative 4 - Option D
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Alternative 4 - Option F
Alternative 5 - Option A
Alternative 5 - Option B
Alternative 5 - Option C
Alternative 5 - Option D
Alternative

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
500,000 Acre-Foot Reservoir - No Liner
Benefit Cost Analysis

ALTERNATIVE 1

500,000 Acre-Foot Reservoir			Alternative 1 - Option A 1000 CFS Pump Only		Alternative 1 - Option B 2000 CFS Pump Only		Alternative 1 - Option C 1000 CFS Pump & Generator		Alternative 1 - Option D 2000 CFS Pump & Generator		Alternative 1 - Option E 2000 CFS Pump-Turbine		Alternative 1 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$780,000,000		$1,050,000,000		$880,000,000		$1,200,000,000		$1,050,000,000		$790,000,000
Water Treatment Construction Costs				$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000
Subtotal 1				801000000		**$1,071,000,000**		**$901,000,000**		**$1,221,000,000**		**$1,071,000,000**		**$811,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946	$190,000	$76,922	$185,000	$74,897
Year 25	PW Factor	0.32293	$57,000,000	$18,407,010	$74,000,000	$23,896,820	$59,000,000	$19,052,870	$77,000,000	$24,865,610	$74,000,000	$23,896,820	$57,000,000	$18,407,010
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$17,500,000	$3,595,725	$37,000,000	$7,602,390	$33,000,000	$6,780,510	$70,000,000	$14,382,900	$39,000,000	$8,013,330	$18,000,000	$3,698,460
Year 40	PW Factor	0.16390	$20,000,000	$3,278,000	$43,000,000	$7,047,700	$36,000,000	$5,900,400	$76,000,000	$12,456,400	$45,000,000	$7,375,500	$21,000,000	$3,441,900
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$27,129,126**		**$40,429,239**		**$33,705,696**		**$53,768,437**		**$41,167,979**		**$27,395,760**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$2,900,000	$56,163,691	$3,300,000	$63,910,407	$3,600,000	$69,720,444	$4,400,000	$85,213,876	$3,300,000	$63,910,407	$2,900,000	$56,163,691
Operations Costs	PWA Factor	19.36679	$3,000,000	$58,100,370	$3,400,000	$65,847,086	$3,300,000	$63,910,407	$3,700,000	$71,657,123	$3,400,000	$65,847,086	$3,000,000	$58,100,370
Other Annual O&M Misc Costs (non-major equipment)	PWA Factor	19.36679	$610,000	$11,813,742	$730,000	$14,137,757	$760,000	$14,718,760	$940,000	$18,204,783	$730,000	$14,137,757	$610,000	$11,813,742
Other Costs (Evaporated Water)	PWA Factor	19.36679	$125,219	$2,425,090	$165,798	$3,210,975	$125,219	$2,425,090	$165,798	$3,210,975	$165,798	$3,210,975	$125,219	$2,425,090
Other Costs (Water Seepage)	PWA Factor	19.36679	$579,840	$11,229,640	$667,695	$12,931,109	$579,840	$11,229,640	$667,695	$12,931,109	$667,695	$12,931,109	$579,840	$11,229,640
Subtotal 3				**$139,732,533**		**$160,037,334**		**$162,004,341**		**$191,217,866**		**$160,037,334**		**$139,732,533**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$967,861,659**		**$1,271,466,573**		**$1,096,710,037**		**$1,465,986,303**		**$1,272,205,313**		**$978,128,293**
Total Present Worth Costs Rounded				**$970,000,000**		**$1,250,000,000**		**$1,100,000,000**		**$1,450,000,000**		**$1,250,000,000**		**$980,000,000**

Assumptions:

- Inflation rate multiplier = 1.04625
- 50-year analysis period

- FY2009 planning interest rate 4.625% per year for 50 years.

- PW Factor = P/F = $(1+ i)^{-n}$ = Single Payment Present Worth (P/F, 4.625%, 50)
- PWA Factor = P/A = $((1+i)^n - 1)/(i*((1+i)^n)$ = Uniform Series Present Worth Factor (P/A, 4.625%, 50)

BY: Jeff Morris (86-68170)	CHECKED: D.McKelvie 04/07/2009
DATE PREPARED: 04/07/2009	PEER REVIEW: D. Donaldson 04/08/2009

Preliminary Interest During Construction Costs			**86,010,727**		**110,838,816**		**121,469,321**		**140,772,098**		**110,748,574**		**87,157,126**	
Preliminary Total Project Costs = Subtotal 1 + 2 + 3 + IDC			**1,056,010,727**			**1,360,838,816**		**1,221,469,321**		**1,590,772,098**		**1,360,748,574**		**1,067,157,126**
Preliminary Total Project Costs = Subtotal 1+2+3+IDC			**$1,060,000,000**			**$1,360,000,000**		**$1,220,000,000**		**$1,590,000,000**		**$1,360,000,000**		**$1,070,000,000**

Preliminary Project Benefit Summary

	0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power		**$0**	**$0**	**$0**	**$0**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**
Preliminary Total Project Benefits = A + B + C + D		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**
Preliminary Total Project Benefits = A + B + C + D Rounded		**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**

Preliminary Benefit Cost Calculation			**0.02**		**0.02**		**0.03**		**0.02**		**0.03**		**0.04**	

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
500,000 Acre-Foot Reservoir - No Liner
Benefit Cost Analysis

ALTERNATIVE 2

500,000 Acre-Foot Reservoir			Alternative 2 - Option A 1000 CFS Pump Only		Alternative 2 - Option B 2000 CFS Pump Only		Alternative 2 - Option C 1000 CFS Pump & Generator		Alternative 2 - Option D 2000 CFS Pump & Generator		Alternative 2 - Option E 2000 CFS Pump-Turbine		Alternative 2 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$610,000,000		$950,000,000		$710,000,000		$1,100,000,000		$940,000,000		$610,000,000
Water Treatment Construction Costs				$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000
Subtotal 1				**$631,000,000**		**$971,000,000**		**$731,000,000**		**$1,121,000,000**		**$961,000,000**		**$631,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$190,000	$76,922	$190,000	$76,922	$185,000	$74,897
Year 25	PW Factor	0.32293	$81,000,000	$26,157,330	$110,000,000	$35,522,300	$83,000,000	$26,803,190	$110,000,000	$35,522,300	$110,000,000	$35,522,300	$81,000,000	$26,157,330
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$17,500,000	$3,595,725	$37,000,000	$7,602,390	$33,000,000	$6,780,510	$70,000,000	$14,382,900	$39,000,000	$8,013,330	$19,500,000	$4,006,665
Year 40	PW Factor	0.16390	$20,000,000	$3,278,000	$43,000,000	$7,047,700	$36,000,000	$5,900,400	$76,000,000	$12,456,400	$45,000,000	$7,375,500	$21,000,000	$3,441,900
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$34,879,445**		**$52,054,719**		**$41,456,016**		**$64,423,103**		**$52,793,459**		**$35,454,285**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$3,900,000	$75,530,481	$4,900,000	$94,897,271	$4,700,000	$91,023,913	$5,900,000	$114,264,061	$4,900,000	$94,897,271	$3,900,000	$75,530,481
Operations Costs	PWA Factor	19.36679	$3,000,000	$58,100,370	$3,400,000	$65,847,086	$3,300,000	$63,910,407	$3,700,000	$71,657,123	$3,400,000	$65,847,086	$3,000,000	$58,100,370
Other Annual O&M Misc Costs (non-major equipment)	PWA Factor	19.36679	$770,000	$14,912,428	$960,000	$18,592,118	$920,000	$17,817,447	$1,150,000	$22,271,809	$965,000	$18,688,952	$770,000	$14,912,428
Other Costs (Evaporated Water)	PWA Factor	19.36679	$125,219	$2,425,090	$165,798	$3,210,975	$125,219	$2,425,090	$165,798	$3,210,975	$165,798	$3,210,975	$125,219	$2,425,090
Other Costs (Water Seepage)	PWA Factor	19.36679	$579,840	$11,229,640	$667,695	$12,931,109	$579,840	$11,229,640	$667,695	$12,931,109	$667,695	$12,931,109	$579,840	$11,229,640
Subtotal 3				**$162,198,009**		**$195,478,559**		**$186,406,497**		**$224,335,077**		**$195,575,393**		**$162,198,009**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$828,077,454**		**$1,218,533,278**		**$958,862,513**		**$1,409,758,180**		**$1,209,368,852**		**$828,652,294**
Total Present Worth Costs Rounded				**$830,000,000**		**$1,200,000,000**		**$960,000,000**		**$1,400,000,000**		**$1,200,000,000**		**$830,000,000**

Assumptions:

- Inflation rate multiplier = 1.04625
- 50-year analysis period

- FY2009 planning interest rate 4.625% per year for 50 years.

- PW Factor = P/F = $(1+ i)^{-n}$ = Single Payment Present Worth (P/F, 4.625%, 50)
- PWA Factor = P/A = $((1+i)^n - 1)/(i*((1+i)^n)$ = Uniform Series Present Worth Factor (P/A, 4.625%, 50)

BY: Jeff Morris (86-68170)	CHECKED: D.McKelvie 04/07/2009
DATE PREPARED: 04/07/2009	PEER REVIEW: D. Donaldson 04/08/2009

Preliminary Interest During Construction Costs			**72,465,792**		**100,855,762**		**106,393,541**		**127,735,633**		**148,763,362**		**73,040,202**	
Preliminary Total Project Costs = Subtotal 1 + 2 + 3 + IDC			**902,465,792**		**1,300,855,762**		**1,066,393,541**		**1,527,735,633**		**1,348,763,362**		**903,040,202**	
Preliminary Total Project Costs = Subtotal 1+2+3+IDC			**$900,000,000**		**$1,300,000,000**		**$1,070,000,000**		**$1,530,000,000**		**$1,350,000,000**		**$900,000,000**	

Preliminary Project Benefit Summary

	0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power		**$0**	**$0**	**$0**	**$0**	**$720,000**	**$13,944,087**	**$720,000**	**$13,944,087**	**$720,000**	**$13,944,087**	**$720,000**	**$13,944,087**
Preliminary Total Project Benefits = A + B + C + D		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,946,560**	**$37,698,620**	**$1,946,560**	**$37,698,620**	**$1,946,560**	**$37,698,620**	**$1,946,560**	**$37,698,620**
Preliminary Total Project Benefits = A + B + C + D Rounded		**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$1,950,000**	**$37,700,000**	**$1,950,000**	**$37,700,000**	**$1,950,000**	**$37,700,000**	**$1,950,000**	**$37,700,000**

Preliminary Benefit Cost Calculation	**0.03**	**0.02**	**0.04**	**0.02**	**0.03**	**0.04**

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
500,000 Acre-Foot Reservoir - No Liner
Benefit Cost Analysis

ALTERNATIVE 3

500,000 Acre-Foot Reservoir			Alternative 3 - Option A 1000 CFS Pump Only		Alternative 3 - Option B 2000 CFS Pump Only		Alternative 3 - Option C 1000 CFS Pump & Generator		Alternative 3 - Option D 2000 CFS Pump & Generator		Alternative 3 - Option E 2000 CFS Pump-Turbine		Alternative 3 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$760,000,000		$1,050,000,000		$850,000,000		$1,200,000,000		$1,050,000,000		$760,000,000
Water Treatment Construction Costs				$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000
Subtotal 1				**$781,000,000**		**$1,071,000,000**		**$871,000,000**		**$1,221,000,000**		**$1,071,000,000**		**$781,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946	$190,000	$76,922	$185,000	$74,897
Year 25	PW Factor	0.32293	$57,000,000	$18,407,010	$74,000,000	$23,896,820	$59,000,000	$19,052,870	$77,000,000	$24,865,610	$74,000,000	$23,896,820	$57,000,000	$18,407,010
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$17,500,000	$3,595,725	$37,000,000	$7,602,390	$33,000,000	$6,780,510	$73,000,000	$14,999,310	$39,000,000	$8,013,330	$18,500,000	$3,801,195
Year 40	PW Factor	0.16390	$20,000,000	$3,278,000	$43,000,000	$7,047,700	$36,000,000	$5,900,400	$74,000,000	$12,128,600	$45,000,000	$7,375,500	$21,000,000	$3,441,900
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$27,129,125**		**$40,429,239**		**$33,705,696**		**$54,057,047**		**$41,167,979**		**$27,498,495**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$2,900,000	$56,163,691	$3,300,000	$63,910,407	$3,600,000	$69,720,444	$4,400,000	$85,213,876	$3,300,000	$63,910,407	$2,900,000	$56,163,691
Operations Costs	PWA Factor	19.36679	$3,000,000	$58,100,370	$3,400,000	$65,847,086	$3,300,000	$63,910,407	$3,700,000	$71,657,123	$3,400,000	$65,847,086	$3,000,000	$58,100,370
Other Annual O&M Misc Costs (non-major equipment)	PWA Factor	19.36679	$610,000	$11,813,742	$730,000	$14,137,757	$760,000	$14,718,760	$940,000	$18,204,783	$730,000	$14,137,757	$610,000	$11,813,742
Other Costs (Evaporated Water)	PWA Factor	19.36679	$125,219	$2,425,090	$165,798	$3,210,975	$125,219	$2,425,090	$165,798	$3,210,975	$165,798	$3,210,975	$125,219	$2,425,090
Other Costs (Water Seepage)	PWA Factor	19.36679	$579,840	$11,229,640	$667,695	$12,931,109	$579,840	$11,229,640	$667,695	$12,931,109	$667,695	$12,931,109	$579,840	$11,229,640
Subtotal 3				**$139,732,533**		**$160,037,334**		**$162,004,341**		**$191,217,866**		**$160,037,334**		**$139,732,533**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$947,861,658**		**$1,271,466,573**		**$1,066,710,037**		**$1,466,274,913**		**$1,272,205,313**		**$948,231,028**
Total Present Worth Costs Rounded				**$950,000,000**		**$1,250,000,000**		**$1,050,000,000**		**$1,450,000,000**		**$1,250,000,000**		**$950,000,000**

Assumptions:

- Inflation rate multiplier = 1.04625
- 50-year analysis period

- FY2009 planning interest rate 4.625% per year for 50 years.

- PW Factor = P/F = $(1+ i)^{-n}$ = Single Payment Present Worth (P/F, 4.625%, 50)
- PWA Factor = P/A = $((1+i)^n - 1)/(i*((1+i)^n)$ = Uniform Series Present Worth Factor (P/A, 4.625%, 50)

BY: Jeff Morris (86-68170)	CHECKED: D.McKelvie 04/07/2009
DATE PREPARED: 04/07/2009	PEER REVIEW: D. Donaldson 04/08/2009

Preliminary Interest During Construction Costs	**83,836,926**		**110,838,816**		**117,405,336**		**140,772,098**		**110,748,574**		**83,894,105**	
Preliminary Total Project Costs = Subtotal 1 + 2 + 3 + IDC	**1,033,836,926**		**1,360,838,816**		**1,167,405,336**		**1,590,772,098**		**1,360,748,574**		**1,033,894,105**	
Preliminary Total Project Costs = Subtotal 1+2+3+IDC	**$1,030,000,000**		**$1,360,000,000**		**$1,170,000,000**		**$1,590,000,000**		**$1,360,000,000**		**$1,030,000,000**	

Preliminary Project Benefit Summary

0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power	**$0**	**$0**	**$0**	**$0**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**
Preliminary Total Project Benefits = A + B + C + D	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**
Preliminary Total Project Benefits = A + B + C + D Rounded	**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**

Preliminary Benefit Cost Calculation	**0.02**	**0.02**	**0.03**	**0.02**	**0.03**	**0.04**

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
500,000 Acre-Foot Reservoir - No Liner
Benefit Cost Analysis

ALTERNATIVE 4

500,000 Acre-Foot Reservoir			Alternative 4 - Option A 1000 CFS Pump Only		Alternative 4 - Option B 2000 CFS Pump Only		Alternative 4 - Option C 1000 CFS Pump & Generator		Alternative 4 - Option D 2000 CFS Pump & Generator		Alternative 4 - Option E 2000 CFS Pump-Turbine		Alternative 4 - Option F 1000 CFS Pump-Turbine	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs														
Initial Construction and Other Costs														
Construction Costs Rev1 - July 2008				$680,000,000		$950,000,000		$780,000,000		$1,100,000,000		$950,000,000		$690,000,000
Water Treatment Construction Costs				$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000		$21,000,000
Subtotal 1				**$701,000,000**		**$971,000,000**		**$801,000,000**		**$1,121,000,000**		**$971,000,000**		**$711,000,000**
Periodic Costs		P/F												
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687	$1,350,000	$685,179	$1,300,000	$659,802
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946	$190,000	$76,922	$185,000	$74,897
Year 25	PW Factor	0.32293	$57,000,000	$18,407,010	$75,000,000	$24,219,750	$59,000,000	$19,052,870	$78,000,000	$25,188,540	$74,000,000	$23,896,820	$57,000,000	$18,407,010
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529	$2,900,000	$747,011	$2,900,000	$747,011
Year 35	PW Factor	0.20547	$17,500,000	$3,595,725	$37,000,000	$7,602,390	$33,000,000	$6,780,510	$70,000,000	$14,382,900	$39,000,000	$8,013,330	$18,000,000	$3,698,460
Year 40	PW Factor	0.16390	$20,000,000	$3,278,000	$43,000,000	$7,047,700	$36,000,000	$5,900,400	$76,000,000	$12,456,400	$45,000,000	$7,375,500	$21,000,000	$3,441,900
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647	$1,350,000	$176,499	$1,300,000	$169,962
Subtotal 2				**$27,129,125**		**$40,752,169**		**$33,705,696**		**$54,091,367**		**$41,167,979**		**$27,395,760**
Annual Costs		P/A												
Maintenance	PWA Factor	19.36679	$2,800,000	$54,227,012	$3,300,000	$63,910,407	$3,600,000	$69,720,444	$4,400,000	$85,213,876	$3,300,000	$63,910,407	$2,800,000	$54,227,012
Operations Costs	PWA Factor	19.36679	$3,000,000	$58,100,370	$3,400,000	$65,847,086	$3,300,000	$63,910,407	$3,700,000	$71,657,123	$3,400,000	$65,847,086	$3,000,000	$58,100,370
Other Annual O&M Misc Costs (non-major equipment)	PWA Factor	19.36679	$600,000	$11,620,074	$720,000	$13,944,089	$760,000	$14,718,760	$930,000	$18,011,115	$720,000	$13,944,089	$600,000	$11,620,074
Other Costs (Evaporated Water)	PWA Factor	19.36679	$125,219	$2,425,090	$165,798	$3,210,975	$125,219	$2,425,090	$165,798	$3,210,975	$165,798	$3,210,975	$125,219	$2,425,090
Other Costs (Water Seepage)	PWA Factor	19.36679	$579,840	$11,229,640	$667,695	$12,931,109	$579,840	$11,229,640	$667,695	$12,931,109	$667,695	$12,931,109	$579,840	$11,229,640
Subtotal 3				**$137,602,186**		**$159,843,666**		**$162,004,341**		**$191,024,198**		**$159,843,666**		**$137,602,186**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$865,731,311**		**$1,171,595,835**		**$996,710,037**		**$1,366,115,565**		**$1,172,011,645**		**$875,997,946**
Total Present Worth Costs Rounded				**$870,000,000**		**$1,150,000,000**		**$1,000,000,000**		**$1,350,000,000**		**$1,150,000,000**		**$880,000,000**

Assumptions:

- Inflation rate multiplier = 1.04625
- 50-year analysis period

- FY2009 planning interest rate 4.625% per year for 50 years.

- PW Factor = P/F = $(1+ i)^{-n}$ = Single Payment Present Worth (P/F, 4.625%, 50)
- PWA Factor = P/A = $((1+i)^n - 1)/(i*((1+i)^n)$ = Uniform Series Present Worth Factor (P/A, 4.625%, 50)

BY: Jeff Morris (86-68170)	CHECKED: D.McKelvie 04/07/2009
DATE PREPARED: 04/07/2009	PEER REVIEW: D. Donaldson 04/08/2009

Preliminary Interest During Construction Costs			**72,832,230**		**97,873,533**		**107,317,221**		**123,576,961**		**97,478,987**		**73,984,107**	
Preliminary Total Project Costs = Subtotal 1 + 2 + 3 + IDC			**942,832,230**		**1,247,873,533**		**1,107,317,221**		**1,473,576,961**		**1,247,478,987**		**953,984,107**	
Preliminary Total Project Costs = Subtotal 1+2+3+IDC			**$940,000,000**		**$1,250,000,000**		**$1,110,000,000**		**$1,470,000,000**		**$1,250,000,000**		**$950,000,000**	

Preliminary Project Benefit Summary

	0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power		**$0**	**$0**	**$0**	**$0**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**
Preliminary Total Project Benefits = A + B + C + D		**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**
Preliminary Total Project Benefits = A + B + C + D Rounded		**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**

Preliminary Benefit Cost Calculation	**0.03**	**0.02**	**0.04**	**0.03**	**0.03**	**0.04**

ATTACHMENT E
Upper Klamath Offstream Storage Study At Long Lake Valley Optimization Study
500,000 Acre-Foot Reservoir - No Liner
Benefit Cost Analysis

ALTERNATIVE 5

500,000 Acre-Foot Reservoir			Alternative 5 - Option A 1000 CFS Pump Only		Alternative 5 - Option B 2000 CFS Pump Only		Alternative 5 - Option C 1000 CFS Pump & Generator		Alternative 5 - Option D 2000 CFS Pump & Generator	
			Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth	Estimated Costs	Present Worth
Initial Capital Costs										
Initial Construction and Other Costs										
Construction Costs Rev1 - July 2008				$850,000,000		$1,300,000,000		$950,000,000		$1,450,000,000
Water Treatment Construction Costs				$21,000,000		$21,000,000		$21,000,000		$21,000,000
Subtotal 1				**$871,000,000**		**$1,321,000,000**		**$971,000,000**		**$1,471,000,000**
Periodic Costs		P/F								
Year 5	PW Factor	0.79767	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732	$115,000	$91,732
Year 10	PW Factor	0.63628	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986	$165,000	$104,986
Year 15	PW Factor	0.50754	$1,300,000	$659,802	$1,350,000	$685,179	$1,450,000	$735,933	$1,550,000	$786,687
Year 20	PW Factor	0.40485	$185,000	$74,897	$190,000	$76,922	$190,000	$76,922	$195,000	$78,946
Year 25	PW Factor	0.32293	$120,000,000	$38,751,600	$155,000,000	$50,054,150	$125,000,000	$40,366,250	$160,000,000	$51,668,800
Year 30	PW Factor	0.25759	$2,900,000	$747,011	$2,900,000	$747,011	$3,000,000	$772,770	$3,100,000	$798,529
Year 35	PW Factor	0.20547	$17,500,000	$3,595,725	$37,000,000	$7,602,390	$33,000,000	$6,780,510	$70,000,000	$14,382,900
Year 40	PW Factor	0.16390	$20,000,000	$3,278,000	$43,000,000	$7,047,700	$36,000,000	$5,900,400	$76,000,000	$12,456,400
Year 45	PW Factor	0.13074	$1,300,000	$169,962	$1,350,000	$176,499	$1,450,000	$189,573	$1,550,000	$202,647
Subtotal 2				**$47,473,715**		**$66,586,569**		**$55,019,076**		**$80,571,627**
Annual Costs		P/A								
Maintenance	PWA Factor	19.36679	$6,000,000	$116,200,740	$7,300,000	$141,377,567	$6,800,000	$131,694,172	$8,400,000	$162,681,036
Operations Costs	PWA Factor	19.36679	$3,000,000	$58,100,370	$3,400,000	$65,847,086	$3,300,000	$63,910,407	$3,700,000	$71,657,123
Other Annual O&M Misc Costs (non-major equipment)	PWA Factor	19.36679	$1,000,000	$19,366,790	$1,250,000	$24,208,488	$1,200,000	$23,240,148	$1,500,000	$29,050,185
Other Costs (Evaporated Water)	PWA Factor	19.36679	$125,219	$2,425,090	$165,798	$3,210,975	$125,219	$2,425,090	$165,798	$3,210,975
Other Costs (Water Seepage)	PWA Factor	19.36679	$579,840	$11,229,640	$667,695	$12,931,109	$579,840	$11,229,640	$667,695	$12,931,109
Subtotal 3				**$207,322,630**		**$247,575,225**		**$232,499,457**		**$279,530,428**
Total Present Worth Costs = Subtotal 1 + 2 + 3				**$1,125,796,345**		**$1,635,161,794**		**$1,258,518,533**		**$1,831,102,055**
Total Present Worth Costs Rounded				**$1,150,000,000**		**$1,650,000,000**		**$1,250,000,000**		**$1,850,000,000**

Assumptions:
- Inflation rate multiplier = 1.04625
- 50-year analysis period

- FY2009 planning interest rate 4.625% per year for 50 years.

- PW Factor = P/F = $(1+ i)^{-n}$ = Single Payment Present Worth (P/F, 4.625%, 50)
- PWA Factor = P/A = $((1+i)^n - 1)/(i*((1+i)^n)$ = Uniform Series Present Worth Factor (P/A, 4.625%, 50)

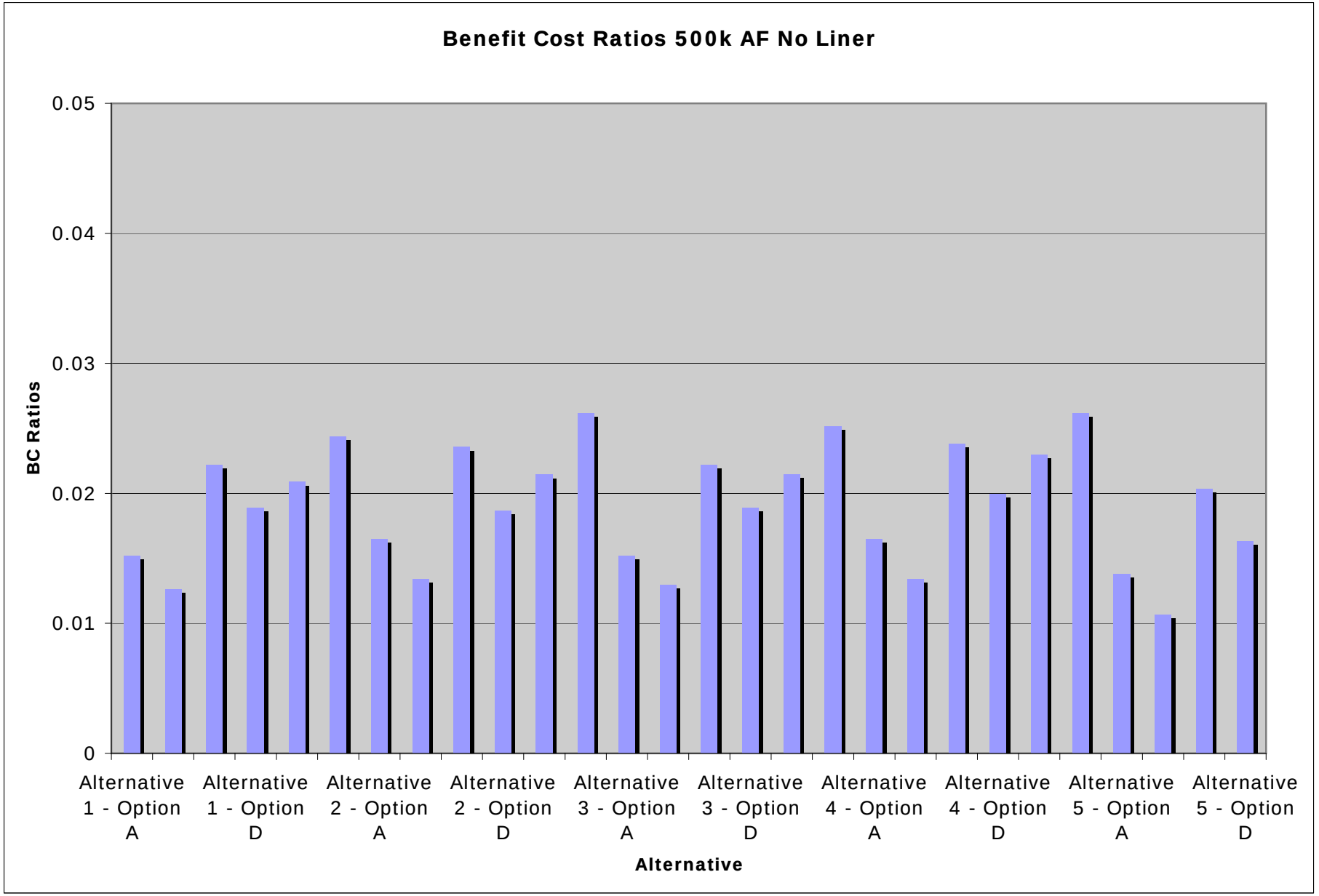
BY: Jeff Morris (86-68170)	CHECKED: D.McKelvie 04/07/2009
DATE PREPARED: 04/07/2009	PEER REVIEW: D. Donaldson 04/08/09

Preliminary Interest During Construction Costs	**101,194,808**		**198,403,092**		**137,605,171**		**176,783,203**	
Preliminary Total Project Costs = Subtotal 1 + 2 + 3 + IDC	**1,251,194,808**		**1,848,403,092**		**1,387,605,171**		**2,026,783,203**	
Preliminary Total Project Costs = Subtotal 1+2+3+IDC	**$1,250,000,000**		**$1,850,000,000**		**$1,390,000,000**		**$2,030,000,000**	

Preliminary Project Benefit Summary

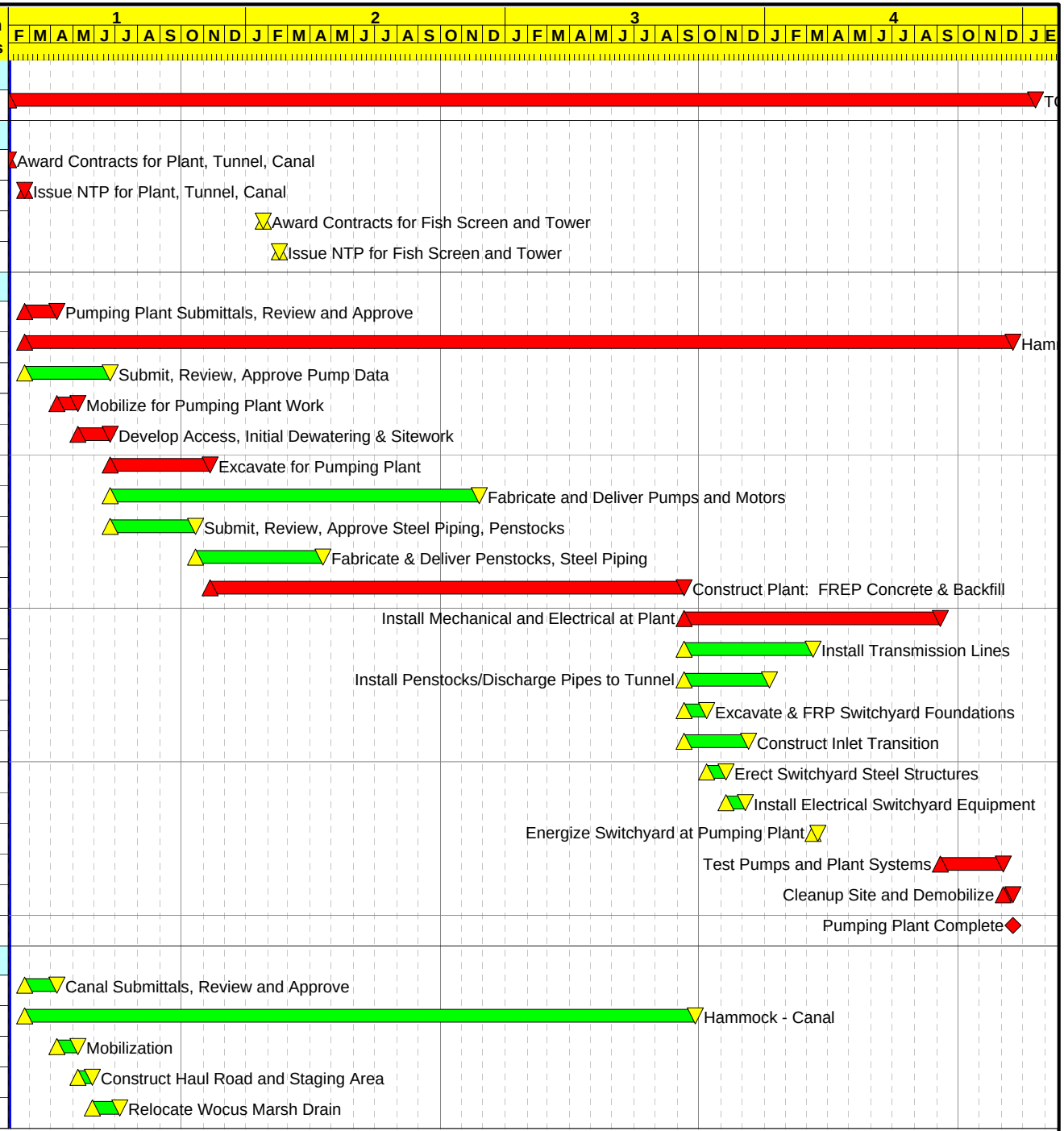
0.04625	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth	Annual Benefit	Present Worth
A. Agriculture	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**
B. Recreation	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
C. Fisheries	Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate		Insufficient data to calculate	
D. Power	**$0**	**$0**	**$0**	**$0**	**$800,000**	**$15,493,430**	**$800,000**	**$15,493,430**
Preliminary Total Project Benefits = A + B + C + D	**$1,226,560**	**$23,754,534**	**$1,226,560**	**$23,754,534**	**$2,026,560**	**$39,247,963**	**$2,026,560**	**$39,247,963**
Preliminary Total Project Benefits = A + B + C + D Rounded	**$1,230,000**	**$23,750,000**	**$1,230,000**	**$23,750,000**	**$2,030,000**	**$39,250,000**	**$2,030,000**	**$39,250,000**

Preliminary Benefit Cost Calculation	**0.02**	**0.01**	**0.03**	**0.02**


Benefit Cost Ratios 500k AF No Liner
BC Ratios
0.05
0.04
0.03
0.02
0.01
0
Alternative 1 - Option A
Alternative 1 - Option D
Alternative 2 - Option A
Alternative 2 - Option D
Alternative 3 - Option A
Alternative 3 - Option D
Alternative 4 - Option A
Alternative 4 - Option D
Alternative 5 - Option A
Alternative 5 - Option D
Alternative

Attachment F—Construction Schedules

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	TOTAL PROJECT DURATION - NTP to	1,447*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping Plant - 1,000 cfs		
1PA1100	Pumping Plant Submittals, Review and Approve	45
HAMPP	Hammock - Pumping Plant	1,394*
1PA1125	Submit, Review, Approve Pump Data	120
1PA1150	Mobilize for Pumping Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping Plant	140
1PA1225	Fabricate and Deliver Pumps and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	670
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pumping Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping Plant Complete	0
Canal - 1,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
HAMC	Hammock - Canal	946*
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Relocate Wocus Marsh Drain	37



Start Date 01FEB16
Finish Date 17JAN20
Data Date 01FEB16
Run Date 31MAR09 10:04

Early Bar
Progress Bar
Critical Activity

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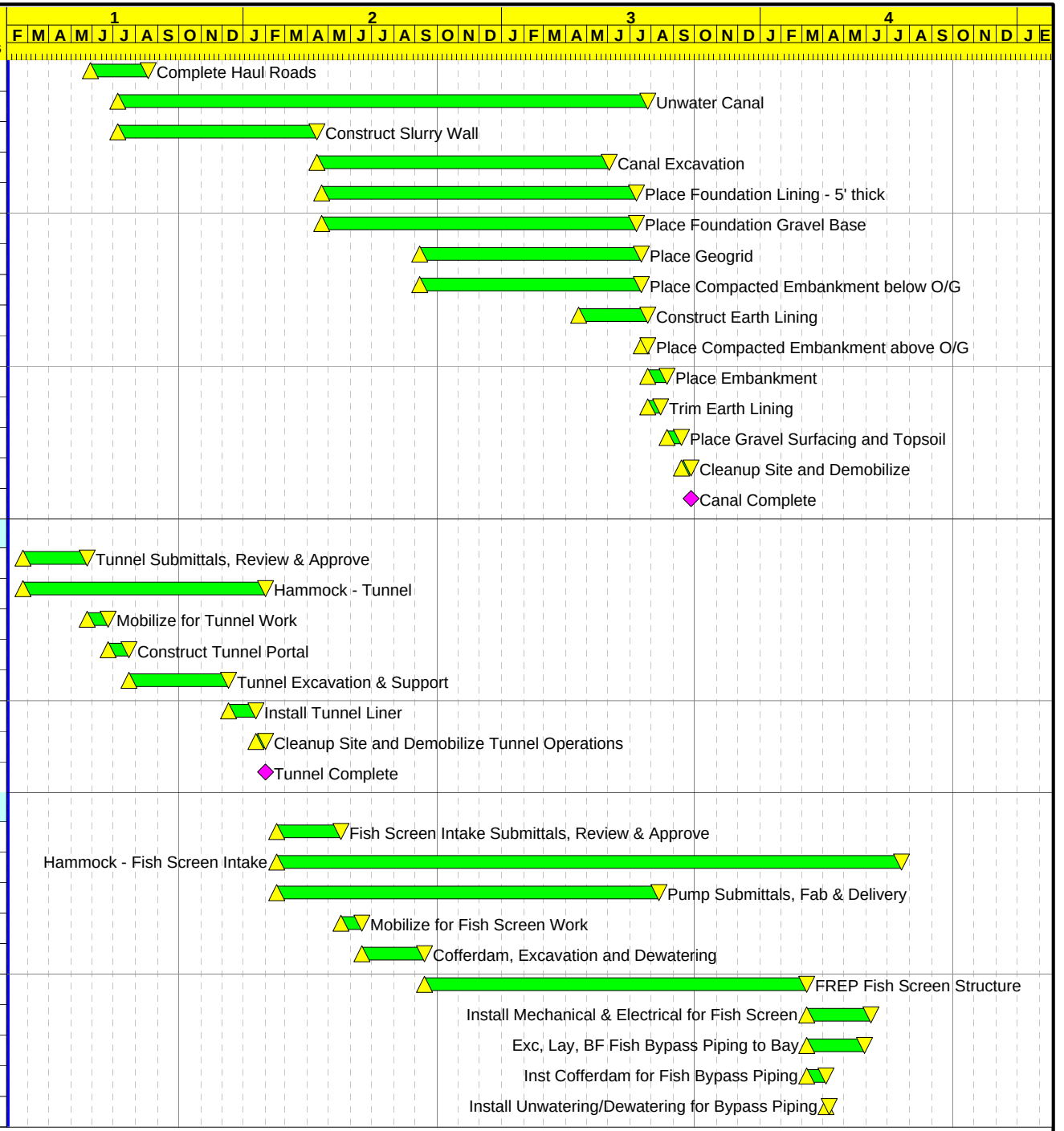
L1A1

Alternative No. 1, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 1A
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 month weather impact		
	each winter for canal work.		

Activity ID	Activity Description	Duration Cal Days
1C13075	Complete Haul Roads	82
1C13125	Unwater Canal	539*
1C13150	Construct Slurry Wall	177
1C13175	Canal Excavation	307
1C13200	Place Foundation Lining - 5' thick	338
1C13225	Place Foundation Gravel Base	338*
1C13250	Place Geogrid	208*
1C13275	Place Compacted Embankment below O/G	208
1C13300	Construct Earth Lining	97
1C13325	Place Compacted Embankment above O/G	10
1C13350	Place Embankment	28
1C13375	Trim Earth Lining	19
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 1,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	344*
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	140
1T12200	Install Tunnel Liner	40
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 1,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	884*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	90
1F15175	FREP Fish Screen Structure	540
1F15250	Install Mechanical & Electrical for Fish Screen	90
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3



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Data Date 01FEB16
Run Date 31MAR09 10:04

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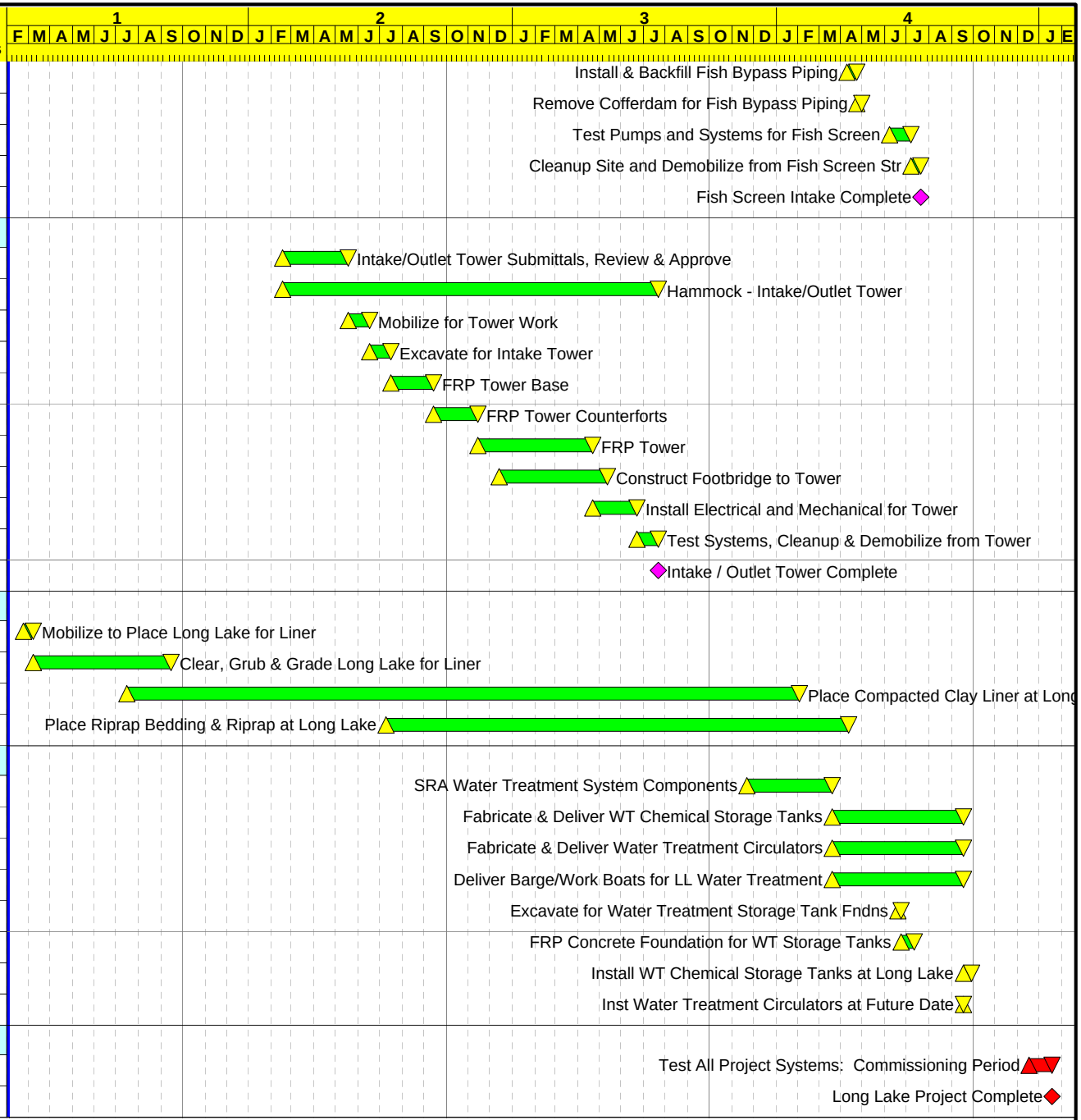
Early Bar
Progress Bar
Critical Activity

L1A1

Alternative No. 1, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 1A
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 month weather impact		
	each winter for canal work.		

Activity ID	Activity Description	Duration Cal Days
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 1,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	520*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	60
1T14100	FRP Tower Counterforts	60
1T14125	FRP Tower	160
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	10
1CL6120	Clear, Grub & Grade Long Lake for Liner	133
1CL6140	Place Compacted Clay Liner at Long Lake	650
1CL6160	Place Riprap Bedding & Riprap at Long Lake	450
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	5
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date 01FEB16
Finish Date 17JAN20
Data Date 01FEB16
Run Date 31MAR09 10:04

Early Bar
Progress Bar
Critical Activity

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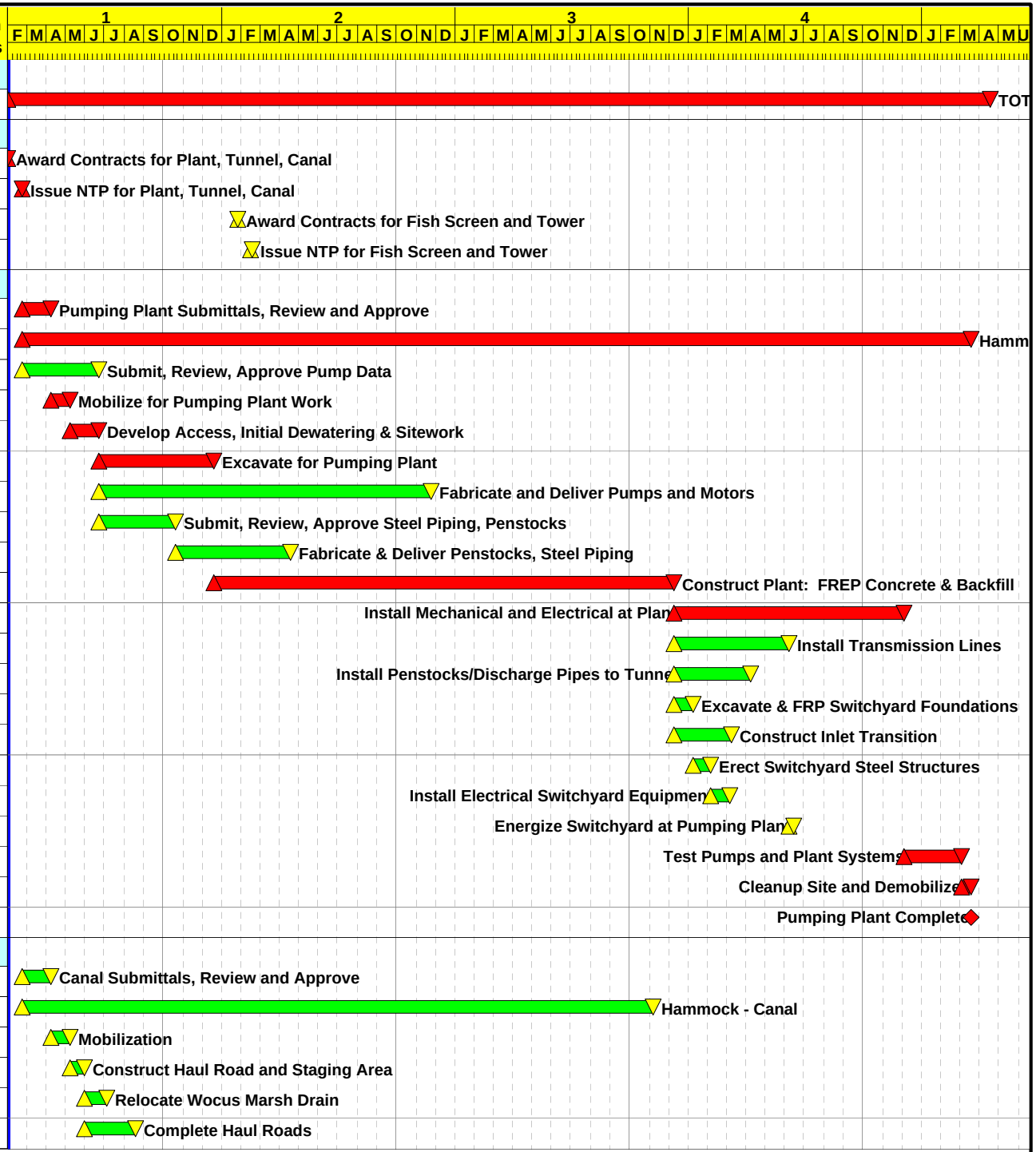
L1A1

Alternative No. 1, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 1A
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 month weather impact		
	each winter for canal work.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	TOTAL PROJECT DURATION - NTP TO COMPLETION	1,537*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping Plant - 2,000 cfs		
1PA1100	Pumping Plant Submittals, Review and Approve	45
HAMPP	Hammock - Pumping Plant	1,484*
1PA1125	Submit, Review, Approve Pump Data	120
1PA1150	Mobilize for Pumping Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping Plant	180
1PA1225	Fabricate and Deliver Pumps and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	720
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pumping Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping Plant Complete	0
Canal - 2,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
HAMC	Hammock - Canal	987*
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Relocate Wocus Marsh Drain	37
1C13075	Complete Haul Roads	82



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Data Date 01FEB16
Run Date 31MAR09 09:06

Early Bar
Progress Bar
Critical Activity

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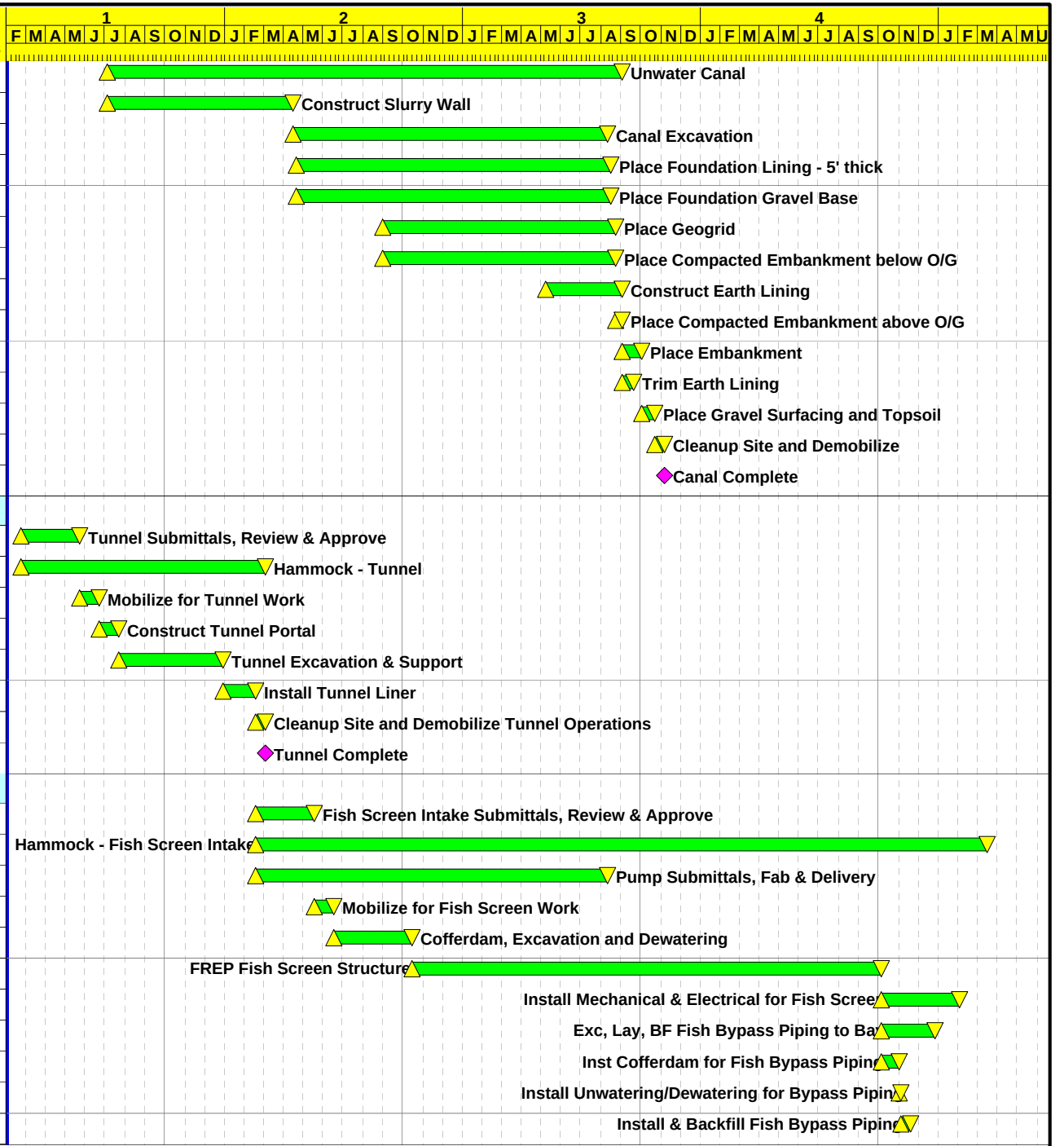
L1B2

Alternative No. 1, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 1B
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
1C13125	Unwater Canal	576*
1C13150	Construct Slurry Wall	177
1C13175	Canal Excavation	378
1C13200	Place Foundation Lining - 5' thick	375
1C13225	Place Foundation Gravel Base	375*
1C13250	Place Geogrid	250*
1C13275	Place Compacted Embankment below O/G	250
1C13300	Construct Earth Lining	116
1C13325	Place Compacted Embankment above O/G	10
1C13350	Place Embankment	32
1C13375	Trim Earth Lining	19
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 2,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	374*
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	160
1T12200	Install Tunnel Liner	50
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 2,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	1,124*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	120
1F15175	FREP Fish Screen Structure	720
1F15250	Install Mechanical & Electrical for Fish Screen	120
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15



Start Date 01FEB16
Finish Date 16APR20
Data Date 01FEB16
Run Date 31MAR09 09:06

Early Bar
Progress Bar
Critical Activity

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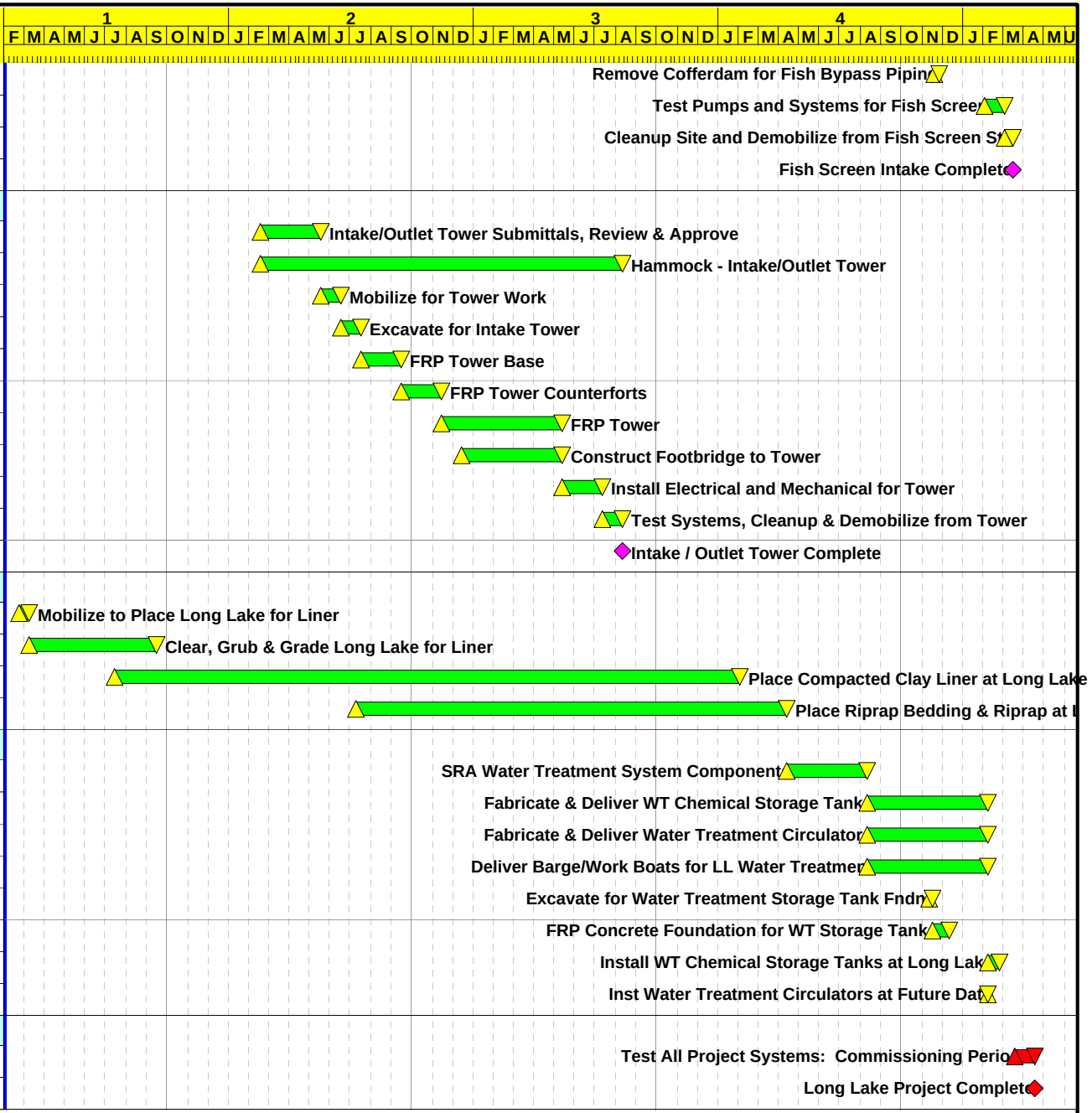
L1B2

Alternative No. 1, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 1B
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 2,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	540*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	60
1T14100	FRP Tower Counterforts	60
1T14125	FRP Tower	180
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	10
1CL6120	Clear, Grub & Grade Long Lake for Liner	133
1CL6140	Place Compacted Clay Liner at Long Lake	650
1CL6160	Place Riprap Bedding & Riprap at Long Lake	450
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	5
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date 01FEB16
Finish Date 16APR20
Data Date 01FEB16
Run Date 31MAR09 09:06

Early Bar
Progress Bar
Critical Activity

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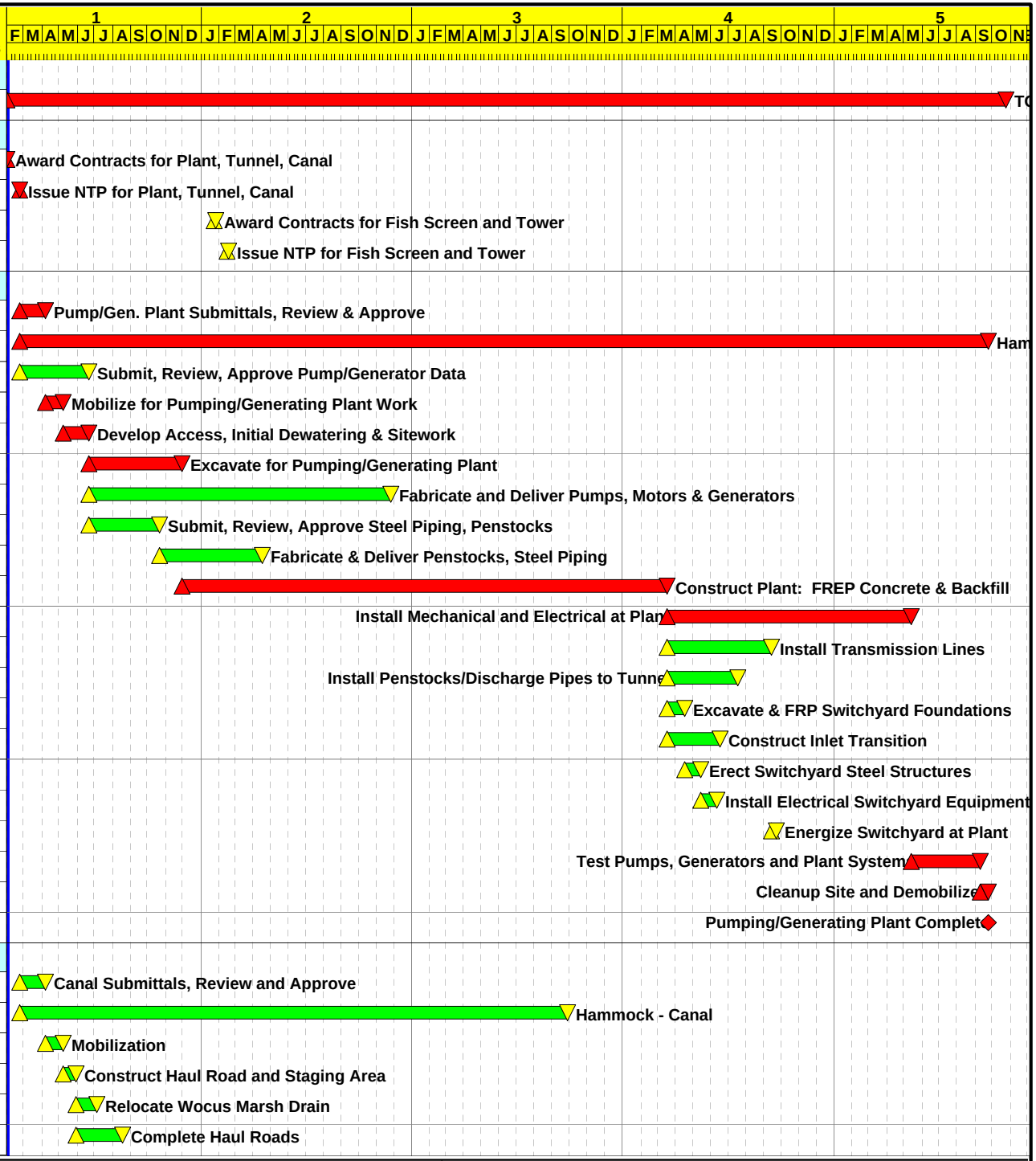
L1B2

Alternative No. 1, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 1B
Summary Construction Schedule

Sheet 3 of 3

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	TOTAL PROJECT DURATION - NTP TO COMPLETION	1,727*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping and Generating Plant - 1,000 cfs		
1PA1100	Pump/Gen. Plant Submittals, Review & Approve	45
HAMPP	Hammock - Pumping Plant	1,674*
1PA1125	Submit, Review, Approve Pump/Generator Data	120
1PA1150	Mobilize for Pumping/Generating Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping/Generating Plant	160
1PA1225	Fabricate and Deliver Pumps, Motors & Generators	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	840
1PA1375	Install Mechanical and Electrical at Plant	420
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Plant	7
1PA1575	Test Pumps, Generators and Plant Systems	120
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping/Generating Plant Complete	0
Canal - 1,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
HAMC	Hammock - Canal	946*
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Relocate Wocus Marsh Drain	37
1C13075	Complete Haul Roads	82



Start Date 01FEB16
Finish Date 23OCT20
Data Date 01FEB16
Run Date 31MAR09 09:07

Early Bar
Progress Bar
Critical Activity

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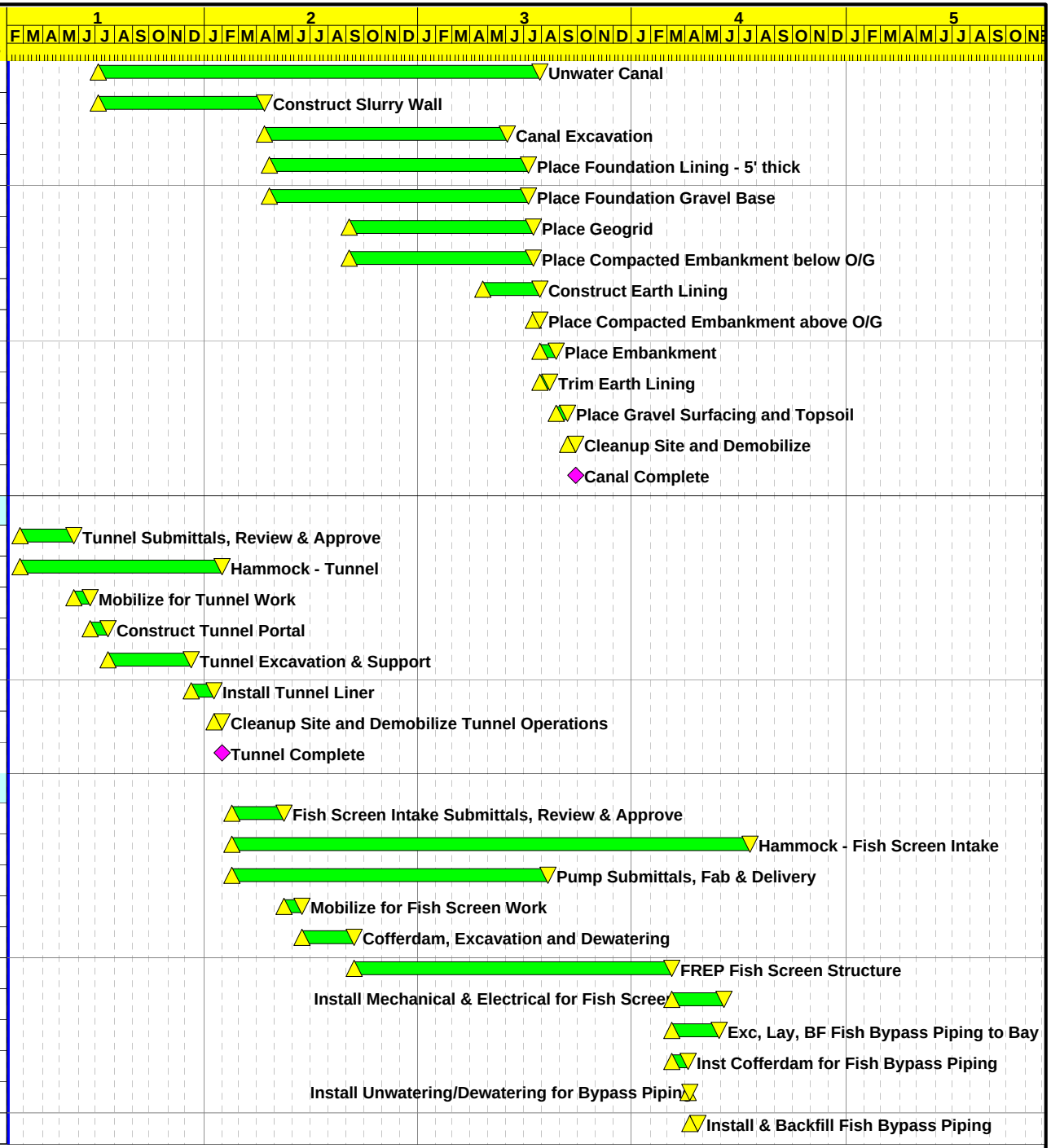
L1C1

Alternative No. 1, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 1C
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assumed 3.5 months of weather impact		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
1C13125	Unwater Canal	539*
1C13150	Construct Slurry Wall	177
1C13175	Canal Excavation	307
1C13200	Place Foundation Lining - 5' thick	338
1C13225	Place Foundation Gravel Base	338*
1C13250	Place Geogrid	208*
1C13275	Place Compacted Embankment below O/G	208
1C13300	Construct Earth Lining	97
1C13325	Place Compacted Embankment above O/G	10
1C13350	Place Embankment	28
1C13375	Trim Earth Lining	19
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 1,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	344*
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	140
1T12200	Install Tunnel Liner	40
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 1,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	884*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	90
1F15175	FREP Fish Screen Structure	540
1F15250	Install Mechanical & Electrical for Fish Screen	90
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15



Start Date	01FEB16
Finish Date	23OCT20
Data Date	01FEB16
Run Date	31MAR09 09:07

Early Bar
Progress Bar
Critical Activity

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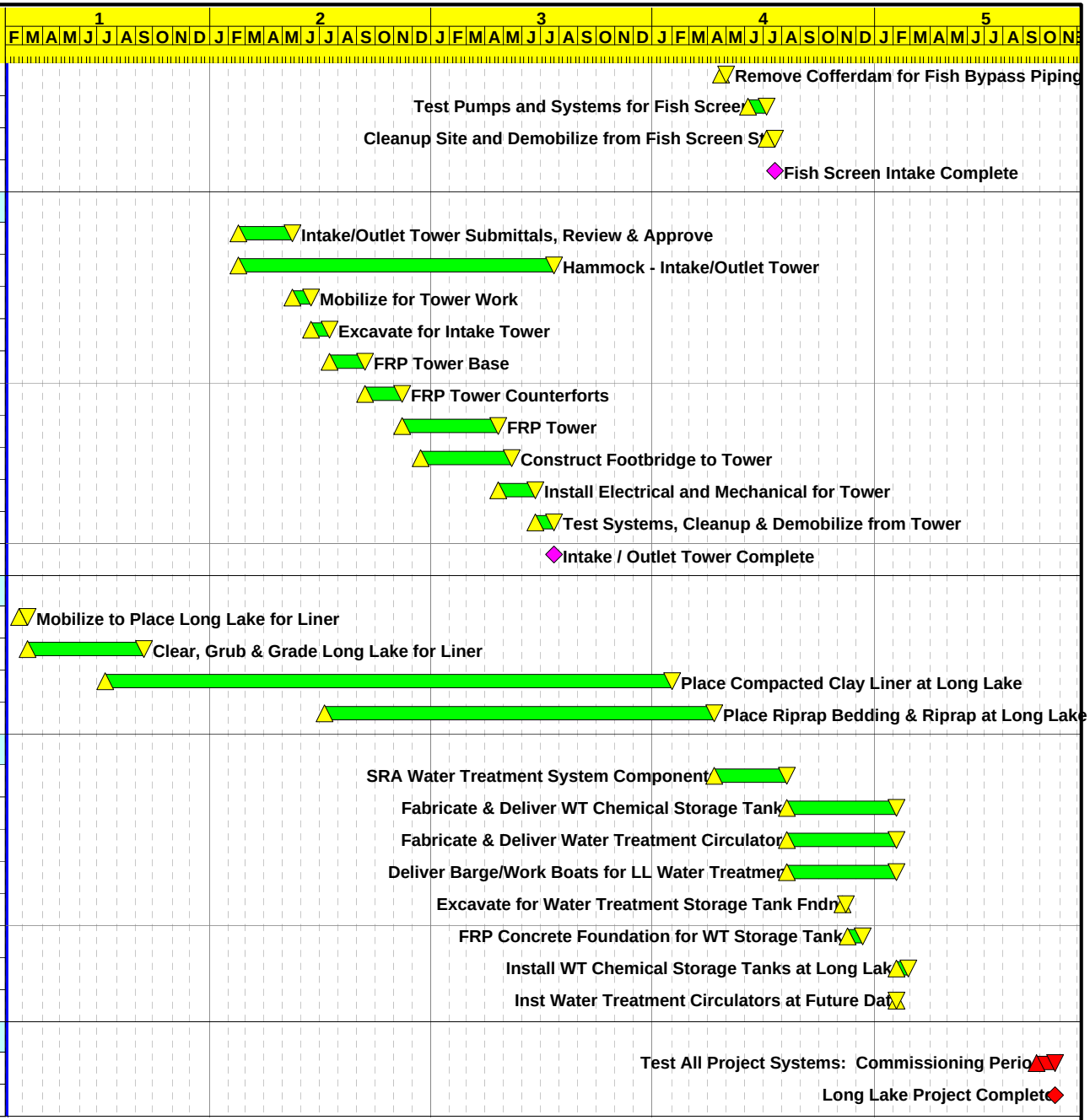
L1C1

Alternative No. 1, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 1C
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assumed 3.5 months of weather impact		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 1,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	520*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	60
1T14100	FRP Tower Counterforts	60
1T14125	FRP Tower	160
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	10
1CL6120	Clear, Grub & Grade Long Lake for Liner	133
1CL6140	Place Compacted Clay Liner at Long Lake	650
1CL6160	Place Riprap Bedding & Riprap at Long Lake	450
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	5
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date 01FEB16
Finish Date 23OCT20
Data Date 01FEB16
Run Date 31MAR09 09:07

Early Bar
Progress Bar
Critical Activity

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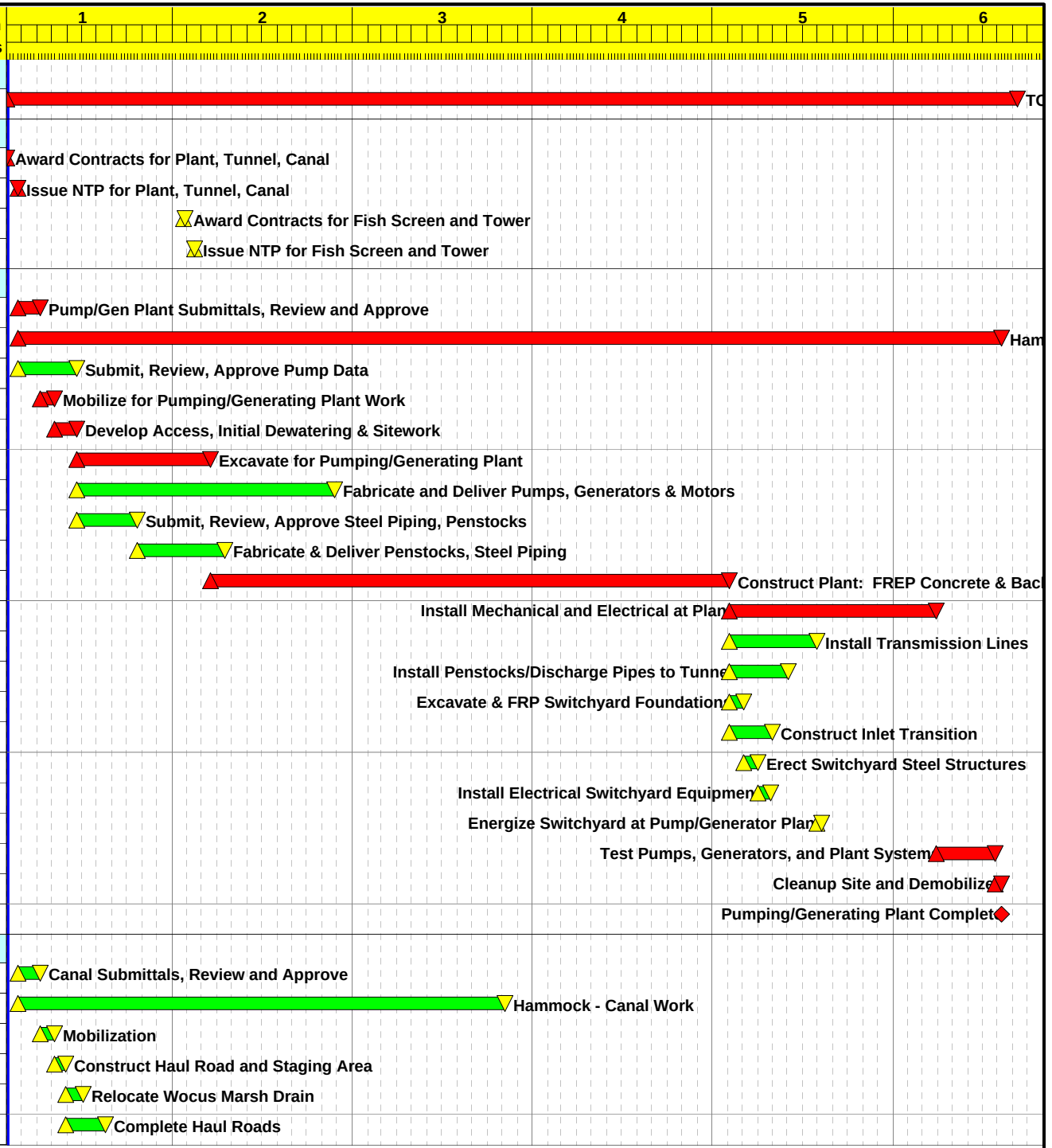
L1C1

Alternative No. 1, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 1C
Summary Construction Schedule

Sheet 3 of 3

Date	Revision	Checked	Approved
	NOTE: Assumed 3.5 months of weather impact		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	TOTAL PROJECT DURATION - NTP TO	2,047*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping and Generating Plant - 2,000 cfs		
1PA1100	Pump/Gen Plant Submittals, Review and Approve	45
HAMPP	Hammock - Pumping Plant, Switchyard & Penstocks	1,994*
1PA1125	Submit, Review, Approve Pump Data	120
1PA1150	Mobilize for Pumping/Generating Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping/Generating Plant	270
1PA1225	Fabricate and Deliver Pumps, Generators & Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	1,050
1PA1375	Install Mechanical and Electrical at Plant	420
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pump/Generator Plant	7
1PA1575	Test Pumps, Generators, and Plant Systems	120
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping/Generating Plant Complete	0
Canal - 2,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
HAMC	Hammock - Canal Work	987*
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Relocate Wocus Marsh Drain	37
1C13075	Complete Haul Roads	82



Start Date 01FEB16
Finish Date 08SEP21
Data Date 01FEB16
Run Date 27MAR09 15:38

Early Bar
Progress Bar
Critical Activity

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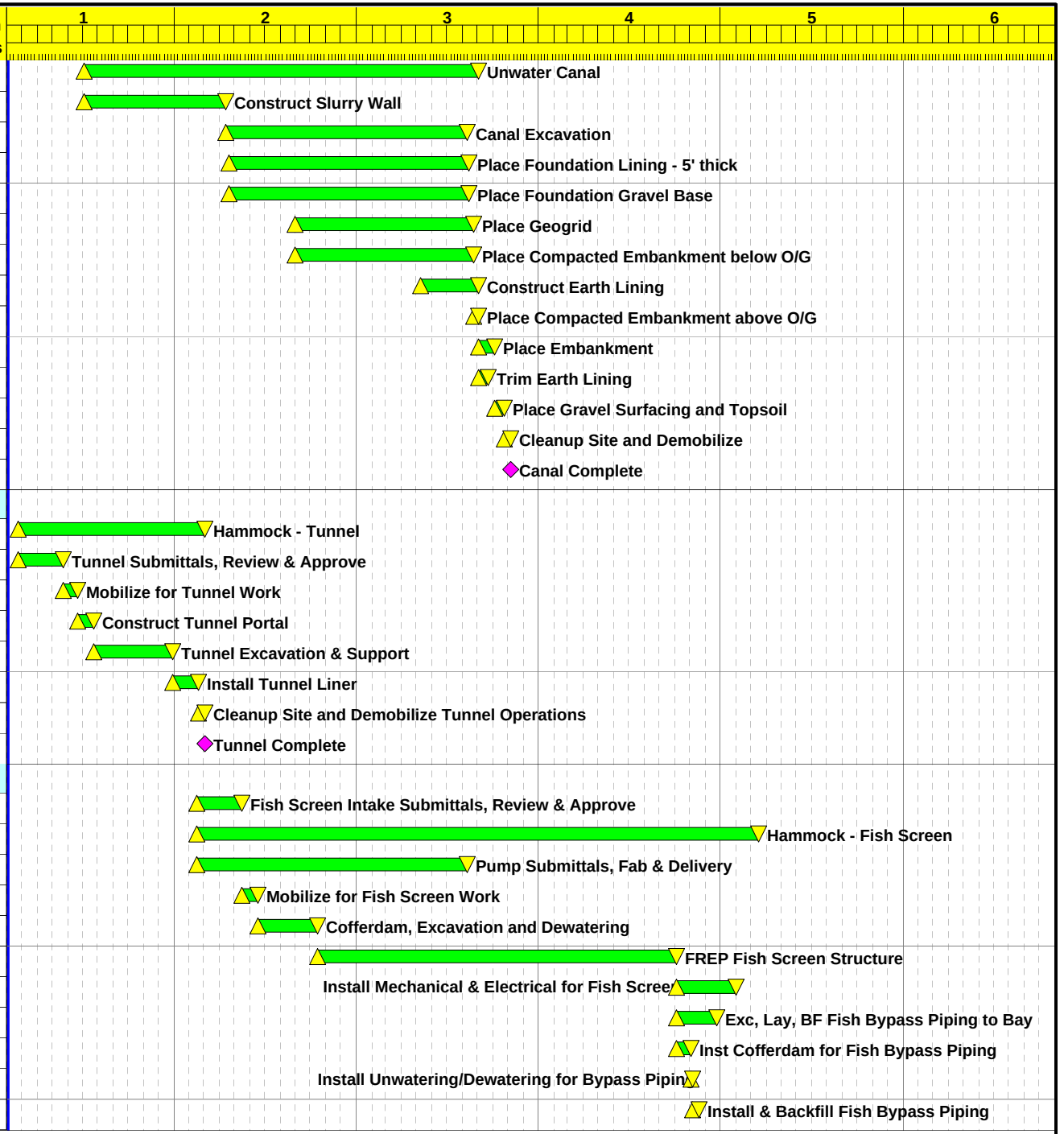
L1D2

Alternative No. 1, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 1D
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impact		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
1C13125	Unwater Canal	576*
1C13150	Construct Slurry Wall	177
1C13175	Canal Excavation	378
1C13200	Place Foundation Lining - 5' thick	375
1C13225	Place Foundation Gravel Base	375*
1C13250	Place Geogrid	250*
1C13275	Place Compacted Embankment below O/G	250
1C13300	Construct Earth Lining	116
1C13325	Place Compacted Embankment above O/G	10
1C13350	Place Embankment	32
1C13375	Trim Earth Lining	19
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 2,000 cfs		
HAMT	Hammock - Tunnel	374*
1T12100	Tunnel Submittals, Review & Approve	90
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	160
1T12200	Install Tunnel Liner	50
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 2,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen	1,124*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	120
1F15175	FREP Fish Screen Structure	720
1F15250	Install Mechanical & Electrical for Fish Screen	120
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15



Start Date	01FEB16
Finish Date	08SEP21
Data Date	01FEB16
Run Date	27MAR09 15:38

Early Bar
Progress Bar
Critical Activity

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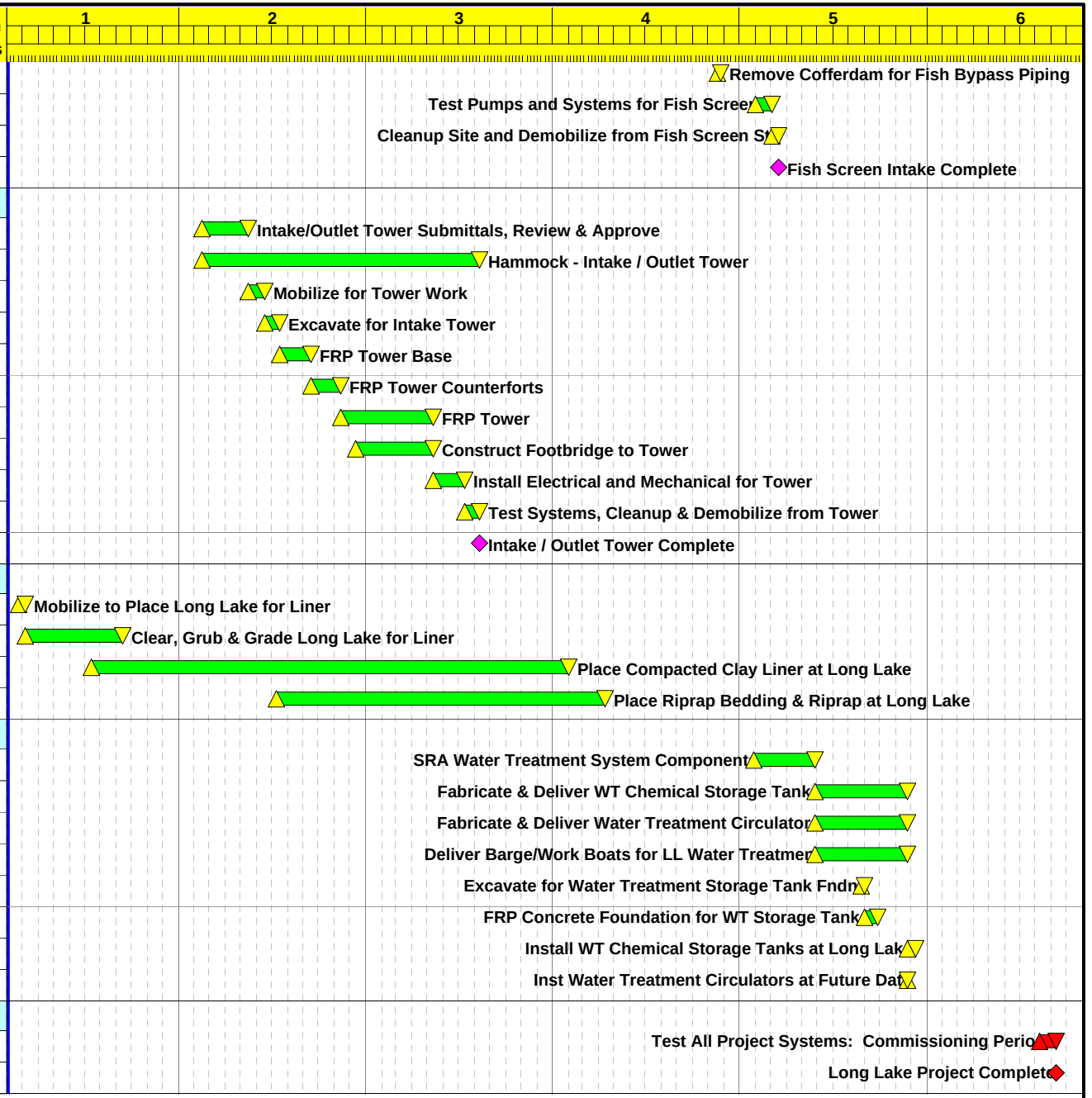
L1D2

Alternative No. 1, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 1D
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impact		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 2,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake / Outlet Tower	540*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	60
1T14100	FRP Tower Counterforts	60
1T14125	FRP Tower	180
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	10
1CL6120	Clear, Grub & Grade Long Lake for Liner	133
1CL6140	Place Compacted Clay Liner at Long Lake	650
1CL6160	Place Riprap Bedding & Riprap at Long Lake	450
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	5
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date 01FEB16
Finish Date 08SEP21
Data Date 01FEB16
Run Date 27MAR09 15:38

Early Bar
Progress Bar
Critical Activity

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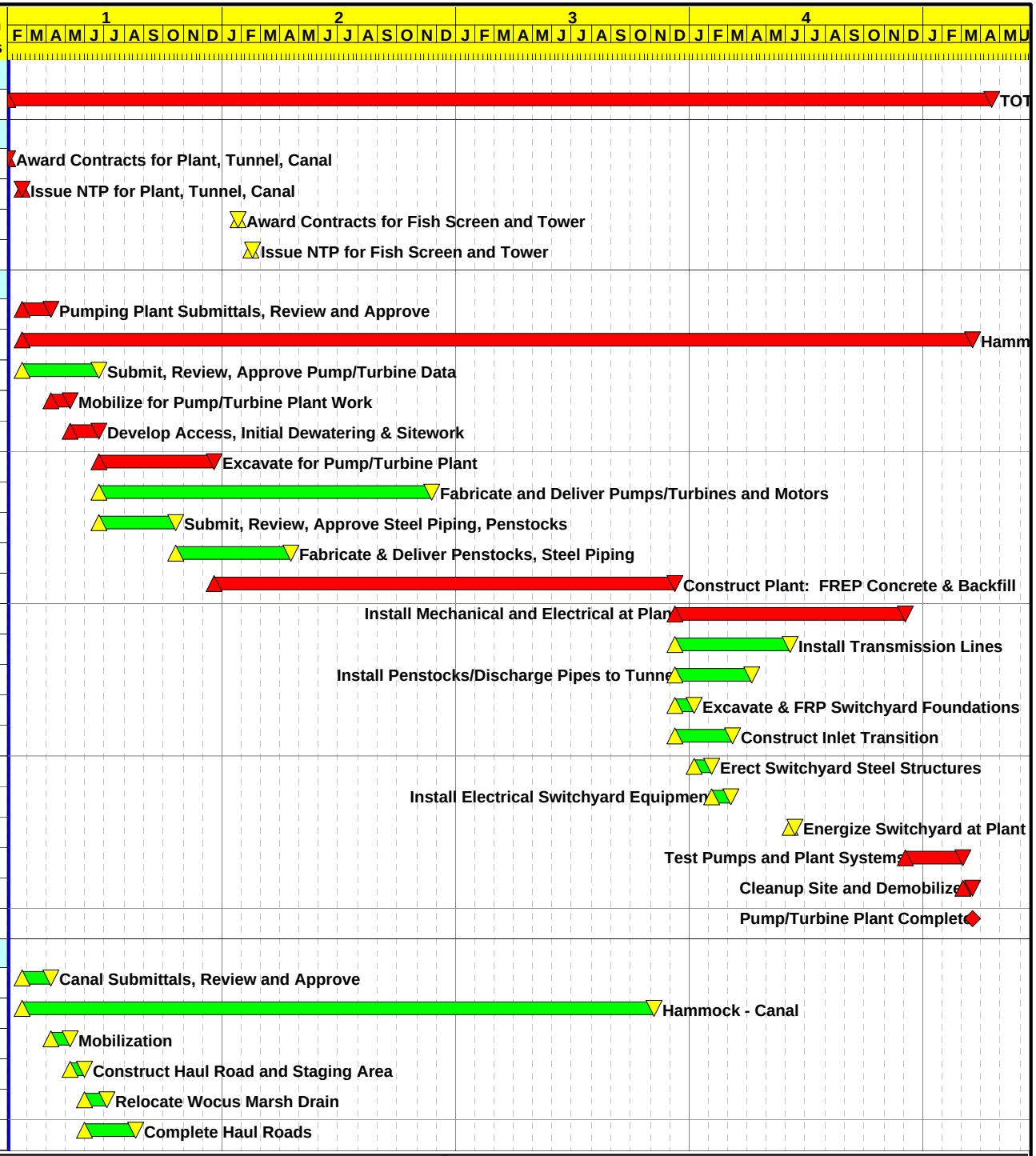
L1D2

Alternative No. 1, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 1D
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impact		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	TOTAL PROJECT DURATION - NTP TO COMPLETION	1,537*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pump/Turbine Plant - 2,000 cfs		
1PA1100	Pumping Plant Submittals, Review and Approve	45
HAMPP	Hammock - Pumping Plant	1,484*
1PA1125	Submit, Review, Approve Pump/Turbine Data	120
1PA1150	Mobilize for Pump/Turbine Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pump/Turbine Plant	180
1PA1225	Fabricate and Deliver Pumps/Turbines and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	720
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pump/Turbine Plant Complete	0
Canal - 2,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
HAMC	Hammock - Canal	987*
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Relocate Wocus Marsh Drain	37
1C13075	Complete Haul Roads	82



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Run Date 31MAR09 09:08

Early Bar
Progress Bar
Critical Activity

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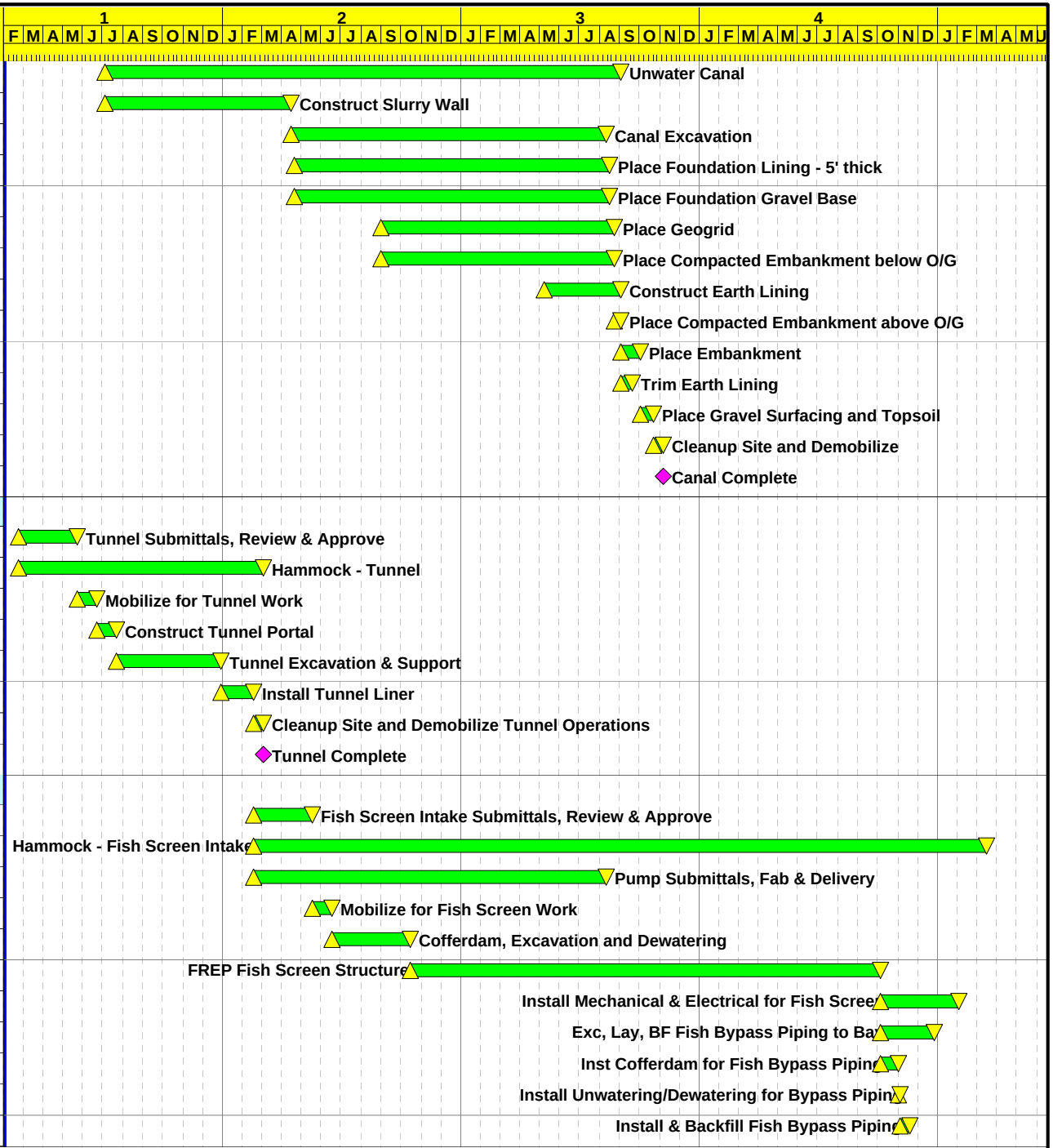
L1E2

Alternative No. 1, Option E
(2,000 cfs Pump/Turbine Plant)
Long Lake Valley - 1E
Summary Construction Schedule

Sheet 1 of 3

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
1C13125	Unwater Canal	576*
1C13150	Construct Slurry Wall	177
1C13175	Canal Excavation	378
1C13200	Place Foundation Lining - 5' thick	375
1C13225	Place Foundation Gravel Base	375*
1C13250	Place Geogrid	250*
1C13275	Place Compacted Embankment below O/G	250
1C13300	Construct Earth Lining	116
1C13325	Place Compacted Embankment above O/G	10
1C13350	Place Embankment	32
1C13375	Trim Earth Lining	19
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 2,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	374*
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	160
1T12200	Install Tunnel Liner	50
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 2,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	1,124*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	120
1F15175	FREP Fish Screen Structure	720
1F15250	Install Mechanical & Electrical for Fish Screen	120
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15



Start Date 01FEB16
Finish Date 16APR20
Data Date 01FEB16
Run Date 31MAR09 09:08

Early Bar
Progress Bar
Critical Activity

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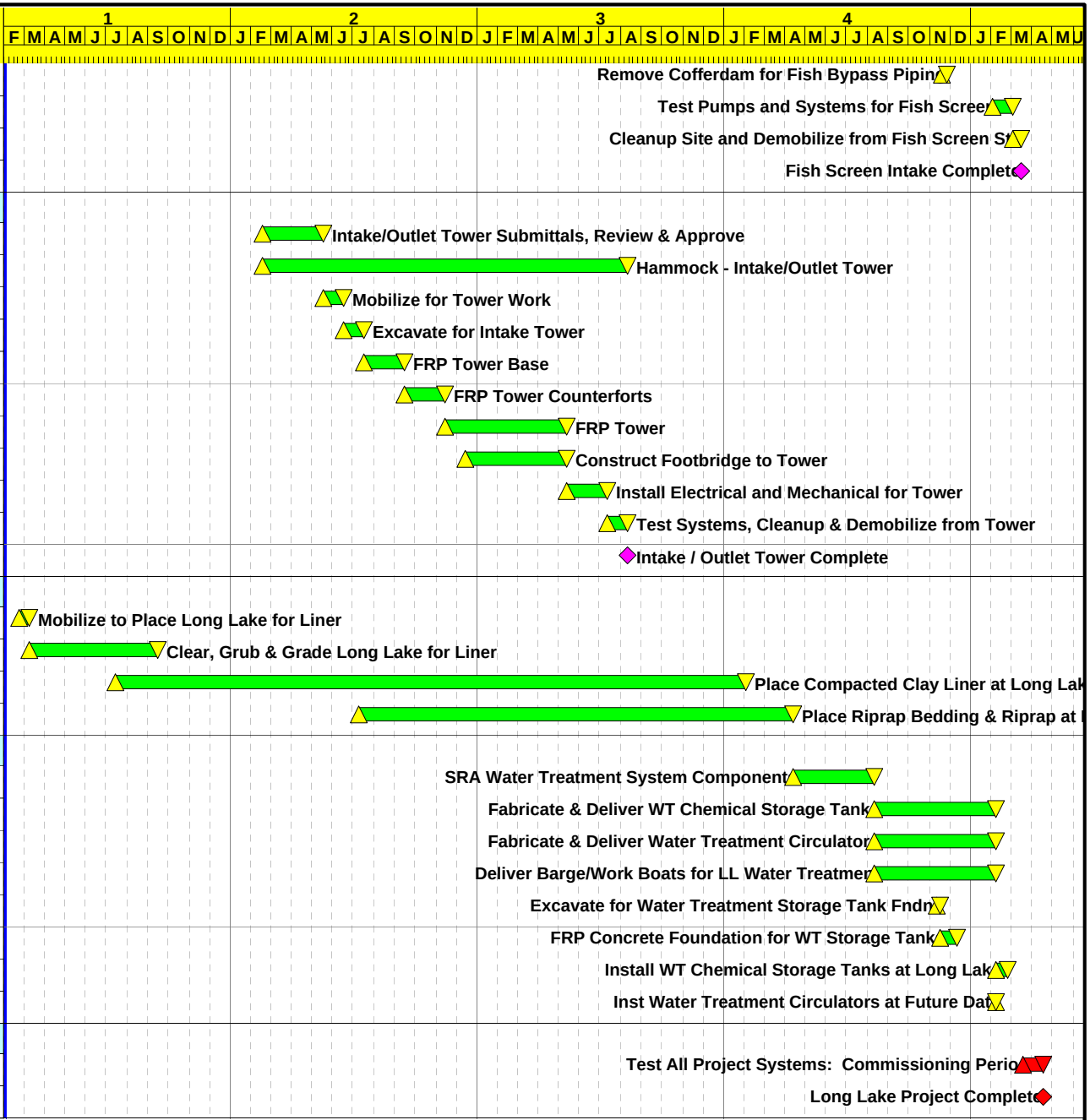
L1E2

Alternative No. 1, Option E
(2,000 cfs Pump/Turbine Plant)
Long Lake Valley - 1E
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 2,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	540*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	60
1T14100	FRP Tower Counterforts	60
1T14125	FRP Tower	180
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	10
1CL6120	Clear, Grub & Grade Long Lake for Liner	133
1CL6140	Place Compacted Clay Liner at Long Lake	650
1CL6160	Place Riprap Bedding & Riprap at Long Lake	450
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	5
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



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Early Bar
Progress Bar
Critical Activity

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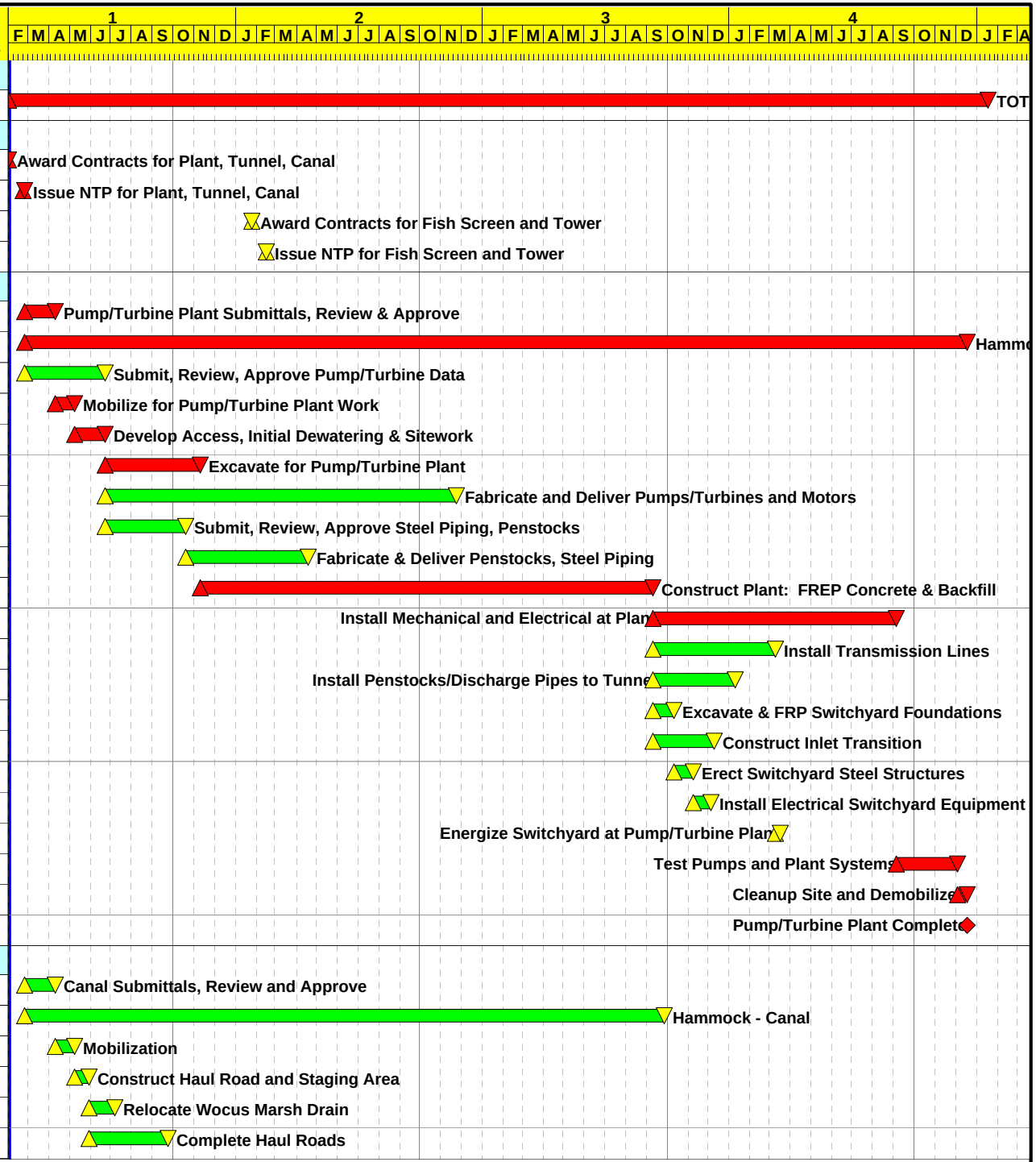
L1E2

Alternative No. 1, Option E
(2,000 cfs Pump/Turbine Plant)
Long Lake Valley - 1E
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	TOTAL PROJECT DURATION - NTP TO COMPLETION	1,447*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pump/Turbine Plant - 1,000 cfs		
1PA1100	Pump/Turbine Plant Submittals, Review & Approve	45
HAMPP	Hammock - Pumping Plant	1,394*
1PA1125	Submit, Review, Approve Pump/Turbine Data	120
1PA1150	Mobilize for Pump/Turbine Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pump/Turbine Plant	140
1PA1225	Fabricate and Deliver Pumps/Turbines and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	670
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pump/Turbine Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pump/Turbine Plant Complete	0
Canal - 1,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
HAMC	Hammock - Canal	946*
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Relocate Wocus Marsh Drain	37
1C13075	Complete Haul Roads	82



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Early Bar
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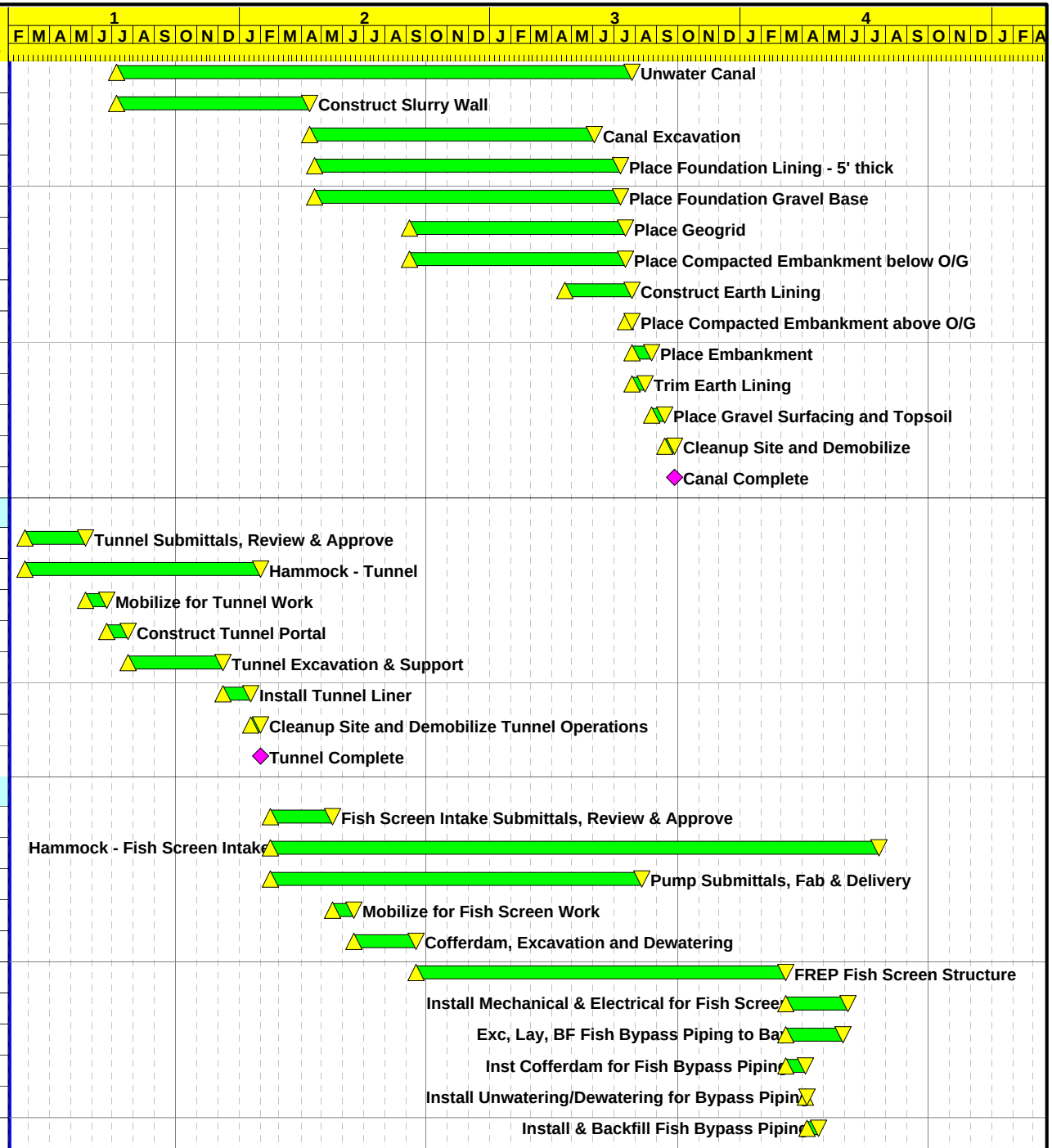
L1F1

Alternative No. 1, Option F
(1,000 cfs Pump/Turbine Plant)
Long Lake Valley - 1F
Summary Construction Schedule

Sheet 1 of 3

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
1C13125	Unwater Canal	539*
1C13150	Construct Slurry Wall	177
1C13175	Canal Excavation	307
1C13200	Place Foundation Lining - 5' thick	338
1C13225	Place Foundation Gravel Base	338*
1C13250	Place Geogrid	208*
1C13275	Place Compacted Embankment below O/G	208
1C13300	Construct Earth Lining	97
1C13325	Place Compacted Embankment above O/G	10
1C13350	Place Embankment	28
1C13375	Trim Earth Lining	19
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 1,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	344*
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	140
1T12200	Install Tunnel Liner	40
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 1,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	884*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	90
1F15175	FREP Fish Screen Structure	540
1F15250	Install Mechanical & Electrical for Fish Screen	90
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15



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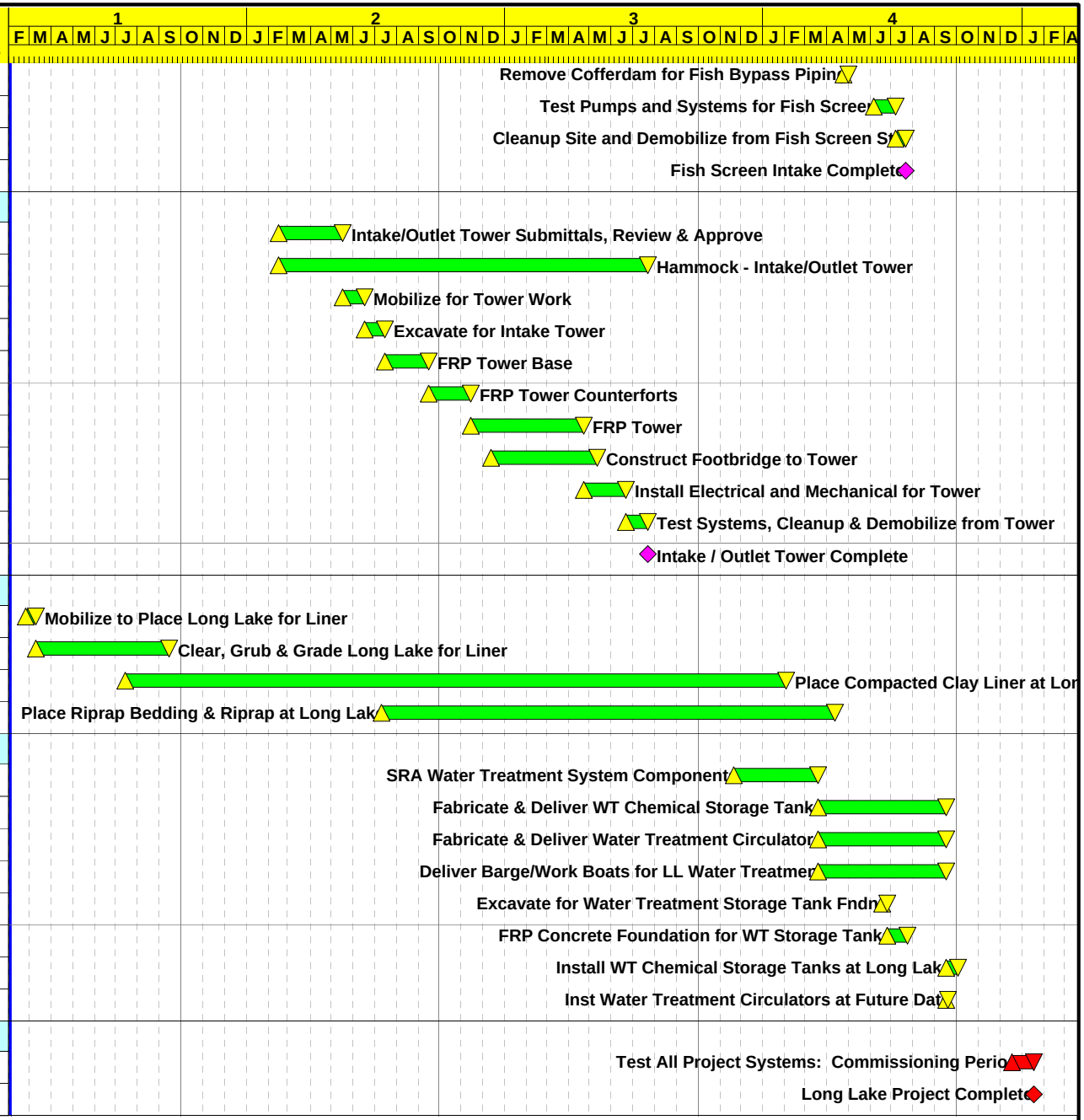
L1F1

Alternative No. 1, Option F
(1,000 cfs Pump/Turbine Plant)
Long Lake Valley - 1F
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 1,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	520*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	60
1T14100	FRP Tower Counterforts	60
1T14125	FRP Tower	160
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	10
1CL6120	Clear, Grub & Grade Long Lake for Liner	133
1CL6140	Place Compacted Clay Liner at Long Lake	650
1CL6160	Place Riprap Bedding & Riprap at Long Lake	450
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	5
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



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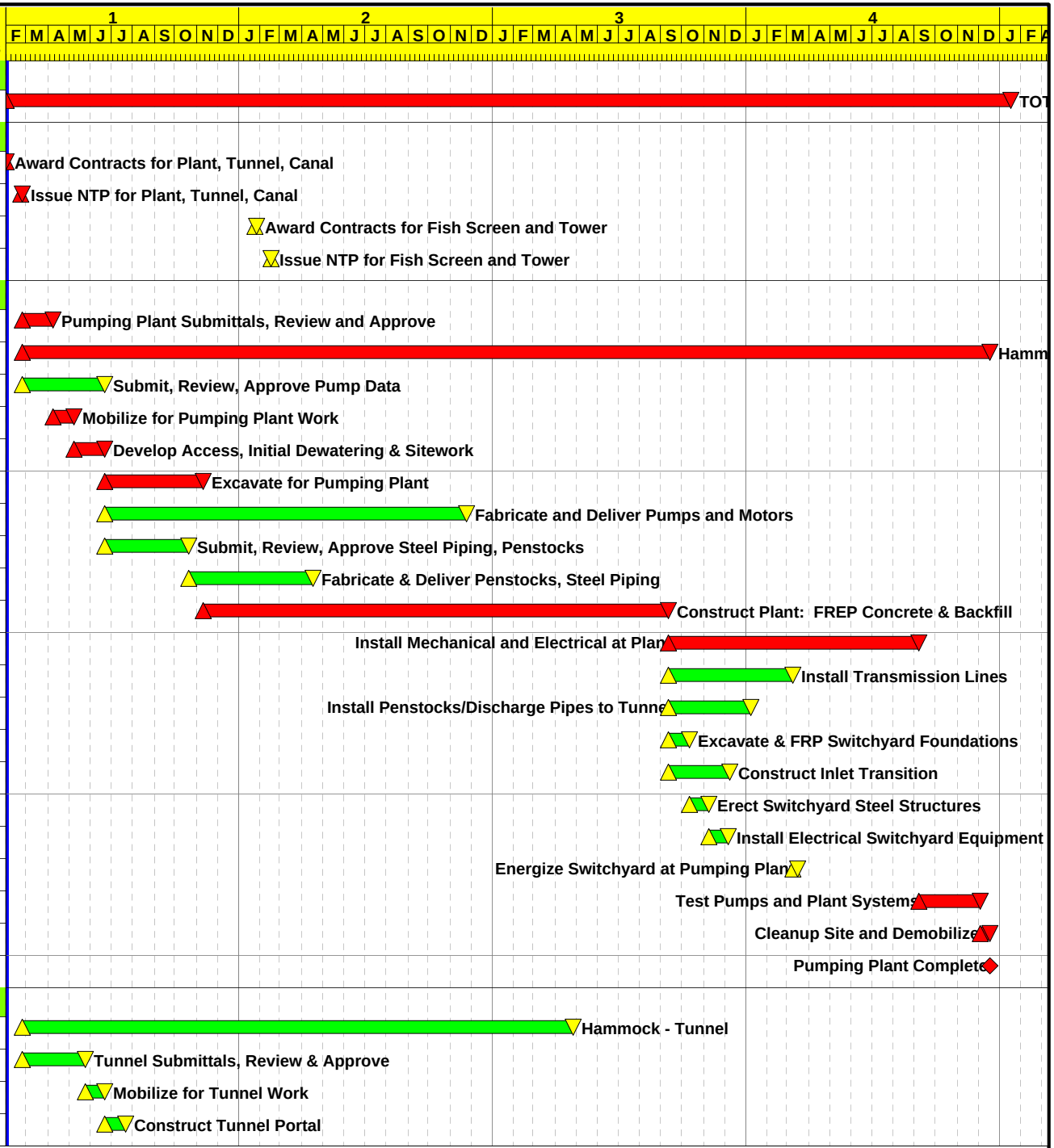
L1F1

Alternative No. 1, Option F
(1,000 cfs Pump/Turbine Plant)
Long Lake Valley - 1F
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	TOTAL PROJECT DURATION - NTP TO	1,447*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping Plant - 1,000 cfs		
1PA1100	Pumping Plant Submittals, Review and Approve	45
HAMPP	Hammock - Pumping Plant, Switchyard & Penstocks	1,394*
1PA1125	Submit, Review, Approve Pump Data	120
1PA1150	Mobilize for Pumping Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping Plant	140
1PA1225	Fabricate and Deliver Pumps and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	670
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pumping Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping Plant Complete	0
Tunnel - 1,000 cfs		
HAMT	Hammock - Tunnel	794*
1T12100	Tunnel Submittals, Review & Approve	90
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30



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Run Date 27MAR09 15:50

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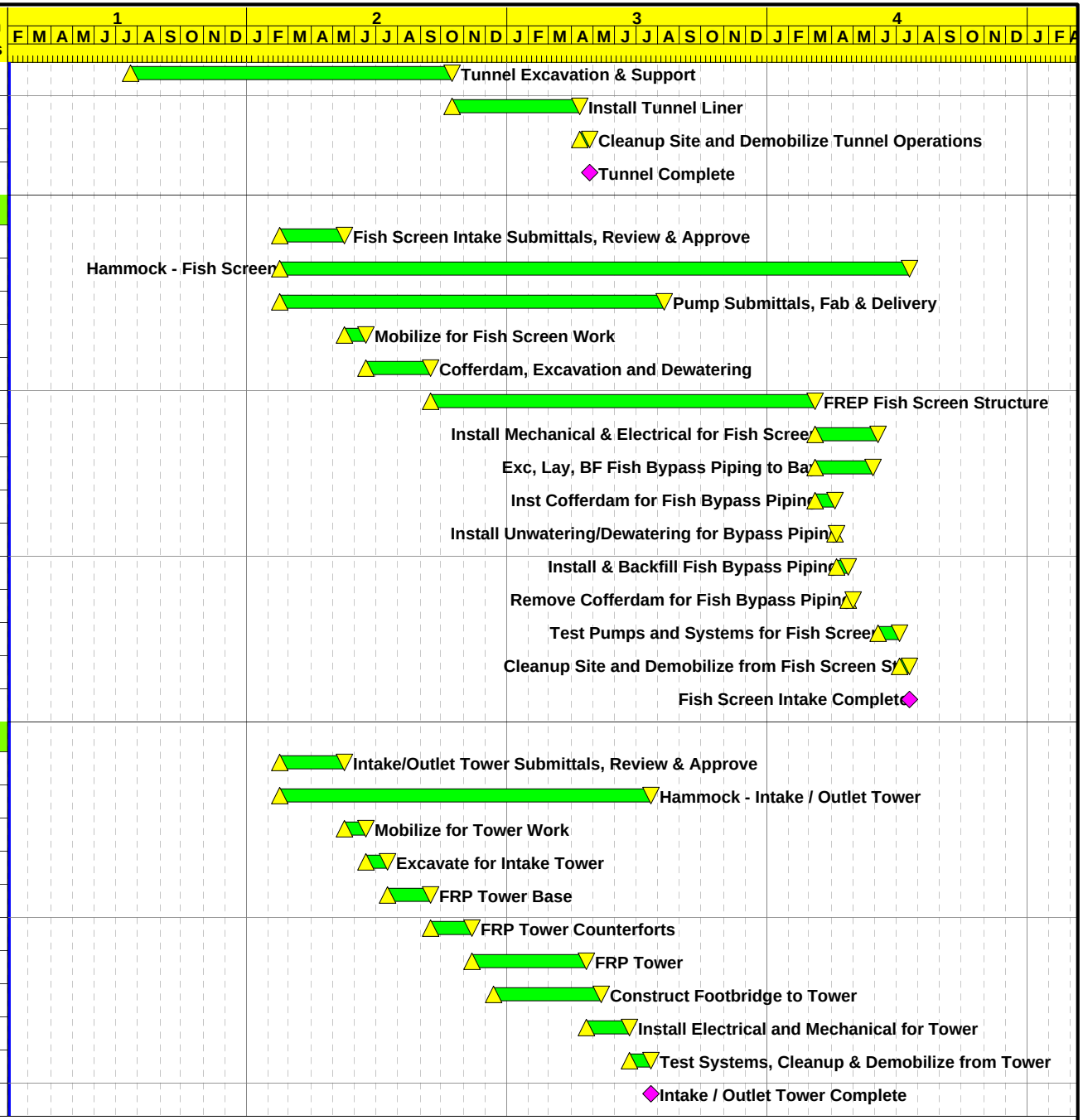
L2A1 Sheet 1 of 3

Alternative No. 2, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 2A
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
1T12175	Tunnel Excavation & Support	450
1T12200	Install Tunnel Liner	180
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 1,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen	884*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	90
1F15175	FREP Fish Screen Structure	540
1F15250	Install Mechanical & Electrical for Fish Screen	90
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 1,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake / Outlet Tower	520*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	60
1T14100	FRP Tower Counterforts	60
1T14125	FRP Tower	160
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0



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Finish Date	17JAN20
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Early Bar
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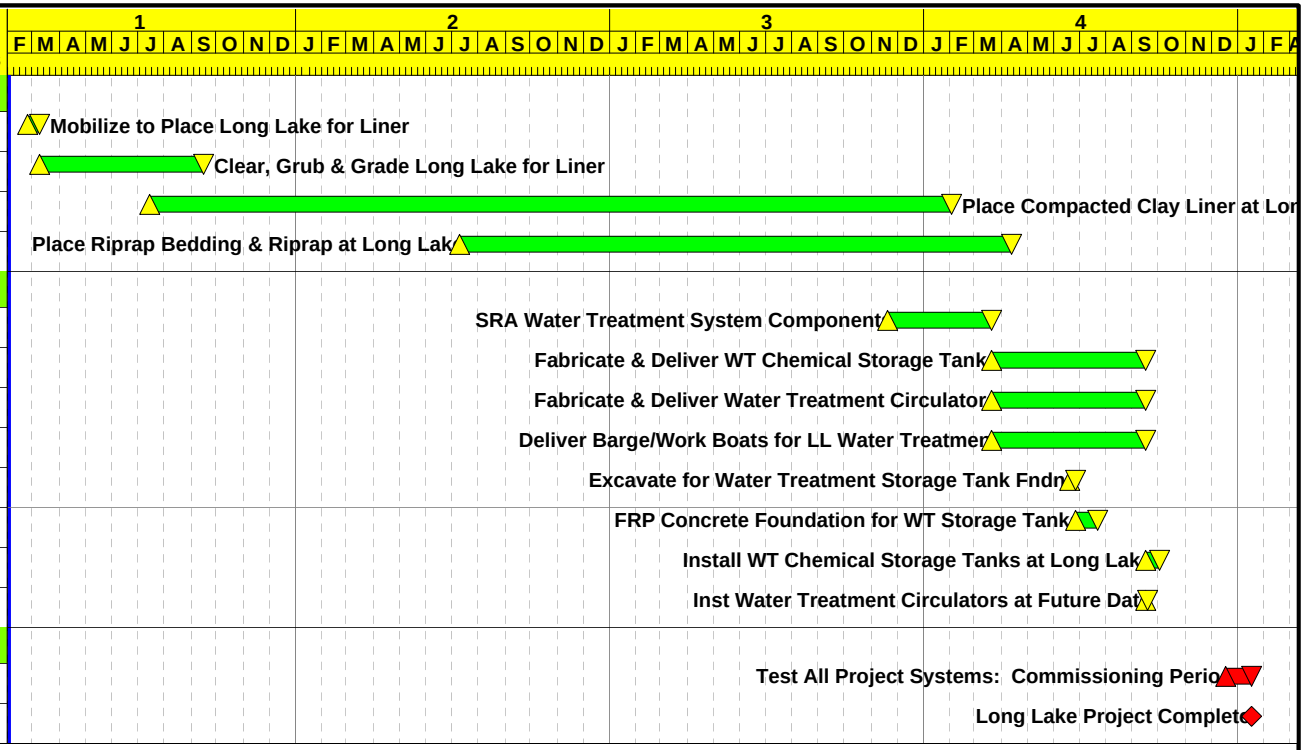
L2A1

Sheet 2 of 3

Alternative No. 2, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 2A
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	10
1CL6120	Clear, Grub & Grade Long Lake for Liner	133
1CL6140	Place Compacted Clay Liner at Long Lake	650
1CL6160	Place Riprap Bedding & Riprap at Long Lake	450
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	5
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



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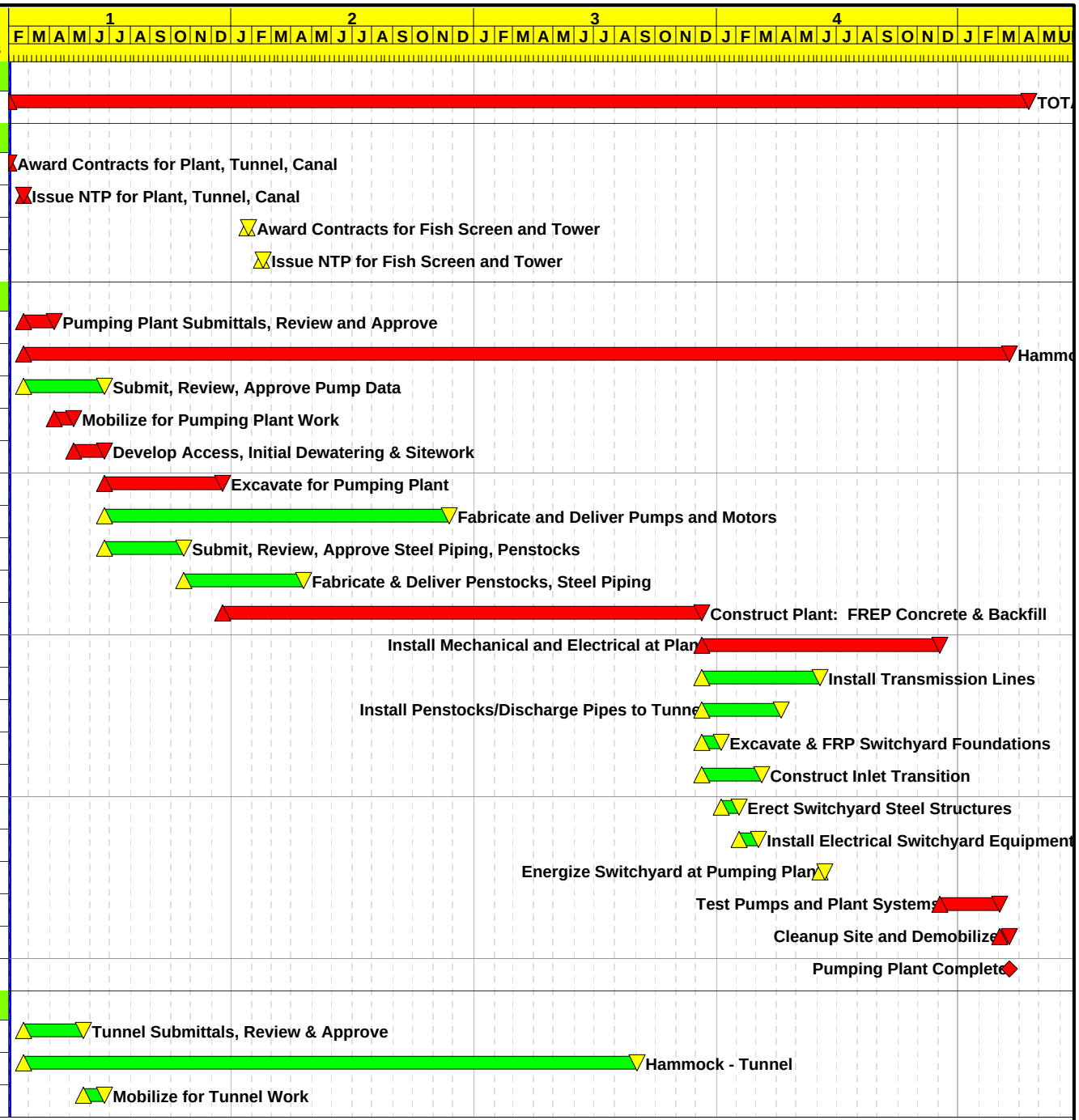
Sheet 3 of 3

Alternative No. 2, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 2A
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	TOTAL PROJECT DURATION - NTP TO	1,537*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping Plant - 2,000 cfs		
1PA1100	Pumping Plant Submittals, Review and Approve	45
HAMPP	Hammock - Pumping Plant	1,484*
1PA1125	Submit, Review, Approve Pump Data	120
1PA1150	Mobilize for Pumping Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping Plant	180
1PA1225	Fabricate and Deliver Pumps and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	720
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pumping Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping Plant Complete	0
Tunnel - 2,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	924*
1T12125	Mobilize for Tunnel Work	30



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Data Date 01FEB16
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Early Bar
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Critical Activity

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L2B2

Sheet 1 of 3

Alternative No. 2, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 2B
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	530
1T12200	Install Tunnel Liner	230
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 2,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	1,124*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	120
1F15175	FREP Fish Screen Structure	720
1F15250	Install Mechanical & Electrical for Fish Screen	120
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 2,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	540*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	60
1T14100	FRP Tower Counterforts	60
1T14125	FRP Tower	180
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0



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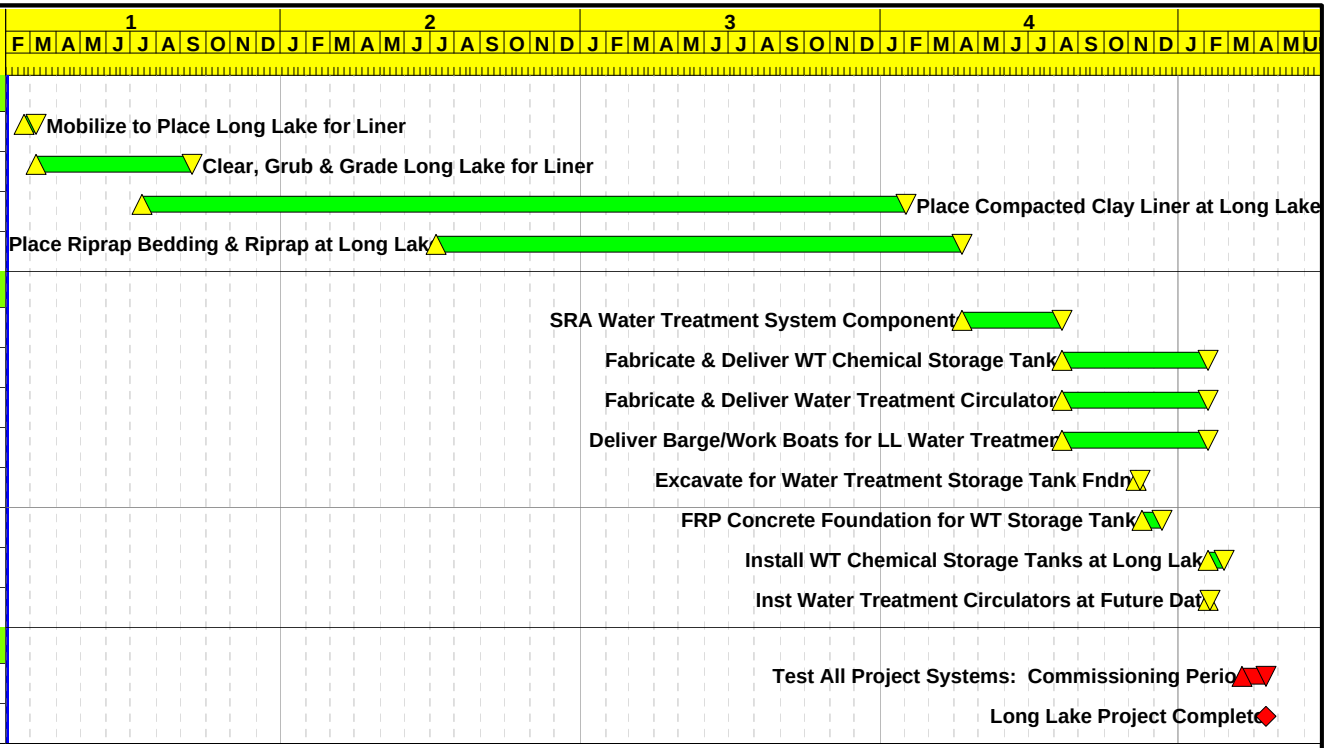
L2B2

Sheet 2 of 3

Alternative No. 2, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 2B
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	10
1CL6120	Clear, Grub & Grade Long Lake for Liner	133
1CL6140	Place Compacted Clay Liner at Long Lake	650
1CL6160	Place Riprap Bedding & Riprap at Long Lake	450
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	5
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



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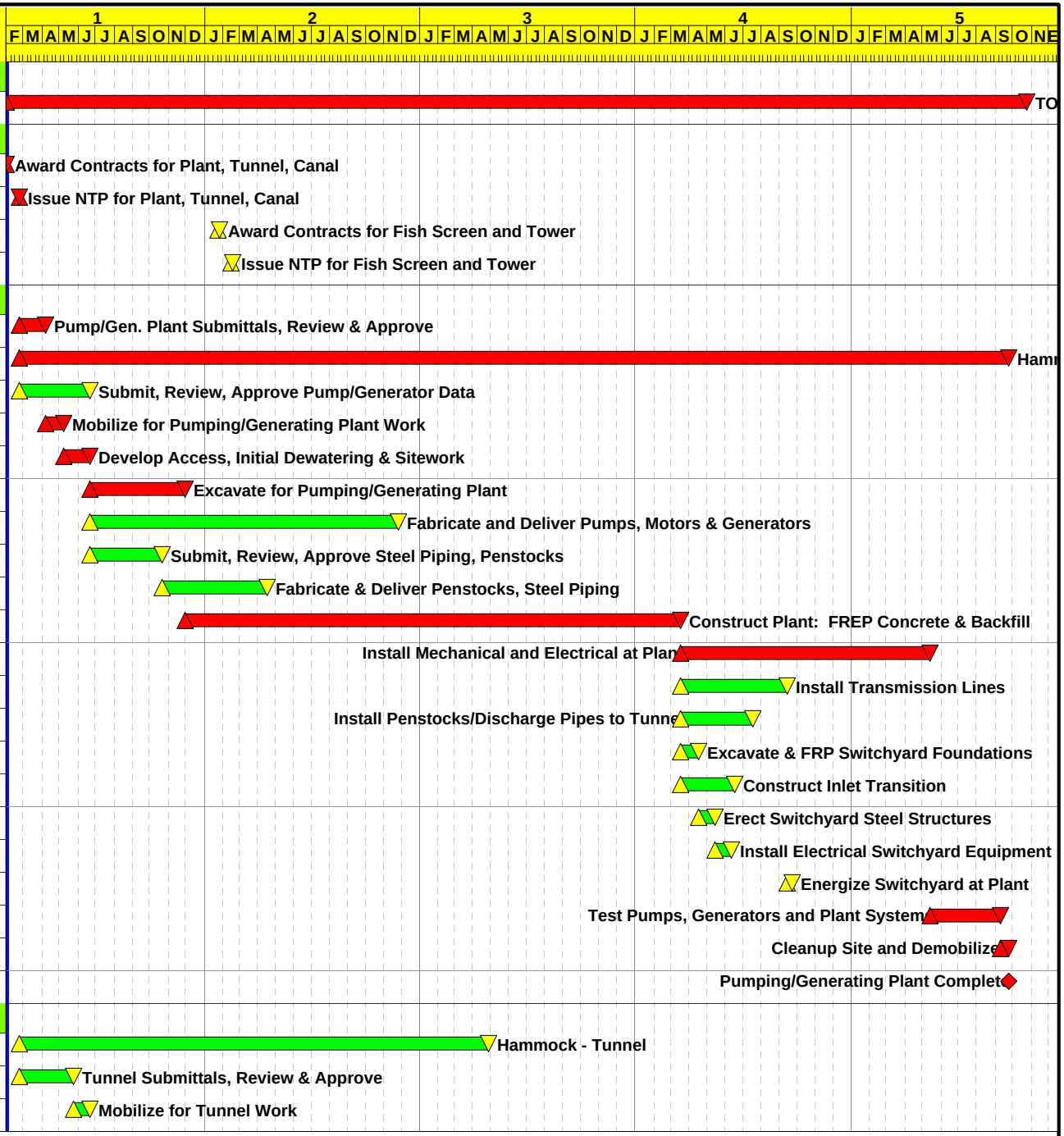
L2B2

Sheet 3 of 3

Alternative No. 2, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 2B
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	TOTAL PROJECT DURATION - NTP TO	1,727*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping and Generating Plant - 1,000 cfs		
1PA1100	Pump/Gen. Plant Submittals, Review & Approve	45
HAMPP	Hammock - Pumping Plant, Switchyard & Penstocks	1,674*
1PA1125	Submit, Review, Approve Pump/Generator Data	120
1PA1150	Mobilize for Pumping/Generating Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping/Generating Plant	160
1PA1225	Fabricate and Deliver Pumps, Motors & Generators	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	840
1PA1375	Install Mechanical and Electrical at Plant	420
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Plant	7
1PA1575	Test Pumps, Generators and Plant Systems	120
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping/Generating Plant Complete	0
Tunnel - 1,000 cfs		
HAMT	Hammock - Tunnel	794*
1T12100	Tunnel Submittals, Review & Approve	90
1T12125	Mobilize for Tunnel Work	30



Start Date 01FEB16
Finish Date 23OCT20
Data Date 01FEB16
Run Date 27MAR09 15:51

Early Bar
Progress Bar
Critical Activity

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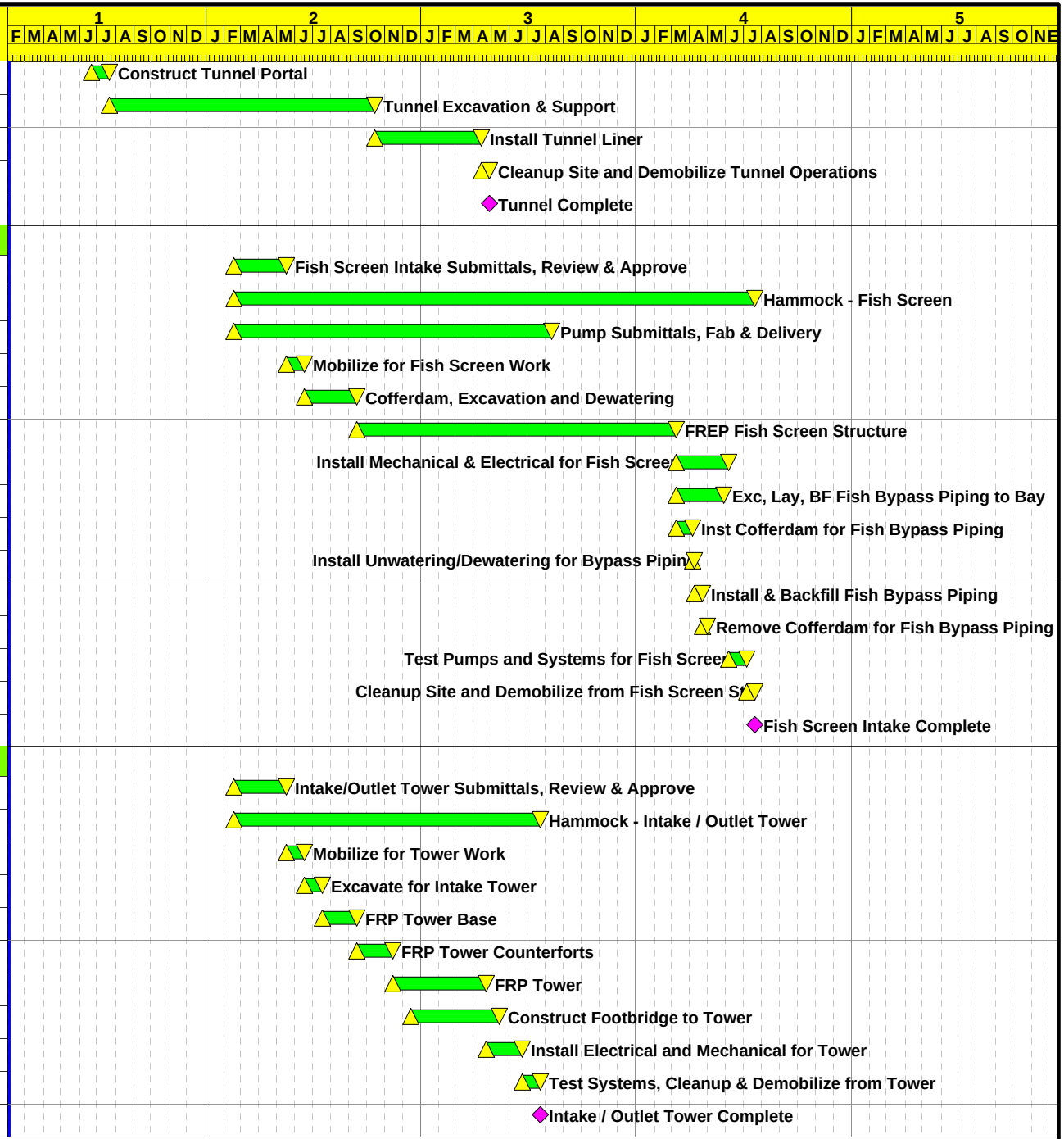
L2C1 Sheet 1 of 3

Alternative No. 2, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 2C
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	450
1T12200	Install Tunnel Liner	180
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 1,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen	884*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	90
1F15175	FREP Fish Screen Structure	540
1F15250	Install Mechanical & Electrical for Fish Screen	90
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 1,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake / Outlet Tower	520*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	60
1T14100	FRP Tower Counterforts	60
1T14125	FRP Tower	160
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0



Start Date 01FEB16
Finish Date 23OCT20
Data Date 01FEB16
Run Date 27MAR09 15:51

Early Bar
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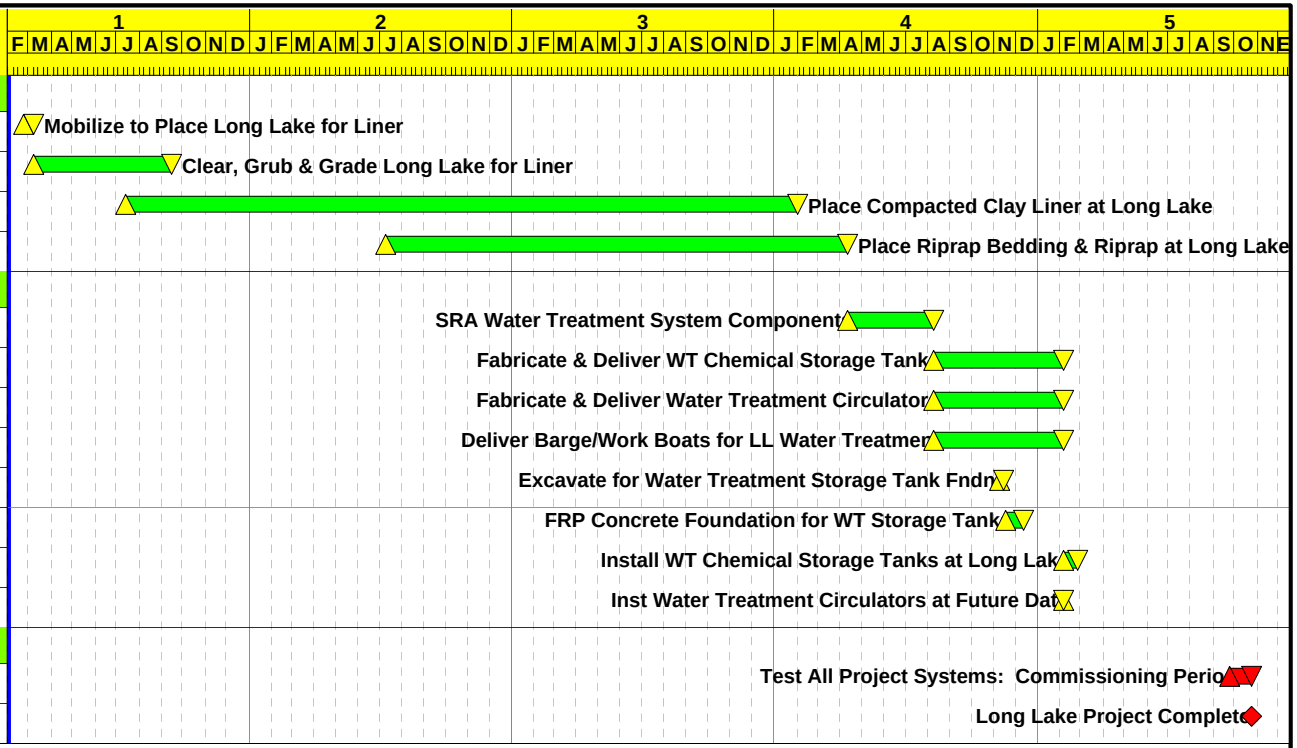
L2C1 Sheet 2 of 3

Alternative No. 2, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 2C
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	10
1CL6120	Clear, Grub & Grade Long Lake for Liner	133
1CL6140	Place Compacted Clay Liner at Long Lake	650
1CL6160	Place Riprap Bedding & Riprap at Long Lake	450
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	5
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date	01FEB16
Finish Date	23OCT20
Data Date	01FEB16
Run Date	27MAR09 15:51

Early Bar
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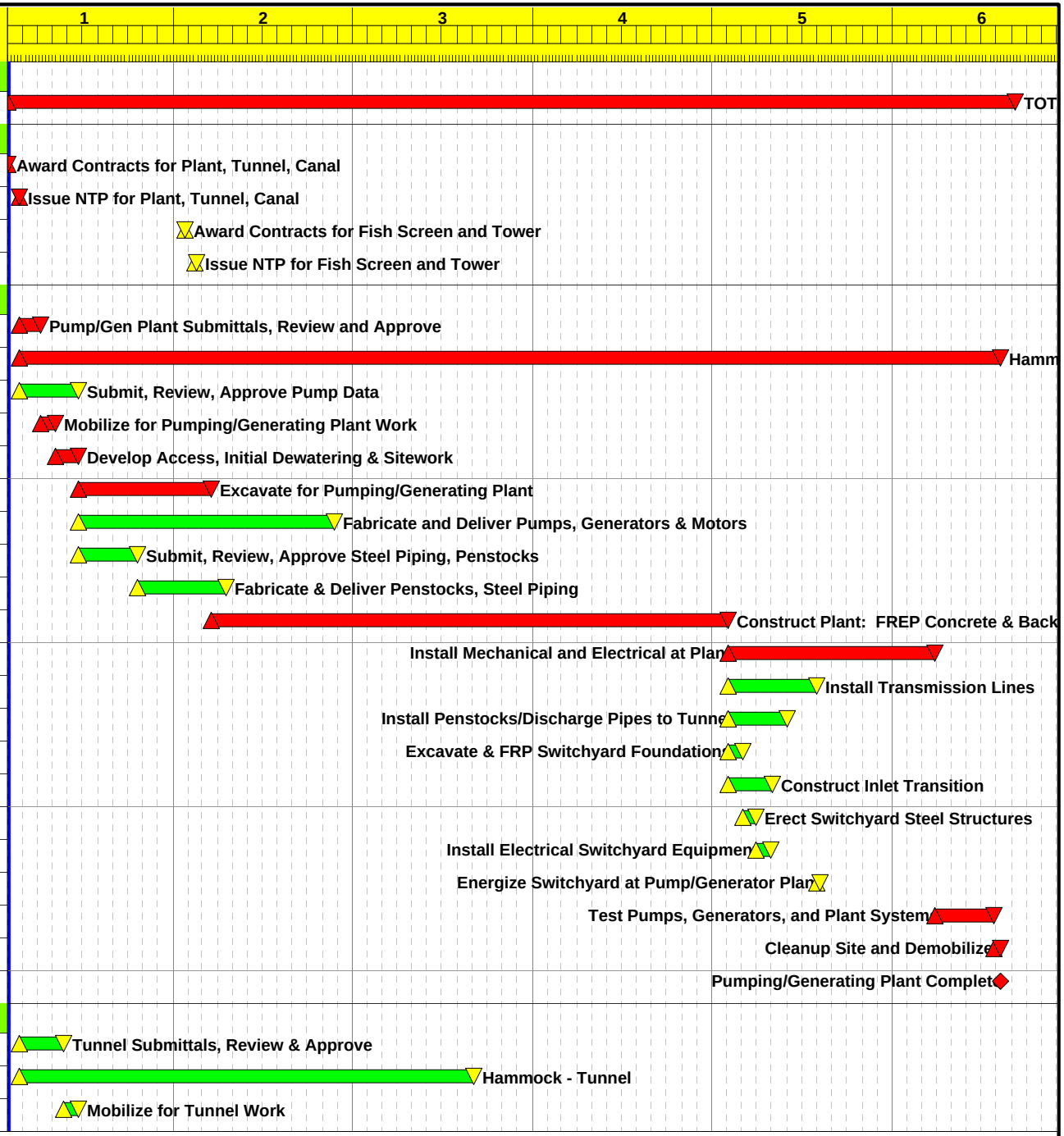
L2C1

Sheet 3 of 3

Alternative No. 2, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 2C
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	TOTAL PROJECT DURATION - NTP TO	2,047*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping and Generating Plant - 2,000 cfs		
1PA1100	Pump/Gen Plant Submittals, Review and Approve	45
HAMPP	Hammock - Pumping Plant	1,994*
1PA1125	Submit, Review, Approve Pump Data	120
1PA1150	Mobilize for Pumping/Generating Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping/Generating Plant	270
1PA1225	Fabricate and Deliver Pumps, Generators & Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	1,050
1PA1375	Install Mechanical and Electrical at Plant	420
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pump/Generator Plant	7
1PA1575	Test Pumps, Generators, and Plant Systems	120
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping/Generating Plant Complete	0
Tunnel - 2,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	924*
1T12125	Mobilize for Tunnel Work	30



Start Date	01FEB16
Finish Date	08SEP21
Data Date	01FEB16
Run Date	31MAR09 09:10

Early Bar
Progress Bar
Critical Activity

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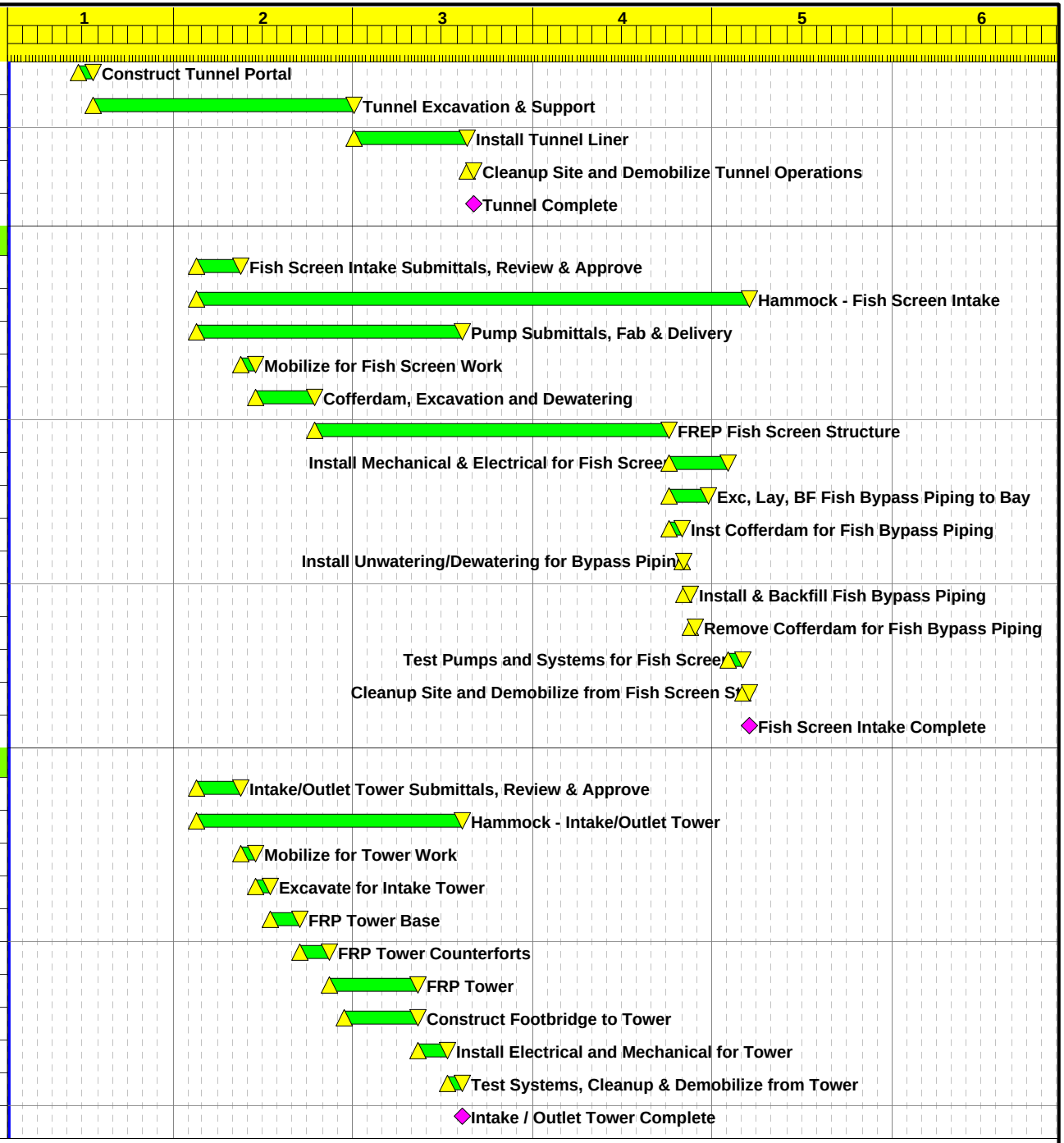
L2D2

Sheet 1 of 3

Alternative No. 2, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 2D
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	530
1T12200	Install Tunnel Liner	230
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 2,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	1,124*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	120
1F15175	FREP Fish Screen Structure	720
1F15250	Install Mechanical & Electrical for Fish Screen	120
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 2,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	540*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	60
1T14100	FRP Tower Counterforts	60
1T14125	FRP Tower	180
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0



Start Date	01FEB16
Finish Date	08SEP21
Data Date	01FEB16
Run Date	31MAR09 09:10

Early Bar
Progress Bar
Critical Activity

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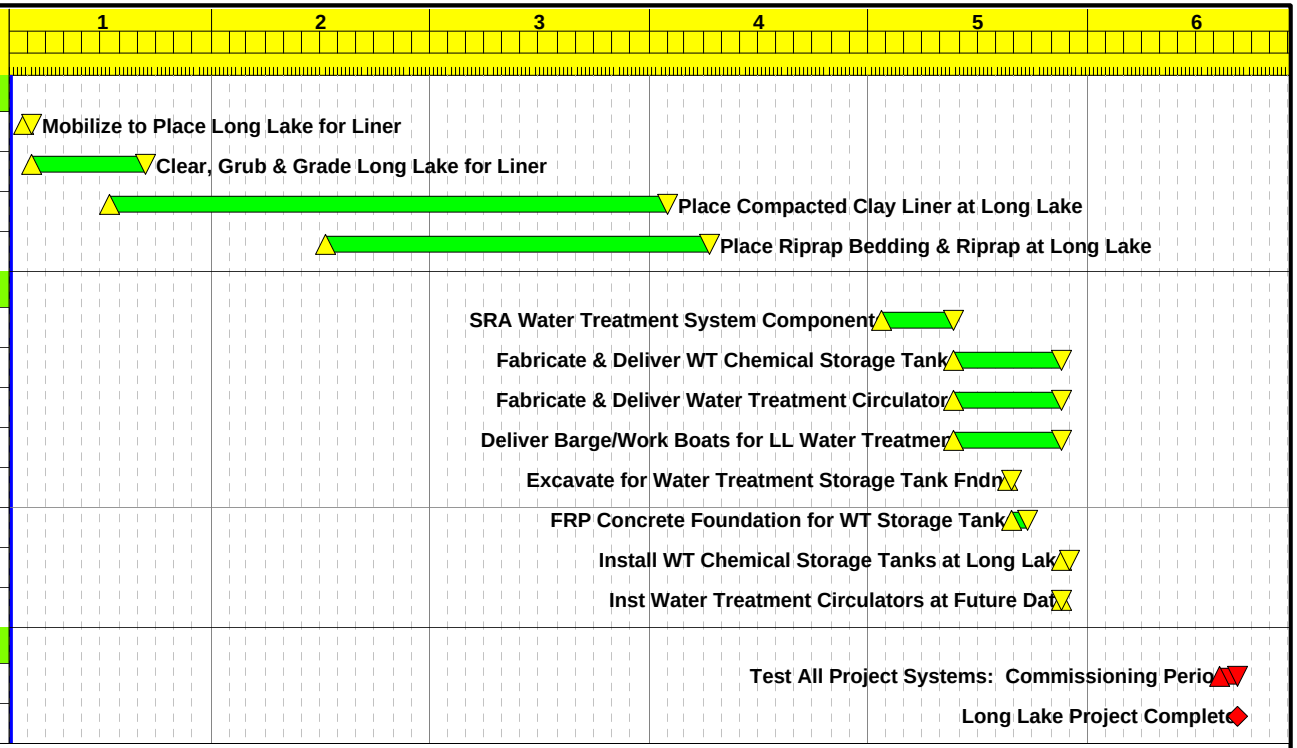
L2D2

Alternative No. 2, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 2D
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	10
1CL6120	Clear, Grub & Grade Long Lake for Liner	133
1CL6140	Place Compacted Clay Liner at Long Lake	650
1CL6160	Place Riprap Bedding & Riprap at Long Lake	450
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	5
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date 01FEB16
Finish Date 08SEP21
Data Date 01FEB16
Run Date 31MAR09 09:10

Early Bar
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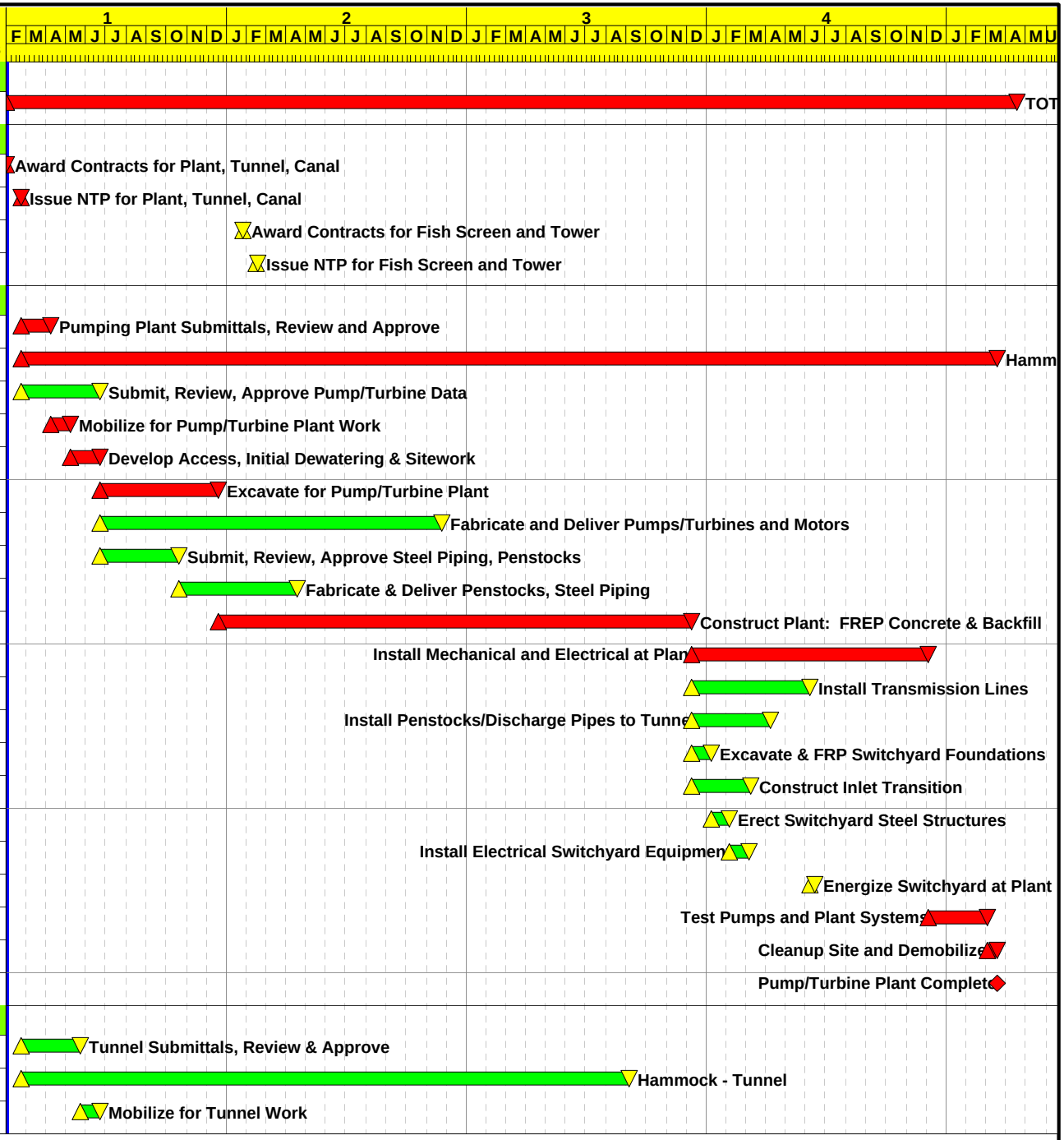
L2D2

Sheet 3 of 3

Alternative No. 2, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 2D
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	TOTAL PROJECT DURATION - NTP TO COMPLETION	1,537*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pump/Turbine Plant - 2,000 cfs		
1PA1100	Pumping Plant Submittals, Review and Approve	45
HAMPP	Hammock - Pumping Plant	1,484*
1PA1125	Submit, Review, Approve Pump/Turbine Data	120
1PA1150	Mobilize for Pump/Turbine Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pump/Turbine Plant	180
1PA1225	Fabricate and Deliver Pumps/Turbines and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	720
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pump/Turbine Plant Complete	0
Tunnel - 2,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	924*
1T12125	Mobilize for Tunnel Work	30



Start Date 01FEB16
Finish Date 16APR20
Data Date 01FEB16
Run Date 31MAR09 09:10

Early Bar
Progress Bar
Critical Activity

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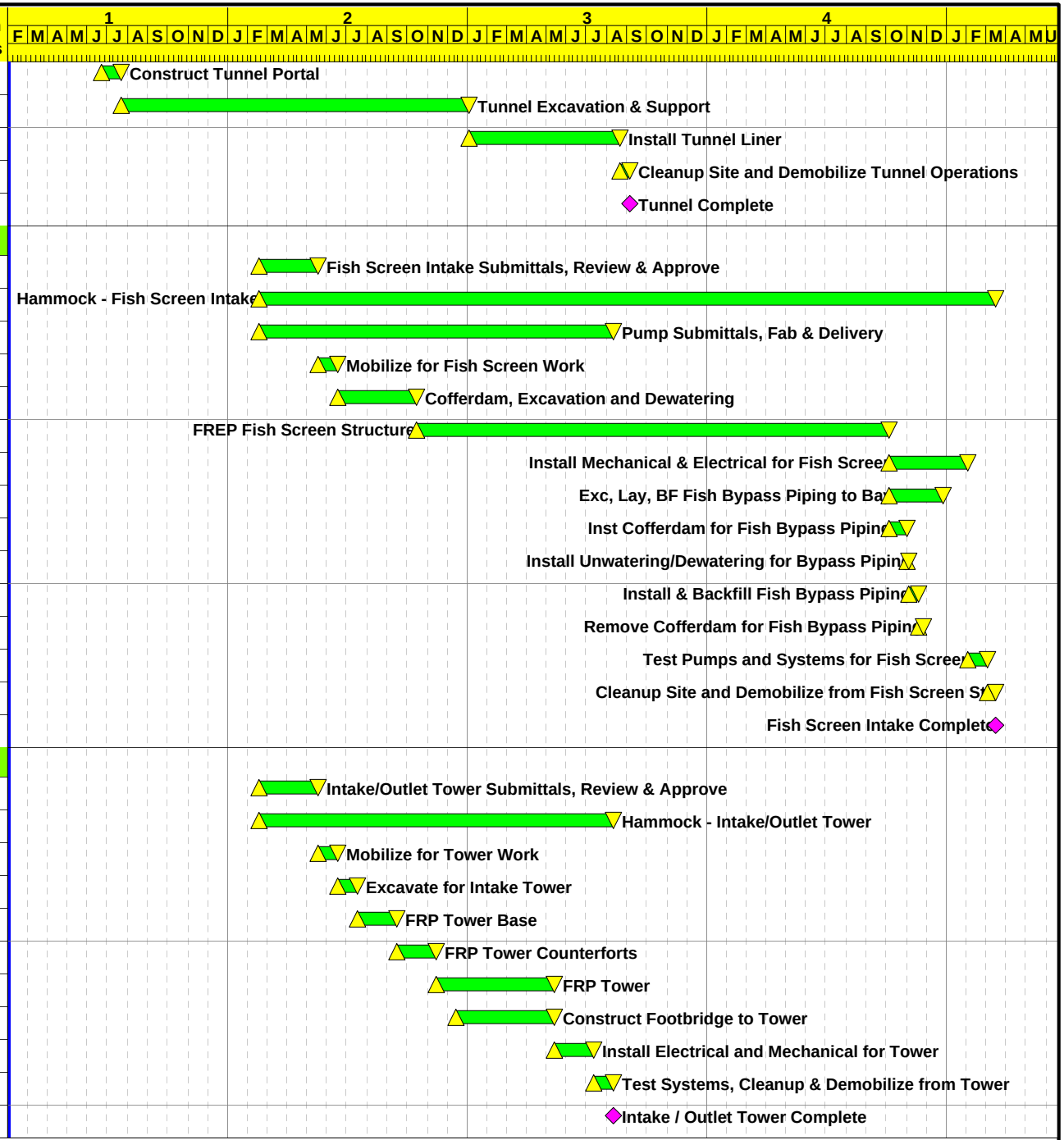
L2E2

Sheet 1 of 3

Alternative No. 2, Option E
(2,000 cfs Pump/Turbine Plant)
Long Lake Valley - 2E
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	530
1T12200	Install Tunnel Liner	230
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 2,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	1,124*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	120
1F15175	FREP Fish Screen Structure	720
1F15250	Install Mechanical & Electrical for Fish Screen	120
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 2,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	540*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	60
1T14100	FRP Tower Counterforts	60
1T14125	FRP Tower	180
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0



Start Date 01FEB16
Finish Date 16APR20
Data Date 01FEB16
Run Date 31MAR09 09:10

Early Bar
Progress Bar
Critical Activity

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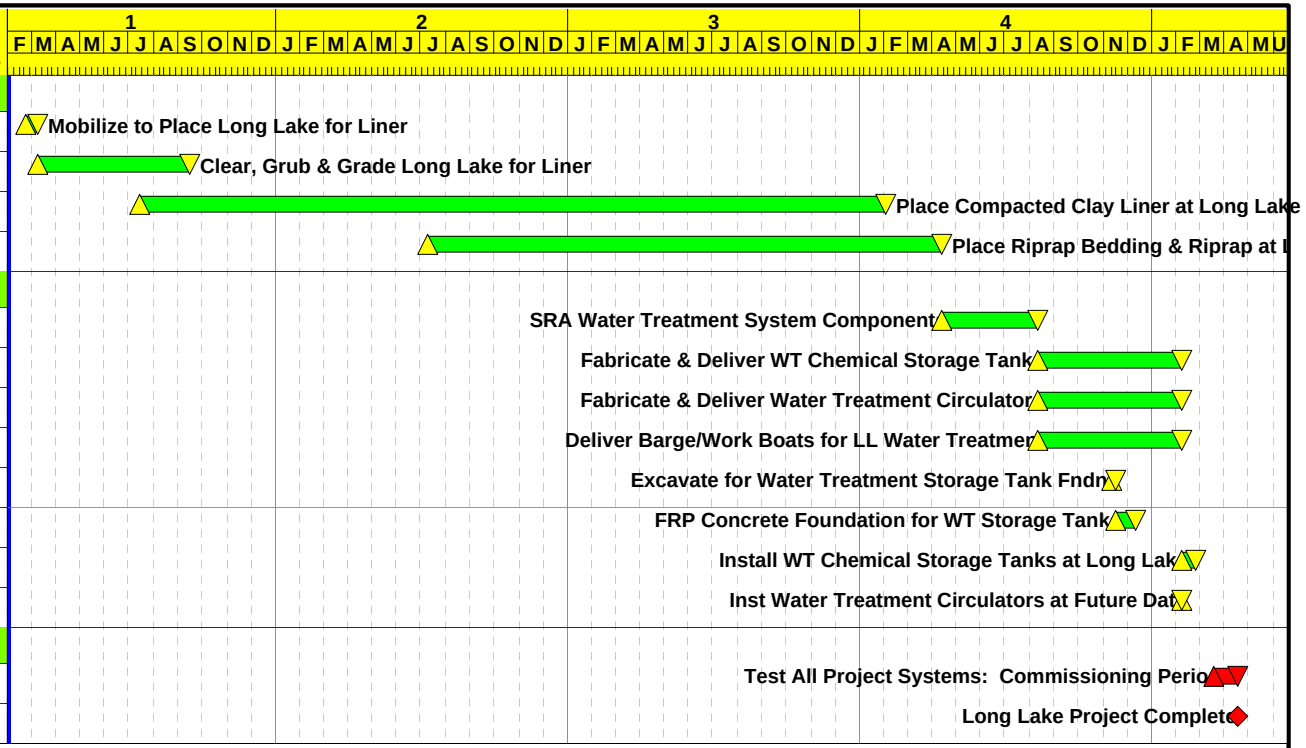
L2E2

Sheet 2 of 3

Alternative No. 2, Option E
(2,000 cfs Pump/Turbine Plant)
Long Lake Valley - 2E
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	10
1CL6120	Clear, Grub & Grade Long Lake for Liner	133
1CL6140	Place Compacted Clay Liner at Long Lake	650
1CL6160	Place Riprap Bedding & Riprap at Long Lake	450
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	5
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date 01FEB16
Finish Date 16APR20
Data Date 01FEB16
Run Date 31MAR09 09:10

Early Bar
Progress Bar
Critical Activity

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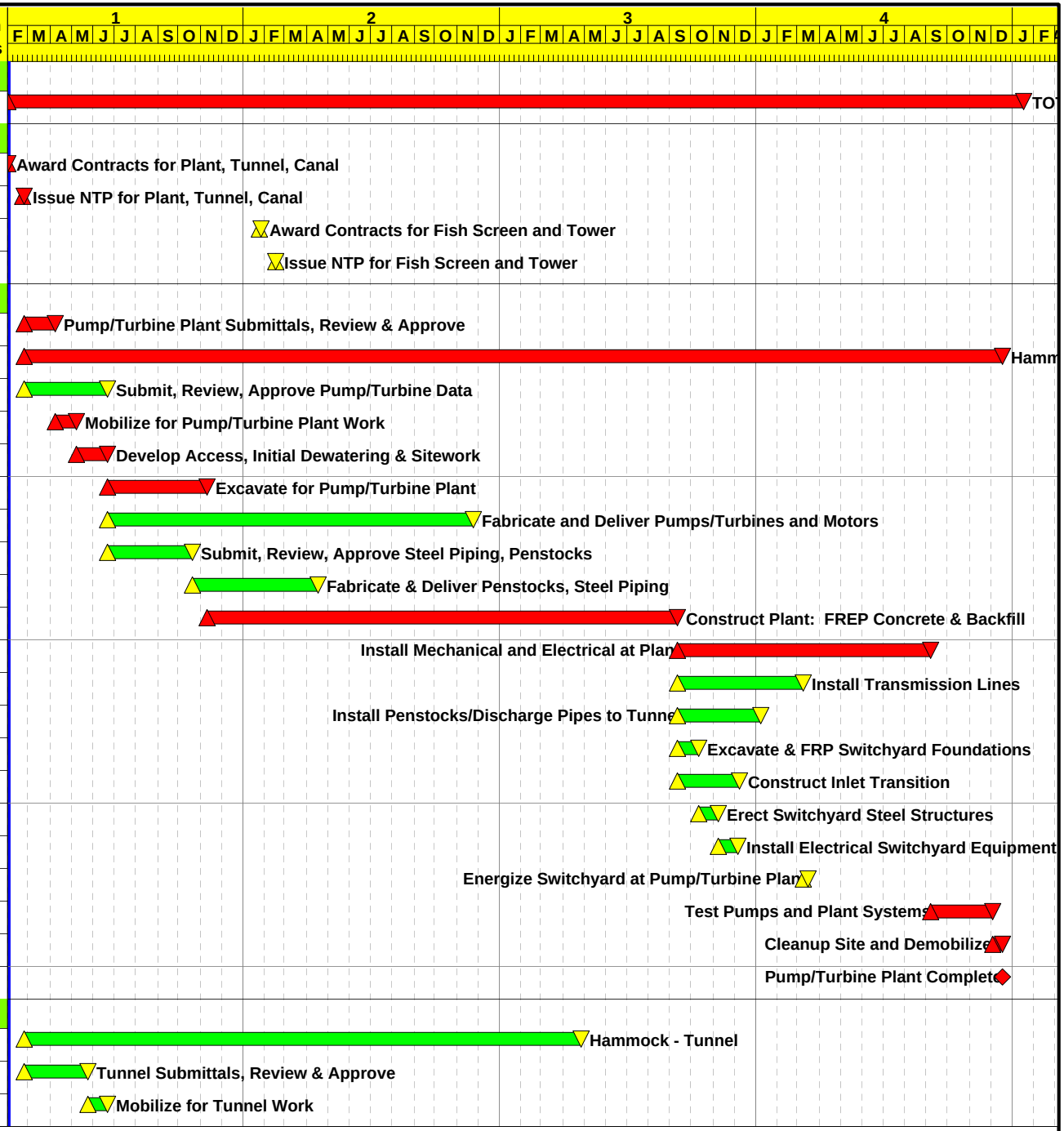
Sheet 3 of 3

Alternative No. 2, Option E
(2,000 cfs Pump/Turbine Plant)
Long Lake Valley - 2E
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	TOTAL PROJECT DURATION - NTP TO	1,447*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pump/Turbine Plant - 1,000 cfs		
1PA1100	Pump/Turbine Plant Submittals, Review & Approve	45
HAMPP	Hammock - Pumping Plant, Switchyard & Penstocks	1,394*
1PA1125	Submit, Review, Approve Pump/Turbine Data	120
1PA1150	Mobilize for Pump/Turbine Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pump/Turbine Plant	140
1PA1225	Fabricate and Deliver Pumps/Turbines and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	670
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pump/Turbine Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pump/Turbine Plant Complete	0
Tunnel - 1,000 cfs		
HAMT	Hammock - Tunnel	794*
1T12100	Tunnel Submittals, Review & Approve	90
1T12125	Mobilize for Tunnel Work	30



Start Date 01FEB16
Finish Date 17JAN20
Data Date 01FEB16
Run Date 27MAR09 15:42

Early Bar
Progress Bar
Critical Activity

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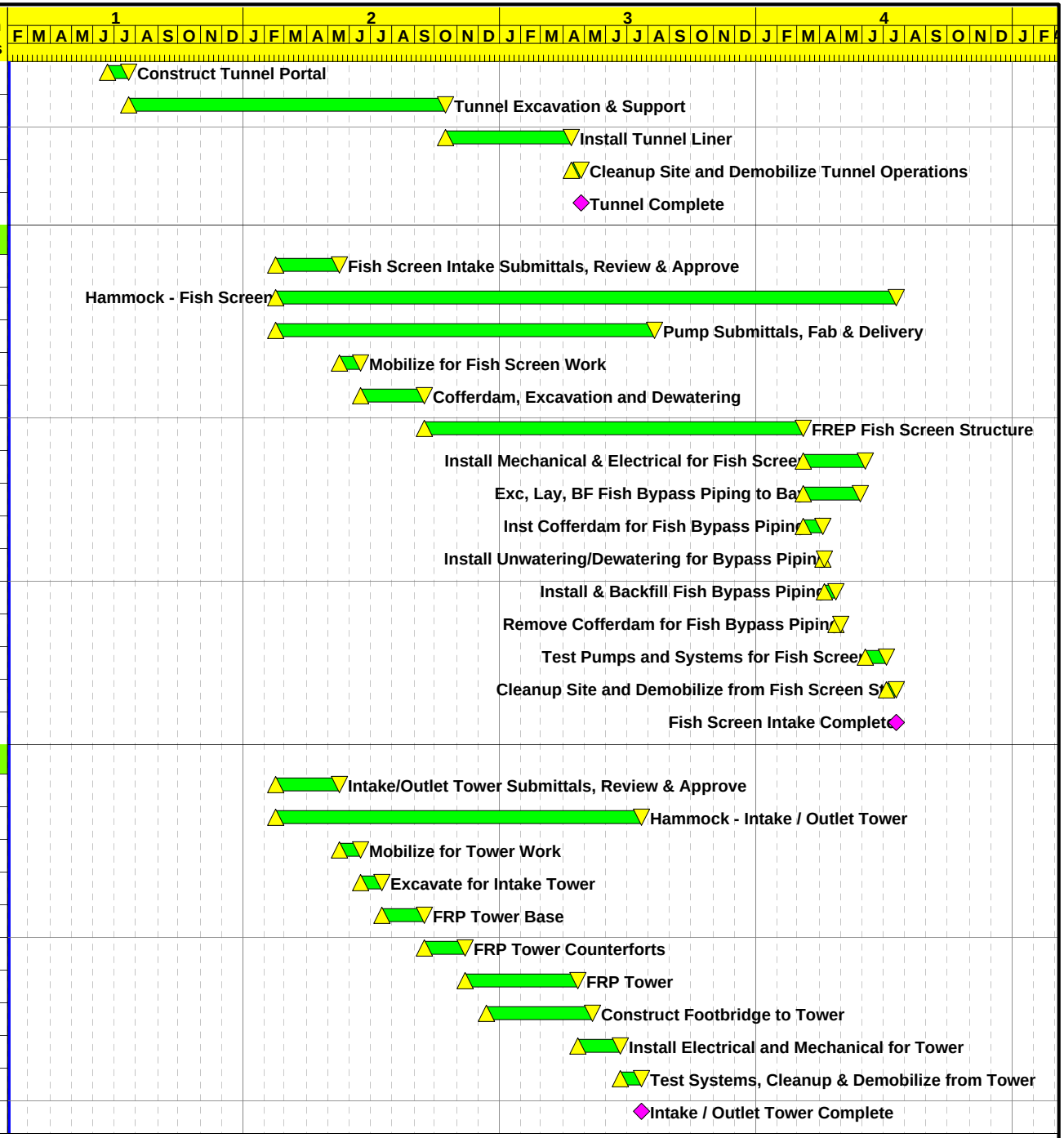
L2F1

Sheet 1 of 3

Alternative No. 1, Option F
(1,000 cfs Pump/Turbine Plant)
Long Lake Valley - 2F
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	450
1T12200	Install Tunnel Liner	180
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 1,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen	884*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	90
1F15175	FREP Fish Screen Structure	540
1F15250	Install Mechanical & Electrical for Fish Screen	90
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 1,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake / Outlet Tower	520*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	60
1T14100	FRP Tower Counterforts	60
1T14125	FRP Tower	160
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0



Start Date 01FEB16
Finish Date 17JAN20
Data Date 01FEB16
Run Date 27MAR09 15:42

Early Bar
Progress Bar
Critical Activity

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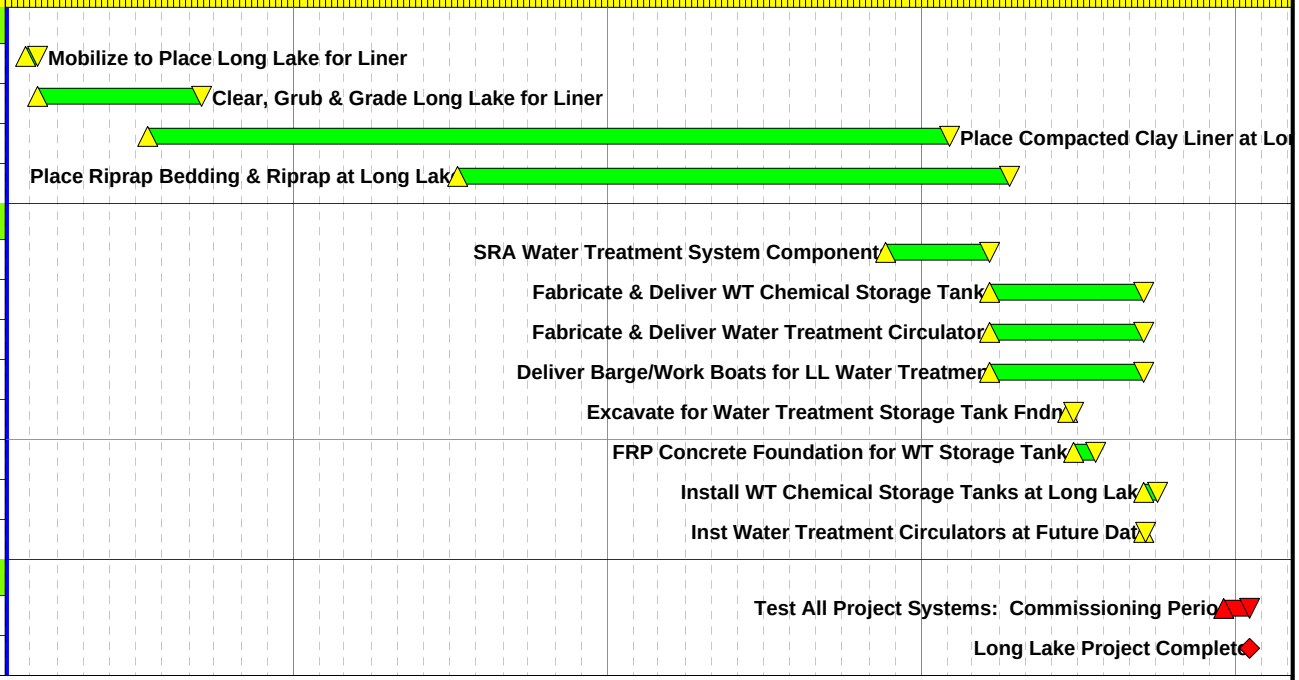
L2F1

Sheet 2 of 3

Alternative No. 1, Option F
(1,000 cfs Pump/Turbine Plant)
Long Lake Valley - 2F
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	10
1CL6120	Clear, Grub & Grade Long Lake for Liner	133
1CL6140	Place Compacted Clay Liner at Long Lake	650
1CL6160	Place Riprap Bedding & Riprap at Long Lake	450
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	5
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date	01FEB16
Finish Date	17JAN20
Data Date	01FEB16
Run Date	27MAR09 15:42

Early Bar
Progress Bar
Critical Activity

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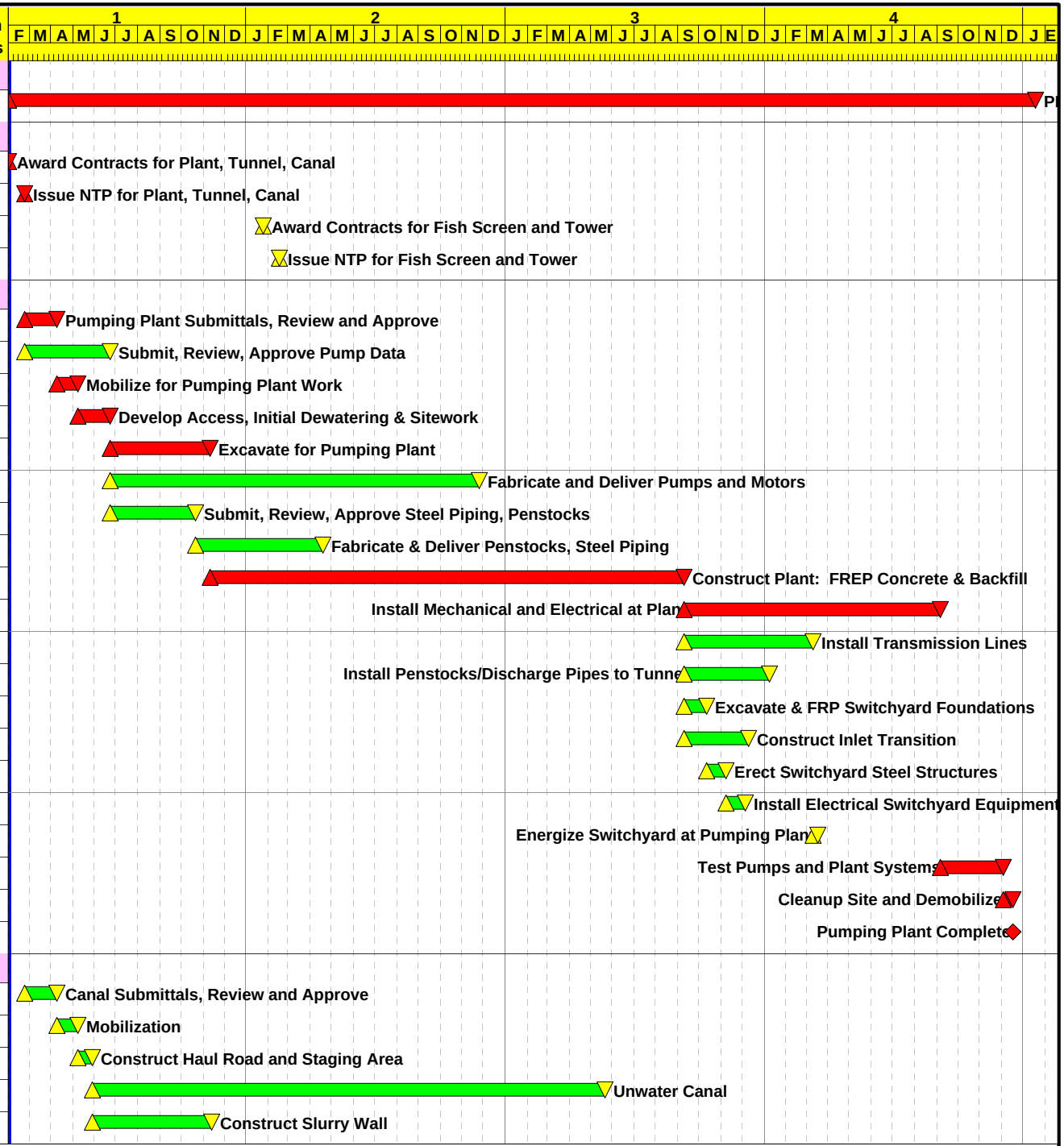
L2F1

Sheet 3 of 3

Alternative No. 1, Option F
(1,000 cfs Pump/Turbine Plant)
Long Lake Valley - 2F
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	1,447*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping Plant - 1,000 cfs		
1PA1100	Pumping Plant Submittals, Review and Approve	45
1PA1125	Submit, Review, Approve Pump Data	120
1PA1150	Mobilize for Pumping Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping Plant	140
1PA1225	Fabricate and Deliver Pumps and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	670
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pumping Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping Plant Complete	0
Canal - 1,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Unwater Canal	509*
1C13150	Construct Slurry Wall	167



Start Date 01FEB16
Finish Date 17JAN20
Data Date 01FEB16
Run Date 31MAR09 09:11

Early Bar
Progress Bar
Critical Activity

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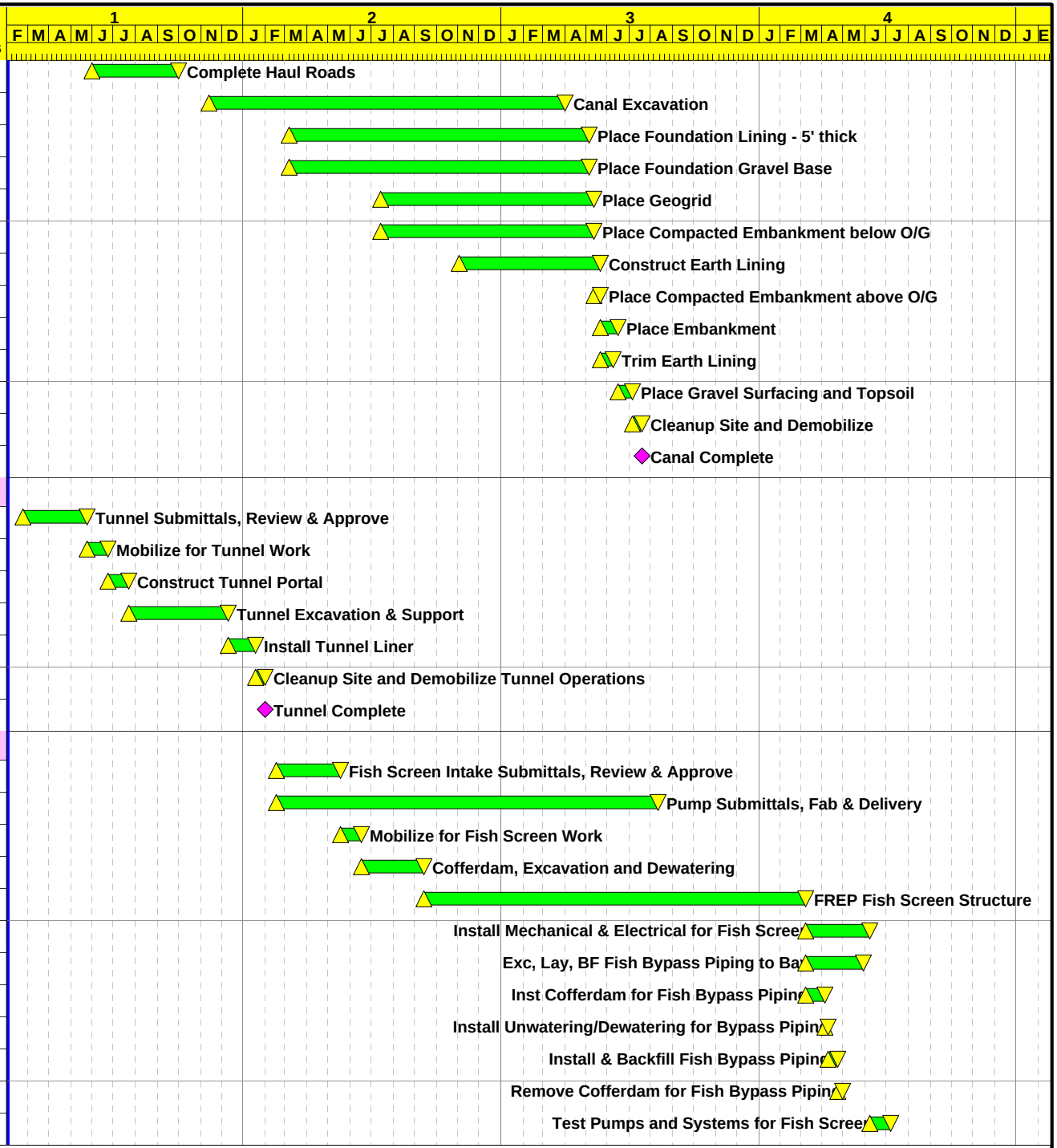
L3A1

Sheet 1 of 3

Alternative No. 3, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 3A
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assumed 3.5 months of weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
1C13075	Complete Haul Roads	87
1C13175	Canal Excavation	292
1C13200	Place Foundation Lining - 5' thick	319
1C13225	Place Foundation Gravel Base	319*
1C13250	Place Geogrid	196*
1C13275	Place Compacted Embankment below O/G	196
1C13300	Construct Earth Lining	93
1C13325	Place Compacted Embankment above O/G	9
1C13350	Place Embankment	27
1C13375	Trim Earth Lining	18
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 1,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	140
1T12200	Install Tunnel Liner	40
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 1,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	90
1F15175	FREP Fish Screen Structure	540
1F15250	Install Mechanical & Electrical for Fish Screen	90
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30



Start Date 01FEB16
Finish Date 17JAN20
Data Date 01FEB16
Run Date 31MAR09 09:11

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Early Bar
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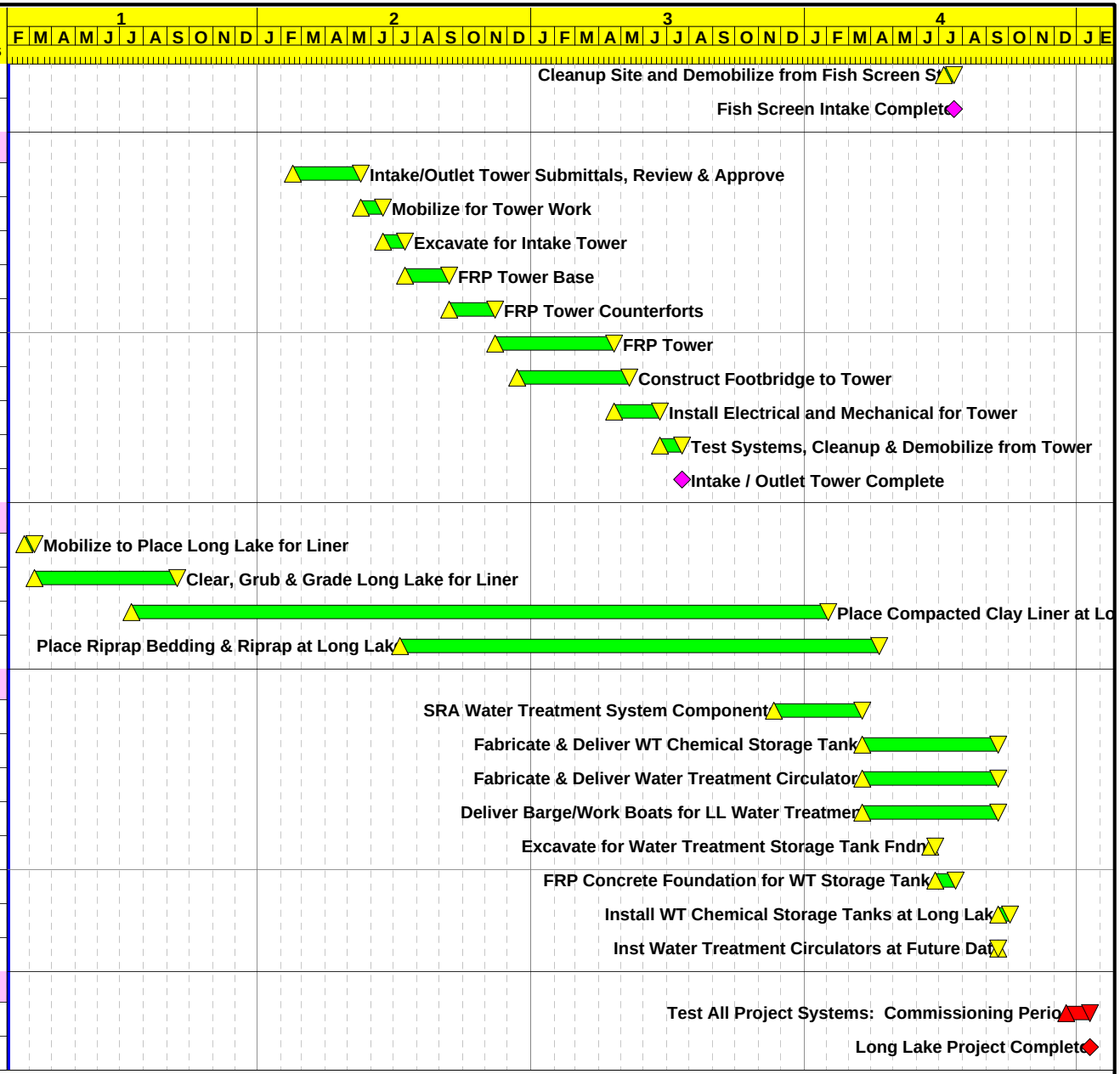
L3A1

Sheet 2 of 3

Alternative No. 3, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 3A
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assumed 3.5 months of weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 1,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	60
1T14100	FRP Tower Counterforts	60
1T14125	FRP Tower	160
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	10
1CL6120	Clear, Grub & Grade Long Lake for Liner	133
1CL6140	Place Compacted Clay Liner at Long Lake	650
1CL6160	Place Riprap Bedding & Riprap at Long Lake	450
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	5
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date 01FEB16
Finish Date 17JAN20
Data Date 01FEB16
Run Date 31MAR09 09:11

Early Bar
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Critical Activity

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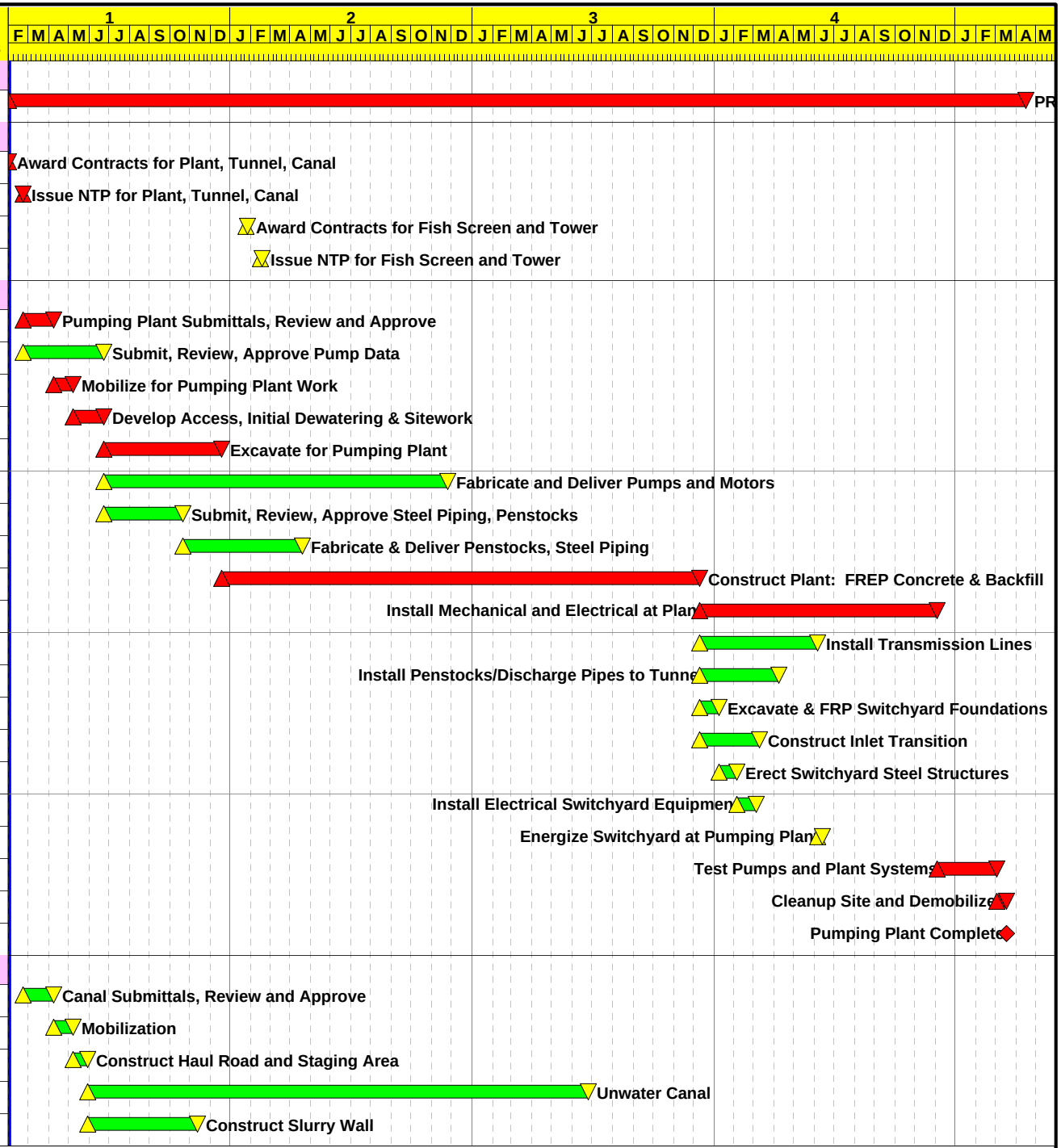
L3A1 Sheet 3 of 3

Alternative No. 3, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 3A
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assumed 3.5 months of weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	1,537*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping Plant - 2,000 cfs		
1PA1100	Pumping Plant Submittals, Review and Approve	45
1PA1125	Submit, Review, Approve Pump Data	120
1PA1150	Mobilize for Pumping Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping Plant	180
1PA1225	Fabricate and Deliver Pumps and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	720
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pumping Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping Plant Complete	0
Canal - 2,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Unwater Canal	545*
1C13150	Construct Slurry Wall	167



Start Date 01FEB16
Finish Date 16APR20
Data Date 01FEB16
Run Date 31MAR09 09:11

Early Bar
Progress Bar
Critical Activity

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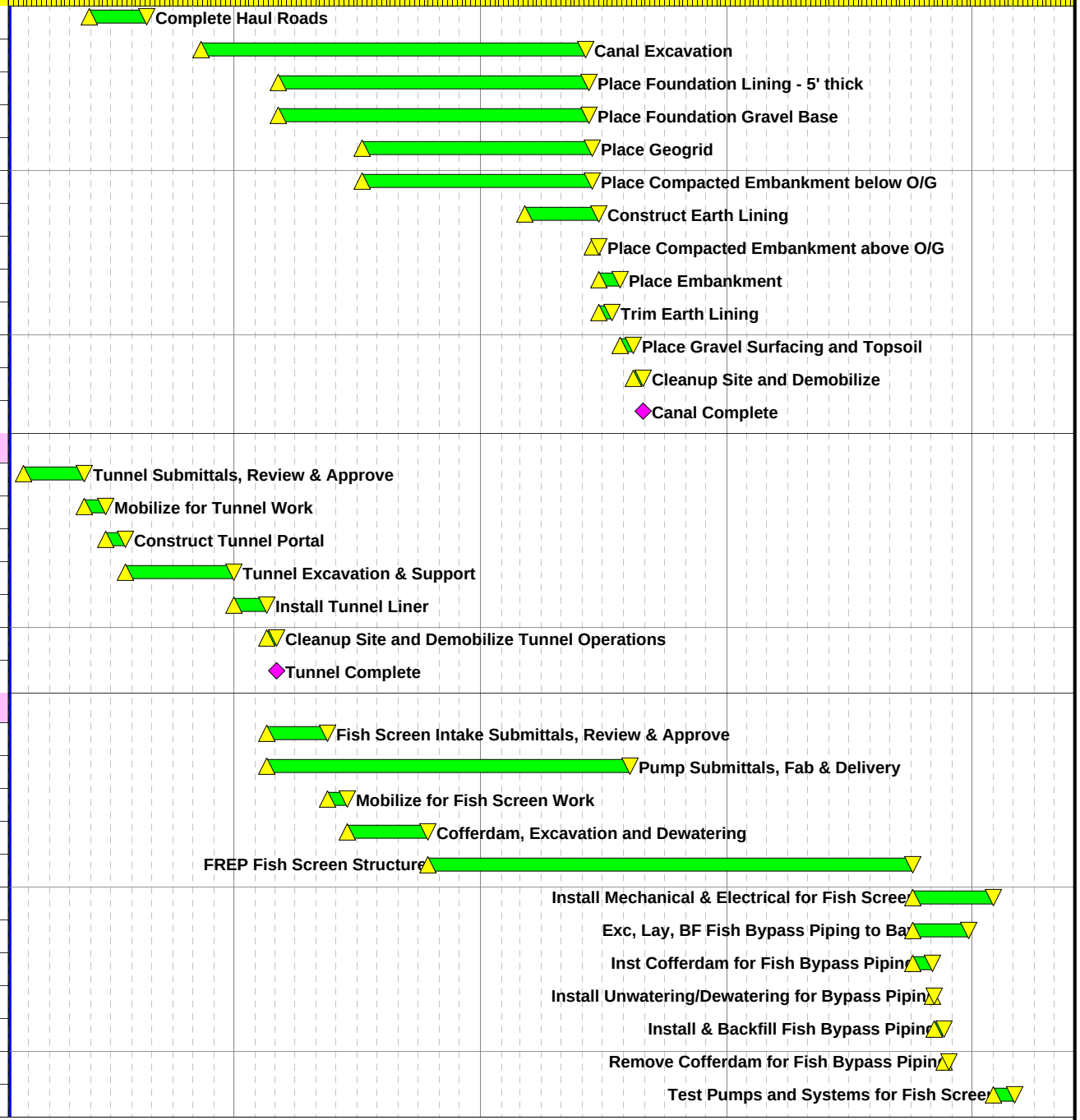
Sheet 1 of 3

Alternative No. 3, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 3B
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
1C13075	Complete Haul Roads	87
1C13175	Canal Excavation	359
1C13200	Place Foundation Lining - 5' thick	355
1C13225	Place Foundation Gravel Base	355*
1C13250	Place Geogrid	236*
1C13275	Place Compacted Embankment below O/G	236
1C13300	Construct Earth Lining	110
1C13325	Place Compacted Embankment above O/G	9
1C13350	Place Embankment	31
1C13375	Trim Earth Lining	18
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 2,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	160
1T12200	Install Tunnel Liner	50
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 2,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	120
1F15175	FREP Fish Screen Structure	720
1F15250	Install Mechanical & Electrical for Fish Screen	120
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30



Start Date 01FEB16
Finish Date 16APR20
Data Date 01FEB16
Run Date 31MAR09 09:11

Early Bar
Progress Bar
Critical Activity

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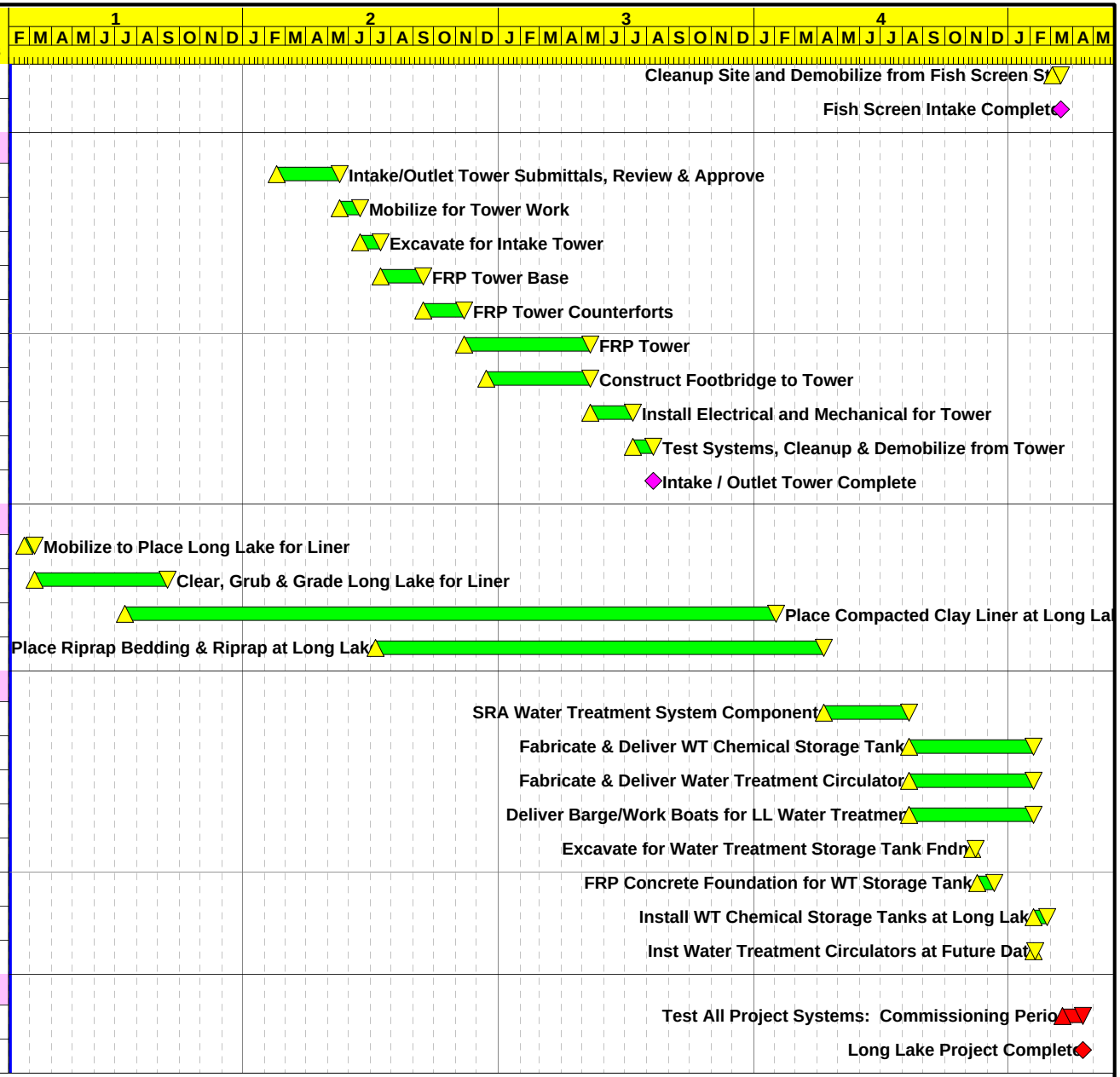
L3B2

Sheet 2 of 3

Alternative No. 3, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 3B
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 2,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	60
1T14100	FRP Tower Counterforts	60
1T14125	FRP Tower	180
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	10
1CL6120	Clear, Grub & Grade Long Lake for Liner	133
1CL6140	Place Compacted Clay Liner at Long Lake	650
1CL6160	Place Riprap Bedding & Riprap at Long Lake	450
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	5
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date 01FEB16
Finish Date 16APR20
Data Date 01FEB16
Run Date 31MAR09 09:11

Early Bar
Progress Bar
Critical Activity

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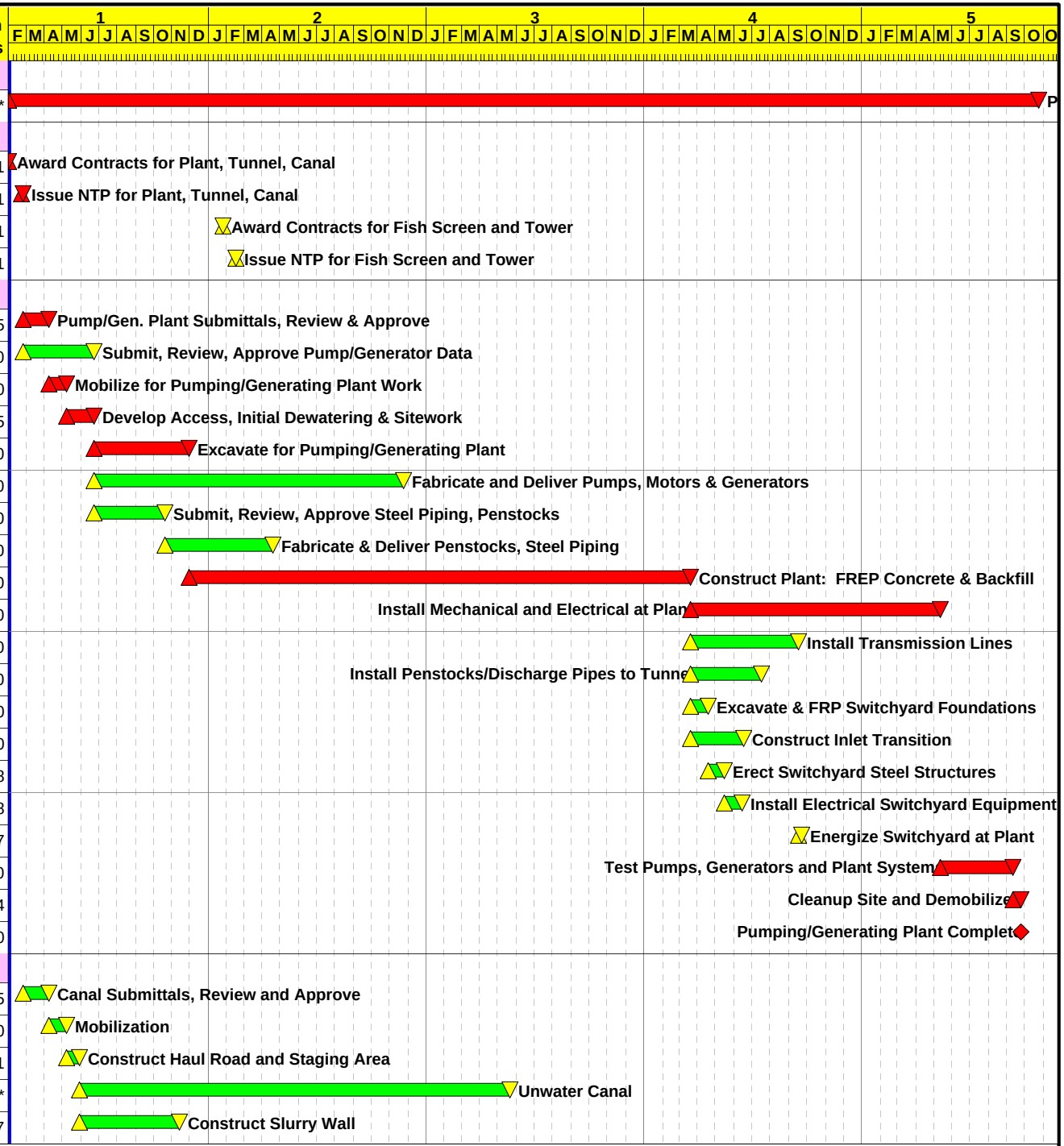
Sheet 3 of 3

Alternative No. 3, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 3B
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	1,727*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping and Generating Plant - 1,000 cfs		
1PA1100	Pump/Gen. Plant Submittals, Review & Approve	45
1PA1125	Submit, Review, Approve Pump/Generator Data	120
1PA1150	Mobilize for Pumping/Generating Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping/Generating Plant	160
1PA1225	Fabricate and Deliver Pumps, Motors & Generators	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	840
1PA1375	Install Mechanical and Electrical at Plant	420
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Plant	7
1PA1575	Test Pumps, Generators and Plant Systems	120
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping/Generating Plant Complete	0
Canal - 1,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Unwater Canal	509*
1C13150	Construct Slurry Wall	167



Start Date	01FEB16
Finish Date	23OCT20
Data Date	01FEB16
Run Date	31MAR09 09:12

Early Bar
Progress Bar
Critical Activity

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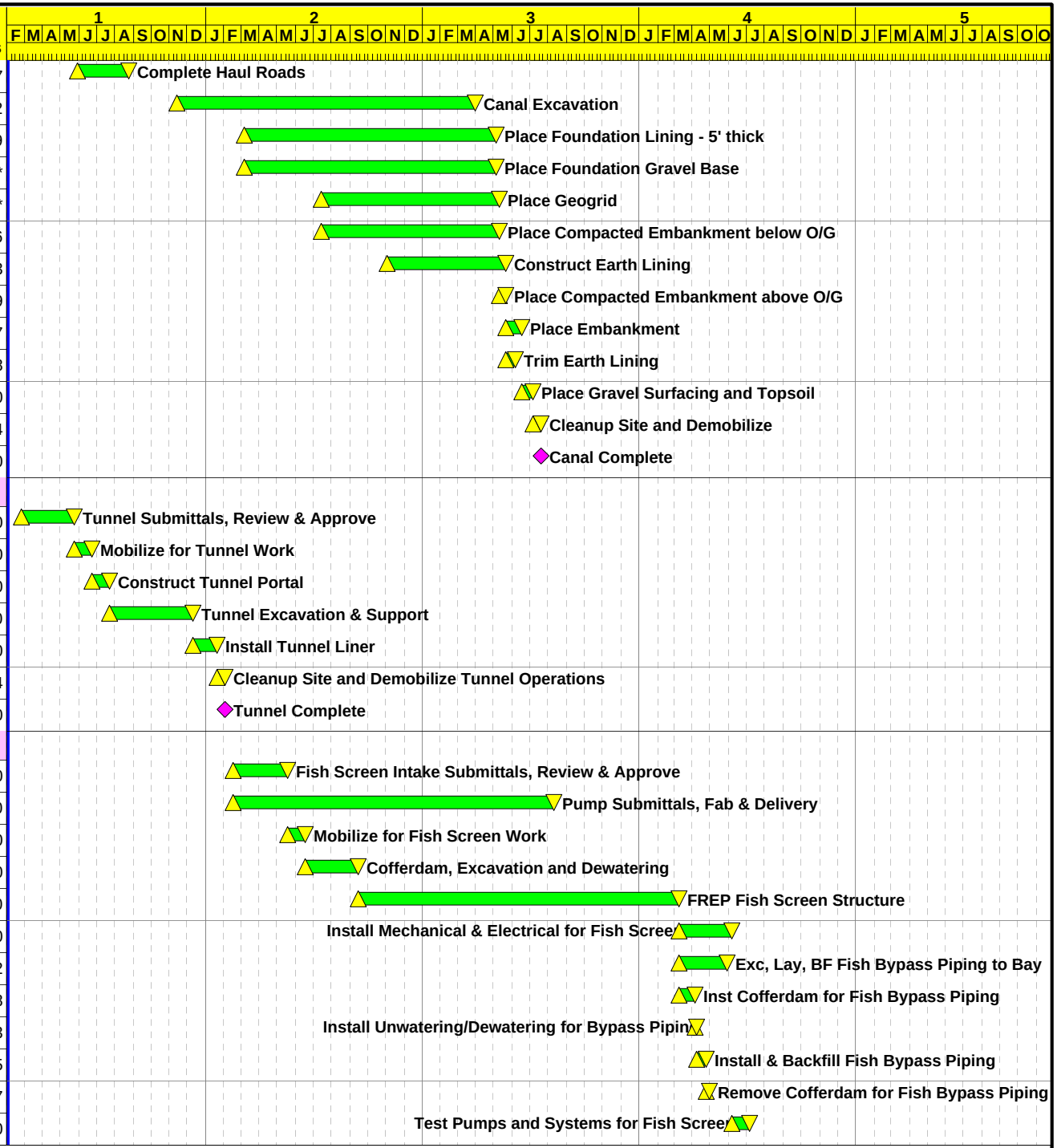
L3C1 Sheet 1 of 3

Alternative No. 3, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 3C
Summary Construction Schedule

Date	Revision	Checked	Approved
	Note: Assume 3.5 months for weather impacts fo		
	canal work each year.		

Activity ID	Activity Description	Duration Cal Days
1C13075	Complete Haul Roads	87
1C13175	Canal Excavation	292
1C13200	Place Foundation Lining - 5' thick	319
1C13225	Place Foundation Gravel Base	319*
1C13250	Place Geogrid	196*
1C13275	Place Compacted Embankment below O/G	196
1C13300	Construct Earth Lining	93
1C13325	Place Compacted Embankment above O/G	9
1C13350	Place Embankment	27
1C13375	Trim Earth Lining	18
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 1,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	140
1T12200	Install Tunnel Liner	40
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 1,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	90
1F15175	FREP Fish Screen Structure	540
1F15250	Install Mechanical & Electrical for Fish Screen	90
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30



Start Date 01FEB16
Finish Date 23OCT20
Data Date 01FEB16
Run Date 31MAR09 09:12

Early Bar
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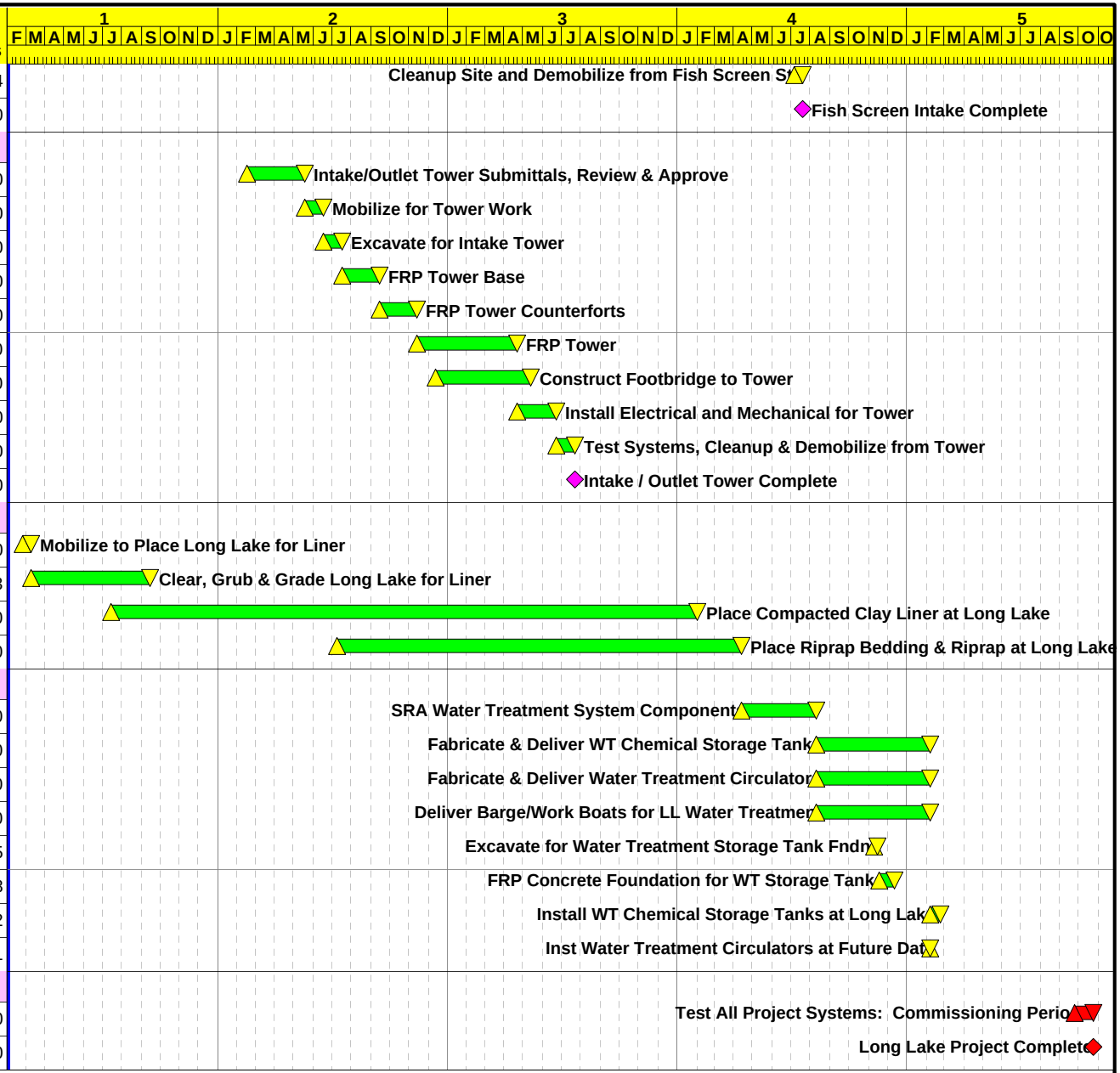
L3C1 Sheet 2 of 3

Alternative No. 3, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 3C
Summary Construction Schedule

Date	Revision	Checked	Approved
	Note: Assume 3.5 months for weather impacts fo		
	canal work each year.		

Activity ID	Activity Description	Duration Cal Days
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 1,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	60
1T14100	FRP Tower Counterforts	60
1T14125	FRP Tower	160
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	10
1CL6120	Clear, Grub & Grade Long Lake for Liner	133
1CL6140	Place Compacted Clay Liner at Long Lake	650
1CL6160	Place Riprap Bedding & Riprap at Long Lake	450
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	5
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date 01FEB16
Finish Date 23OCT20
Data Date 01FEB16
Run Date 31MAR09 09:12

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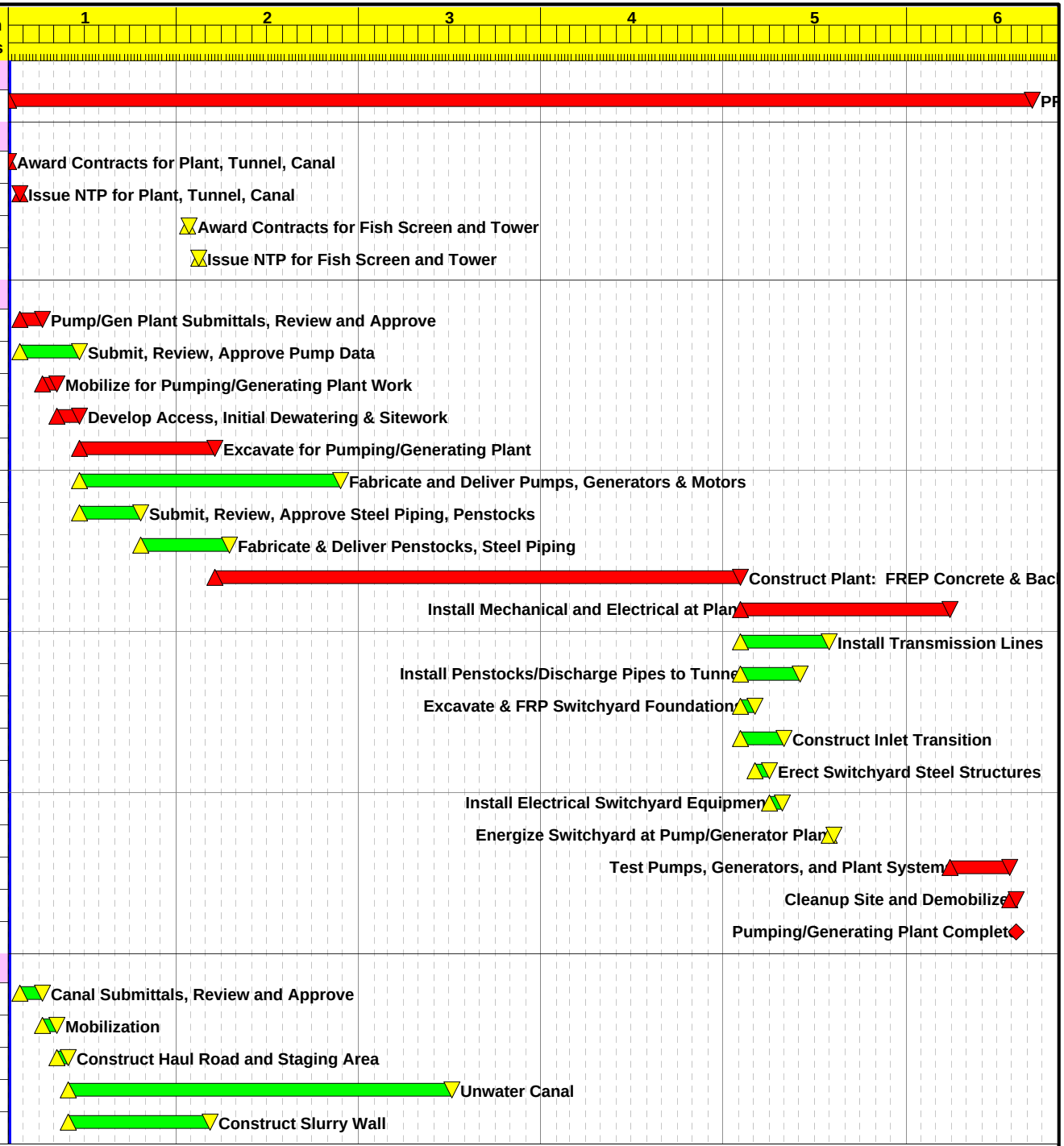
L3C1

Sheet 3 of 3

Alternative No. 3, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 3C
Summary Construction Schedule

Date	Revision	Checked	Approved
	Note: Assume 3.5 months for weather impacts fo		
	canal work each year.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	2,047*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping and Generating Plant - 2,000 cfs		
1PA1100	Pump/Gen Plant Submittals, Review and Approve	45
1PA1125	Submit, Review, Approve Pump Data	120
1PA1150	Mobilize for Pumping/Generating Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping/Generating Plant	270
1PA1225	Fabricate and Deliver Pumps, Generators & Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	1,050
1PA1375	Install Mechanical and Electrical at Plant	420
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pump/Generator Plant	7
1PA1575	Test Pumps, Generators, and Plant Systems	120
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping/Generating Plant Complete	0
Canal - 2,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Unwater Canal	555*
1C13150	Construct Slurry Wall	177



Start Date 01FEB16
Finish Date 08SEP21
Data Date 01FEB16
Run Date 31MAR09 09:13

Early Bar
Progress Bar
Critical Activity

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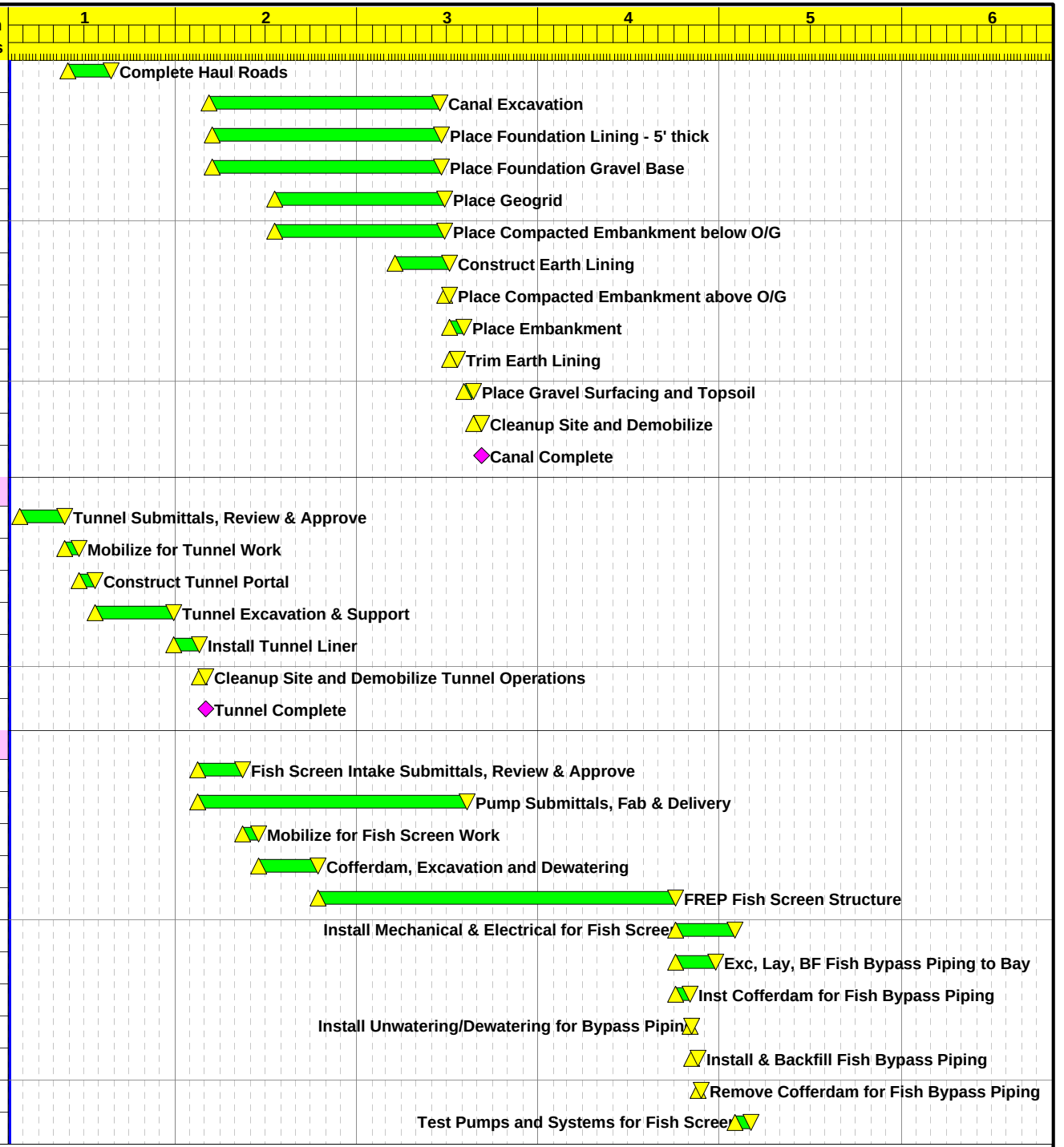
L3D2

Sheet 1 of 3

Alternative No.3, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 3D
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impacts each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
1C13075	Complete Haul Roads	87
1C13175	Canal Excavation	359
1C13200	Place Foundation Lining - 5' thick	355
1C13225	Place Foundation Gravel Base	355*
1C13250	Place Geogrid	236*
1C13275	Place Compacted Embankment below O/G	236
1C13300	Construct Earth Lining	110
1C13325	Place Compacted Embankment above O/G	9
1C13350	Place Embankment	31
1C13375	Trim Earth Lining	18
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 2,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	160
1T12200	Install Tunnel Liner	50
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 2,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	120
1F15175	FREP Fish Screen Structure	720
1F15250	Install Mechanical & Electrical for Fish Screen	120
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30



Start Date 01FEB16
Finish Date 08SEP21
Data Date 01FEB16
Run Date 31MAR09 09:13

Early Bar
Progress Bar
Critical Activity

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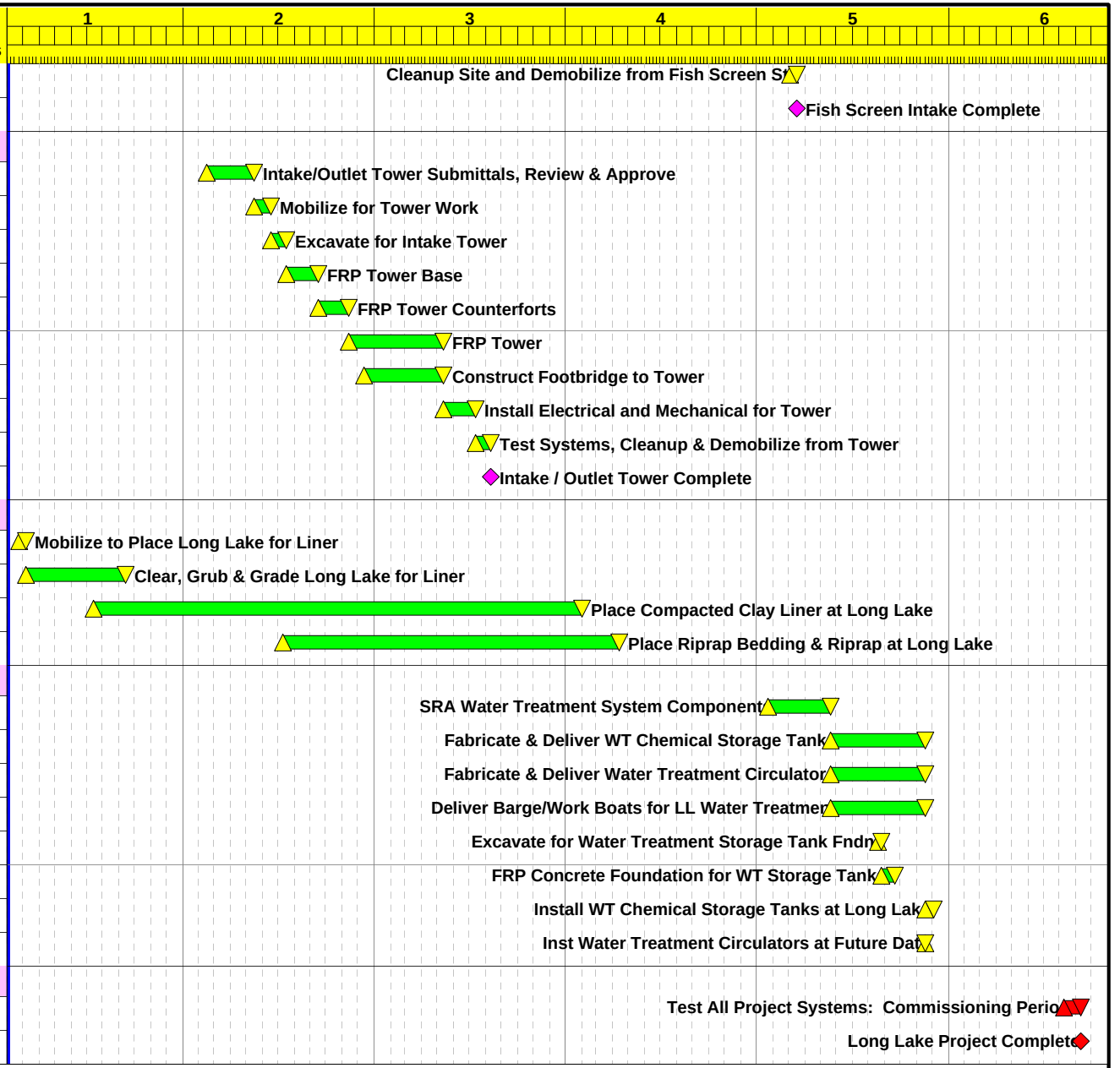
L3D2 Sheet 2 of 3

Alternative No.3, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 3D
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 2,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	60
1T14100	FRP Tower Counterforts	60
1T14125	FRP Tower	180
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	10
1CL6120	Clear, Grub & Grade Long Lake for Liner	133
1CL6140	Place Compacted Clay Liner at Long Lake	650
1CL6160	Place Riprap Bedding & Riprap at Long Lake	450
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	5
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date 01FEB16
Finish Date 08SEP21
Data Date 01FEB16
Run Date 31MAR09 09:13

Early Bar
Progress Bar
Critical Activity

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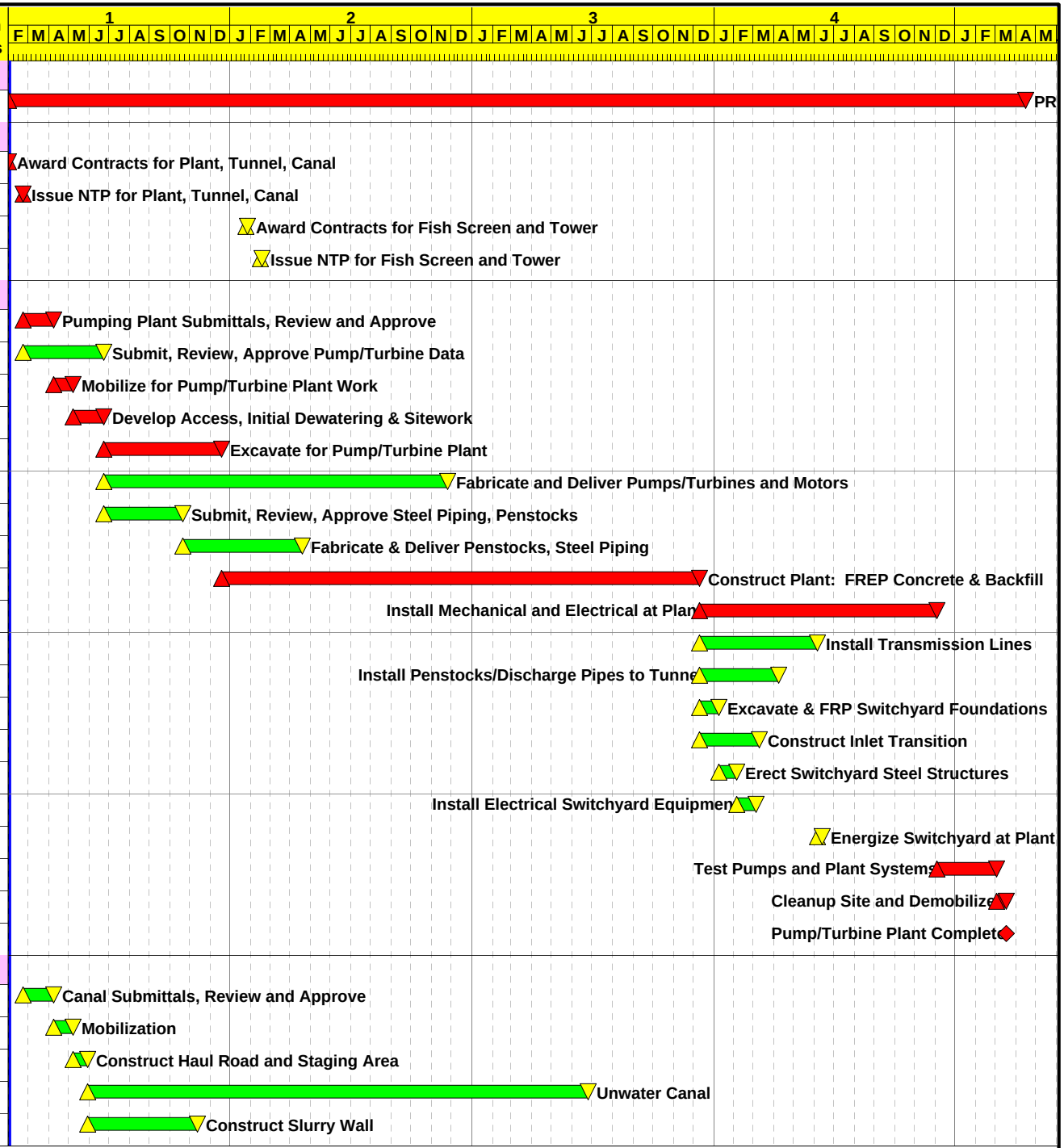
L3D2

Sheet 3 of 3

Alternative No.3, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 3D
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	1,537*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pump/Turbine Plant - 2,000 cfs		
1PA1100	Pumping Plant Submittals, Review and Approve	45
1PA1125	Submit, Review, Approve Pump/Turbine Data	120
1PA1150	Mobilize for Pump/Turbine Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pump/Turbine Plant	180
1PA1225	Fabricate and Deliver Pumps/Turbines and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	720
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pump/Turbine Plant Complete	0
Canal - 2,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Unwater Canal	545*
1C13150	Construct Slurry Wall	167



Start Date	01FEB16
Finish Date	16APR20
Data Date	01FEB16
Run Date	31MAR09 09:20

Early Bar
Progress Bar
Critical Activity

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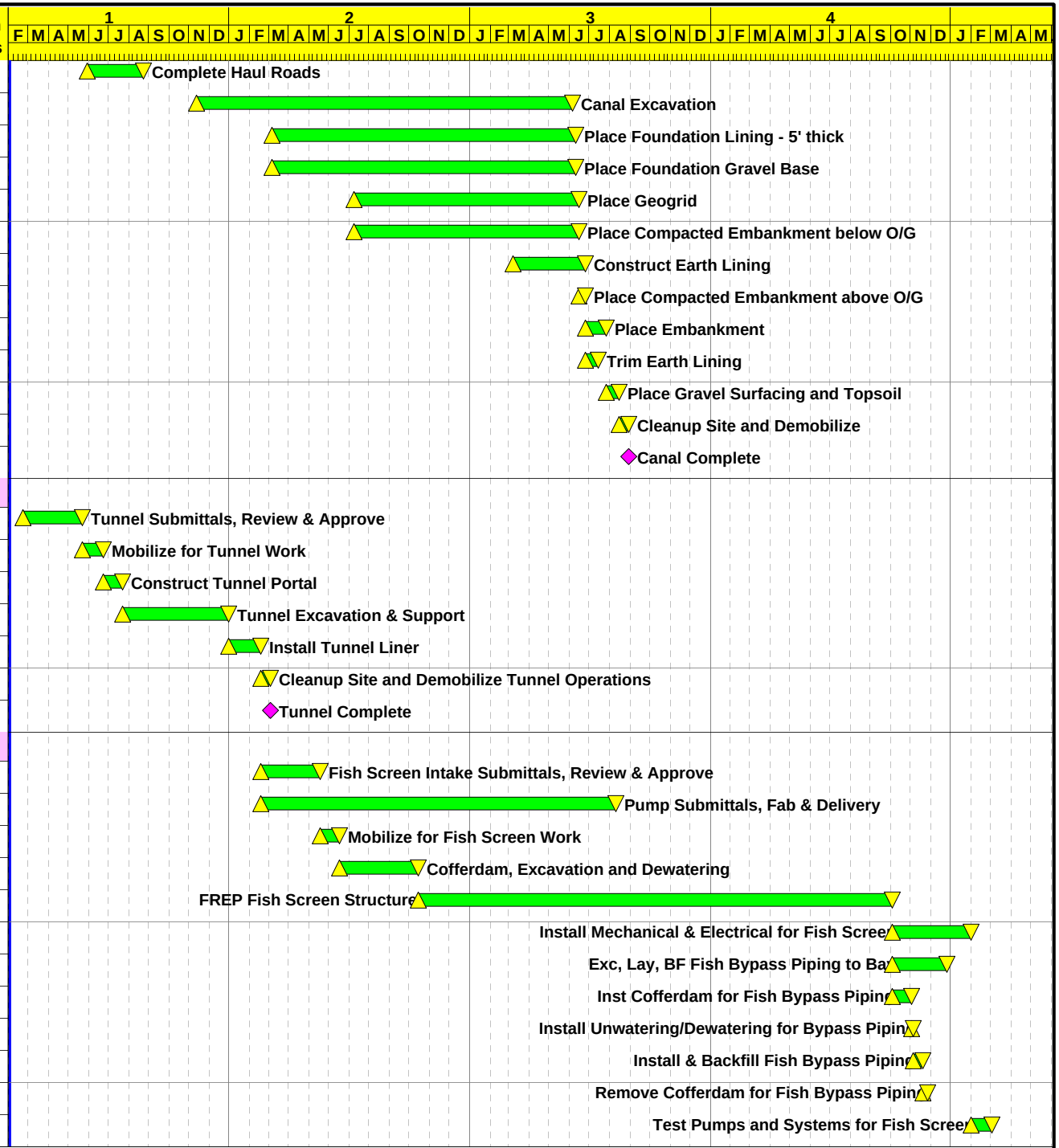
L3E2

Sheet 1 of 3

Alternative No. 3, Option E
(2,000 cfs Pump/Turbine Plant)
Long Lake Valley - 3E
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of winter weather		
	impacts to canal work each year.		

Activity ID	Activity Description	Duration Cal Days
1C13075	Complete Haul Roads	87
1C13175	Canal Excavation	359
1C13200	Place Foundation Lining - 5' thick	355
1C13225	Place Foundation Gravel Base	355*
1C13250	Place Geogrid	236*
1C13275	Place Compacted Embankment below O/G	236
1C13300	Construct Earth Lining	110
1C13325	Place Compacted Embankment above O/G	9
1C13350	Place Embankment	31
1C13375	Trim Earth Lining	18
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 2,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	160
1T12200	Install Tunnel Liner	50
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 2,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	120
1F15175	FREP Fish Screen Structure	720
1F15250	Install Mechanical & Electrical for Fish Screen	120
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30



Start Date 01FEB16
Finish Date 16APR20
Data Date 01FEB16
Run Date 31MAR09 09:20

Early Bar
Progress Bar
Critical Activity

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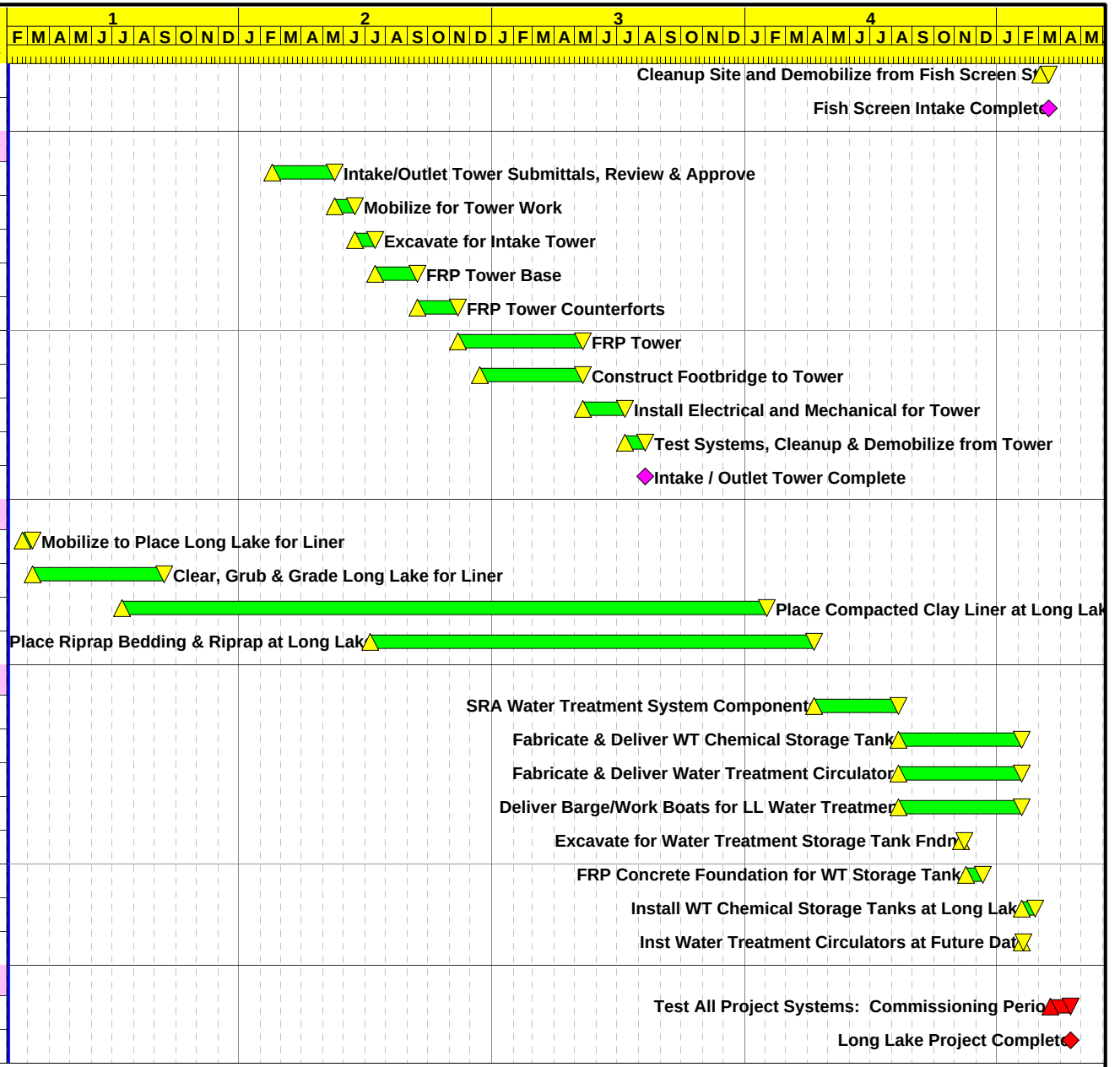
L3E2 Sheet 2 of 3

Alternative No. 3, Option E
(2,000 cfs Pump/Turbine Plant)
Long Lake Valley - 3E
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of winter weather		
	impacts to canal work each year.		

Activity ID	Activity Description	Duration Cal Days
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 2,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	60
1T14100	FRP Tower Counterforts	60
1T14125	FRP Tower	180
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	10
1CL6120	Clear, Grub & Grade Long Lake for Liner	133
1CL6140	Place Compacted Clay Liner at Long Lake	650
1CL6160	Place Riprap Bedding & Riprap at Long Lake	450
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	5
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date 01FEB16
Finish Date 16APR20
Data Date 01FEB16
Run Date 31MAR09 09:20

Early Bar
Progress Bar
Critical Activity

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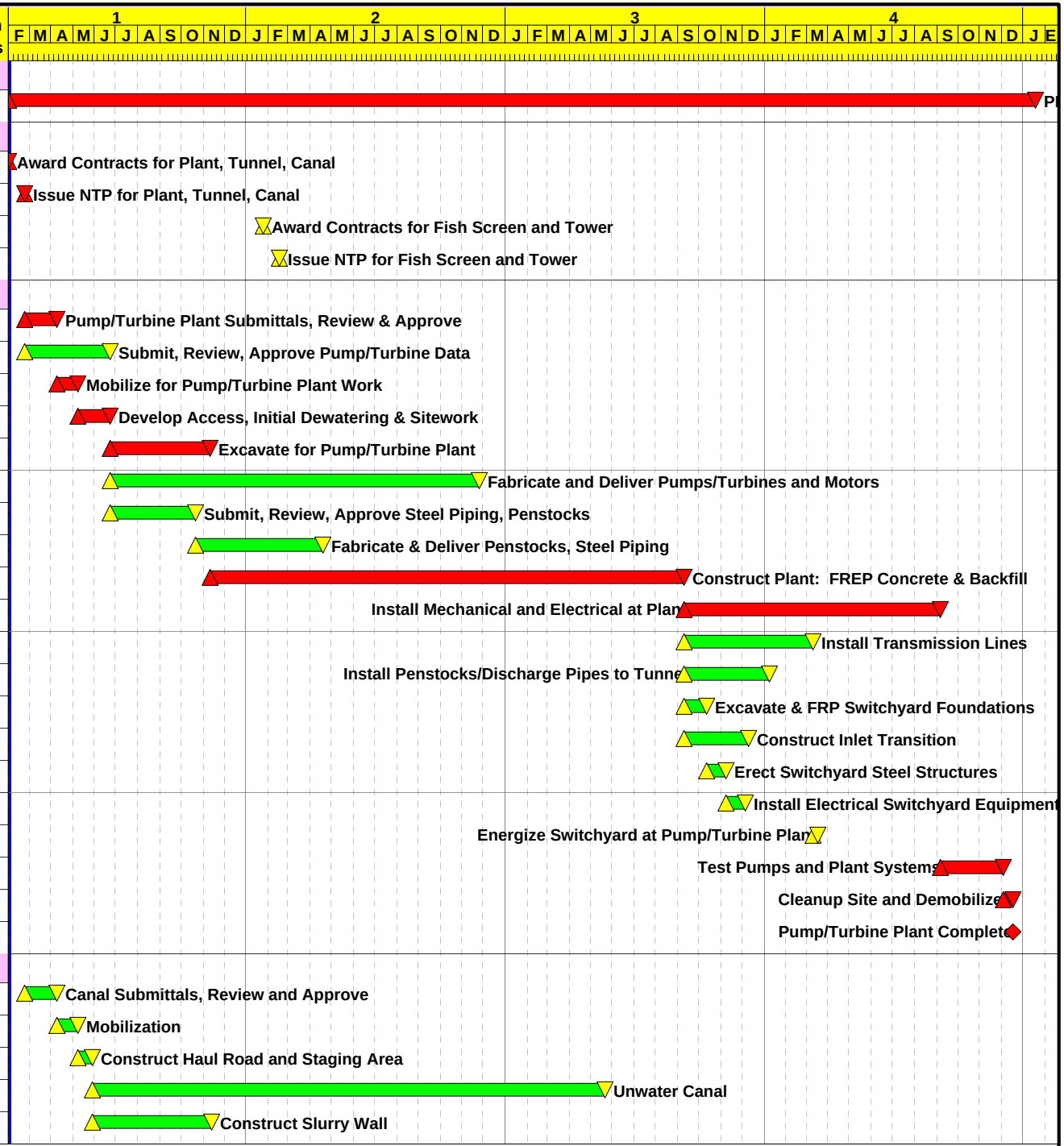
L3E2

Sheet 3 of 3

Alternative No. 3, Option E
(2,000 cfs Pump/Turbine Plant)
Long Lake Valley - 3E
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of winter weather		
	impacts to canal work each year.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	1,447*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pump/Turbine Plant - 1,000 cfs		
1PA1100	Pump/Turbine Plant Submittals, Review & Approve	45
1PA1125	Submit, Review, Approve Pump/Turbine Data	120
1PA1150	Mobilize for Pump/Turbine Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pump/Turbine Plant	140
1PA1225	Fabricate and Deliver Pumps/Turbines and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	670
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pump/Turbine Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pump/Turbine Plant Complete	0
Canal - 1,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Unwater Canal	509*
1C13150	Construct Slurry Wall	167



Start Date 01FEB16
Finish Date 17JAN20
Data Date 01FEB16
Run Date 31MAR09 09:20

Early Bar
Progress Bar
Critical Activity

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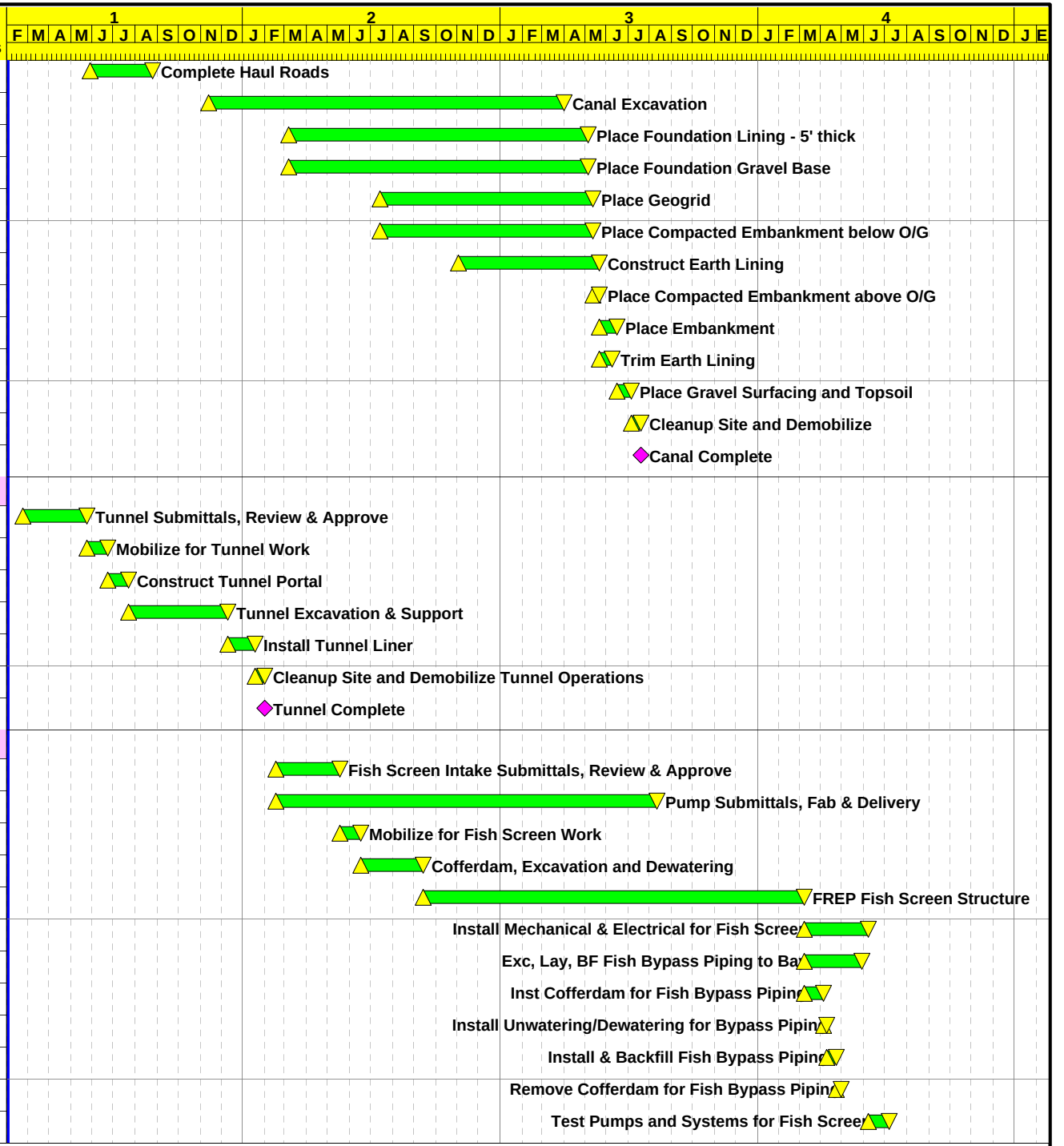
L3F1

Sheet 1 of 3

Alternative No. 3, Option F
(1,000 cfs Pump/Turbine Plant)
Long Lake Valley - 3F
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of winter weather		
	impacts to canal work each year.		

Activity ID	Activity Description	Duration Cal Days
1C13075	Complete Haul Roads	87
1C13175	Canal Excavation	292
1C13200	Place Foundation Lining - 5' thick	319
1C13225	Place Foundation Gravel Base	319*
1C13250	Place Geogrid	196*
1C13275	Place Compacted Embankment below O/G	196
1C13300	Construct Earth Lining	93
1C13325	Place Compacted Embankment above O/G	9
1C13350	Place Embankment	27
1C13375	Trim Earth Lining	18
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 1,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	140
1T12200	Install Tunnel Liner	40
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 1,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	90
1F15175	FREP Fish Screen Structure	540
1F15250	Install Mechanical & Electrical for Fish Screen	90
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30



Start Date 01FEB16
Finish Date 17JAN20
Data Date 01FEB16
Run Date 31MAR09 09:20

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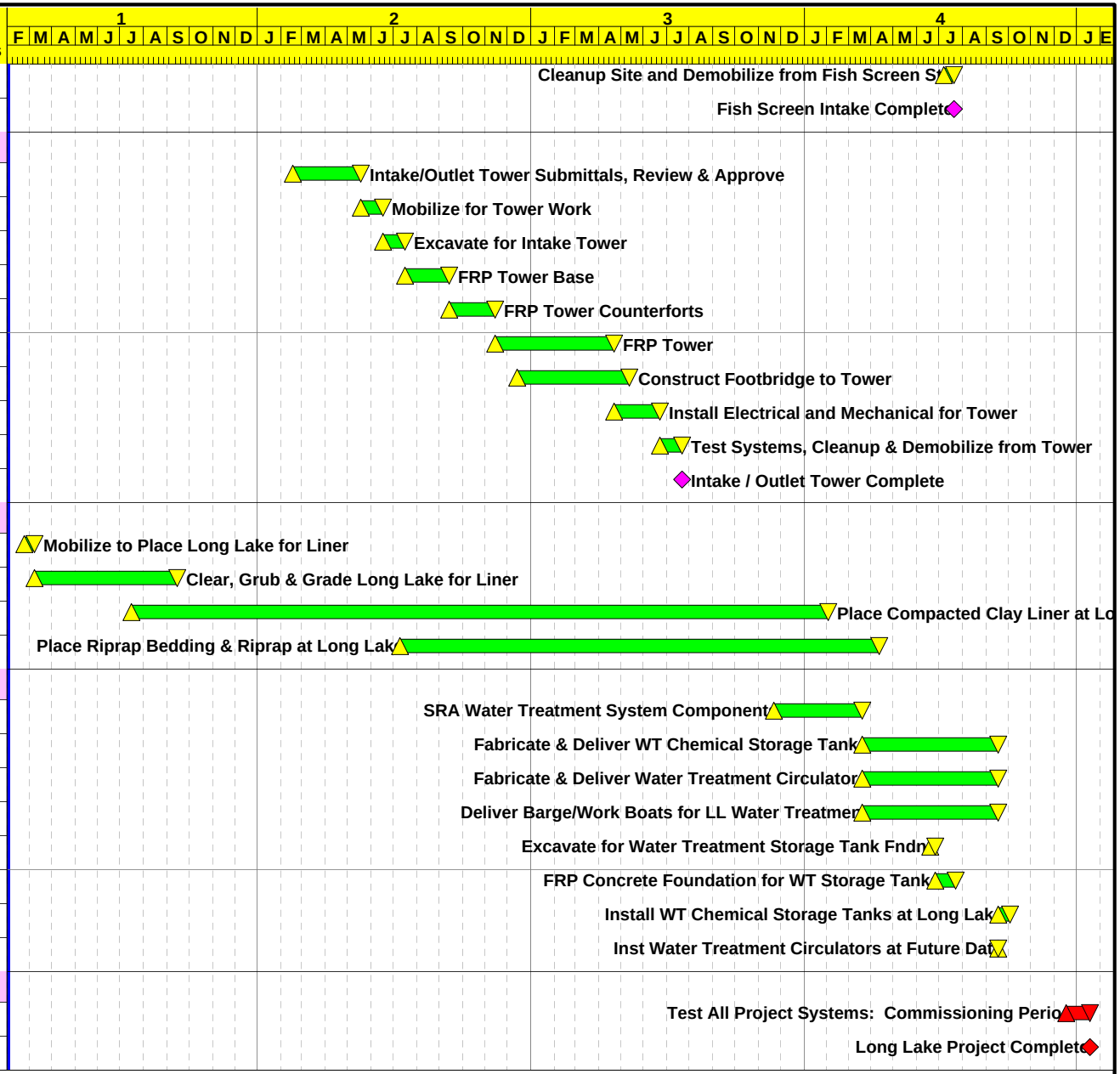
Early Bar
Progress Bar
Critical Activity

L3F1 Sheet 2 of 3

Alternative No. 3, Option F
(1,000 cfs Pump/Turbine Plant)
Long Lake Valley - 3F
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of winter weather		
	impacts to canal work each year.		

Activity ID	Activity Description	Duration Cal Days
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 1,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	60
1T14100	FRP Tower Counterforts	60
1T14125	FRP Tower	160
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	10
1CL6120	Clear, Grub & Grade Long Lake for Liner	133
1CL6140	Place Compacted Clay Liner at Long Lake	650
1CL6160	Place Riprap Bedding & Riprap at Long Lake	450
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	5
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date 01FEB16
Finish Date 17JAN20
Data Date 01FEB16
Run Date 31MAR09 09:20

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Early Bar
Progress Bar
Critical Activity

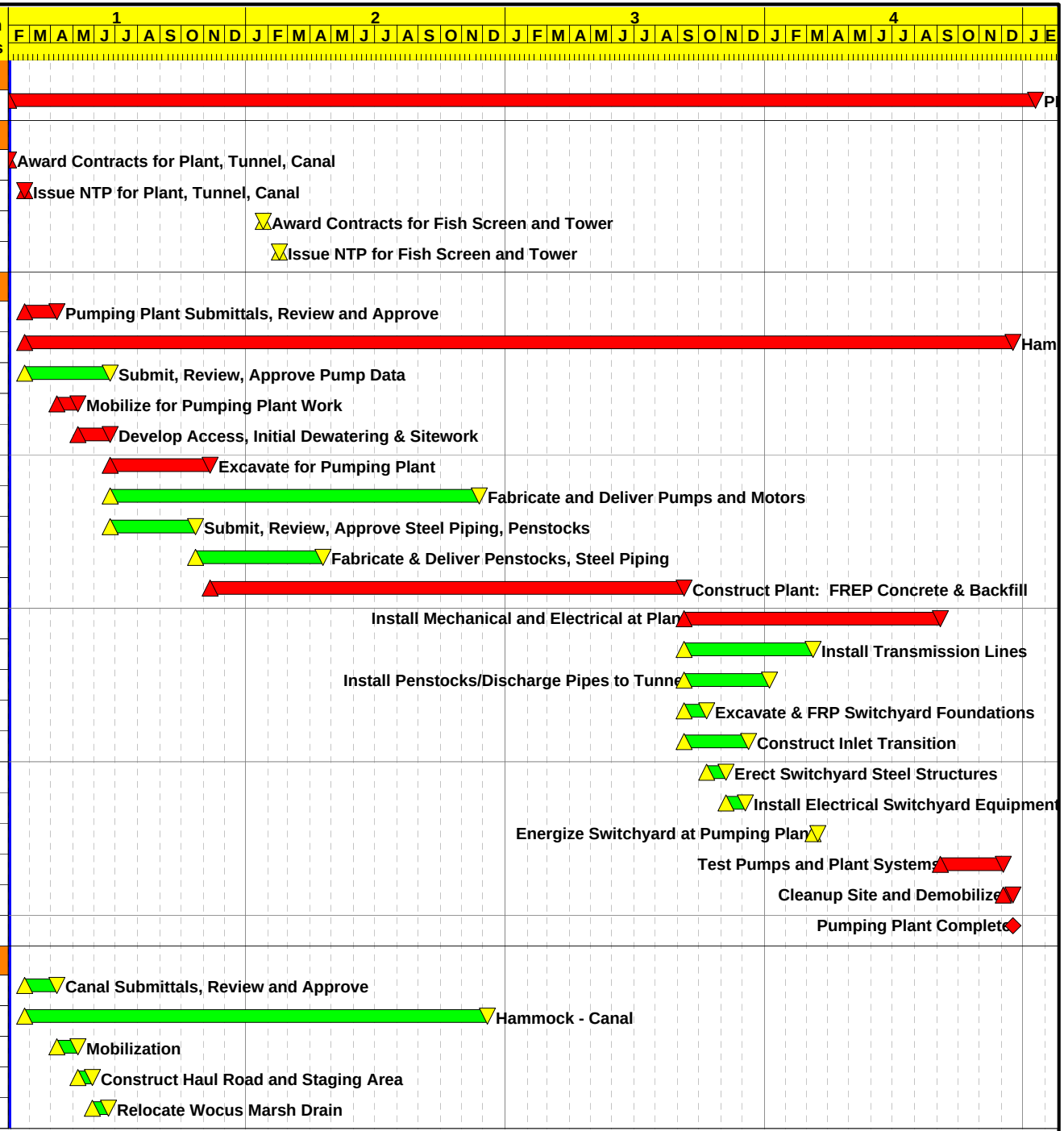
L3F1

Sheet 3 of 3

Alternative No. 3, Option F
(1,000 cfs Pump/Turbine Plant)
Long Lake Valley - 3F
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of winter weather		
	impacts to canal work each year.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	1,447*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping Plant - 1,000 cfs		
1PA1100	Pumping Plant Submittals, Review and Approve	45
HAMPP	Hammock - Pumping Plant	1,394*
1PA1125	Submit, Review, Approve Pump Data	120
1PA1150	Mobilize for Pumping Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping Plant	140
1PA1225	Fabricate and Deliver Pumps and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	670
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pumping Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping Plant Complete	0
Canal - 1,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
HAMC	Hammock - Canal	653*
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Relocate Wocus Marsh Drain	23



Start Date 01FEB16
Finish Date 17JAN20
Data Date 01FEB16
Run Date 31MAR09 09:21

Early Bar
Progress Bar
Critical Activity

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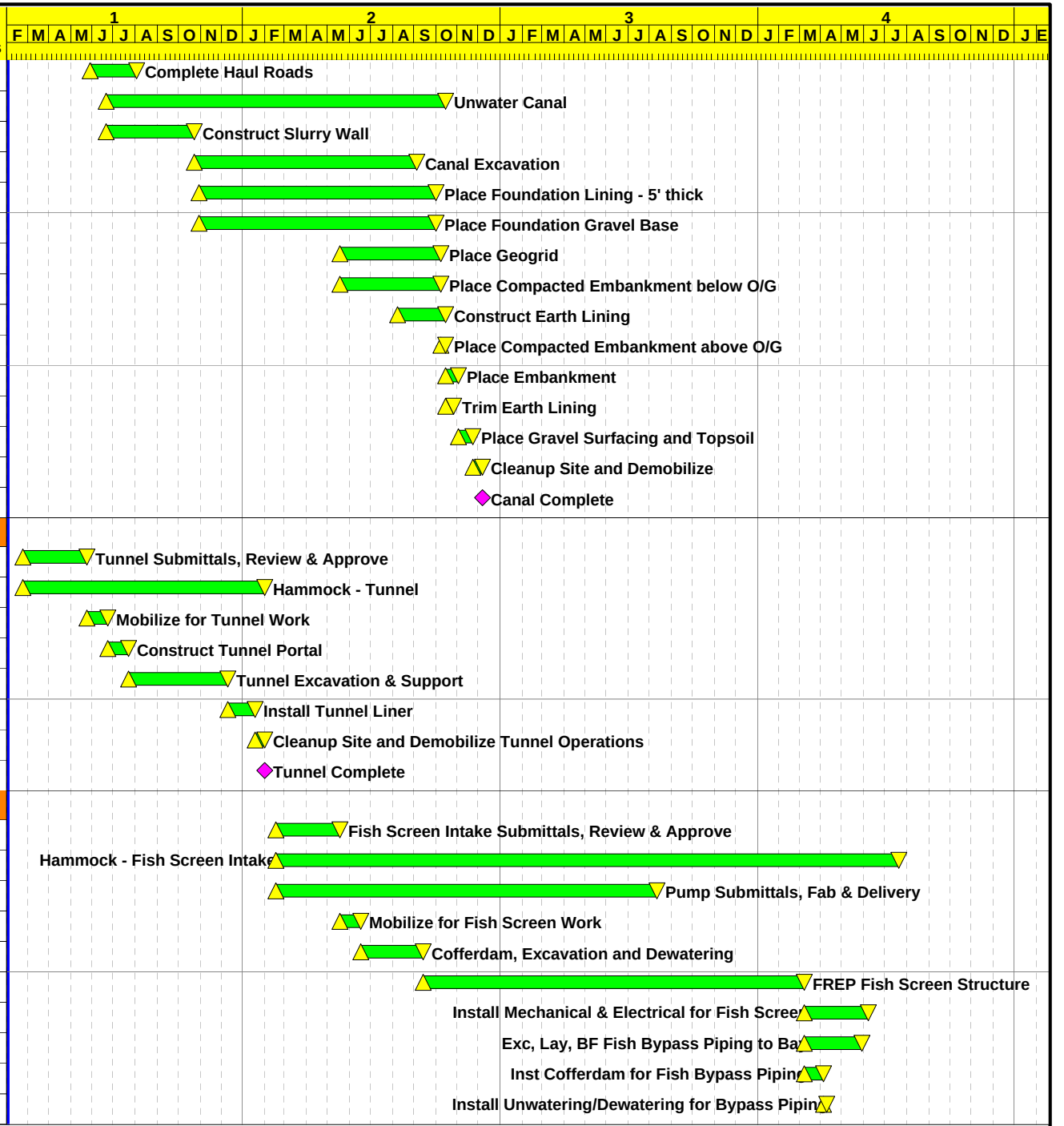
L4A1 Sheet 1 of 3

Alternative No. 4, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 4A
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: For Canal work, assume 3.5 months		
	of winter weather impacts.		

Activity ID	Activity Description	Duration Cal Days
1C13075	Complete Haul Roads	64
1C13125	Unwater Canal	374*
1C13150	Construct Slurry Wall	123
1C13175	Canal Excavation	210
1C13200	Place Foundation Lining - 5' thick	231
1C13225	Place Foundation Gravel Base	231*
1C13250	Place Geogrid	143*
1C13275	Place Compacted Embankment below O/G	143
1C13300	Construct Earth Lining	67
1C13325	Place Compacted Embankment above O/G	6
1C13350	Place Embankment	20
1C13375	Trim Earth Lining	13
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 1,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	344*
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	140
1T12200	Install Tunnel Liner	40
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 1,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	884*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	90
1F15175	FREP Fish Screen Structure	540
1F15250	Install Mechanical & Electrical for Fish Screen	90
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3



Start Date 01FEB16
Finish Date 17JAN20
Data Date 01FEB16
Run Date 31MAR09 09:21

Early Bar
Progress Bar
Critical Activity

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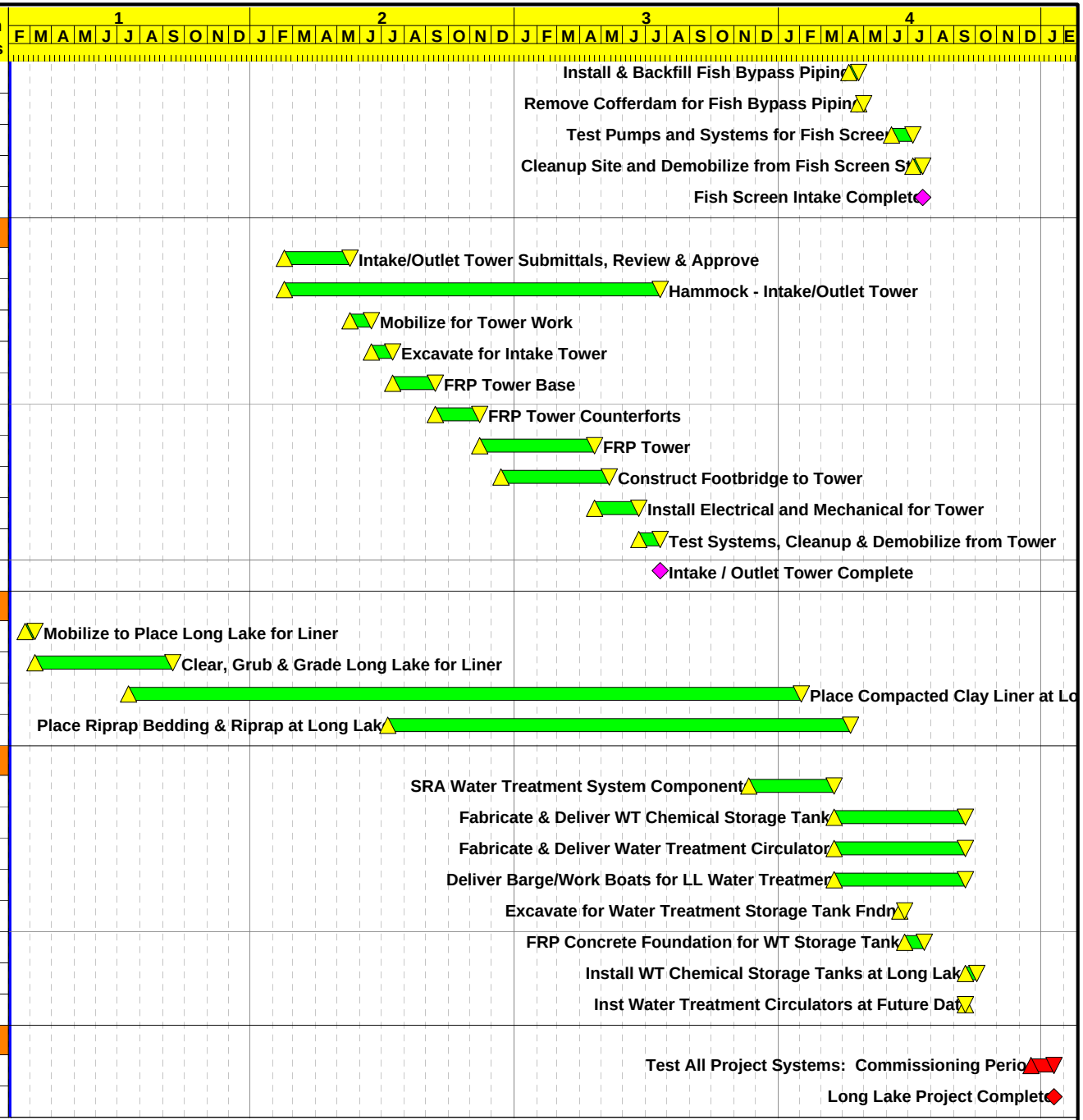
L4A1 Sheet 2 of 3

Alternative No. 4, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 4A
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: For Canal work, assume 3.5 months		
	of winter weather impacts.		

Activity ID	Activity Description	Duration Cal Days
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 1,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	520*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	60
1T14100	FRP Tower Counterforts	60
1T14125	FRP Tower	160
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	10
1CL6120	Clear, Grub & Grade Long Lake for Liner	133
1CL6140	Place Compacted Clay Liner at Long Lake	650
1CL6160	Place Riprap Bedding & Riprap at Long Lake	450
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	5
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date 01FEB16
Finish Date 17JAN20
Data Date 01FEB16
Run Date 31MAR09 09:21

Early Bar
Progress Bar
Critical Activity

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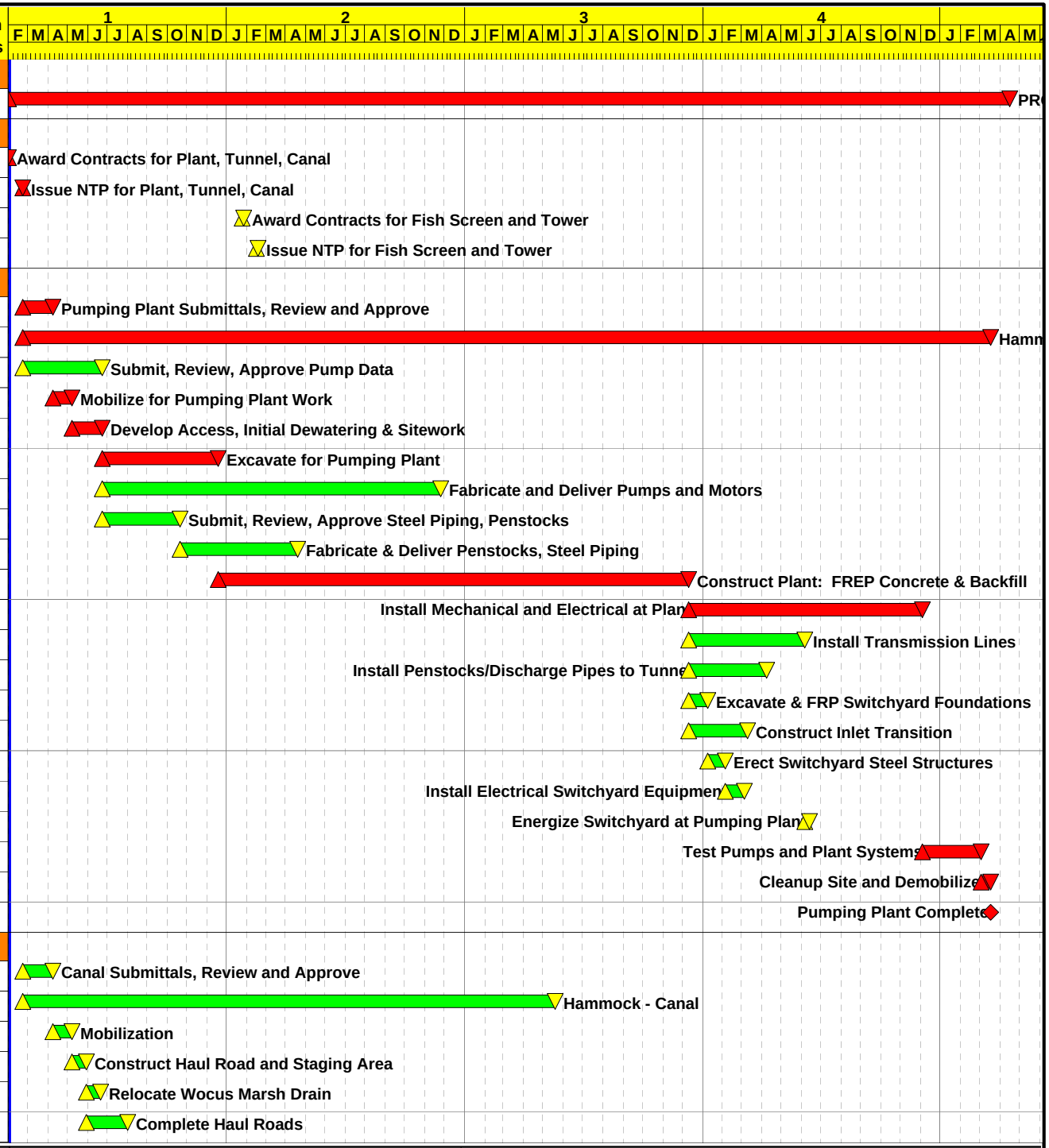
L4A1

Sheet 3 of 3

Alternative No. 4, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 4A
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: For Canal work, assume 3.5 months		
	of winter weather impacts.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	1,537*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping Plant - 2,000 cfs		
1PA1100	Pumping Plant Submittals, Review and Approve	45
HAMPP	Hammock - Pumping Plant	1,484*
1PA1125	Submit, Review, Approve Pump Data	120
1PA1150	Mobilize for Pumping Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping Plant	180
1PA1225	Fabricate and Deliver Pumps and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	720
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pumping Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping Plant Complete	0
Canal - 2,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
HAMC	Hammock - Canal	817*
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Relocate Wocus Marsh Drain	23
1C13075	Complete Haul Roads	64



Start Date	01FEB16
Finish Date	16APR20
Data Date	01FEB16
Run Date	31MAR09 09:22

Early Bar
Progress Bar
Critical Activity

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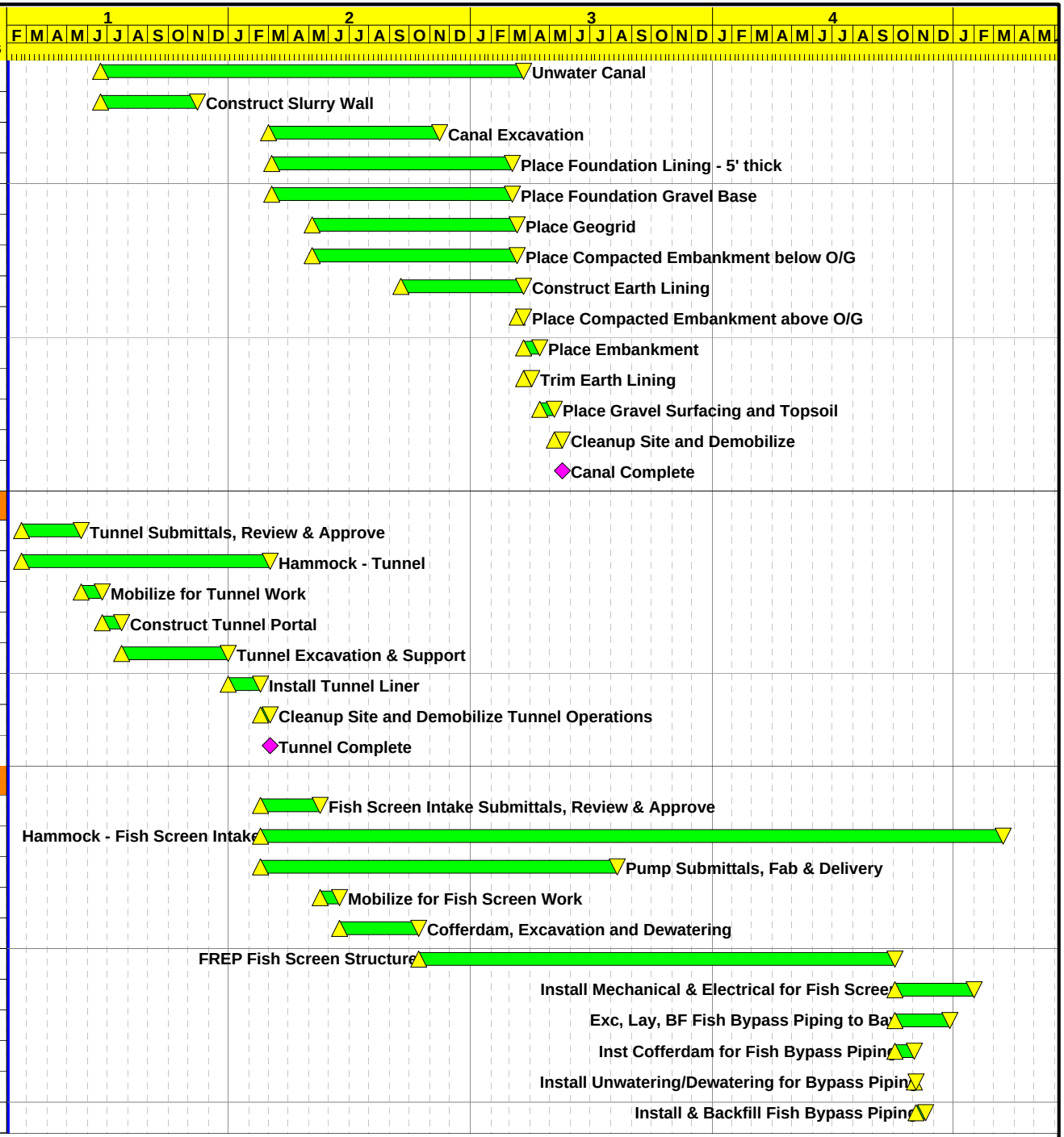
L4B2

Alternative No. 4, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 4B
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: For Canal Work, assume 3.5 months of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
1C13125	Unwater Canal	426*
1C13150	Construct Slurry Wall	146
1C13175	Canal Excavation	259
1C13200	Place Foundation Lining - 5' thick	257
1C13225	Place Foundation Gravel Base	257*
1C13250	Place Geogrid	205*
1C13275	Place Compacted Embankment below O/G	205
1C13300	Construct Earth Lining	80
1C13325	Place Compacted Embankment above O/G	9
1C13350	Place Embankment	26
1C13375	Trim Earth Lining	13
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 2,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	374*
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	160
1T12200	Install Tunnel Liner	50
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 2,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	1,124*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	120
1F15175	FREP Fish Screen Structure	720
1F15250	Install Mechanical & Electrical for Fish Screen	120
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15



Start Date 01FEB16
Finish Date 16APR20
Data Date 01FEB16
Run Date 31MAR09 09:22

Early Bar
Progress Bar
Critical Activity

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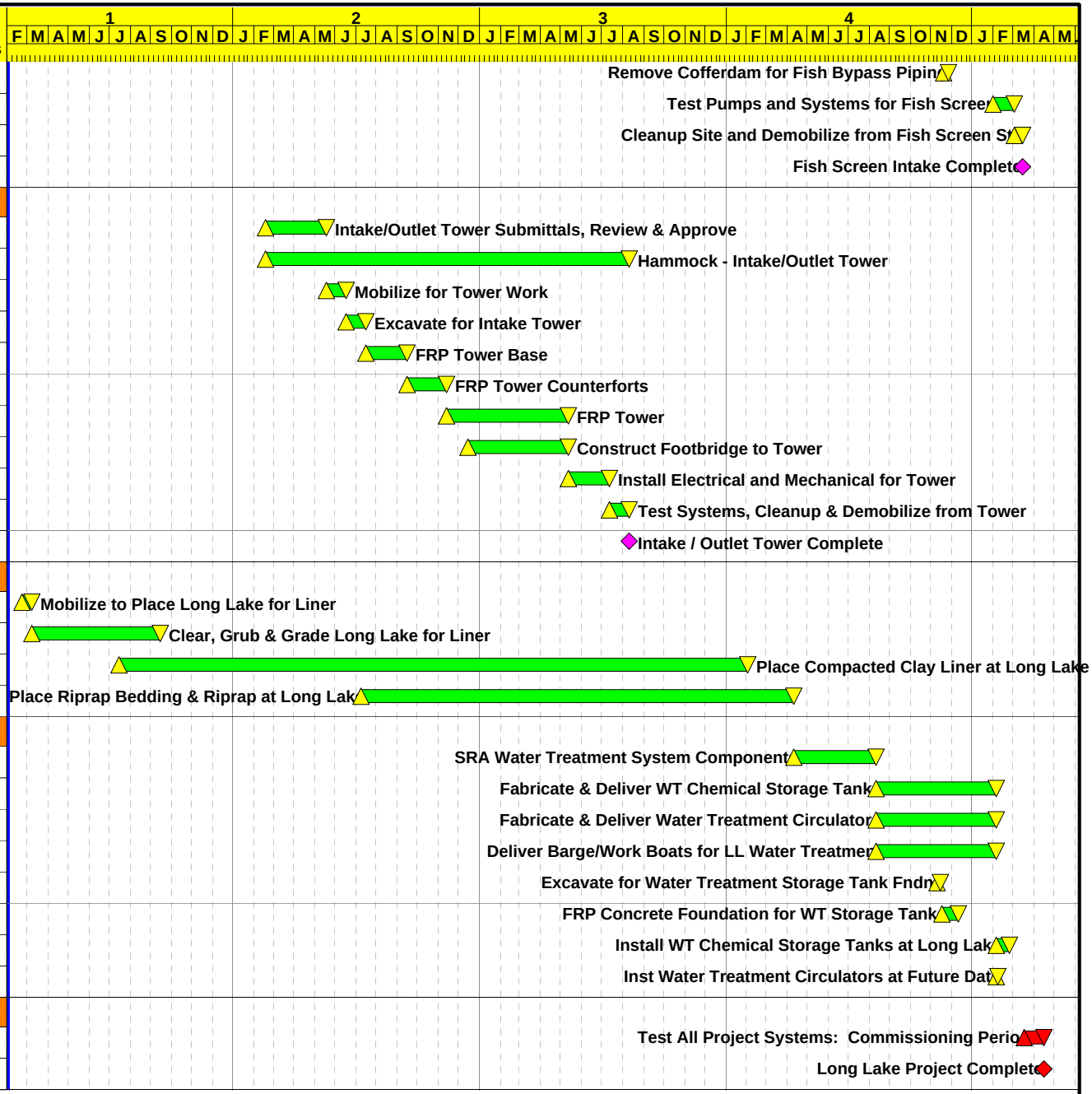
L4B2

Alternative No. 4, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 4B
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: For Canal Work, assume 3.5 months of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 2,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	540*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	60
1T14100	FRP Tower Counterforts	60
1T14125	FRP Tower	180
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	10
1CL6120	Clear, Grub & Grade Long Lake for Liner	133
1CL6140	Place Compacted Clay Liner at Long Lake	650
1CL6160	Place Riprap Bedding & Riprap at Long Lake	450
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	5
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date 01FEB16
Finish Date 16APR20
Data Date 01FEB16
Run Date 31MAR09 09:22

Early Bar
Progress Bar
Critical Activity

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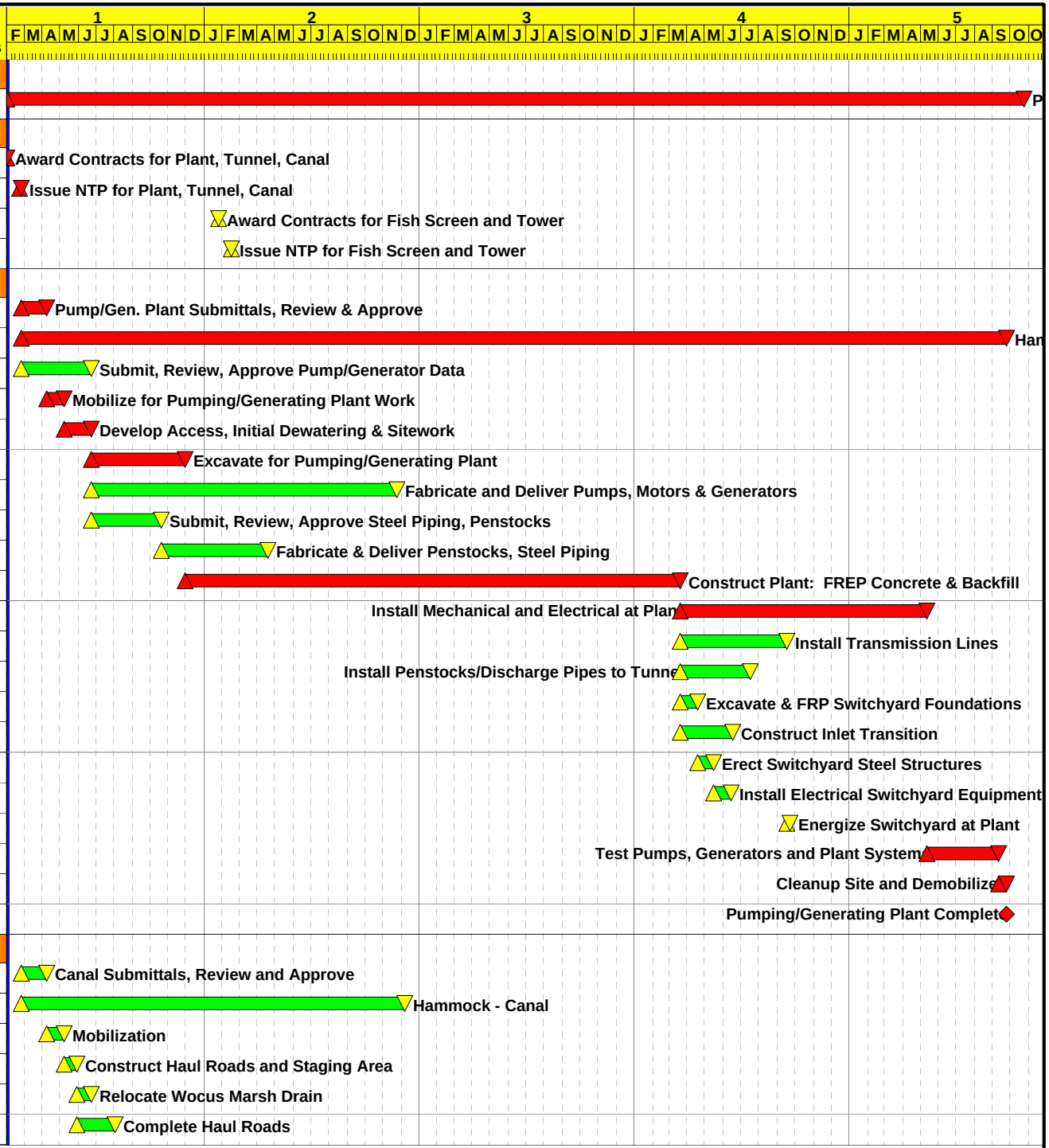
L4B2

Alternative No. 4, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 4B
Summary Construction Schedule

Sheet 3 of 3

Date	Revision	Checked	Approved
	NOTE: For Canal Work, assume 3.5 months of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	1,727*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping and Generating Plant - 1,000 cfs		
1PA1100	Pump/Gen. Plant Submittals, Review & Approve	45
HAMPP	Hammock - Pumping Plant	1,674*
1PA1125	Submit, Review, Approve Pump/Generator Data	120
1PA1150	Mobilize for Pumping/Generating Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping/Generating Plant	160
1PA1225	Fabricate and Deliver Pumps, Motors & Generators	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	840
1PA1375	Install Mechanical and Electrical at Plant	420
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Plant	7
1PA1575	Test Pumps, Generators and Plant Systems	120
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping/Generating Plant Complete	0
Canal - 1,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
HAMC	Hammock - Canal	653*
1C13025	Mobilization	30
1C13050	Construct Haul Roads and Staging Area	21
1C13100	Relocate Wocus Marsh Drain	23
1C13075	Complete Haul Roads	64



Start Date 01FEB16
Finish Date 23OCT20
Data Date 01FEB16
Run Date 31MAR09 09:22

Early Bar
Progress Bar
Critical Activity

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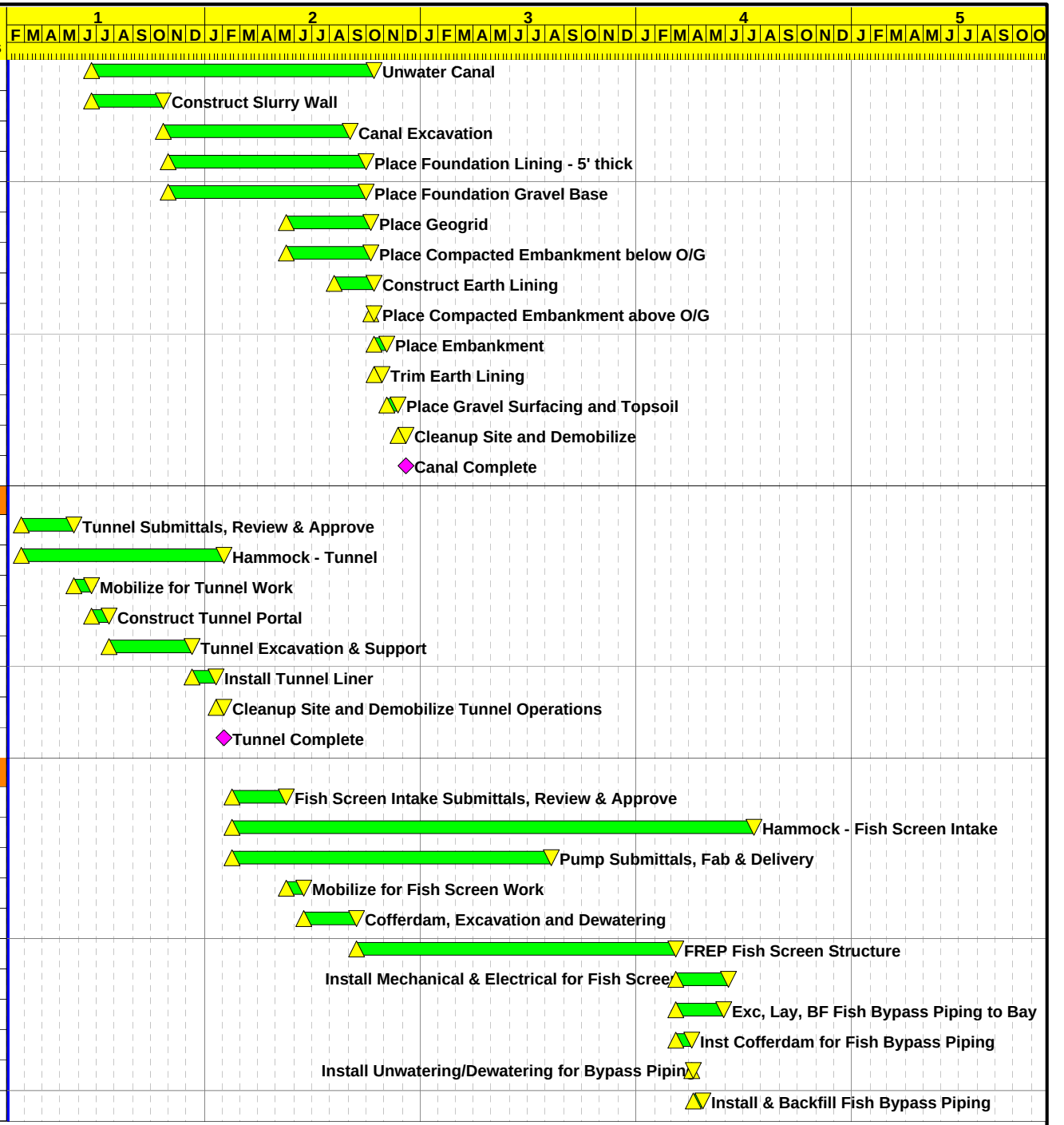
L4C1

Alternative No. 4, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 4C
Summary Construction Schedule

Sheet 1 of 3

Date	Revision	Checked	Approved
	NOTE: For canal work, assume 3.5 months of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
1C13125	Unwater Canal	374*
1C13150	Construct Slurry Wall	123
1C13175	Canal Excavation	210
1C13200	Place Foundation Lining - 5' thick	231
1C13225	Place Foundation Gravel Base	231*
1C13250	Place Geogrid	143*
1C13275	Place Compacted Embankment below O/G	143
1C13300	Construct Earth Lining	67
1C13325	Place Compacted Embankment above O/G	6
1C13350	Place Embankment	20
1C13375	Trim Earth Lining	13
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 1,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	344*
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	140
1T12200	Install Tunnel Liner	40
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 1,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	884*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	90
1F15175	FREP Fish Screen Structure	540
1F15250	Install Mechanical & Electrical for Fish Screen	90
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15



Start Date 01FEB16
Finish Date 23OCT20
Data Date 01FEB16
Run Date 31MAR09 09:22

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Early Bar
Progress Bar
Critical Activity

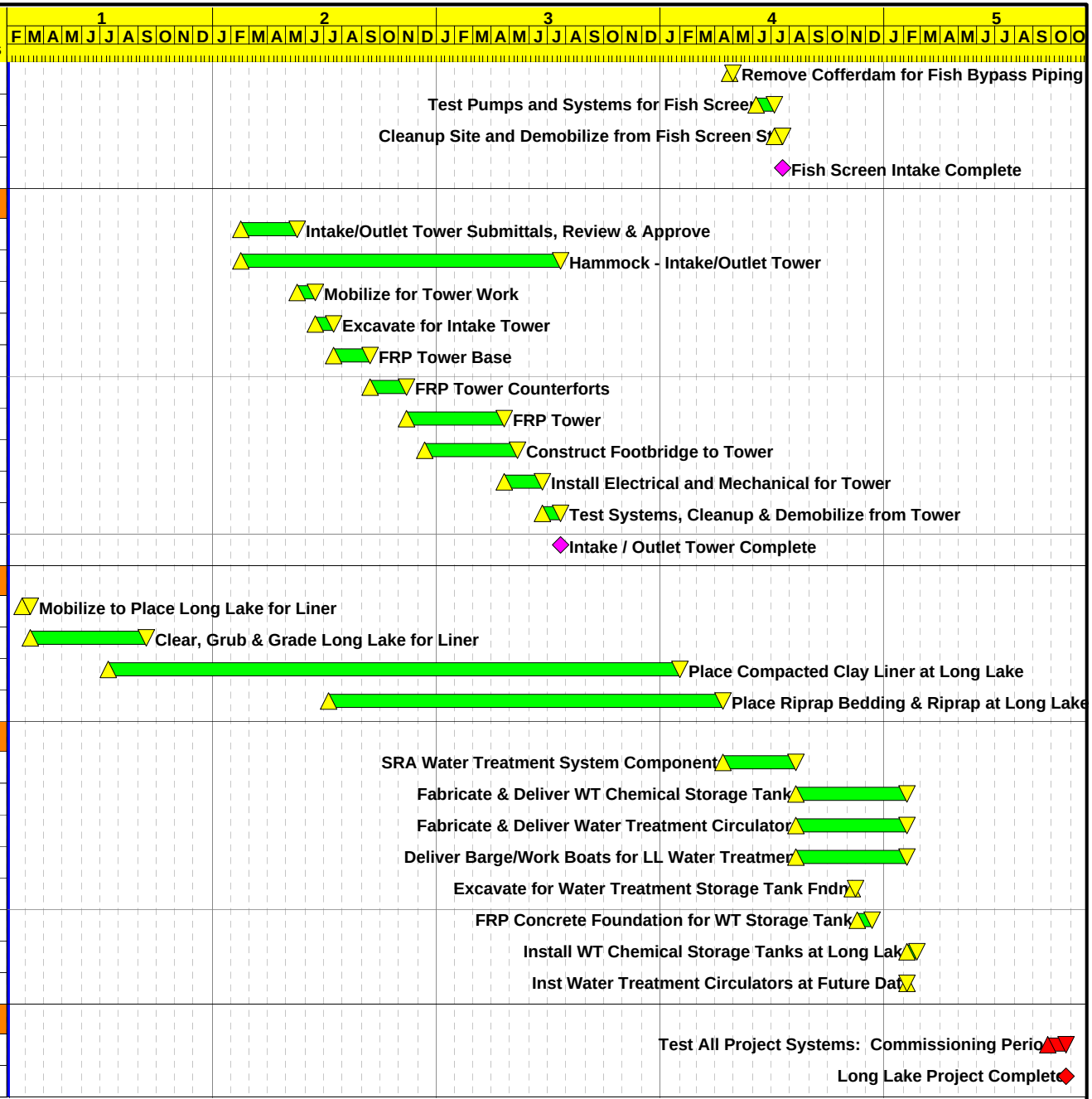
L4C1

Alternative No. 4, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 4C
Summary Construction Schedule

Sheet 2 of 3

Date	Revision	Checked	Approved
	NOTE: For canal work, assume 3.5 months of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 1,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	520*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	60
1T14100	FRP Tower Counterforts	60
1T14125	FRP Tower	160
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	10
1CL6120	Clear, Grub & Grade Long Lake for Liner	133
1CL6140	Place Compacted Clay Liner at Long Lake	650
1CL6160	Place Riprap Bedding & Riprap at Long Lake	450
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	5
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date 01FEB16
Finish Date 23OCT20
Data Date 01FEB16
Run Date 31MAR09 09:22

Early Bar
Progress Bar
Critical Activity

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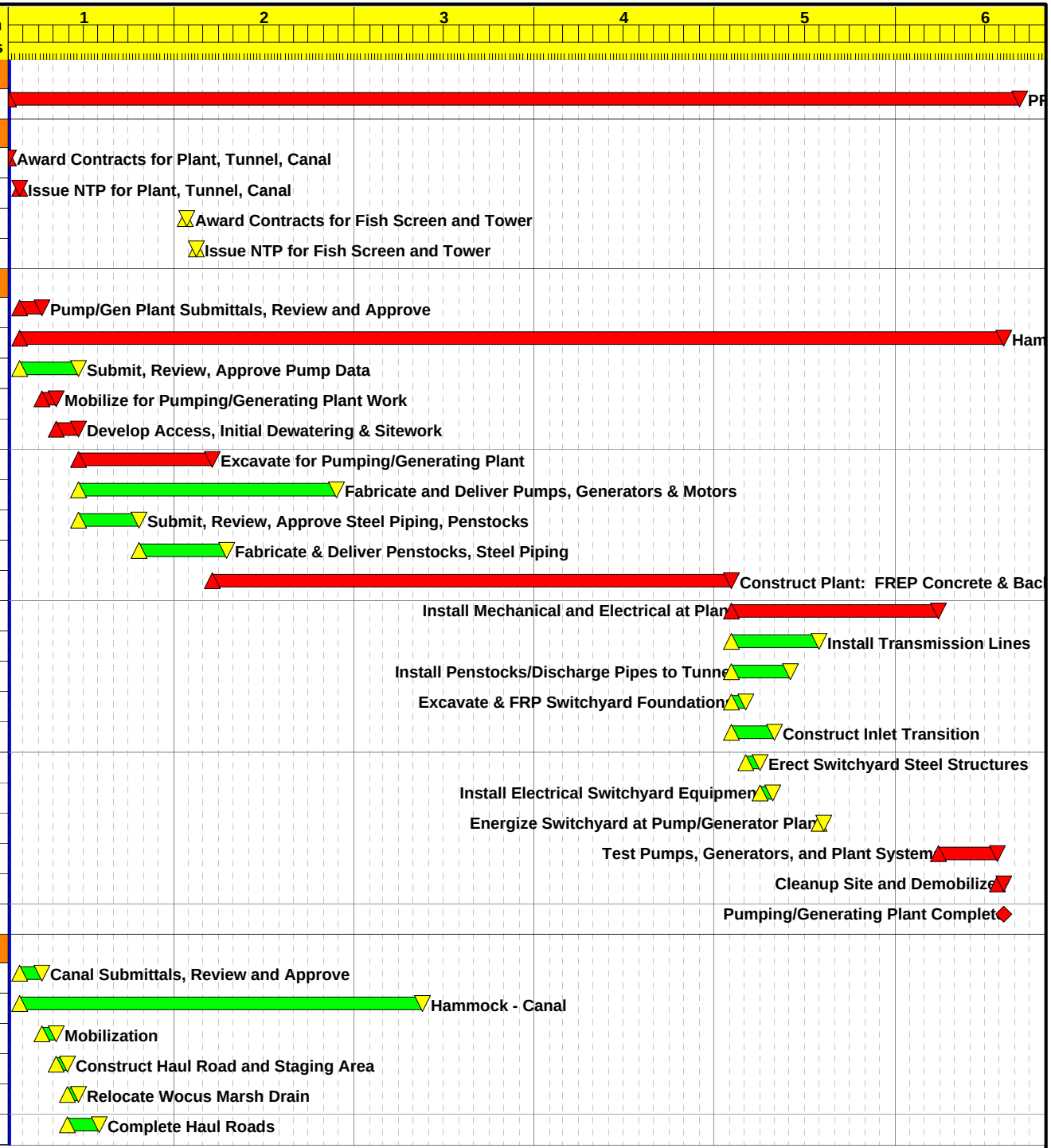
L4C1

Alternative No. 4, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 4C
Summary Construction Schedule

Sheet 3 of 3

Date	Revision	Checked	Approved
	NOTE: For canal work, assume 3.5 months of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	2,047*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping and Generating Plant - 2,000 cfs		
1PA1100	Pump/Gen Plant Submittals, Review and Approve	45
HAMPP	Hammock - Pumping Plant	1,994*
1PA1125	Submit, Review, Approve Pump Data	120
1PA1150	Mobilize for Pumping/Generating Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping/Generating Plant	270
1PA1225	Fabricate and Deliver Pumps, Generators & Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	1,050
1PA1375	Install Mechanical and Electrical at Plant	420
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pump/Generator Plant	7
1PA1575	Test Pumps, Generators, and Plant Systems	120
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping/Generating Plant Complete	0
Canal - 2,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
HAMC	Hammock - Canal	817*
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Relocate Wocus Marsh Drain	23
1C13075	Complete Haul Roads	64



Start Date	01FEB16
Finish Date	08SEP21
Data Date	01FEB16
Run Date	31MAR09 09:23

Early Bar
Progress Bar
Critical Activity

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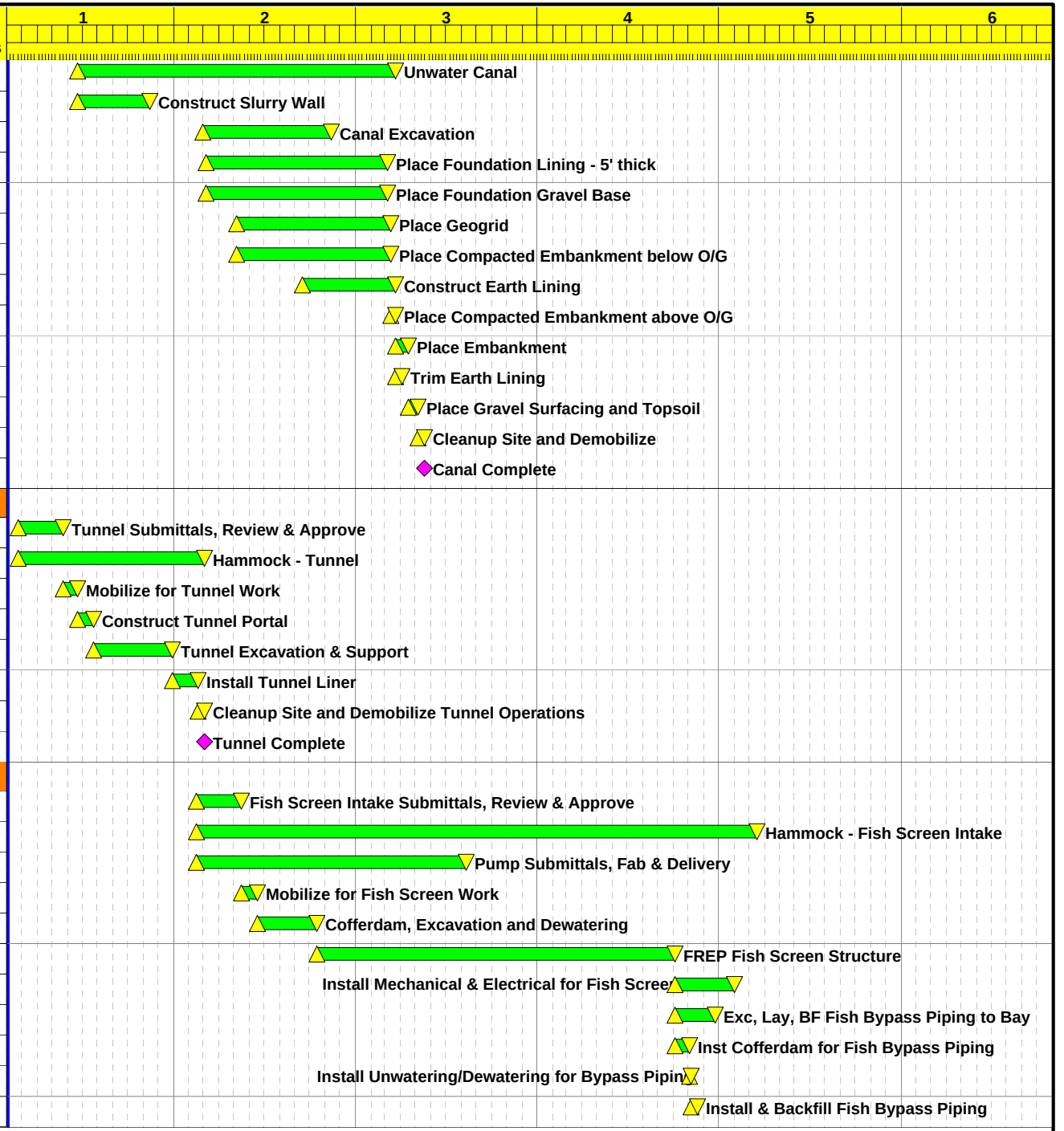
L4D2

Alternative No. 4, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 4D
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: For canal work, assumer 3.5 months		
	of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
1C13125	Unwater Canal	426*
1C13150	Construct Slurry Wall	146
1C13175	Canal Excavation	259
1C13200	Place Foundation Lining - 5' thick	257
1C13225	Place Foundation Gravel Base	257*
1C13250	Place Geogrid	205*
1C13275	Place Compacted Embankment below O/G	205
1C13300	Construct Earth Lining	80
1C13325	Place Compacted Embankment above O/G	9
1C13350	Place Embankment	26
1C13375	Trim Earth Lining	13
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 2,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	374*
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	160
1T12200	Install Tunnel Liner	50
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 2,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	1,124*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	120
1F15175	FREP Fish Screen Structure	720
1F15250	Install Mechanical & Electrical for Fish Screen	120
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15



Start Date	01FEB16
Finish Date	08SEP21
Data Date	01FEB16
Run Date	31MAR09 09:23

Early Bar
Progress Bar
Critical Activity

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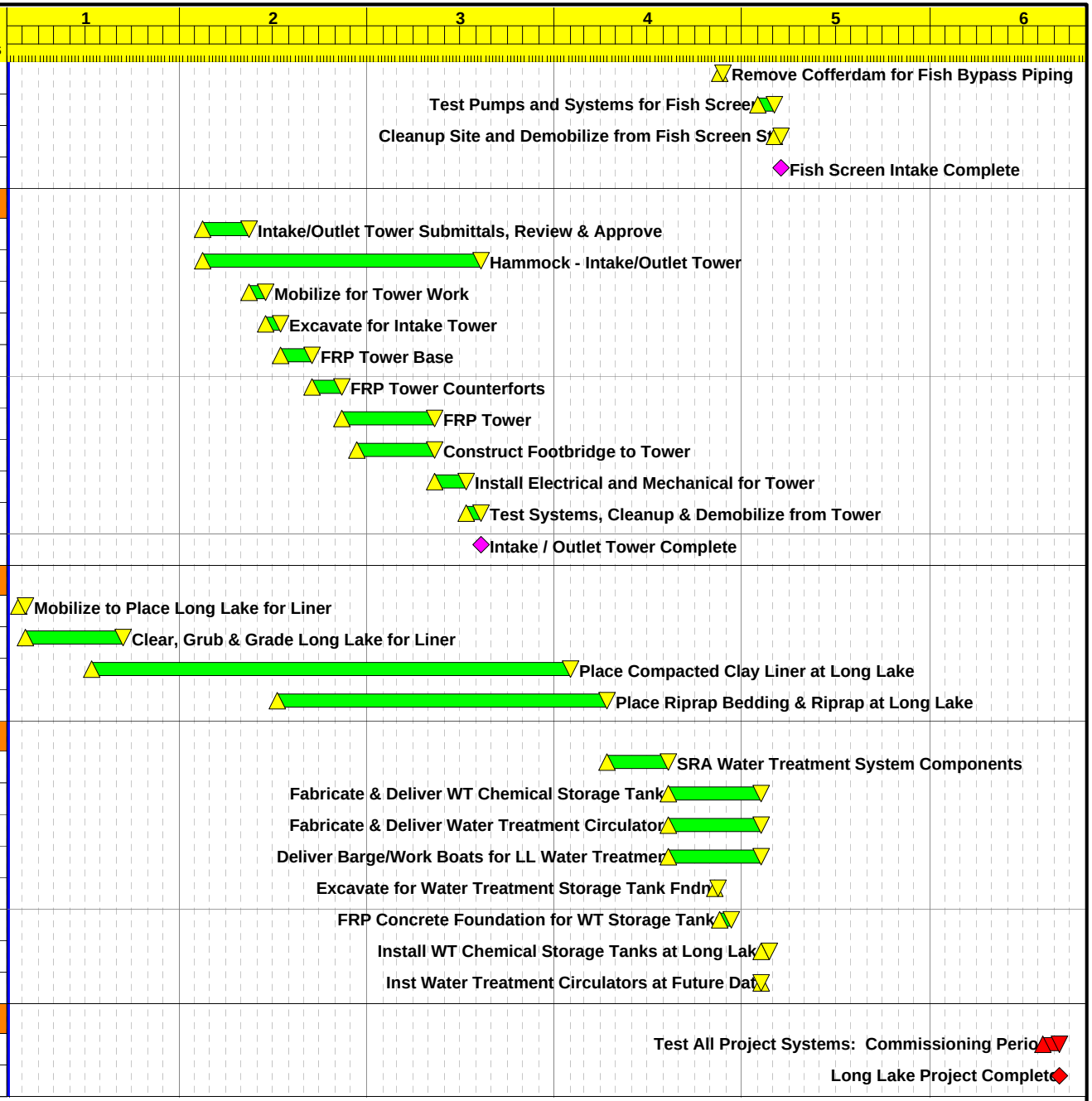
L4D2

Alternative No. 4, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 4D
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: For canal work, assumer 3.5 months		
	of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 2,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	540*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	60
1T14100	FRP Tower Counterforts	60
1T14125	FRP Tower	180
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake CLay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	10
1CL6120	Clear, Grub & Grade Long Lake for Liner	133
1CL6140	Place Compacted Clay Liner at Long Lake	650
1CL6160	Place Riprap Bedding & Riprap at Long Lake	450
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	5
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date 01FEB16
Finish Date 08SEP21
Data Date 01FEB16
Run Date 31MAR09 09:23

Early Bar
Progress Bar
Critical Activity

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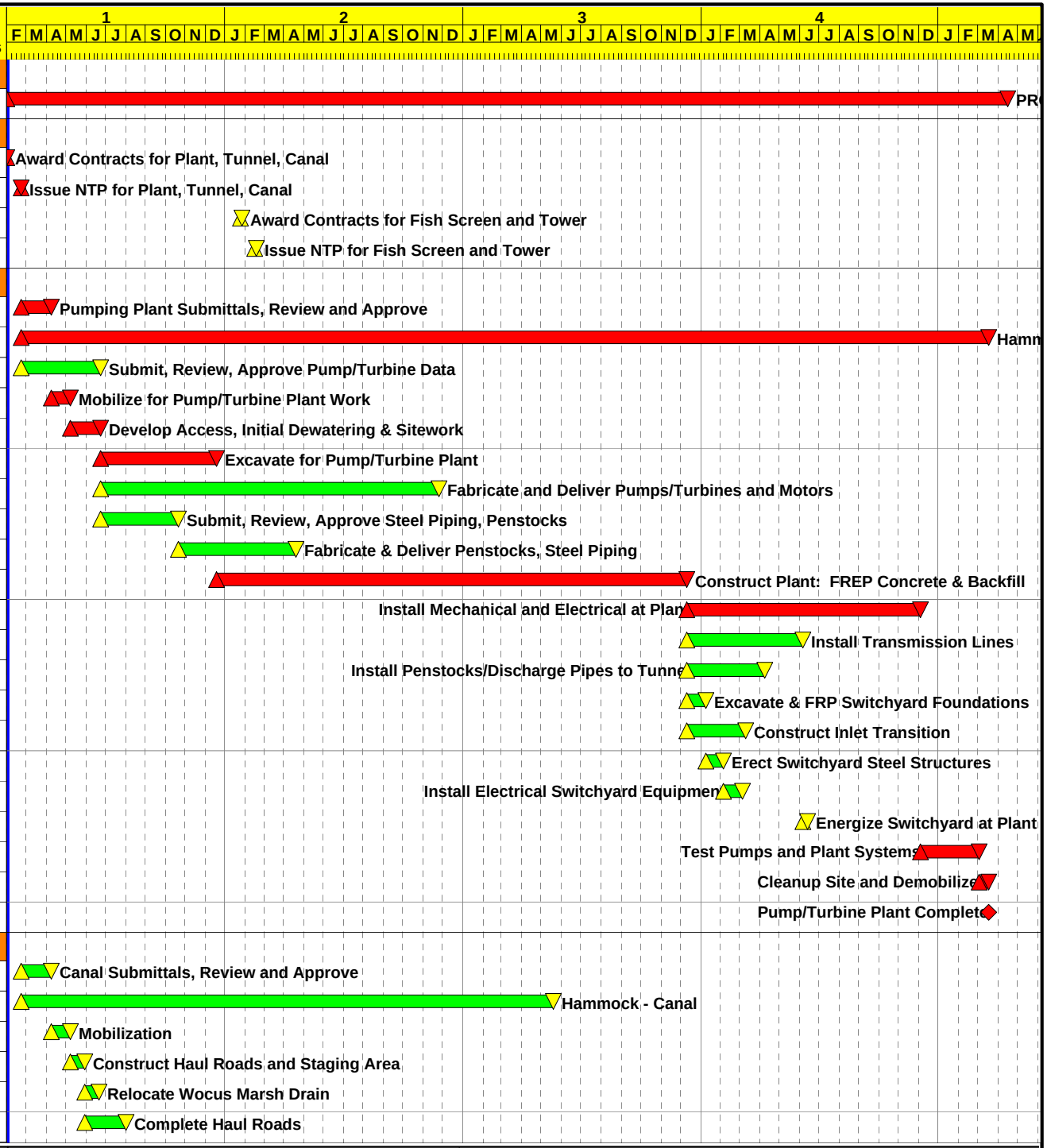
L4D2

Alternative No. 4, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 4D
Summary Construction Schedule

Sheet 3 of 3

Date	Revision	Checked	Approved
	NOTE: For canal work, assumer 3.5 months		
	of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	1,537*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pump/Turbine Plant - 2,000 cfs		
1PA1100	Pumping Plant Submittals, Review and Approve	45
HAMPP	Hammock - Pumping Plant	1,484*
1PA1125	Submit, Review, Approve Pump/Turbine Data	120
1PA1150	Mobilize for Pump/Turbine Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pump/Turbine Plant	180
1PA1225	Fabricate and Deliver Pumps/Turbines and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	720
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pump/Turbine Plant Complete	0
Canal - 2,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
HAMC	Hammock - Canal	817*
1C13025	Mobilization	30
1C13050	Construct Haul Roads and Staging Area	21
1C13100	Relocate Wocus Marsh Drain	23
1C13075	Complete Haul Roads	64



Start Date 01FEB16
Finish Date 16APR20
Data Date 01FEB16
Run Date 31MAR09 09:23

Early Bar
Progress Bar
Critical Activity

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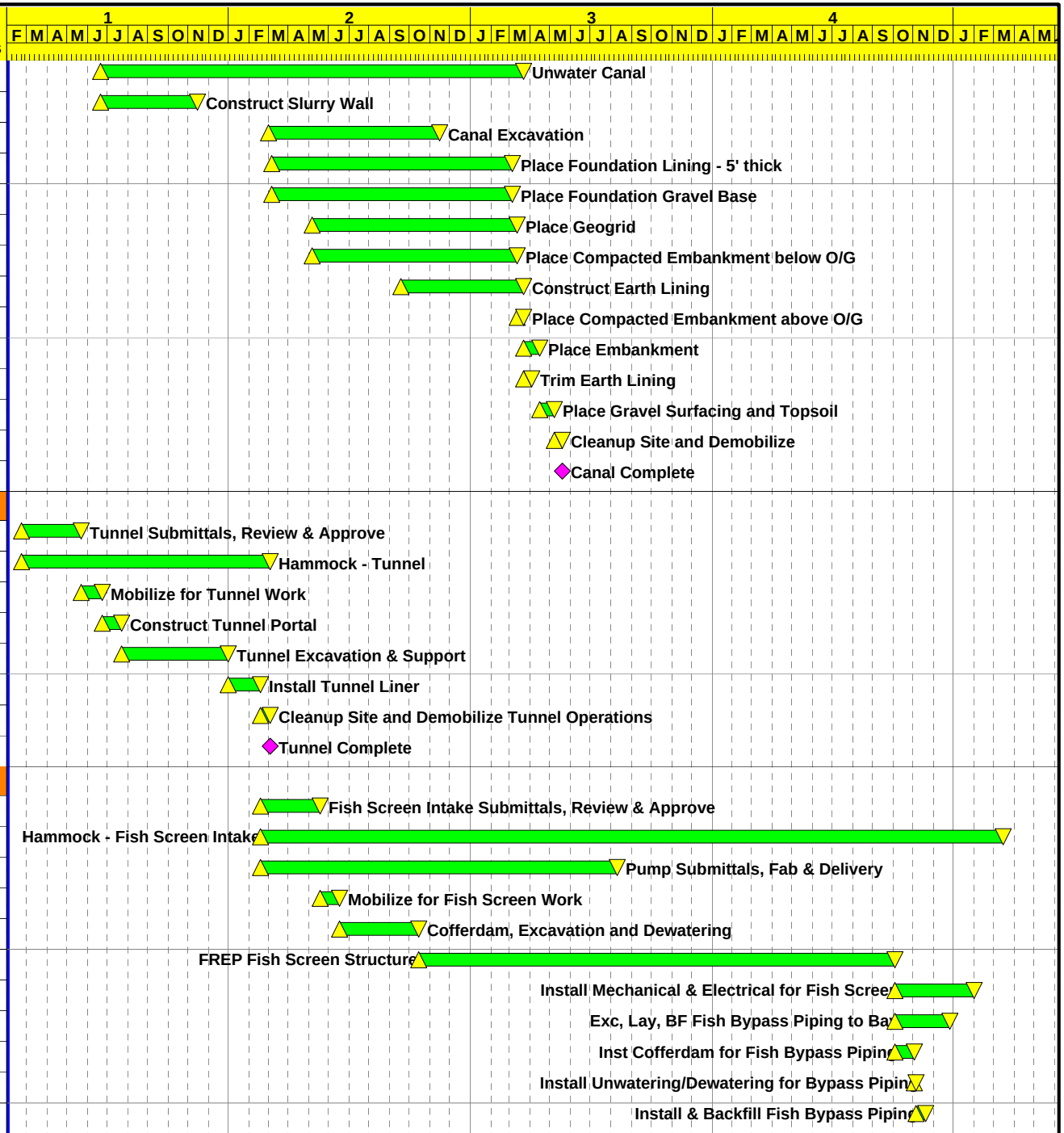
L4E2

Alternative No. 4, Option E
(2,000 cfs Pump/Turbine Plant)
Long Lake Valley - 4E
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: For canaly work, assume 3.5 months		
	of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
1C13125	Unwater Canal	426*
1C13150	Construct Slurry Wall	146
1C13175	Canal Excavation	259
1C13200	Place Foundation Lining - 5' thick	257
1C13225	Place Foundation Gravel Base	257*
1C13250	Place Geogrid	205*
1C13275	Place Compacted Embankment below O/G	205
1C13300	Construct Earth Lining	80
1C13325	Place Compacted Embankment above O/G	9
1C13350	Place Embankment	26
1C13375	Trim Earth Lining	13
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 2,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	374*
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	160
1T12200	Install Tunnel Liner	50
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 2,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	1,124*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	120
1F15175	FREP Fish Screen Structure	720
1F15250	Install Mechanical & Electrical for Fish Screen	120
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15



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Finish Date 16APR20
Data Date 01FEB16
Run Date 31MAR09 09:23

Early Bar
Progress Bar
Critical Activity

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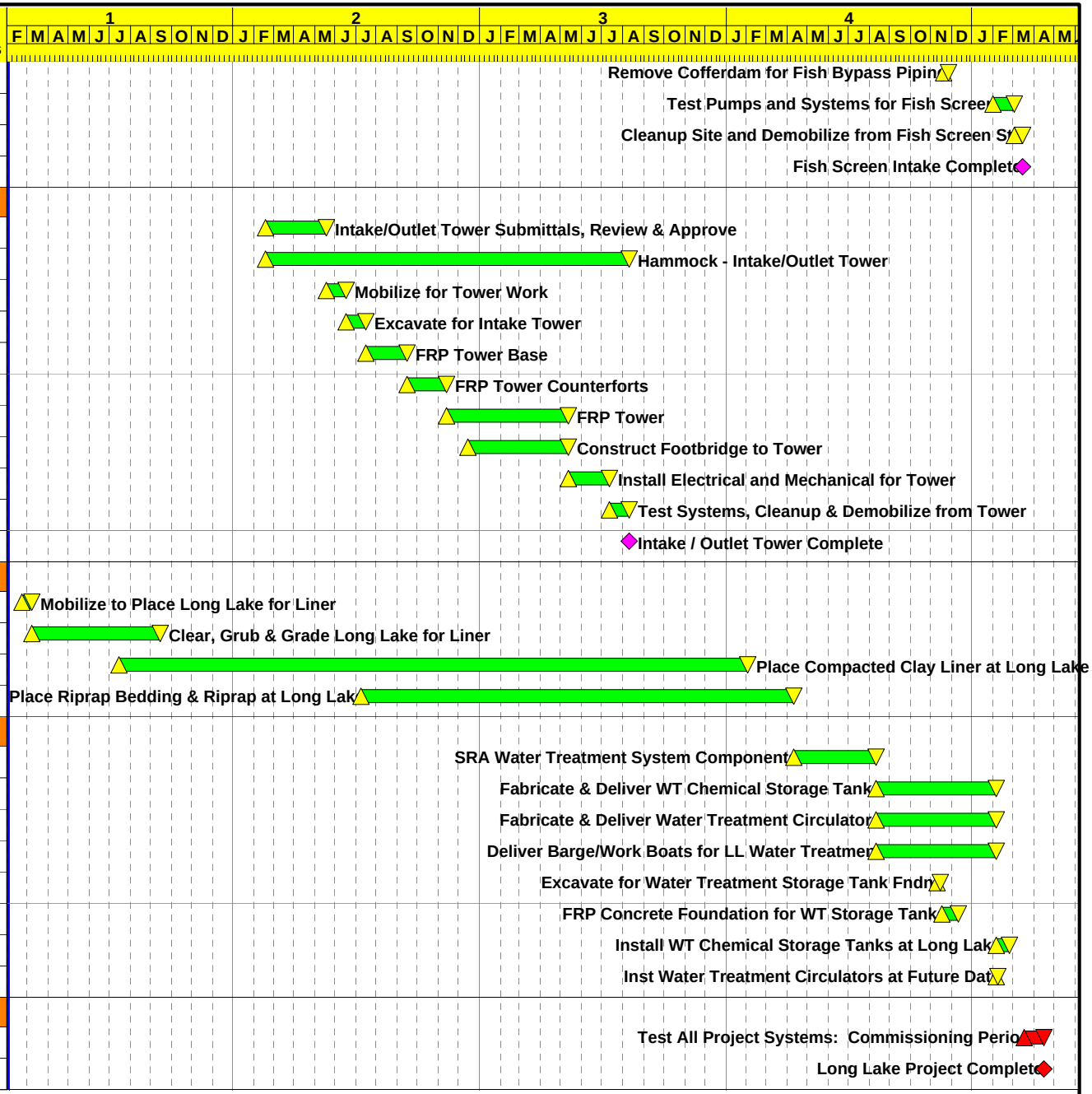
L4E2

Alternative No. 4, Option E
(2,000 cfs Pump/Turbine Plant)
Long Lake Valley - 4E
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: For canaly work, assume 3.5 months		
	of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 2,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	540*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	60
1T14100	FRP Tower Counterforts	60
1T14125	FRP Tower	180
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	10
1CL6120	Clear, Grub & Grade Long Lake for Liner	133
1CL6140	Place Compacted Clay Liner at Long Lake	650
1CL6160	Place Riprap Bedding & Riprap at Long Lake	450
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	5
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



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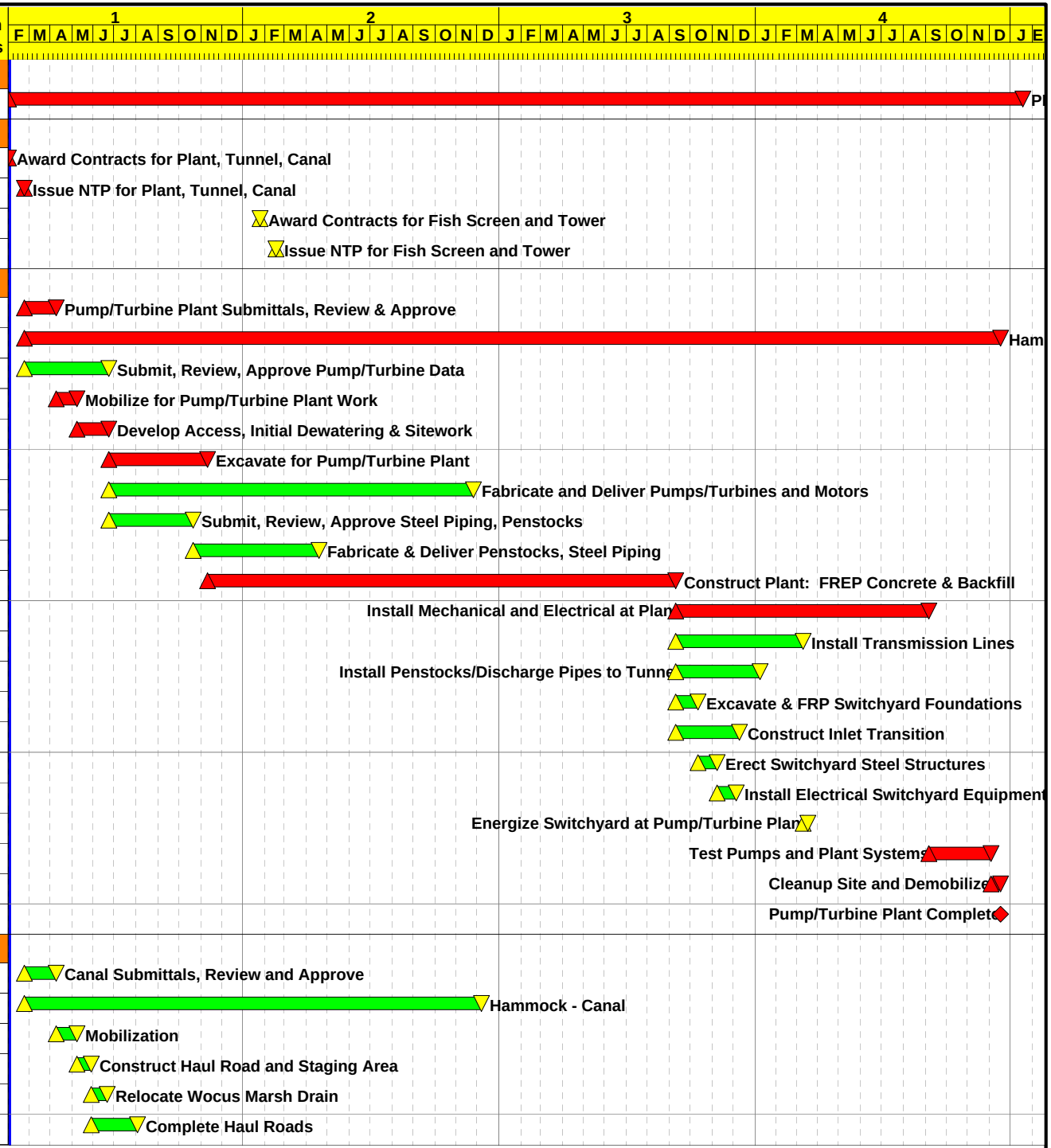
L4E2

Alternative No. 4, Option E
(2,000 cfs Pump/Turbine Plant)
Long Lake Valley - 4E
Summary Construction Schedule

Sheet 3 of 3

Date	Revision	Checked	Approved
	NOTE: For canaly work, assume 3.5 months		
	of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	1,447*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pump/Turbine Plant - 1,000 cfs		
1PA1100	Pump/Turbine Plant Submittals, Review & Approve	45
HAMPP	Hammock - Pumping Plant	1,394*
1PA1125	Submit, Review, Approve Pump/Turbine Data	120
1PA1150	Mobilize for Pump/Turbine Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pump/Turbine Plant	140
1PA1225	Fabricate and Deliver Pumps/Turbines and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	670
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pump/Turbine Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pump/Turbine Plant Complete	0
Canal - 1,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
HAMC	Hammock - Canal	653*
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Relocate Wocus Marsh Drain	23
1C13075	Complete Haul Roads	64



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Data Date 01FEB16
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Early Bar
Progress Bar
Critical Activity

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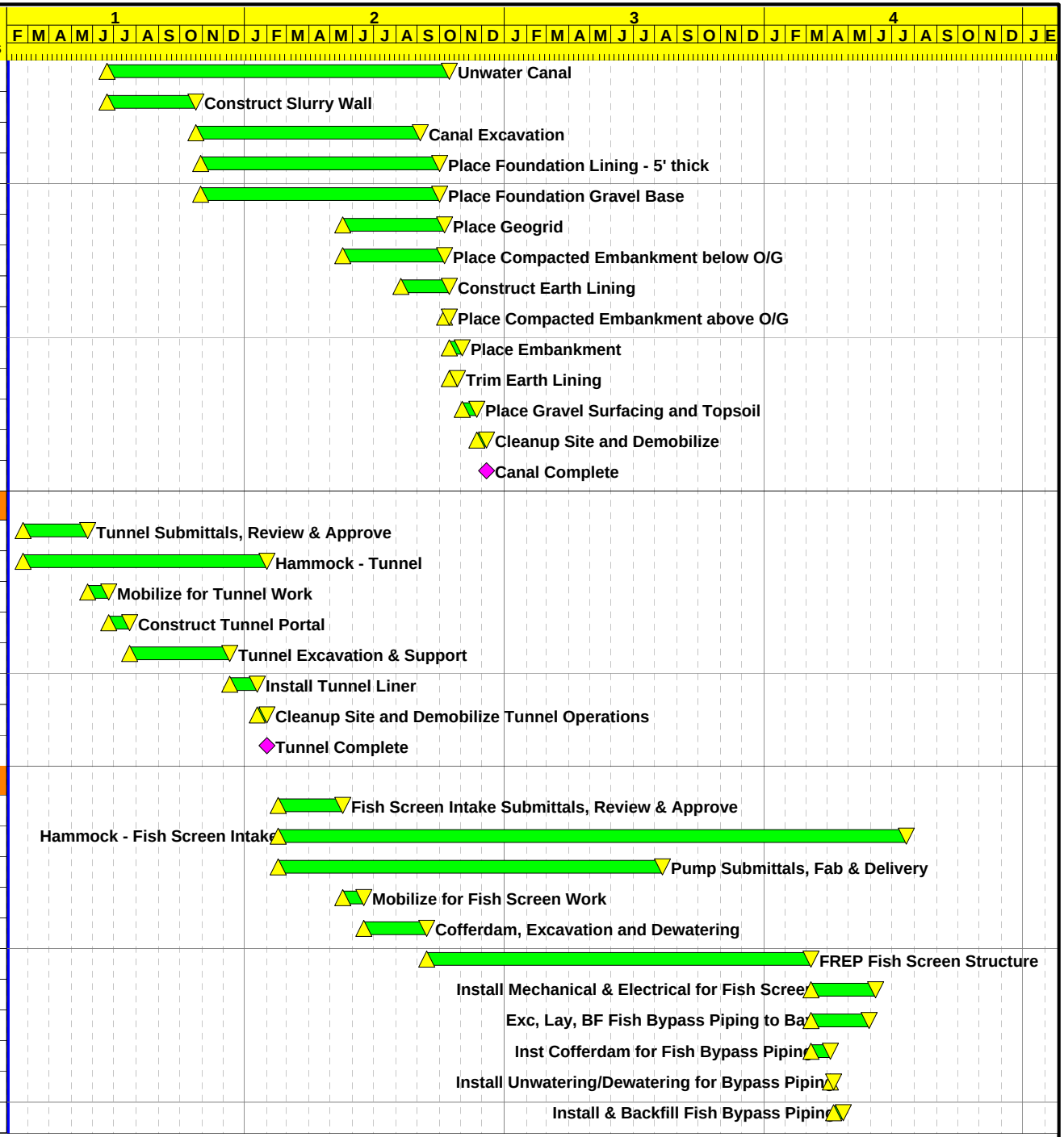
L4F1

Alternative No. 4, Option F
(1,000 cfs Pump/Turbine Plant)
Long Lake Valley - 4F
Summary Construction Schedule

Date	Revision	Checked	Approved
	Note: For Canal work, assume 3.5 months of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
1C13125	Unwater Canal	374*
1C13150	Construct Slurry Wall	123
1C13175	Canal Excavation	210
1C13200	Place Foundation Lining - 5' thick	231
1C13225	Place Foundation Gravel Base	231*
1C13250	Place Geogrid	143*
1C13275	Place Compacted Embankment below O/G	143
1C13300	Construct Earth Lining	67
1C13325	Place Compacted Embankment above O/G	6
1C13350	Place Embankment	20
1C13375	Trim Earth Lining	13
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 1,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	344*
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	140
1T12200	Install Tunnel Liner	40
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 1,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	884*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	90
1F15175	FREP Fish Screen Structure	540
1F15250	Install Mechanical & Electrical for Fish Screen	90
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15



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Finish Date 17JAN20
Data Date 01FEB16
Run Date 31MAR09 09:24

Early Bar
Progress Bar
Critical Activity

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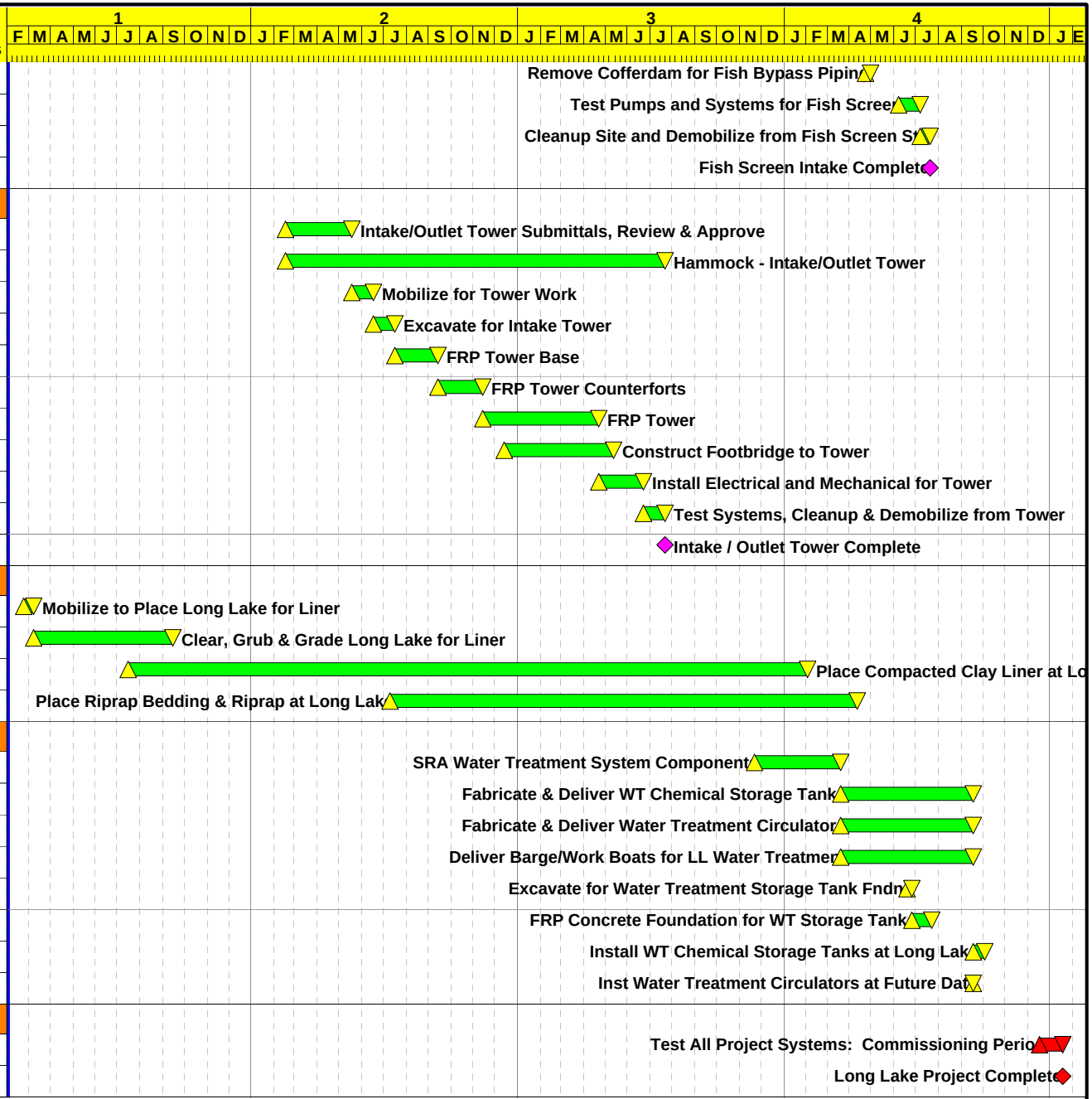
L4F1

Alternative No. 4, Option F
(1,000 cfs Pump/Turbine Plant)
Long Lake Valley - 4F
Summary Construction Schedule

Date	Revision	Checked	Approved
	Note: For Canal work, assume 3.5 months of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 1,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	520*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	60
1T14100	FRP Tower Counterforts	60
1T14125	FRP Tower	160
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	10
1CL6120	Clear, Grub & Grade Long Lake for Liner	133
1CL6140	Place Compacted Clay Liner at Long Lake	650
1CL6160	Place Riprap Bedding & Riprap at Long Lake	450
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	5
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



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Run Date 31MAR09 09:24

Early Bar
Progress Bar
Critical Activity

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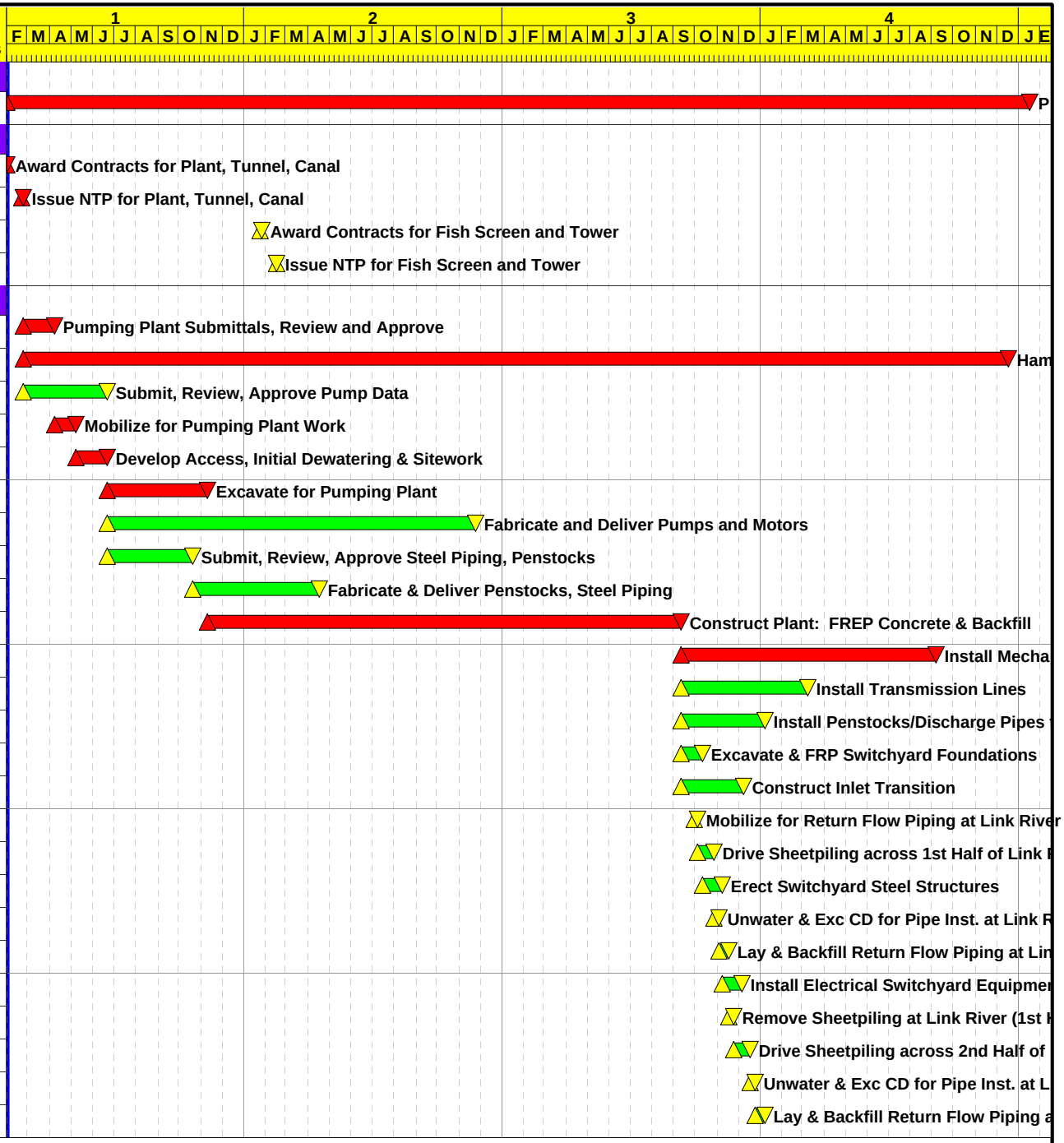
L4F1

Alternative No. 4, Option F
(1,000 cfs Pump/Turbine Plant)
Long Lake Valley - 4F
Summary Construction Schedule

Sheet 3 of 3

Date	Revision	Checked	Approved
	Note: For Canal work, assume 3.5 months of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	1,447*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping Plant - 1,000 cfs		
1PA1100	Pumping Plant Submittals, Review and Approve	45
HAMPP	Hammock - Pumping Plant	1,394*
1PA1125	Submit, Review, Approve Pump Data	120
1PA1150	Mobilize for Pumping Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping Plant	140
1PA1225	Fabricate and Deliver Pumps and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	670
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
RFP1700	Mobilize for Return Flow Piping at Link River	3
RFP1725	Drive Sheetpiling across 1st Half of Link River	25
1PA1500	Erect Switchyard Steel Structures	28
RFP1750	Unwater & Exc CD for Pipe Inst. at Link River	7
RFP1775	Lay & Backfill Return Flow Piping at Link River	12
1PA1525	Install Electrical Switchyard Equipment	28
RFP1800	Remove Sheetpiling at Link River (1st Half)	7
RFP1850	Drive Sheetpiling across 2nd Half of Link River	25
RFP1875	Unwater & Exc CD for Pipe Inst. at Link River	7
RFP1900	Lay & Backfill Return Flow Piping at Link River	12



Start Date 01FEB16
Finish Date 17JAN20
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Run Date 31MAR09 09:24

Early Bar
Progress Bar
Critical Activity

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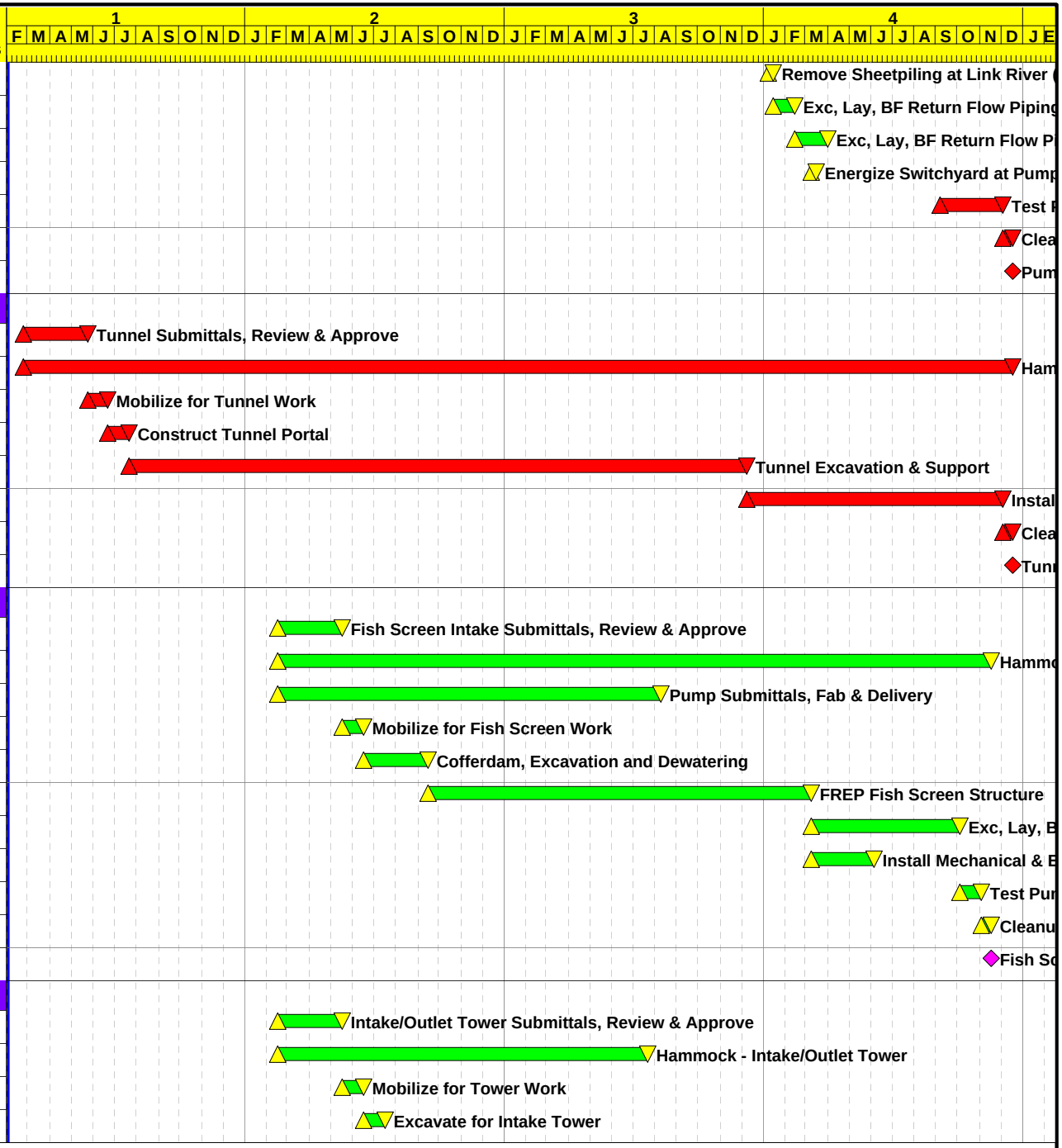
L5A1

Sheet 1 of 3

Alternative No. 5, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 5A
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
RFP1925	Remove Sheetpiling at Link River (2nd Half)	7
RFP1950	Exc, Lay, BF Return Flow Piping River to A-Canal	32
RFP1975	Exc, Lay, BF Return Flow Piping River to Plant	45
1PA1550	Energize Switchyard at Pumping Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping Plant Complete	0
Tunnel - 1,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	1,394*
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	870
1T12200	Install Tunnel Liner	360
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 1,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	1,004*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	90
1F15175	FREP Fish Screen Structure	540
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	210
1F15250	Install Mechanical & Electrical for Fish Screen	90
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 1,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	520*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30



Start Date 01FEB16
Finish Date 17JAN20
Data Date 01FEB16
Run Date 31MAR09 09:24

Early Bar
Progress Bar
Critical Activity

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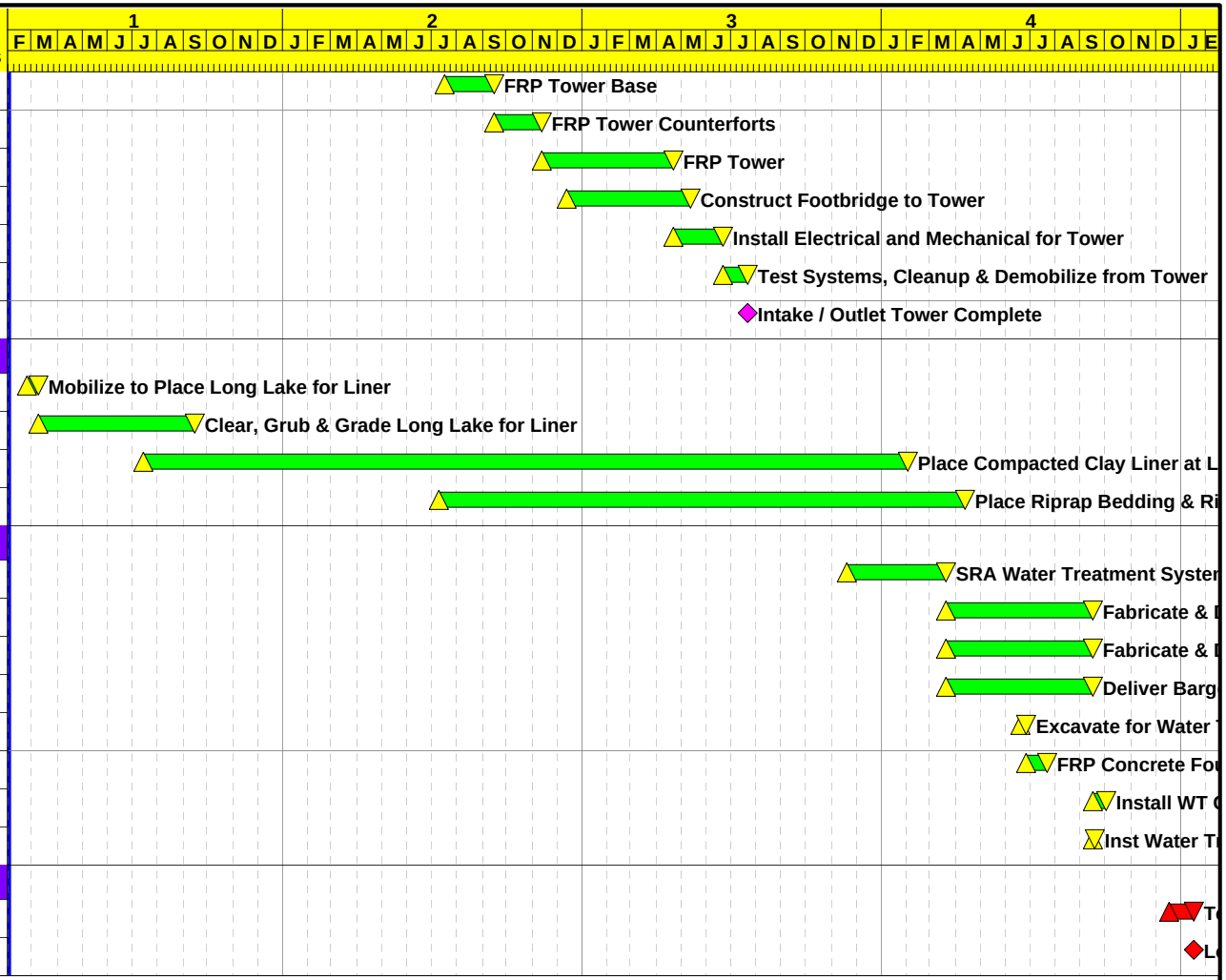
L5A1

Sheet 2 of 3

Alternative No. 5, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 5A
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
1T14075	FRP Tower Base	60
1T14100	FRP Tower Counterforts	60
1T14125	FRP Tower	160
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	10
1CL6120	Clear, Grub & Grade Long Lake for Liner	133
1CL6140	Place Compacted Clay Liner at Long Lake	650
1CL6160	Place Riprap Bedding & Riprap at Long Lake	450
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	5
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date	01FEB16
Finish Date	17JAN20
Data Date	01FEB16
Run Date	31MAR09 09:24

Early Bar
Progress Bar
Critical Activity

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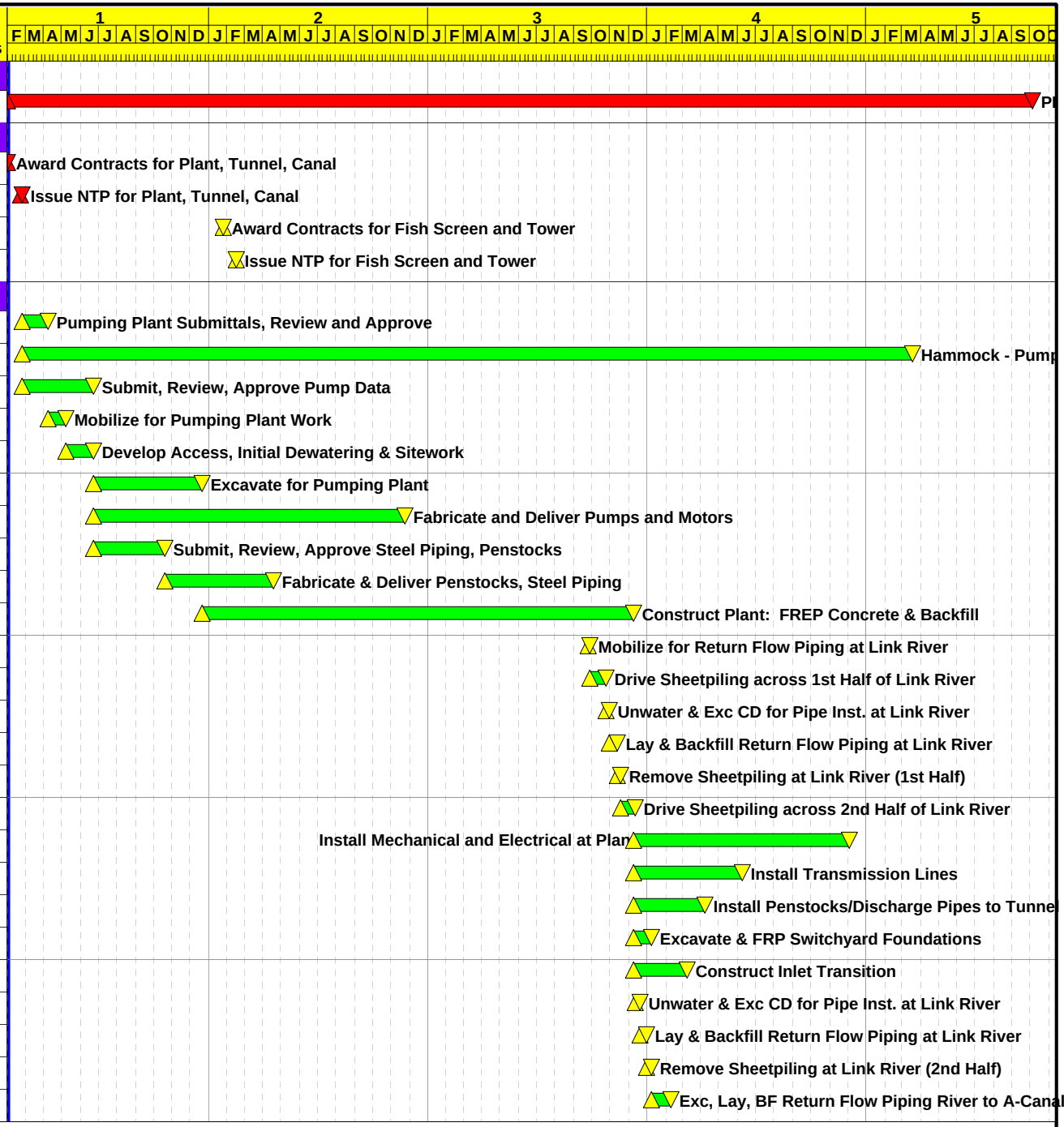
L5A1

Sheet 3 of 3

Alternative No. 5, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 5A
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	1,707*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping Plant - 2,000 cfs		
1PA1100	Pumping Plant Submittals, Review and Approve	45
HAMPP	Hammock - Pumping Plant	1,484*
1PA1125	Submit, Review, Approve Pump Data	120
1PA1150	Mobilize for Pumping Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping Plant	180
1PA1225	Fabricate and Deliver Pumps and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	720
RFP1700	Mobilize for Return Flow Piping at Link River	3
RFP1725	Drive Sheetpiling across 1st Half of Link River	25
RFP1750	Unwater & Exc CD for Pipe Inst. at Link River	7
RFP1775	Lay & Backfill Return Flow Piping at Link River	12
RFP1800	Remove Sheetpiling at Link River (1st Half)	7
RFP1850	Drive Sheetpiling across 2nd Half of Link River	25
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
RFP1875	Unwater & Exc CD for Pipe Inst. at Link River	7
RFP1900	Lay & Backfill Return Flow Piping at Link River	12
RFP1925	Remove Sheetpiling at Link River (2nd Half)	7
RFP1950	Exc, Lay, BF Return Flow Piping River to A-Canal	32



Start Date 01FEB16
Finish Date 03OCT20
Data Date 01FEB16
Run Date 31MAR09 09:25

Early Bar
Progress Bar
Critical Activity

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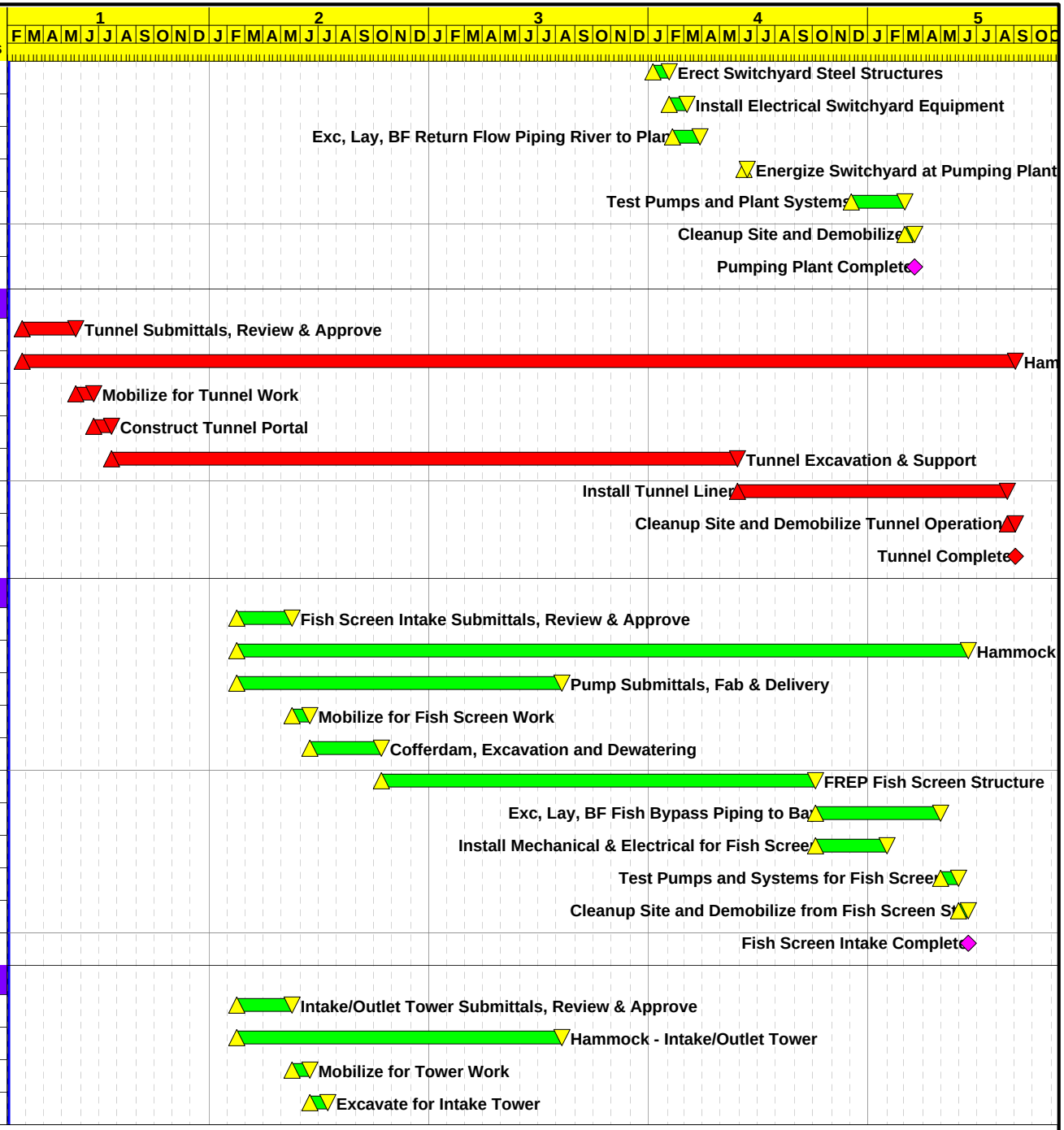
L5B2

Alternative No. 5, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 5B
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
RFP1975	Exc, Lay, BF Return Flow Piping River to Plant	45
1PA1550	Energize Switchyard at Pumping Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping Plant Complete	0
Tunnel - 2,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	1,654*
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	1,040
1T12200	Install Tunnel Liner	450
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 2,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	1,214*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	120
1F15175	FREP Fish Screen Structure	720
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	210
1F15250	Install Mechanical & Electrical for Fish Screen	120
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 2,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	540*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30



Start Date 01FEB16
Finish Date 03OCT20
Data Date 01FEB16
Run Date 31MAR09 09:25

Early Bar
Progress Bar
Critical Activity

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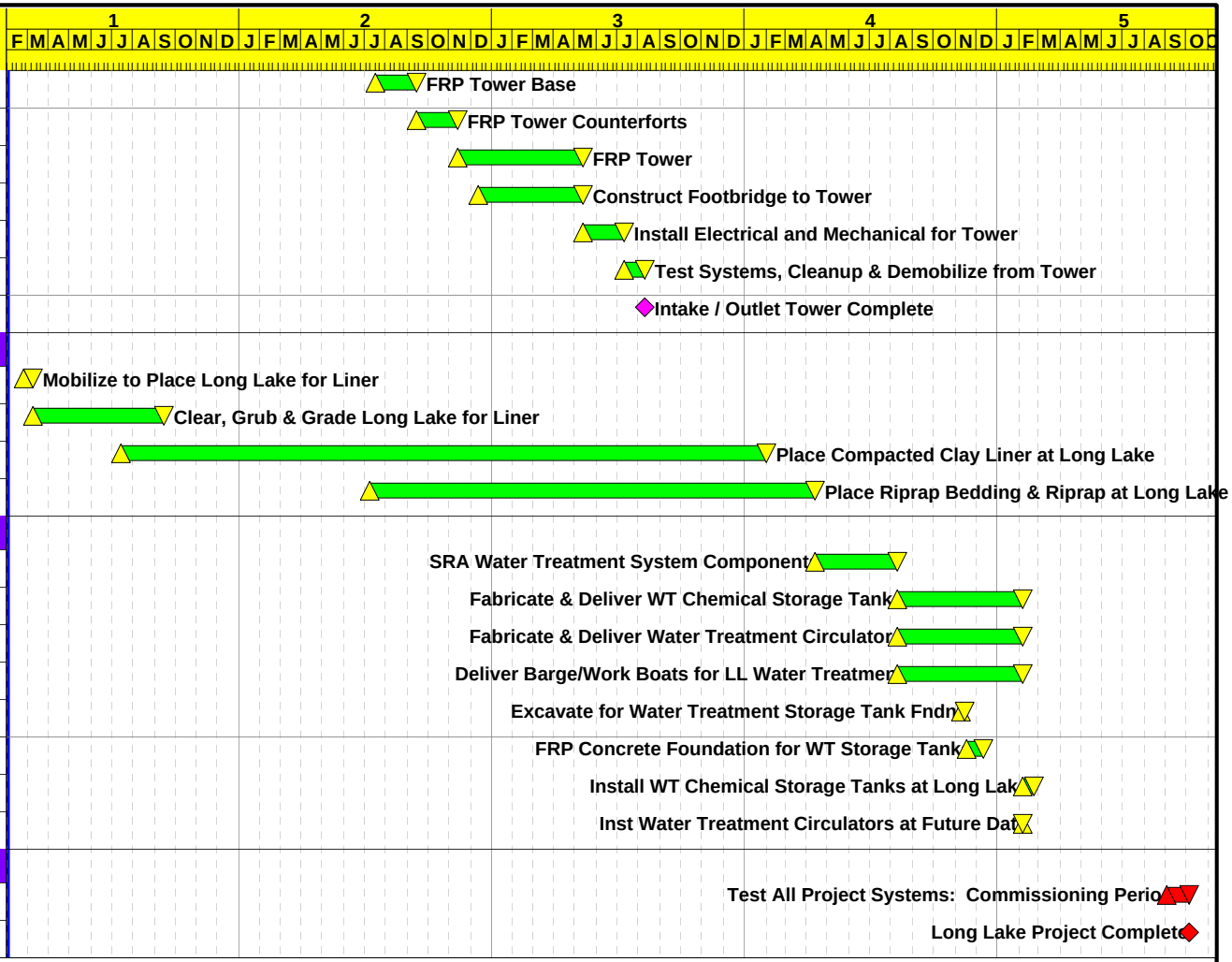
L5B2

Alternative No. 5, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 5B
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
1T14075	FRP Tower Base	60
1T14100	FRP Tower Counterforts	60
1T14125	FRP Tower	180
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	10
1CL6120	Clear, Grub & Grade Long Lake for Liner	133
1CL6140	Place Compacted Clay Liner at Long Lake	650
1CL6160	Place Riprap Bedding & Riprap at Long Lake	450
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	5
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date	01FEB16
Finish Date	03OCT20
Data Date	01FEB16
Run Date	31MAR09 09:25

Early Bar
Progress Bar
Critical Activity

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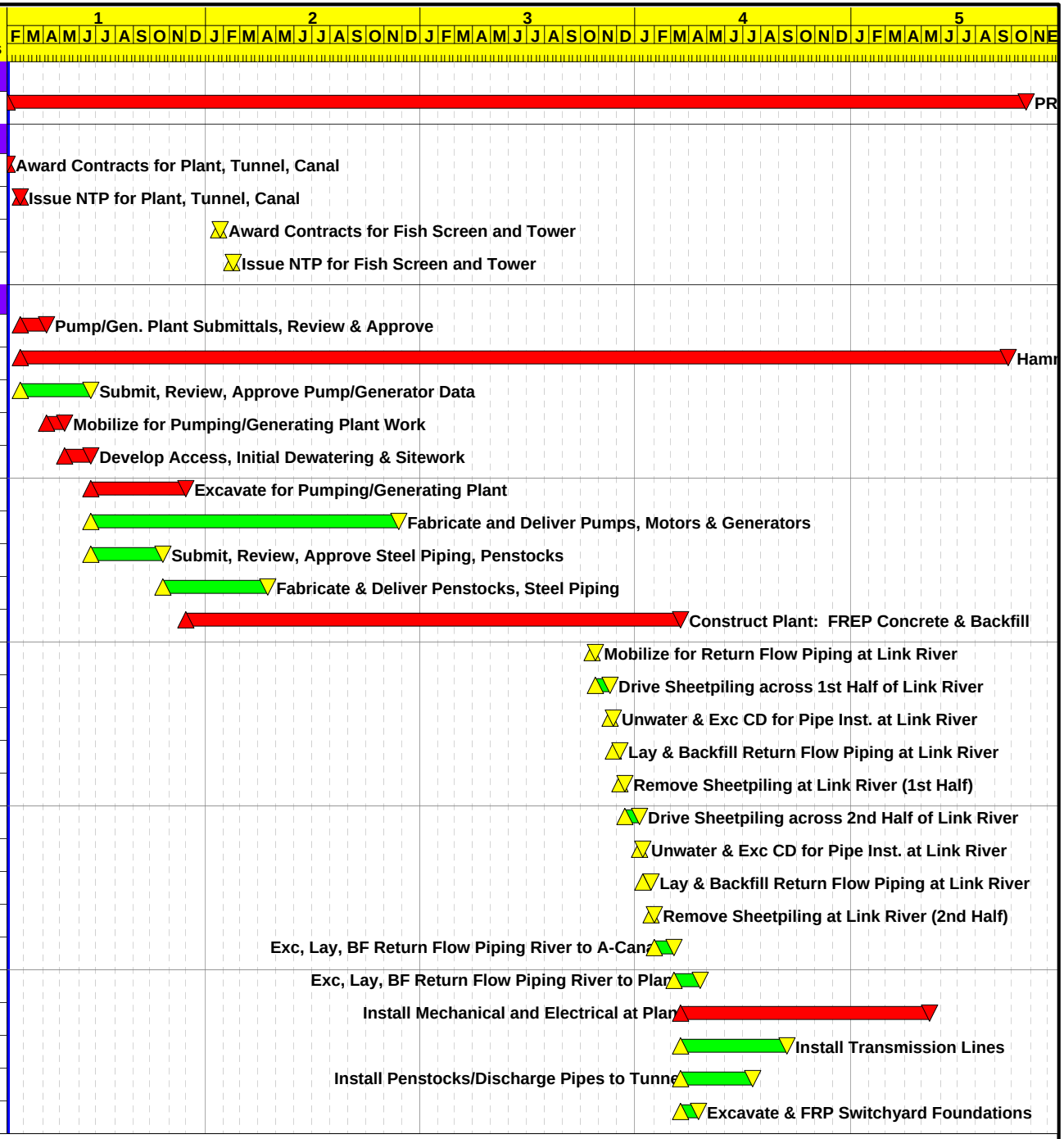
L5B2

Sheet 3 of 3

Alternative No. 5, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 5B
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	1,727*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping and Generating Plant - 1,000 cfs		
1PA1100	Pump/Gen. Plant Submittals, Review & Approve	45
HAMPP	Hammock - Pumping Plant	1,674*
1PA1125	Submit, Review, Approve Pump/Generator Data	120
1PA1150	Mobilize for Pumping/Generating Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping/Generating Plant	160
1PA1225	Fabricate and Deliver Pumps, Motors & Generators	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	840
RFP1700	Mobilize for Return Flow Piping at Link River	3
RFP1725	Drive Sheetpiling across 1st Half of Link River	25
RFP1750	Unwater & Exc CD for Pipe Inst. at Link River	7
RFP1775	Lay & Backfill Return Flow Piping at Link River	12
RFP1800	Remove Sheetpiling at Link River (1st Half)	7
RFP1850	Drive Sheetpiling across 2nd Half of Link River	25
RFP1875	Unwater & Exc CD for Pipe Inst. at Link River	7
RFP1900	Lay & Backfill Return Flow Piping at Link River	12
RFP1925	Remove Sheetpiling at Link River (2nd Half)	7
RFP1950	Exc, Lay, BF Return Flow Piping River to A-Canal	32
RFP1975	Exc, Lay, BF Return Flow Piping River to Plant	45
1PA1375	Install Mechanical and Electrical at Plant	420
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30



Start Date	01FEB16
Finish Date	23OCT20
Data Date	01FEB16
Run Date	31MAR09 09:25

Early Bar
Progress Bar
Critical Activity

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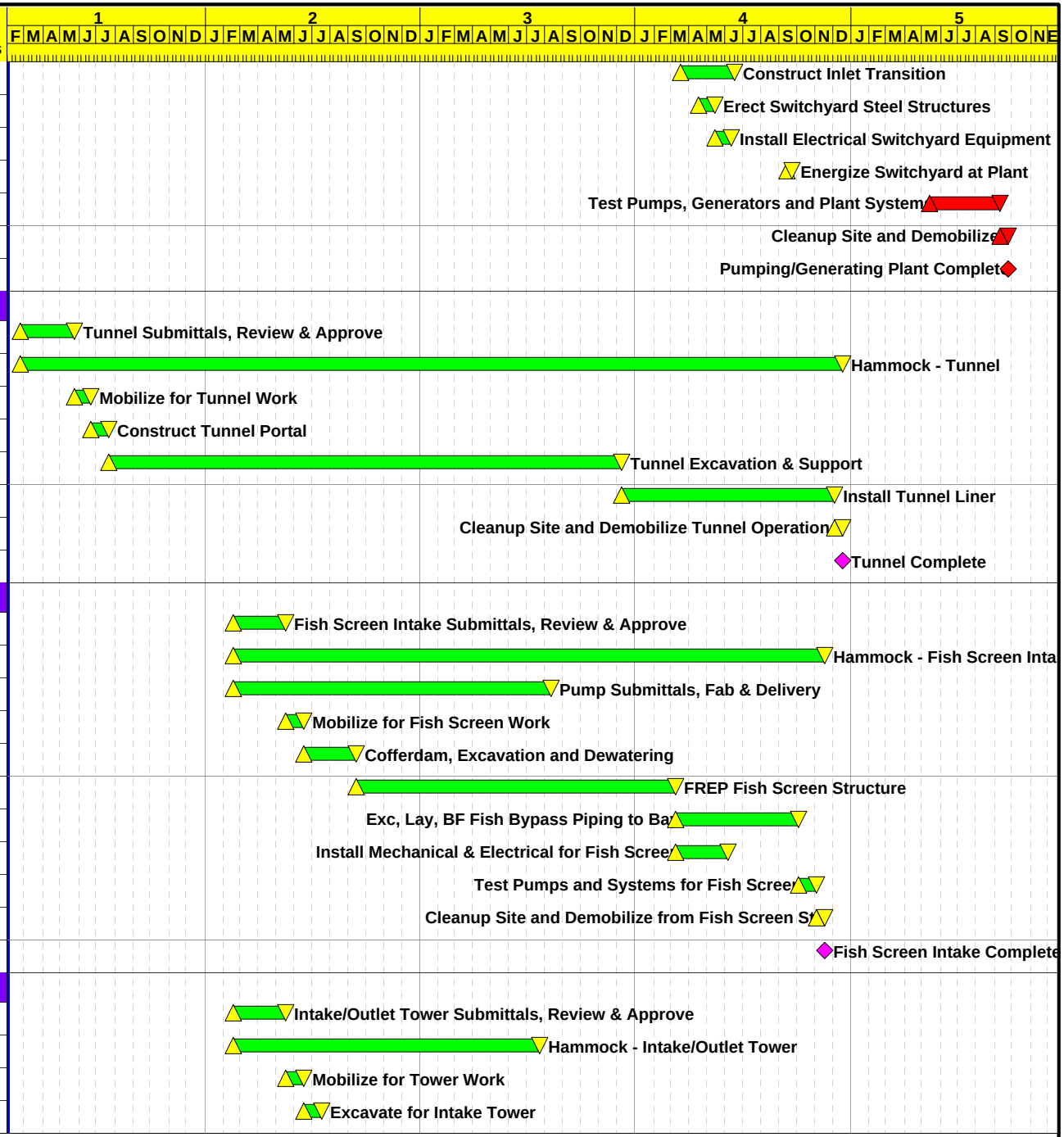
L5C1

Sheet 1 of 3

Alternative No. 5, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 5C
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Plant	7
1PA1575	Test Pumps, Generators and Plant Systems	120
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping/Generating Plant Complete	0
Tunnel - 1,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	1,394*
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	870
1T12200	Install Tunnel Liner	360
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 1,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	1,004*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	90
1F15175	FREP Fish Screen Structure	540
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	210
1F15250	Install Mechanical & Electrical for Fish Screen	90
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 1,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	520*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30



Start Date 01FEB16
Finish Date 23OCT20
Data Date 01FEB16
Run Date 31MAR09 09:25

Early Bar
Progress Bar
Critical Activity

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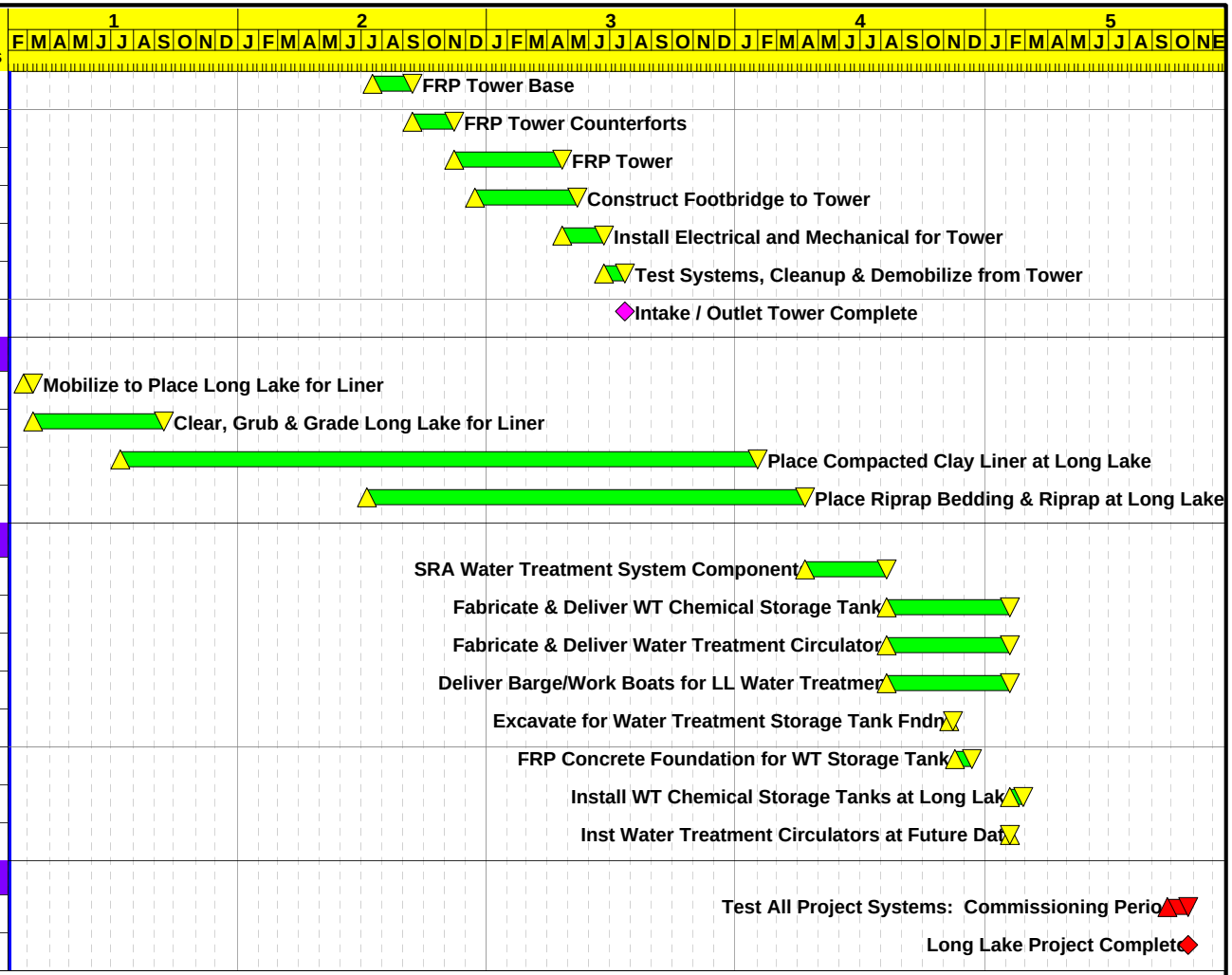
L5C1

Sheet 2 of 3

Alternative No. 5, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 5C
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
1T14075	FRP Tower Base	60
1T14100	FRP Tower Counterforts	60
1T14125	FRP Tower	160
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	10
1CL6120	Clear, Grub & Grade Long Lake for Liner	133
1CL6140	Place Compacted Clay Liner at Long Lake	650
1CL6160	Place Riprap Bedding & Riprap at Long Lake	450
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	5
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date	01FEB16
Finish Date	23OCT20
Data Date	01FEB16
Run Date	31MAR09 09:25

Early Bar
Progress Bar
Critical Activity

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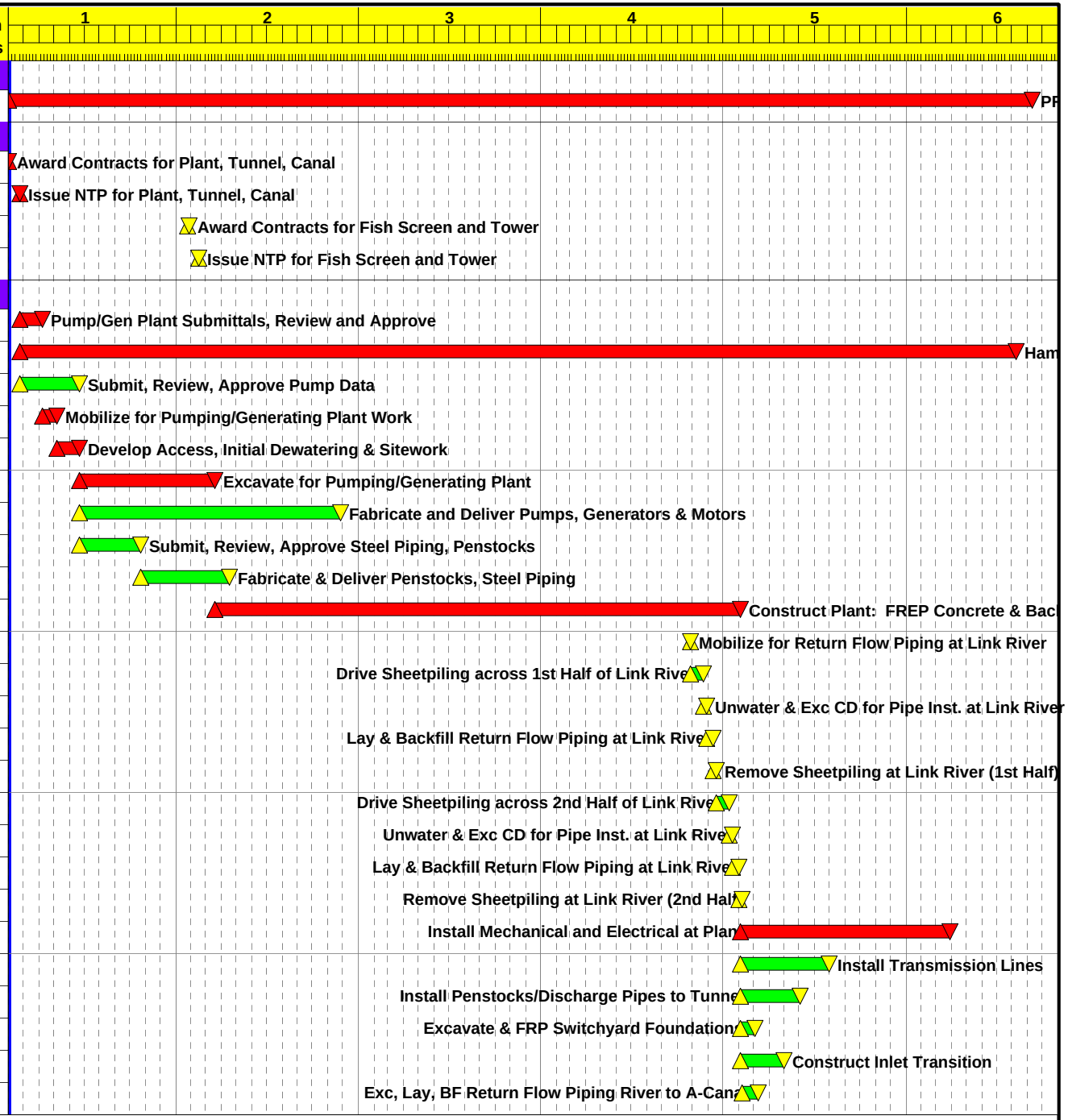
L5C1

Sheet 3 of 3

Alternative No. 5, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 5C
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	2,047*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping and Generating Plant - 2,000 cfs		
1PA1100	Pump/Gen Plant Submittals, Review and Approve	45
HAMPP	Hammock - Pumping Plant	1,994*
1PA1125	Submit, Review, Approve Pump Data	120
1PA1150	Mobilize for Pumping/Generating Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping/Generating Plant	270
1PA1225	Fabricate and Deliver Pumps, Generators & Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	1,050
RFP1700	Mobilize for Return Flow Piping at Link River	3
RFP1725	Drive Sheetpiling across 1st Half of Link River	25
RFP1750	Unwater & Exc CD for Pipe Inst. at Link River	7
RFP1775	Lay & Backfill Return Flow Piping at Link River	12
RFP1800	Remove Sheetpiling at Link River (1st Half)	7
RFP1850	Drive Sheetpiling across 2nd Half of Link River	25
RFP1875	Unwater & Exc CD for Pipe Inst. at Link River	7
RFP1900	Lay & Backfill Return Flow Piping at Link River	12
RFP1925	Remove Sheetpiling at Link River (2nd Half)	7
1PA1375	Install Mechanical and Electrical at Plant	420
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
RFP1950	Exc, Lay, BF Return Flow Piping River to A-Canal	32



Start Date 01FEB16
Finish Date 08SEP21
Data Date 01FEB16
Run Date 31MAR09 09:26

Early Bar
Progress Bar
Critical Activity

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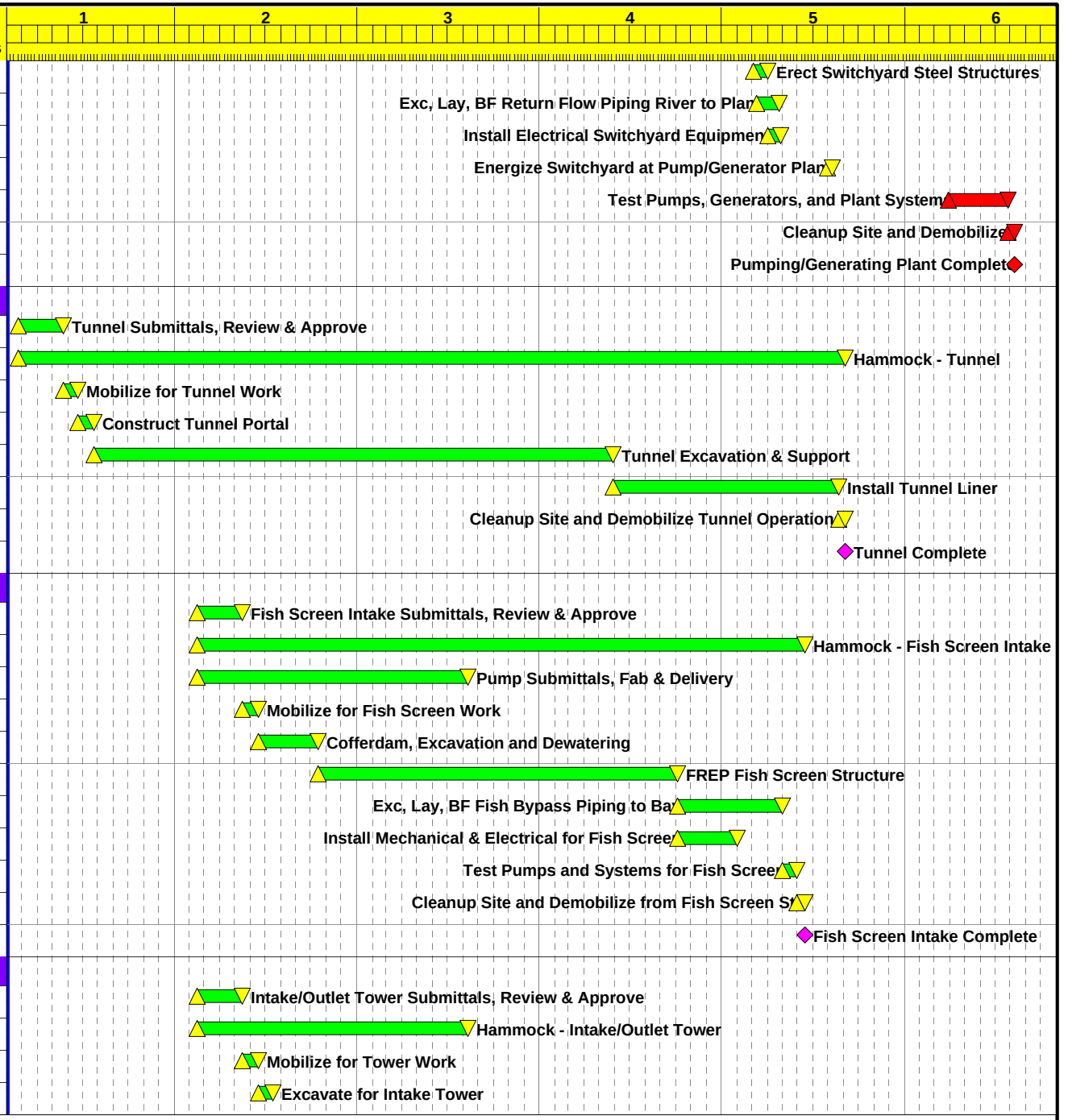
L5D2

Sheet 1 of 3

Alternative No. 5, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 5D
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
1PA1500	Erect Switchyard Steel Structures	28
RFP1975	Exc, Lay, BF Return Flow Piping River to Plant	45
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pump/Generator Plant	7
1PA1575	Test Pumps, Generators, and Plant Systems	120
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping/Generating Plant Complete	0
Tunnel - 2,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	1,654*
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	1,040
1T12200	Install Tunnel Liner	450
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 2,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	1,214*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	120
1F15175	FREP Fish Screen Structure	720
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	210
1F15250	Install Mechanical & Electrical for Fish Screen	120
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 2,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	540*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30



Start Date 01FEB16
Finish Date 08SEP21
Data Date 01FEB16
Run Date 31MAR09 09:26

Early Bar
Progress Bar
Critical Activity

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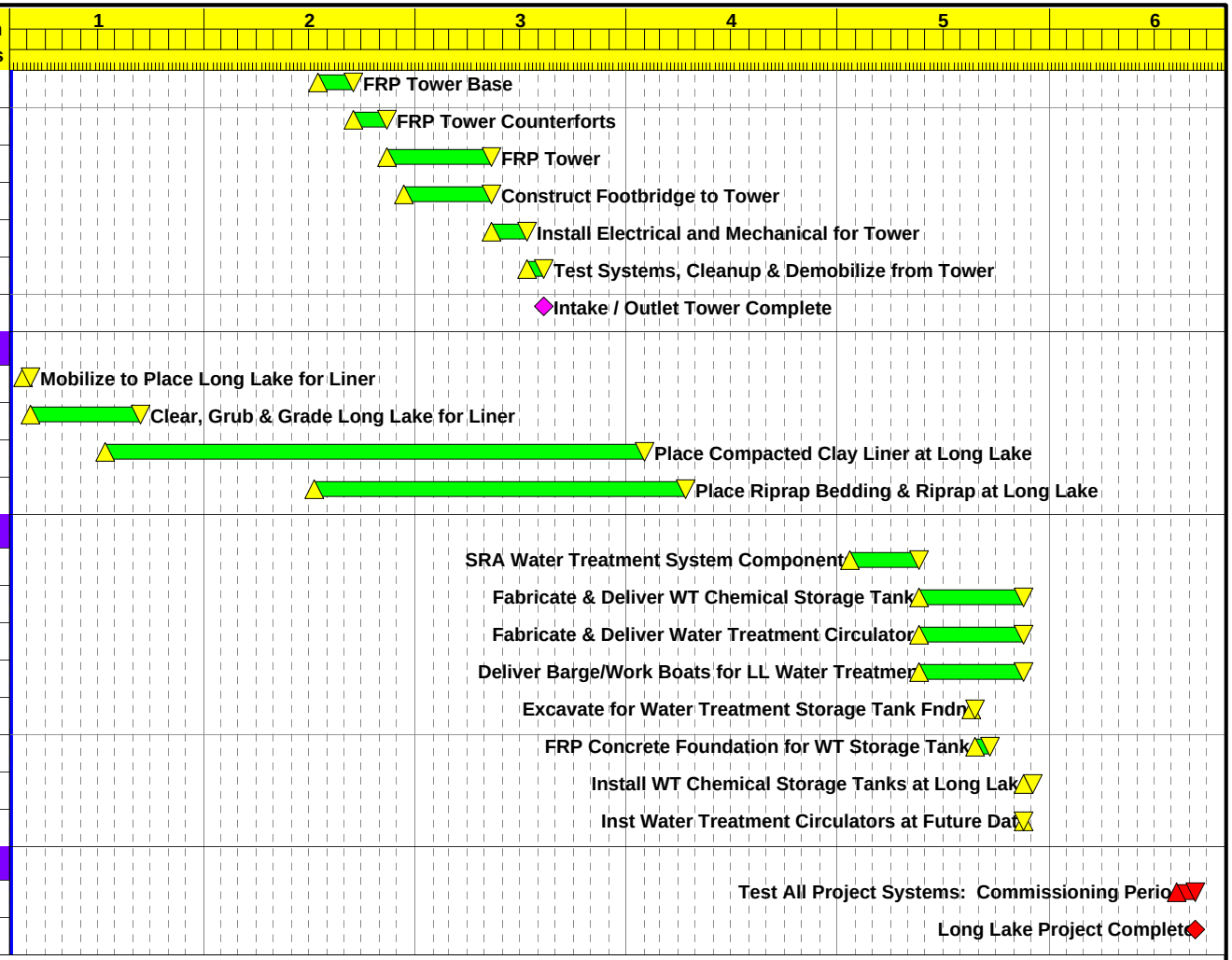
L5D2

Sheet 2 of 3

Alternative No. 5, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 5D
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
1T14075	FRP Tower Base	60
1T14100	FRP Tower Counterforts	60
1T14125	FRP Tower	180
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	10
1CL6120	Clear, Grub & Grade Long Lake for Liner	133
1CL6140	Place Compacted Clay Liner at Long Lake	650
1CL6160	Place Riprap Bedding & Riprap at Long Lake	450
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	5
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date	01FEB16
Finish Date	08SEP21
Data Date	01FEB16
Run Date	31MAR09 09:26

Early Bar
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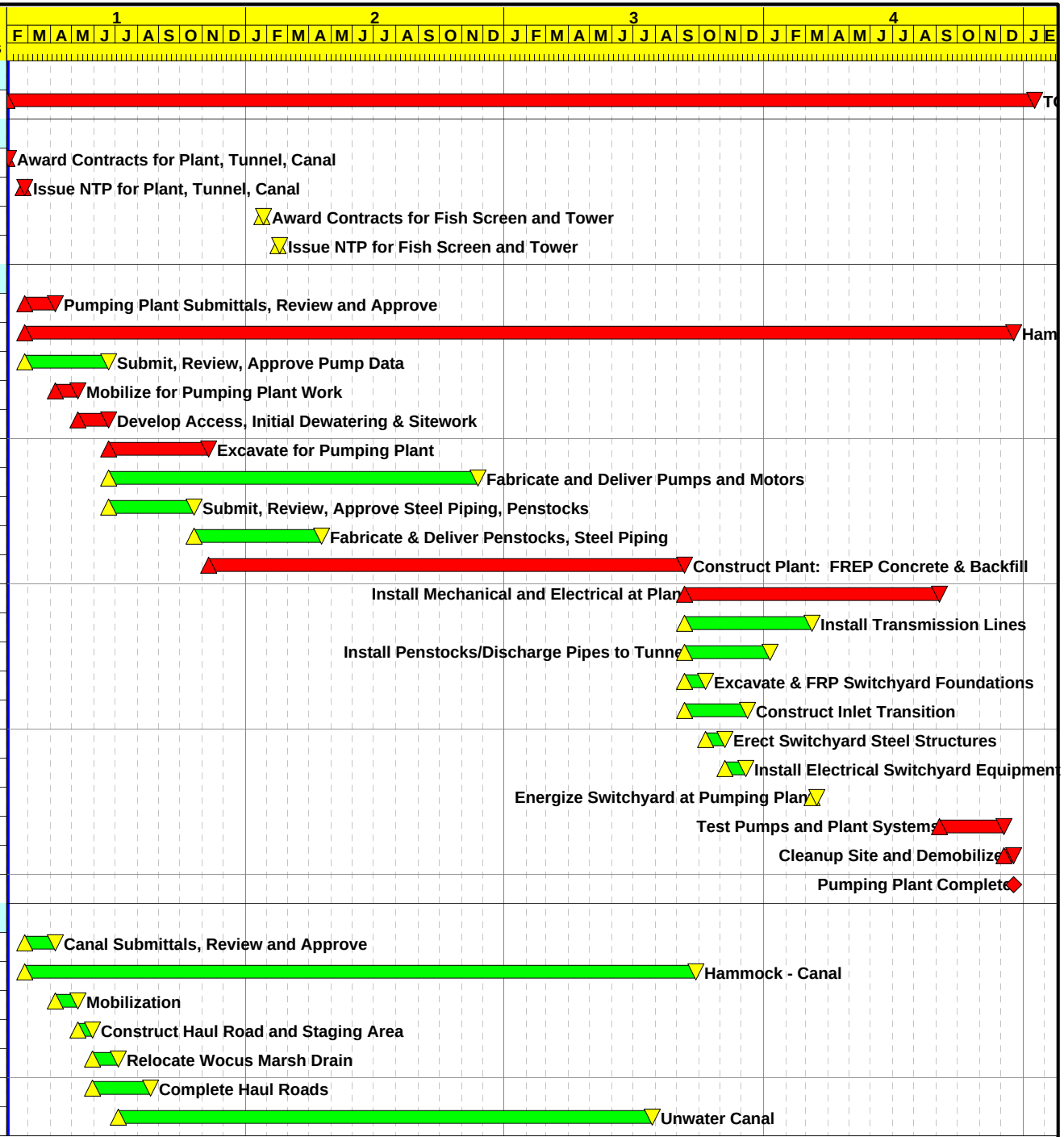
L5D2

Sheet 3 of 3

Alternative No. 5, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 5D
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	TOTAL PROJECT DURATION - NTP to	1,447*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping Plant - 1,000 cfs		
1PA1100	Pumping Plant Submittals, Review and Approve	45
HAMPP	Hammock - Pumping Plant	1,394*
1PA1125	Submit, Review, Approve Pump Data	120
1PA1150	Mobilize for Pumping Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping Plant	140
1PA1225	Fabricate and Deliver Pumps and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	670
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pumping Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping Plant Complete	0
Canal - 1,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
HAMC	Hammock - Canal	946*
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Relocate Wocus Marsh Drain	37
1C13075	Complete Haul Roads	82
1C13125	Unwater Canal	539*



Start Date 01FEB16
Finish Date 17JAN20
Data Date 01FEB16
Run Date 27MAR09 14:13

Early Bar
Progress Bar
Critical Activity

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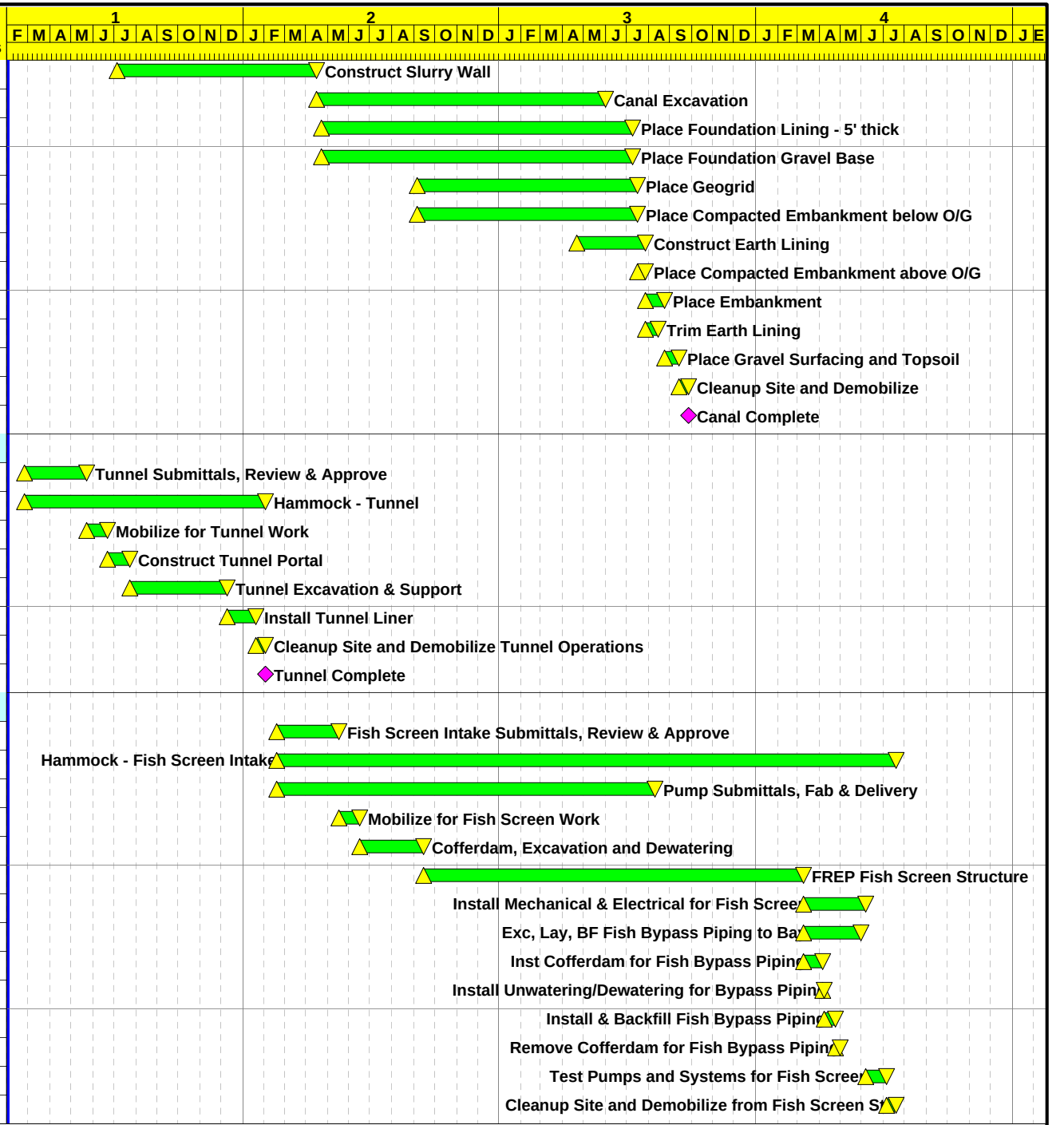
LL1A

Alternative No. 1, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 1A - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 month weather impact		
	each winter for canal work.		

Activity ID	Activity Description	Duration Cal Days
1C13150	Construct Slurry Wall	177
1C13175	Canal Excavation	307
1C13200	Place Foundation Lining - 5' thick	338
1C13225	Place Foundation Gravel Base	338*
1C13250	Place Geogrid	208*
1C13275	Place Compacted Embankment below O/G	208
1C13300	Construct Earth Lining	97
1C13325	Place Compacted Embankment above O/G	10
1C13350	Place Embankment	28
1C13375	Trim Earth Lining	19
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 1,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	344*
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	140
1T12200	Install Tunnel Liner	40
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 1,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	884*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	90
1F15175	FREP Fish Screen Structure	540
1F15250	Install Mechanical & Electrical for Fish Screen	90
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14



Start Date 01FEB16
Finish Date 17JAN20
Data Date 01FEB16
Run Date 27MAR09 14:13

Early Bar
Progress Bar
Critical Activity

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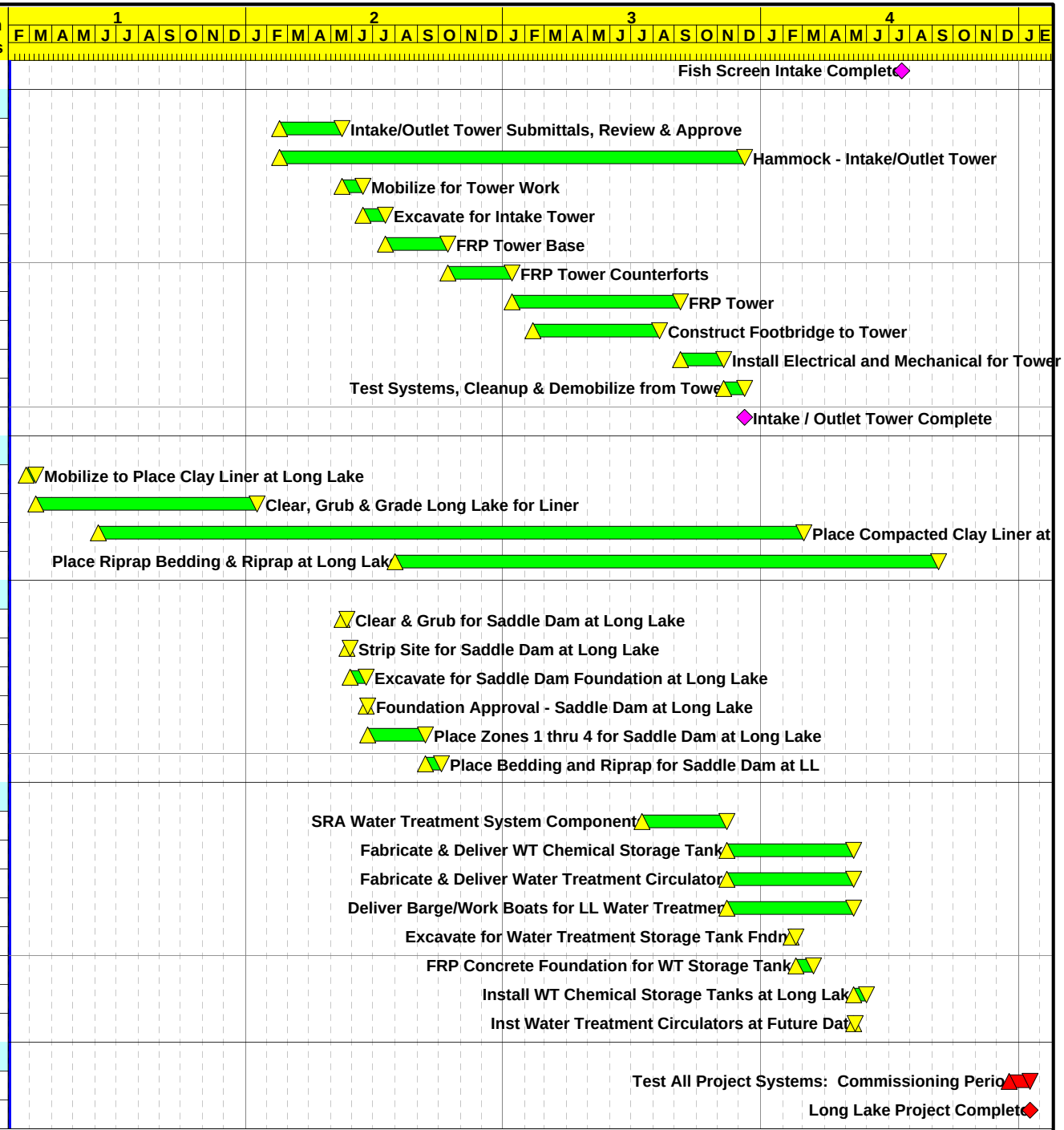
LL1A

Alternative No. 1, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 1A - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 month weather impact		
	each winter for canal work.		

Activity ID	Activity Description	Duration Cal Days
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 1,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	660*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	90
1T14100	FRP Tower Counterforts	90
1T14125	FRP Tower	240
1T14150	Construct Footbridge to Tower	180
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Clay Liner at Long Lake	14
1CL6120	Clear, Grub & Grade Long Lake for Liner	315
1CL6140	Place Compacted Clay Liner at Long Lake	1,000
1CL6160	Place Riprap Bedding & Riprap at Long Lake	770
Long Lake Saddle Dam		
1SD8000	Clear & Grub for Saddle Dam at Long Lake	7
1SD8025	Strip Site for Saddle Dam at Long Lake	5
1SD8050	Excavate for Saddle Dam Foundation at Long Lake	21
1SD8075	Foundation Approval - Saddle Dam at Long Lake	2
1SD8100	Place Zones 1 thru 4 for Saddle Dam at Long Lake	84
1SD8125	Place Bedding and Riprap for Saddle Dam at LL	21
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	6
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date	01FEB16
Finish Date	17JAN20
Data Date	01FEB16
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Early Bar
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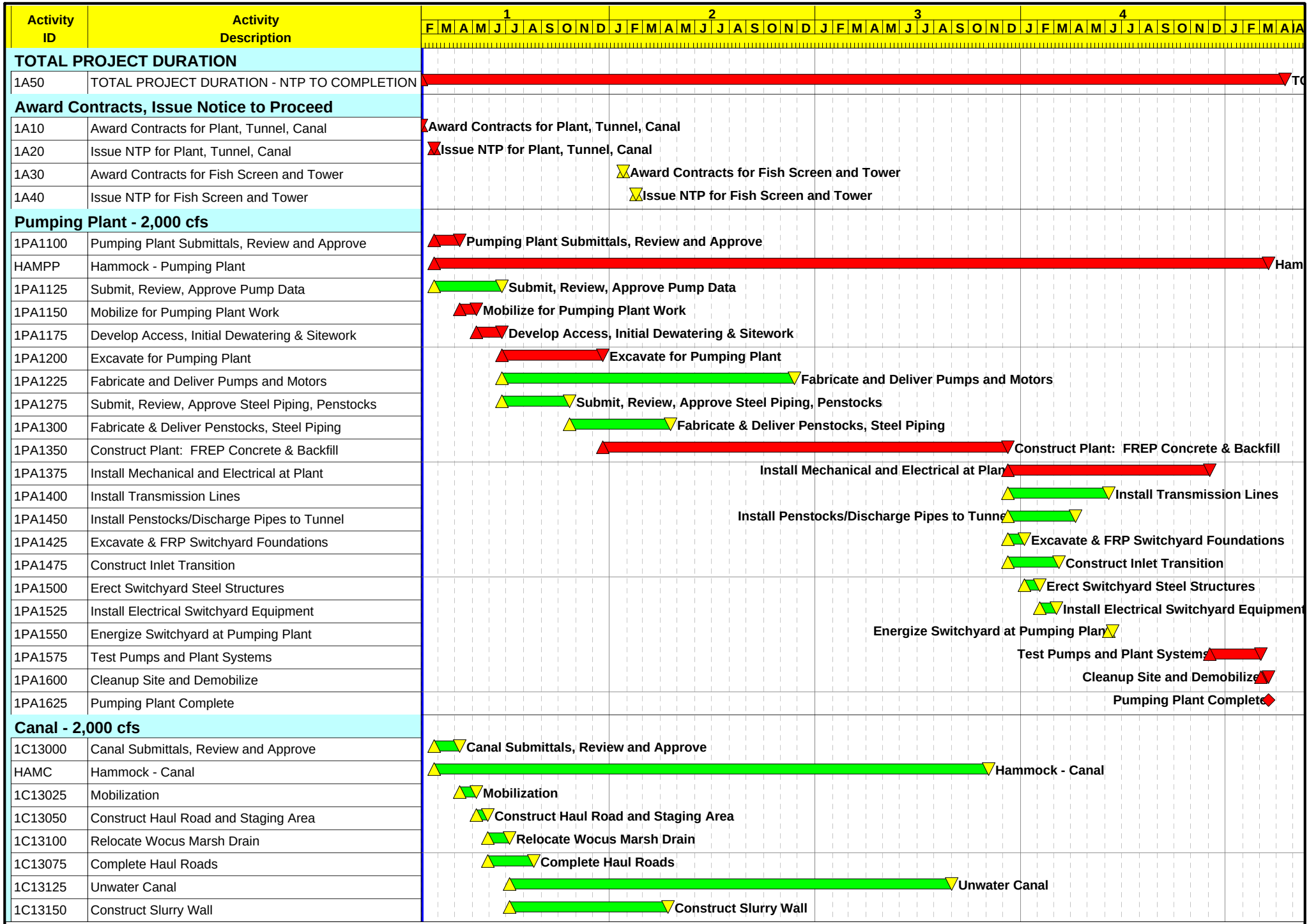
LL1A

Alternative No. 1, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 1A - 500 TAF
Summary Construction Schedule

Sheet 3 of 3

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 month weather impact		
	each winter for canal work.		



Start Date	01FEB16
Finish Date	16APR20
Data Date	01FEB16
Run Date	27MAR09 14:14

Early Bar
Progress Bar
Critical Activity

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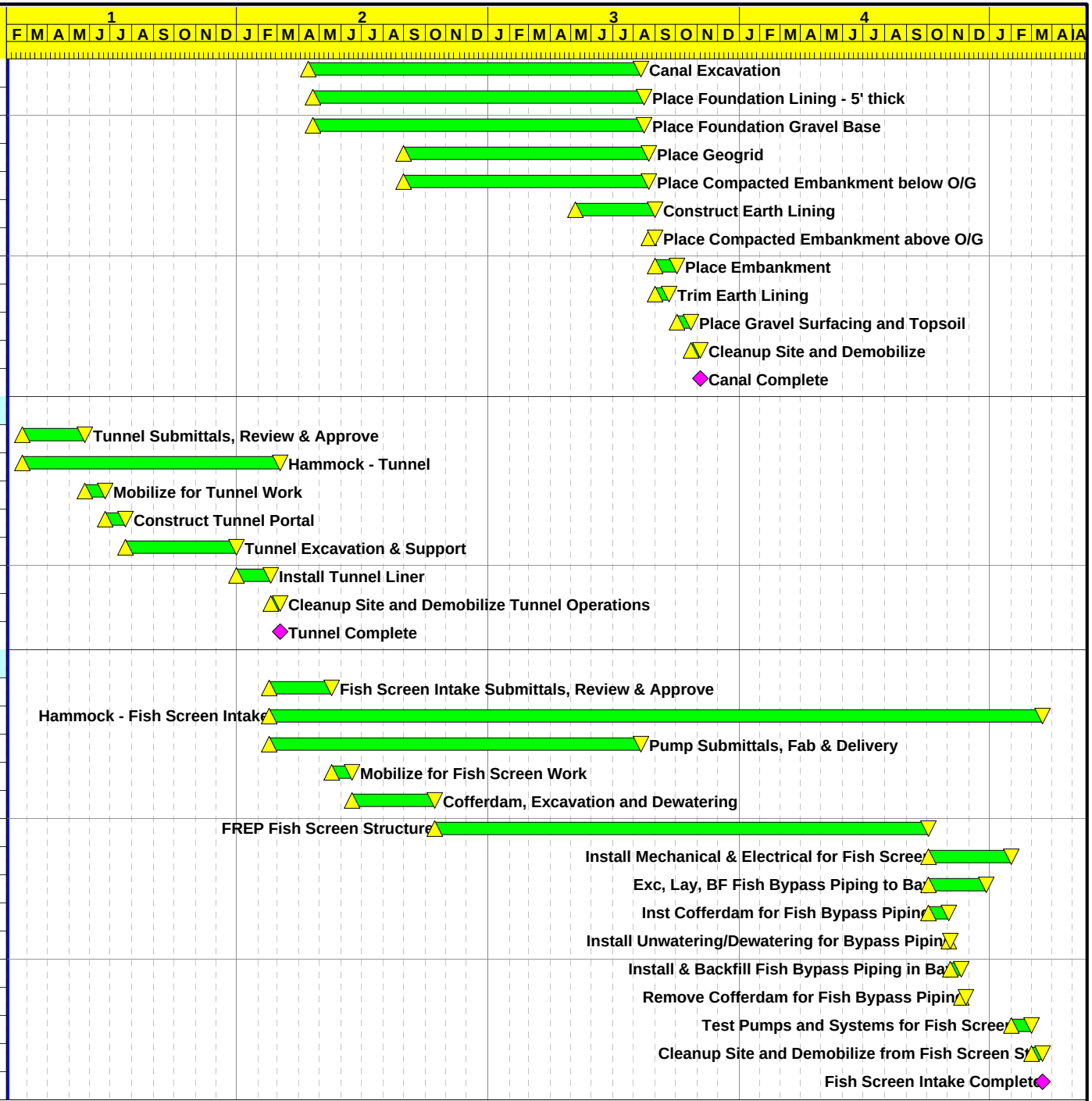
LL1B

Alternative No. 1, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 1B - 500 TAF
Summary Construction Schedule

Sheet 1 of 3

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description
1C13175	Canal Excavation
1C13200	Place Foundation Lining - 5' thick
1C13225	Place Foundation Gravel Base
1C13250	Place Geogrid
1C13275	Place Compacted Embankment below O/G
1C13300	Construct Earth Lining
1C13325	Place Compacted Embankment above O/G
1C13350	Place Embankment
1C13375	Trim Earth Lining
1C13400	Place Gravel Surfacing and Topsoil
1C13425	Cleanup Site and Demobilize
1C13450	Canal Complete
Tunnel - 2,000 cfs	
1T12100	Tunnel Submittals, Review & Approve
HAMT	Hammock - Tunnel
1T12125	Mobilize for Tunnel Work
1T12150	Construct Tunnel Portal
1T12175	Tunnel Excavation & Support
1T12200	Install Tunnel Liner
1T12225	Cleanup Site and Demobilize Tunnel Operations
1T12250	Tunnel Complete
Fish Screen Intake - 2,000 cfs	
1F15100	Fish Screen Intake Submittals, Review & Approve
HAMFS	Hammock - Fish Screen Intake
1F15200	Pump Submittals, Fab & Delivery
1F15125	Mobilize for Fish Screen Work
1F15150	Cofferdam, Excavation and Dewatering
1F15175	FREP Fish Screen Structure
1F15250	Install Mechanical & Electrical for Fish Screen
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay
1F15400	Inst Cofferdam for Fish Bypass Piping
1F15425	Install Unwatering/Dewatering for Bypass Piping
1F15450	Install & Backfill Fish Bypass Piping in Bay
1F15475	Remove Cofferdam for Fish Bypass Piping
1F15300	Test Pumps and Systems for Fish Screen
1F15350	Cleanup Site and Demobilize from Fish Screen Str
1F15375	Fish Screen Intake Complete



Start Date 01FEB16
Finish Date 16APR20
Data Date 01FEB16
Run Date 27MAR09 14:14

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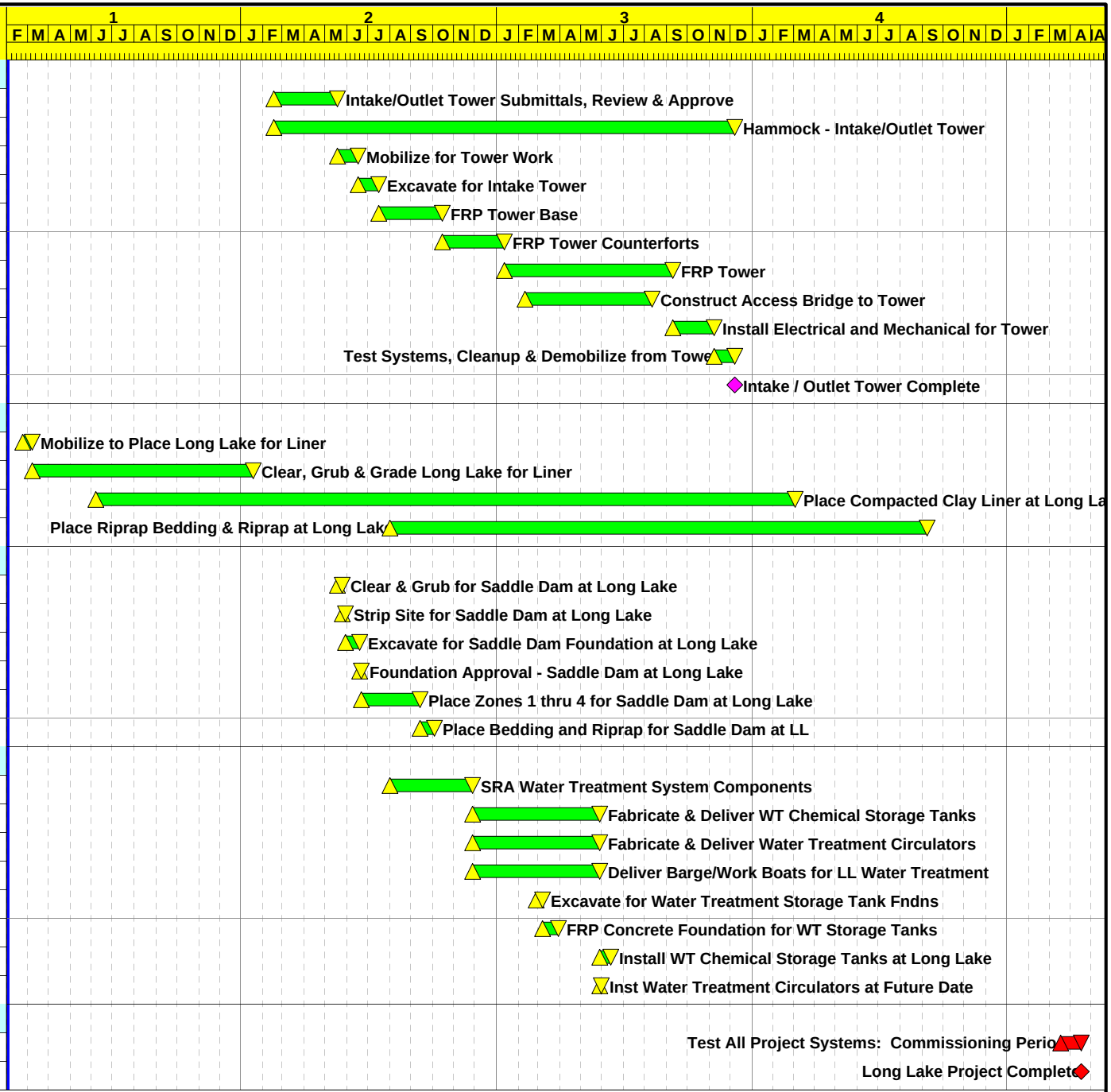
LL1B

Alternative No. 1, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 1B - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description
Intake/Outlet Tower - 2,000 cfs	
1T14000	Intake/Outlet Tower Submittals, Review & Approve
HAMIOT	Hammock - Intake/Outlet Tower
1T14025	Mobilize for Tower Work
1T14050	Excavate for Intake Tower
1T14075	FRP Tower Base
1T14100	FRP Tower Counterforts
1T14125	FRP Tower
1T14150	Construct Access Bridge to Tower
1T14175	Install Electrical and Mechanical for Tower
1T14200	Test Systems, Cleanup & Demobilize from Tower
1T14225	Intake / Outlet Tower Complete
Long Lake Clay Liner	
1CL6100	Mobilize to Place Long Lake for Liner
1CL6120	Clear, Grub & Grade Long Lake for Liner
1CL6140	Place Compacted Clay Liner at Long Lake
1CL6160	Place Riprap Bedding & Riprap at Long Lake
Long Lake Saddle Dam	
1SD8000	Clear & Grub for Saddle Dam at Long Lake
1SD8025	Strip Site for Saddle Dam at Long Lake
1SD8050	Excavate for Saddle Dam Foundation at Long Lake
1SD8075	Foundation Approval - Saddle Dam at Long Lake
1SD8100	Place Zones 1 thru 4 for Saddle Dam at Long Lake
1SD8125	Place Bedding and Riprap for Saddle Dam at LL
Water Treatment	
1WT7100	SRA Water Treatment System Components
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks
1WT7120	Fabricate & Deliver Water Treatment Circulators
1WT7160	Deliver Barge/Work Boats for LL Water Treatment
1WT7180	Excavate for Water Treatment Storage Tank Fndns
1WT7200	FRP Concrete Foundation for WT Storage Tanks
1WT7220	Install WT Chemical Storage Tanks at Long Lake
1WT7300	Inst Water Treatment Circulators at Future Date
Test Project	
1A500	Test All Project Systems: Commissioning Period
1A600	Long Lake Project Complete



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Finish Date 16APR20
Data Date 01FEB16
Run Date 27MAR09 14:14

Early Bar
Progress Bar
Critical Activity

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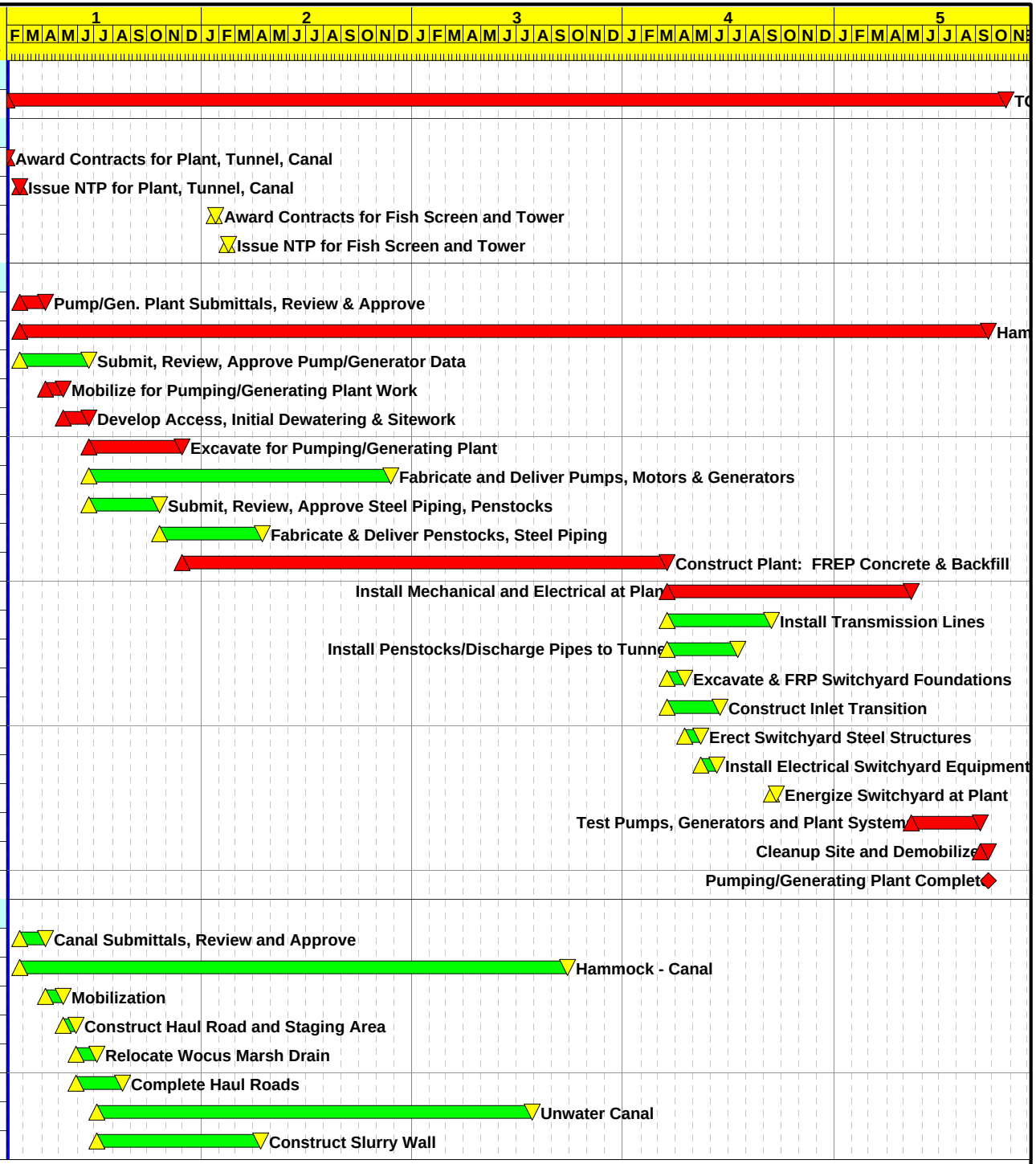
LL1B

Alternative No. 1, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 1B - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	TOTAL PROJECT DURATION - NTP TO COMPLETION	1,727*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping and Generating Plant - 1,000 cfs		
1PA1100	Pump/Gen. Plant Submittals, Review & Approve	45
HAMPP	Hammock - Pumping Plant	1,674*
1PA1125	Submit, Review, Approve Pump/Generator Data	120
1PA1150	Mobilize for Pumping/Generating Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping/Generating Plant	160
1PA1225	Fabricate and Deliver Pumps, Motors & Generators	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	840
1PA1375	Install Mechanical and Electrical at Plant	420
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Plant	7
1PA1575	Test Pumps, Generators and Plant Systems	120
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping/Generating Plant Complete	0
Canal - 1,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
HAMC	Hammock - Canal	946*
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Relocate Wocus Marsh Drain	37
1C13075	Complete Haul Roads	82
1C13125	Unwater Canal	539*
1C13150	Construct Slurry Wall	177



Start Date 01FEB16
Finish Date 23OCT20
Data Date 01FEB16
Run Date 27MAR09 14:14

Early Bar
Progress Bar
Critical Activity

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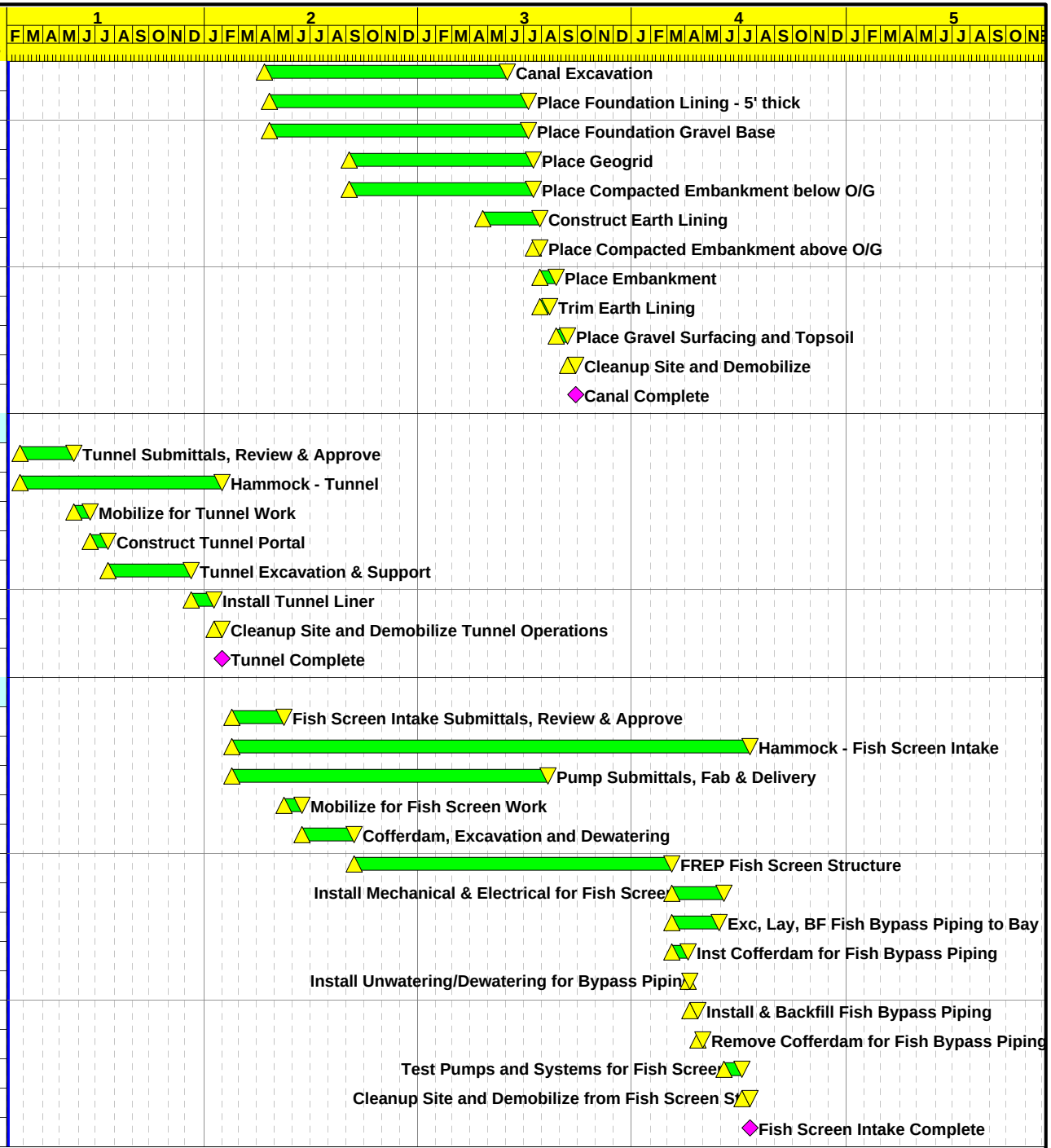
LL1C

Alternative No. 1, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 1C - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assumed 3.5 months of weather impact		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
1C13175	Canal Excavation	307
1C13200	Place Foundation Lining - 5' thick	338
1C13225	Place Foundation Gravel Base	338*
1C13250	Place Geogrid	208*
1C13275	Place Compacted Embankment below O/G	208
1C13300	Construct Earth Lining	97
1C13325	Place Compacted Embankment above O/G	10
1C13350	Place Embankment	28
1C13375	Trim Earth Lining	19
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 1,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	344*
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	140
1T12200	Install Tunnel Liner	40
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 1,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	884*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	90
1F15175	FREP Fish Screen Structure	540
1F15250	Install Mechanical & Electrical for Fish Screen	90
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0



Start Date 01FEB16
Finish Date 23OCT20
Data Date 01FEB16
Run Date 27MAR09 14:14

Early Bar
Progress Bar
Critical Activity

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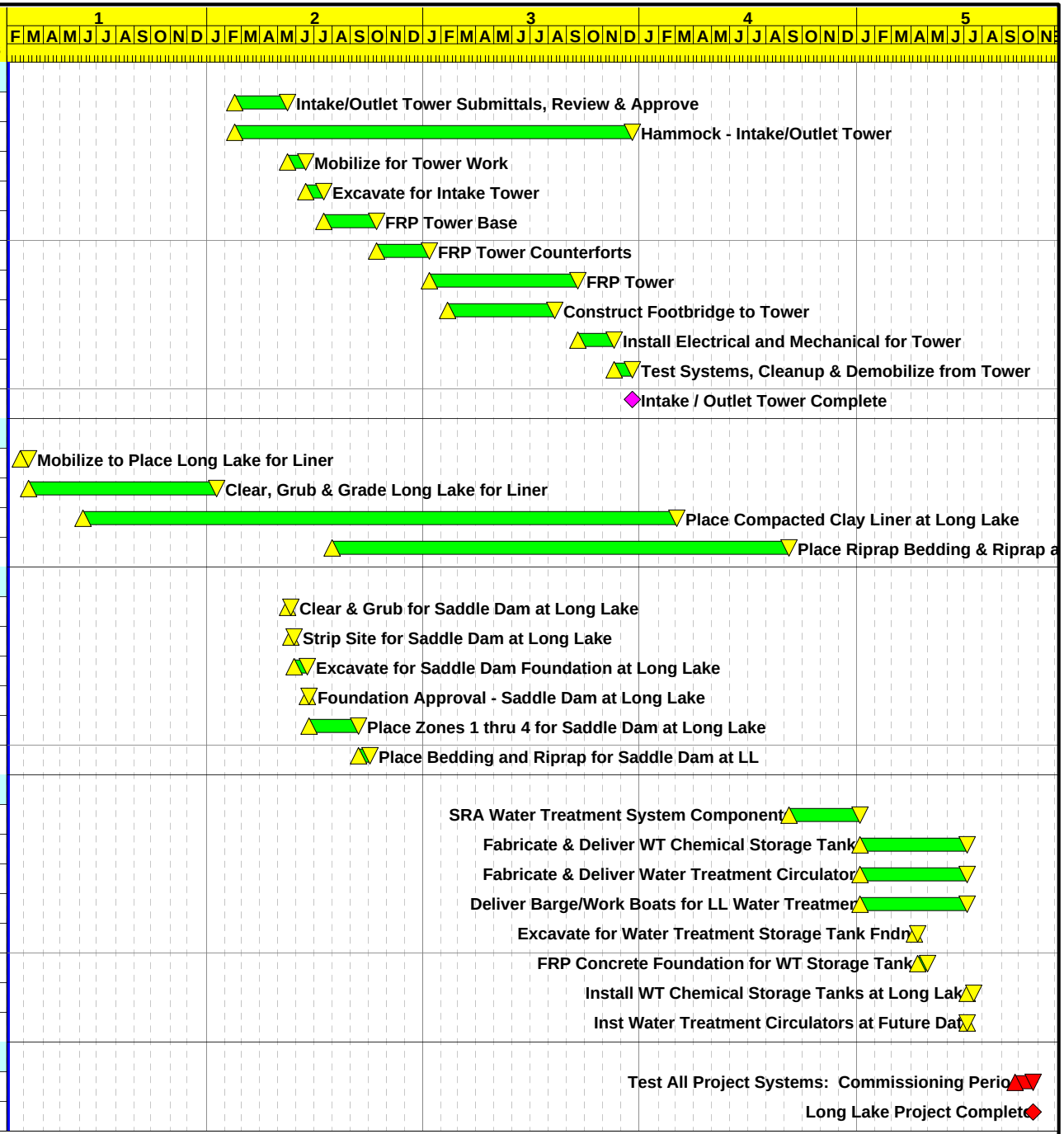
LL1C

Alternative No. 1, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 1C - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assumed 3.5 months of weather impact		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
Intake/Outlet Tower - 1,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	670*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	90
1T14100	FRP Tower Counterforts	90
1T14125	FRP Tower	250
1T14150	Construct Footbridge to Tower	180
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	14
1CL6120	Clear, Grub & Grade Long Lake for Liner	315
1CL6140	Place Compacted Clay Liner at Long Lake	1,000
1CL6160	Place Riprap Bedding & Riprap at Long Lake	770
Long Lake Saddle Dam		
1SD8000	Clear & Grub for Saddle Dam at Long Lake	7
1SD8025	Strip Site for Saddle Dam at Long Lake	5
1SD8050	Excavate for Saddle Dam Foundation at Long Lake	21
1SD8075	Foundation Approval - Saddle Dam at Long Lake	2
1SD8100	Place Zones 1 thru 4 for Saddle Dam at Long Lake	84
1SD8125	Place Bedding and Riprap for Saddle Dam at LL	21
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	6
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date 01FEB16
Finish Date 23OCT20
Data Date 01FEB16
Run Date 27MAR09 14:14

Early Bar
Progress Bar
Critical Activity

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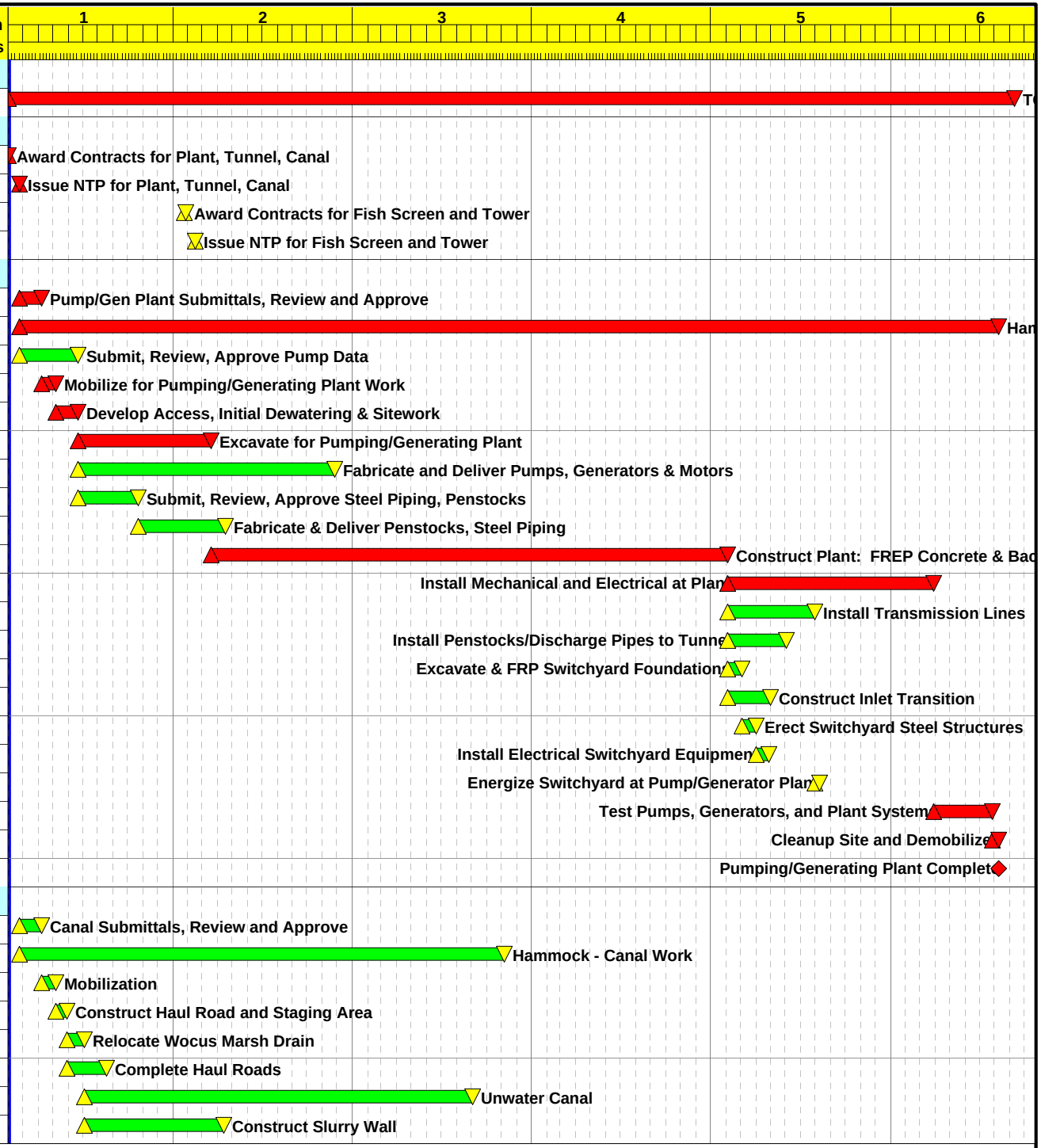
LL1C

Alternative No. 1, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 1C - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assumed 3.5 months of weather impact		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	TOTAL PROJECT DURATION - NTP TO	2,047*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping and Generating Plant - 2,000 cfs		
1PA1100	Pump/Gen Plant Submittals, Review and Approve	45
HAMPP	Hammock - Pumping Plant, Switchyard & Penstocks	1,994*
1PA1125	Submit, Review, Approve Pump Data	120
1PA1150	Mobilize for Pumping/Generating Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping/Generating Plant	270
1PA1225	Fabricate and Deliver Pumps, Generators & Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	1,050
1PA1375	Install Mechanical and Electrical at Plant	420
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pump/Generator Plant	7
1PA1575	Test Pumps, Generators, and Plant Systems	120
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping/Generating Plant Complete	0
Canal - 2,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
HAMC	Hammock - Canal Work	987*
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Relocate Wocus Marsh Drain	37
1C13075	Complete Haul Roads	82
1C13125	Unwater Canal	576*
1C13150	Construct Slurry Wall	177



Start Date 01FEB16
Finish Date 08SEP21
Data Date 01FEB16
Run Date 31MAR09 13:53

Early Bar
Progress Bar
Critical Activity

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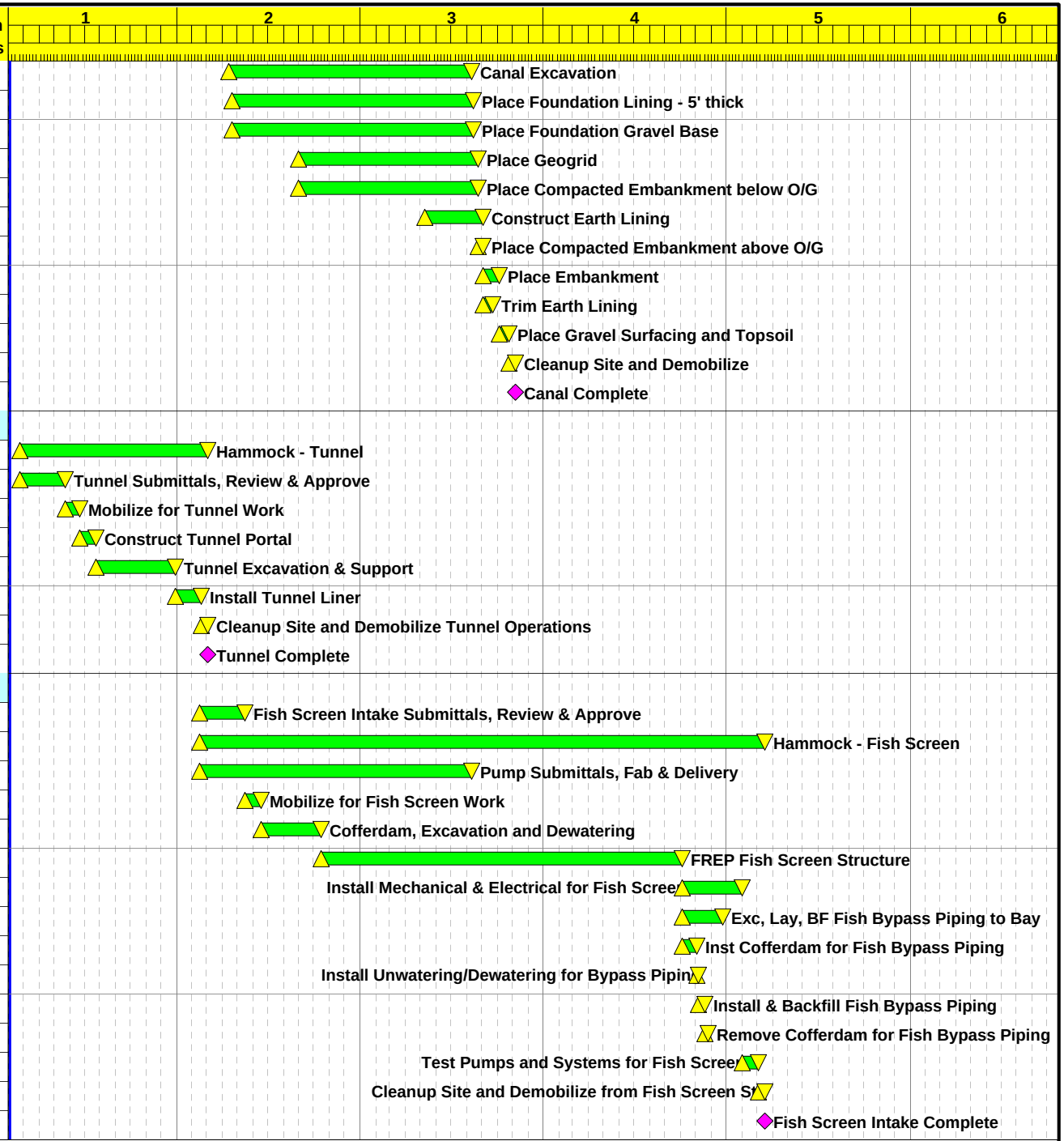
LL1D

Alternative No. 1, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 1D - 500 TAF
Summary Construction Schedule

Sheet 1 of 3

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impact		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
1C13175	Canal Excavation	378
1C13200	Place Foundation Lining - 5' thick	375
1C13225	Place Foundation Gravel Base	375*
1C13250	Place Geogrid	250*
1C13275	Place Compacted Embankment below O/G	250
1C13300	Construct Earth Lining	116
1C13325	Place Compacted Embankment above O/G	10
1C13350	Place Embankment	32
1C13375	Trim Earth Lining	19
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 2,000 cfs		
HAMT	Hammock - Tunnel	374*
1T12100	Tunnel Submittals, Review & Approve	90
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	160
1T12200	Install Tunnel Liner	50
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 2,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen	1,124*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	120
1F15175	FREP Fish Screen Structure	720
1F15250	Install Mechanical & Electrical for Fish Screen	120
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0



Start Date 01FEB16
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Early Bar
Progress Bar
Critical Activity

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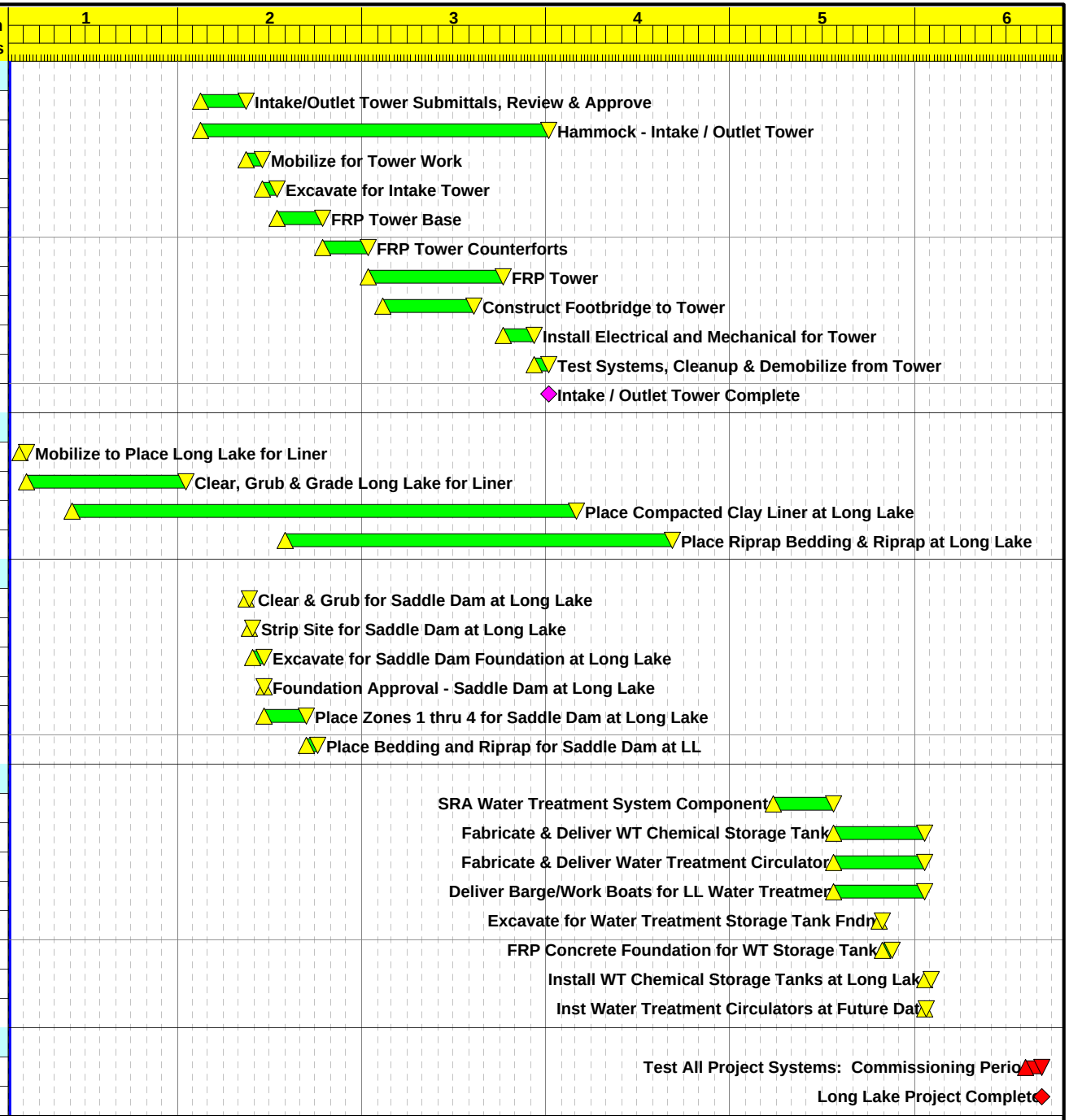
LL1D

Alternative No. 1, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 1D - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impact		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
Intake/Outlet Tower - 2,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake / Outlet Tower	690*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	90
1T14100	FRP Tower Counterforts	90
1T14125	FRP Tower	270
1T14150	Construct Footbridge to Tower	180
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	14
1CL6120	Clear, Grub & Grade Long Lake for Liner	315
1CL6140	Place Compacted Clay Liner at Long Lake	1,000
1CL6160	Place Riprap Bedding & Riprap at Long Lake	770
Long Lake Saddle Dam		
1SD8000	Clear & Grub for Saddle Dam at Long Lake	7
1SD8025	Strip Site for Saddle Dam at Long Lake	5
1SD8050	Excavate for Saddle Dam Foundation at Long Lake	21
1SD8075	Foundation Approval - Saddle Dam at Long Lake	2
1SD8100	Place Zones 1 thru 4 for Saddle Dam at Long Lake	84
1SD8125	Place Bedding and Riprap for Saddle Dam at LL	21
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	6
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



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Run Date 31MAR09 13:53

Early Bar
Progress Bar
Critical Activity

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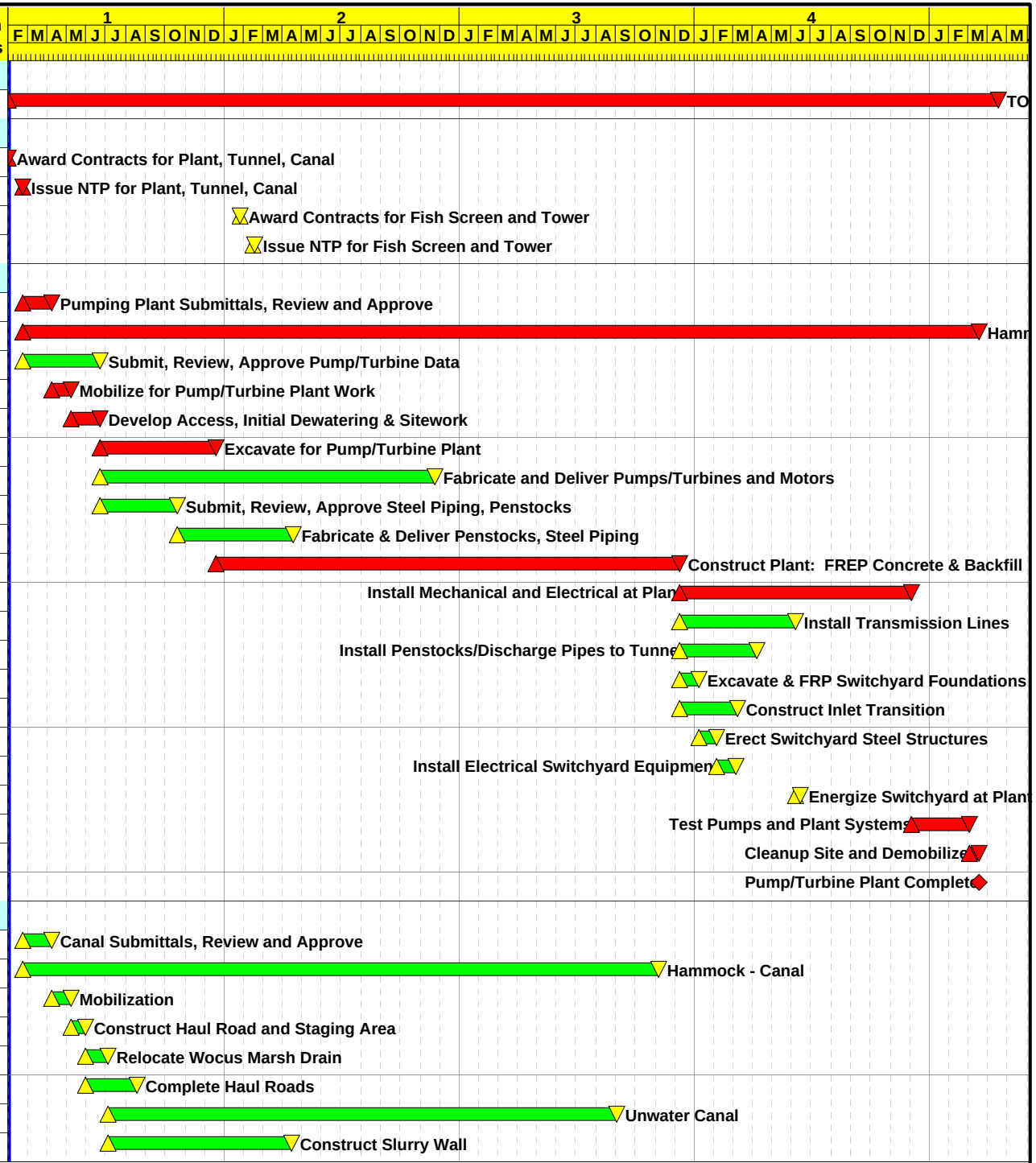
LL1D

Alternative No. 1, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 1D - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impact		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	TOTAL PROJECT DURATION - NTP TO COMPLETION	1,537*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pump/Turbine Plant - 2,000 cfs		
1PA1100	Pumping Plant Submittals, Review and Approve	45
HAMPP	Hammock - Pumping Plant	1,484*
1PA1125	Submit, Review, Approve Pump/Turbine Data	120
1PA1150	Mobilize for Pump/Turbine Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pump/Turbine Plant	180
1PA1225	Fabricate and Deliver Pumps/Turbines and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	720
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pump/Turbine Plant Complete	0
Canal - 2,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
HAMC	Hammock - Canal	987*
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Relocate Wocus Marsh Drain	37
1C13075	Complete Haul Roads	82
1C13125	Unwater Canal	576*
1C13150	Construct Slurry Wall	177



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Early Bar
Progress Bar
Critical Activity

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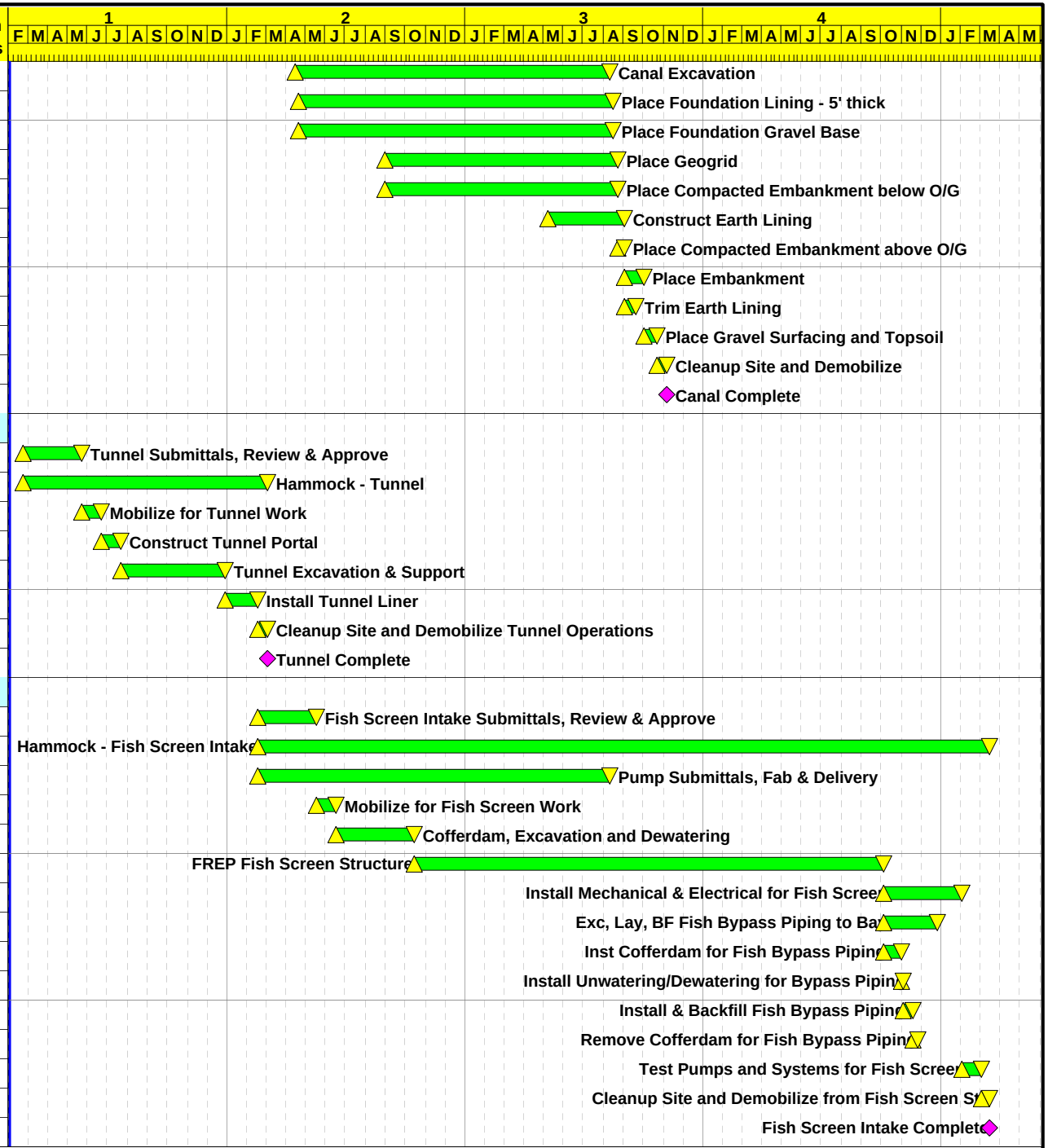
LL1E

Alternative No. 1, Option E
(2,000 cfs Pump/Turbine Plant)
Long Lake Valley - 1E - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
1C13175	Canal Excavation	378
1C13200	Place Foundation Lining - 5' thick	375
1C13225	Place Foundation Gravel Base	375*
1C13250	Place Geogrid	250*
1C13275	Place Compacted Embankment below O/G	250
1C13300	Construct Earth Lining	116
1C13325	Place Compacted Embankment above O/G	10
1C13350	Place Embankment	32
1C13375	Trim Earth Lining	19
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 2,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	374*
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	160
1T12200	Install Tunnel Liner	50
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 2,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	1,124*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	120
1F15175	FREP Fish Screen Structure	720
1F15250	Install Mechanical & Electrical for Fish Screen	120
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0



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Early Bar
Progress Bar
Critical Activity

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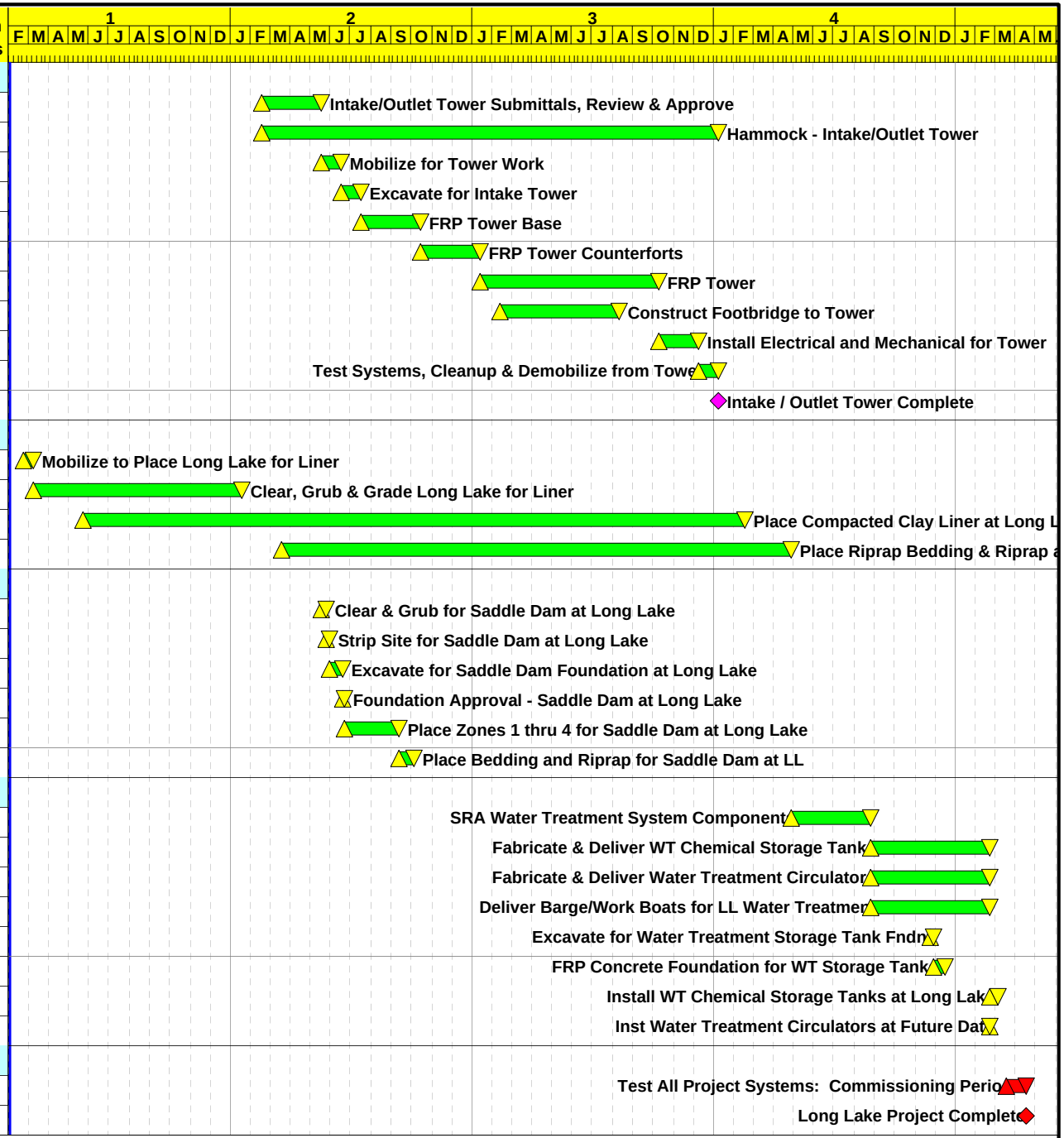
LL1E

Alternative No. 1, Option E
(2,000 cfs Pump/Turbine Plant)
Long Lake Valley - 1E - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
Intake/Outlet Tower - 2,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	690*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	90
1T14100	FRP Tower Counterforts	90
1T14125	FRP Tower	270
1T14150	Construct Footbridge to Tower	180
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	14
1CL6120	Clear, Grub & Grade Long Lake for Liner	315
1CL6140	Place Compacted Clay Liner at Long Lake	1,000
1CL6160	Place Riprap Bedding & Riprap at Long Lake	770
Long Lake Saddle Dam		
1SD8000	Clear & Grub for Saddle Dam at Long Lake	7
1SD8025	Strip Site for Saddle Dam at Long Lake	5
1SD8050	Excavate for Saddle Dam Foundation at Long Lake	21
1SD8075	Foundation Approval - Saddle Dam at Long Lake	2
1SD8100	Place Zones 1 thru 4 for Saddle Dam at Long Lake	84
1SD8125	Place Bedding and Riprap for Saddle Dam at LL	21
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	6
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



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Early Bar
Progress Bar
Critical Activity

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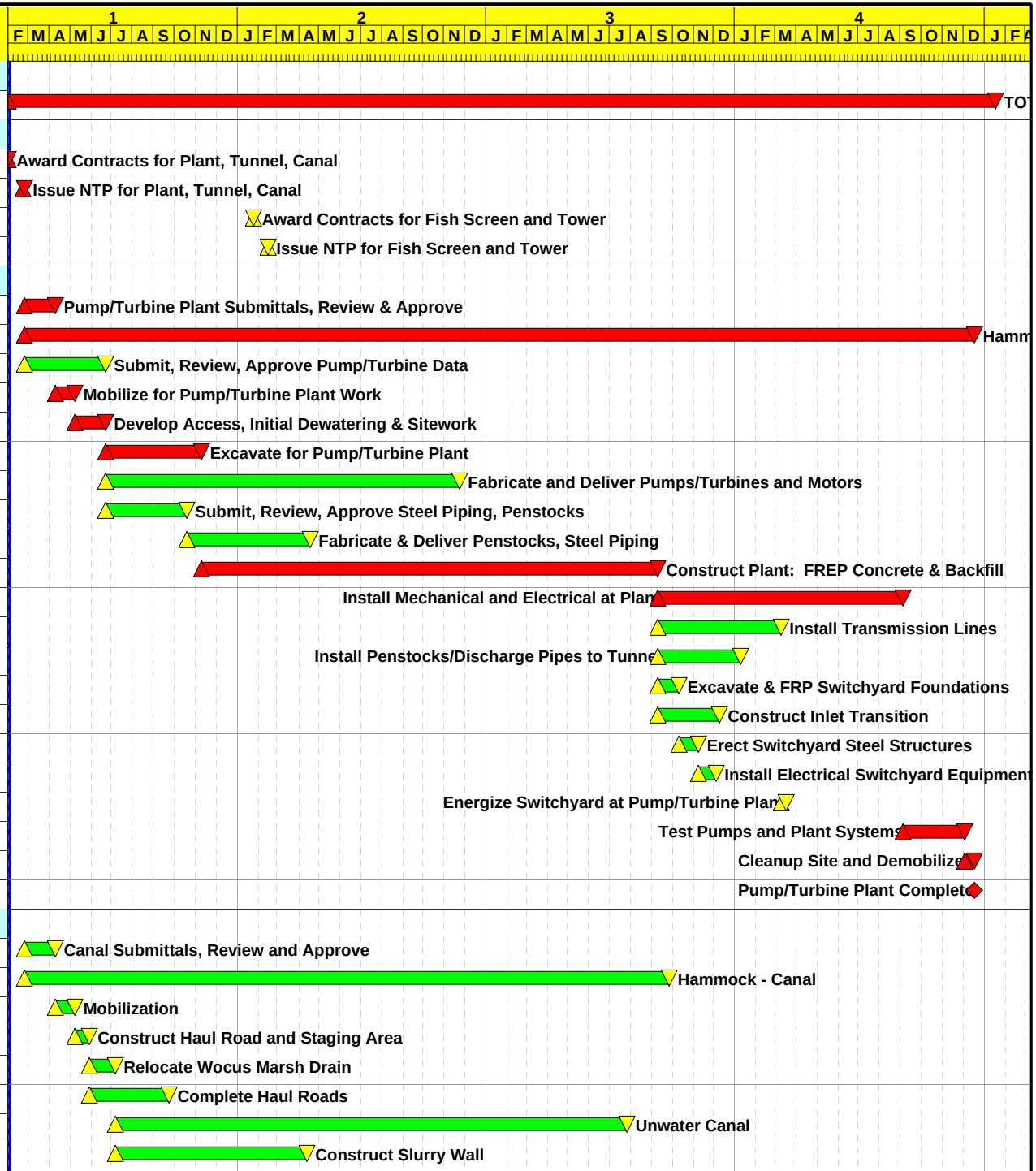
LL1E

Alternative No. 1, Option E
(2,000 cfs Pump/Turbine Plant)
Long Lake Valley - 1E - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	TOTAL PROJECT DURATION - NTP TO COMPLETION	1,447*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pump/Turbine Plant - 1,000 cfs		
1PA1100	Pump/Turbine Plant Submittals, Review & Approve	45
HAMPP	Hammock - Pumping Plant	1,394*
1PA1125	Submit, Review, Approve Pump/Turbine Data	120
1PA1150	Mobilize for Pump/Turbine Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pump/Turbine Plant	140
1PA1225	Fabricate and Deliver Pumps/Turbines and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	670
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pump/Turbine Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pump/Turbine Plant Complete	0
Canal - 1,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
HAMC	Hammock - Canal	946*
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Relocate Wocus Marsh Drain	37
1C13075	Complete Haul Roads	82
1C13125	Unwater Canal	539*
1C13150	Construct Slurry Wall	177



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Early Bar
Progress Bar
Critical Activity

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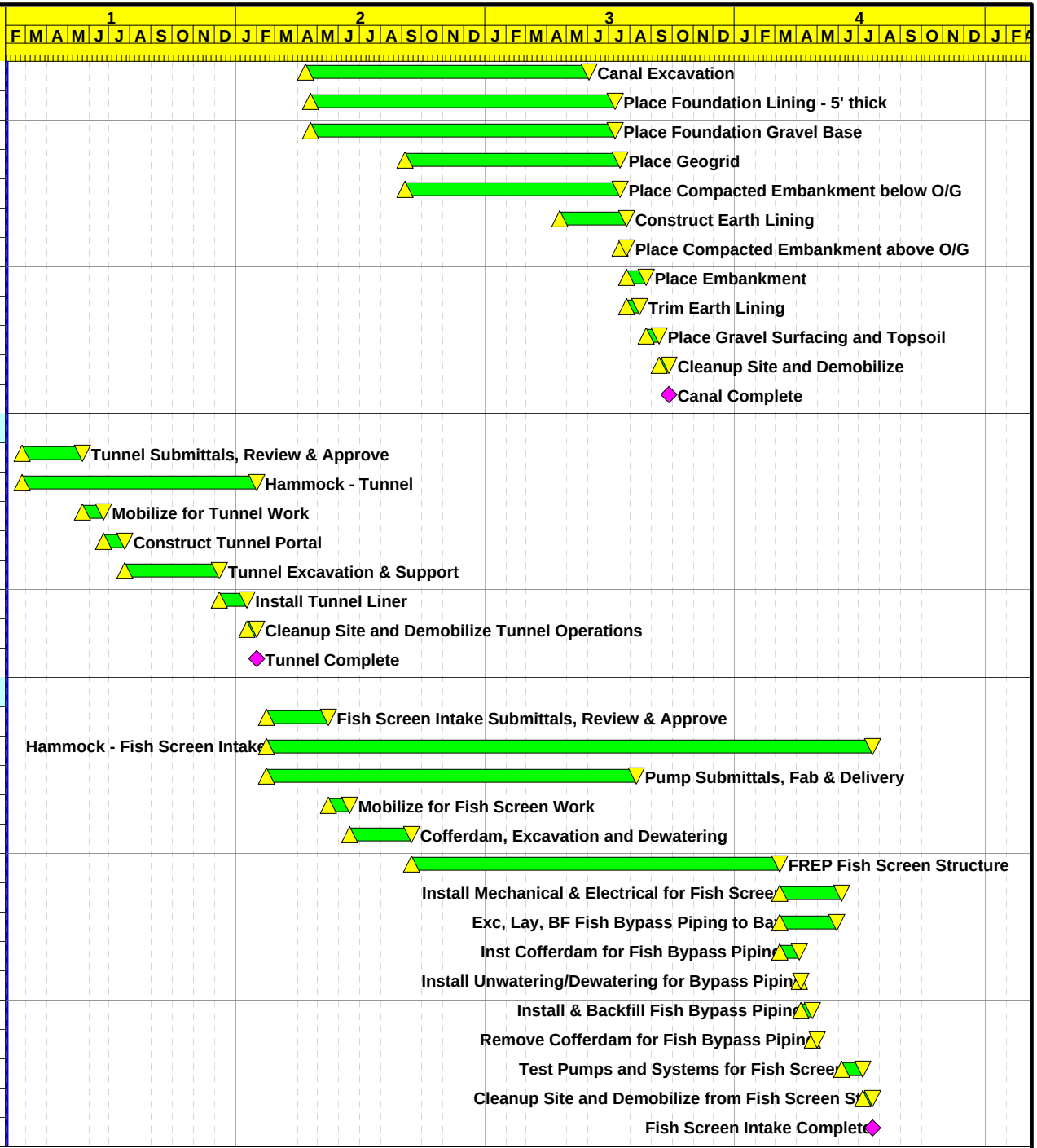
LL1F

Alternative No. 1, Option F
(1,000 cfs Pump/Turbine Plant)
Long Lake Valley - 1F - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
1C13175	Canal Excavation	307
1C13200	Place Foundation Lining - 5' thick	338
1C13225	Place Foundation Gravel Base	338*
1C13250	Place Geogrid	208*
1C13275	Place Compacted Embankment below O/G	208
1C13300	Construct Earth Lining	97
1C13325	Place Compacted Embankment above O/G	10
1C13350	Place Embankment	28
1C13375	Trim Earth Lining	19
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 1,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	344*
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	140
1T12200	Install Tunnel Liner	40
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 1,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	884*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	90
1F15175	FREP Fish Screen Structure	540
1F15250	Install Mechanical & Electrical for Fish Screen	90
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0



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Data Date 01FEB16
Run Date 27MAR09 14:16

Early Bar
Progress Bar
Critical Activity

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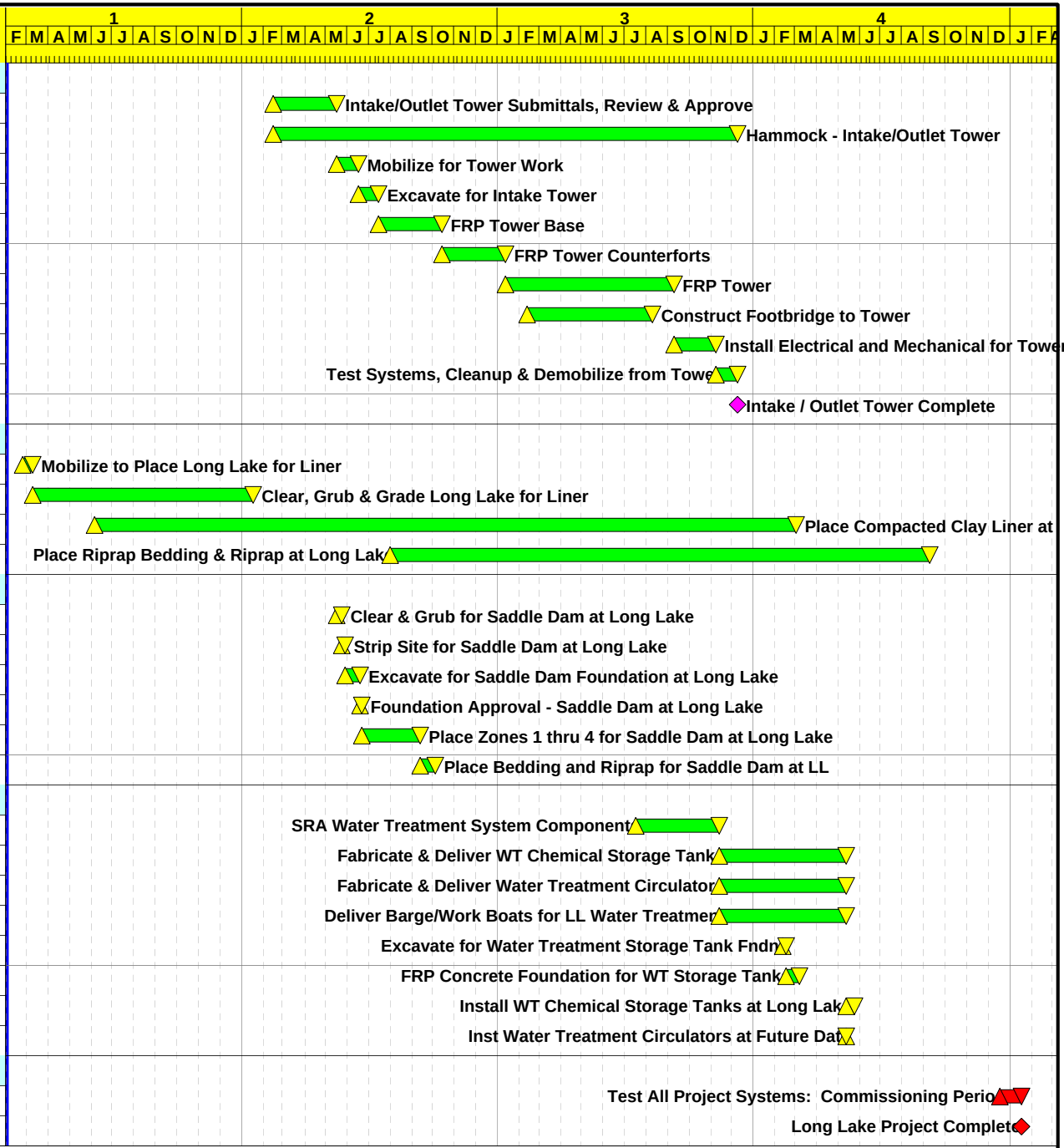
LL1F

Alternative No. 1, Option F
(1,000 cfs Pump/Turbine Plant)
Long Lake Valley - 1F - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
Intake/Outlet Tower - 1,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	660*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	90
1T14100	FRP Tower Counterforts	90
1T14125	FRP Tower	240
1T14150	Construct Footbridge to Tower	180
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	14
1CL6120	Clear, Grub & Grade Long Lake for Liner	315
1CL6140	Place Compacted Clay Liner at Long Lake	1,000
1CL6160	Place Riprap Bedding & Riprap at Long Lake	770
Long Lake Saddle Dam		
1SD8000	Clear & Grub for Saddle Dam at Long Lake	7
1SD8025	Strip Site for Saddle Dam at Long Lake	5
1SD8050	Excavate for Saddle Dam Foundation at Long Lake	21
1SD8075	Foundation Approval - Saddle Dam at Long Lake	2
1SD8100	Place Zones 1 thru 4 for Saddle Dam at Long Lake	84
1SD8125	Place Bedding and Riprap for Saddle Dam at LL	21
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	6
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



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Early Bar
Progress Bar
Critical Activity

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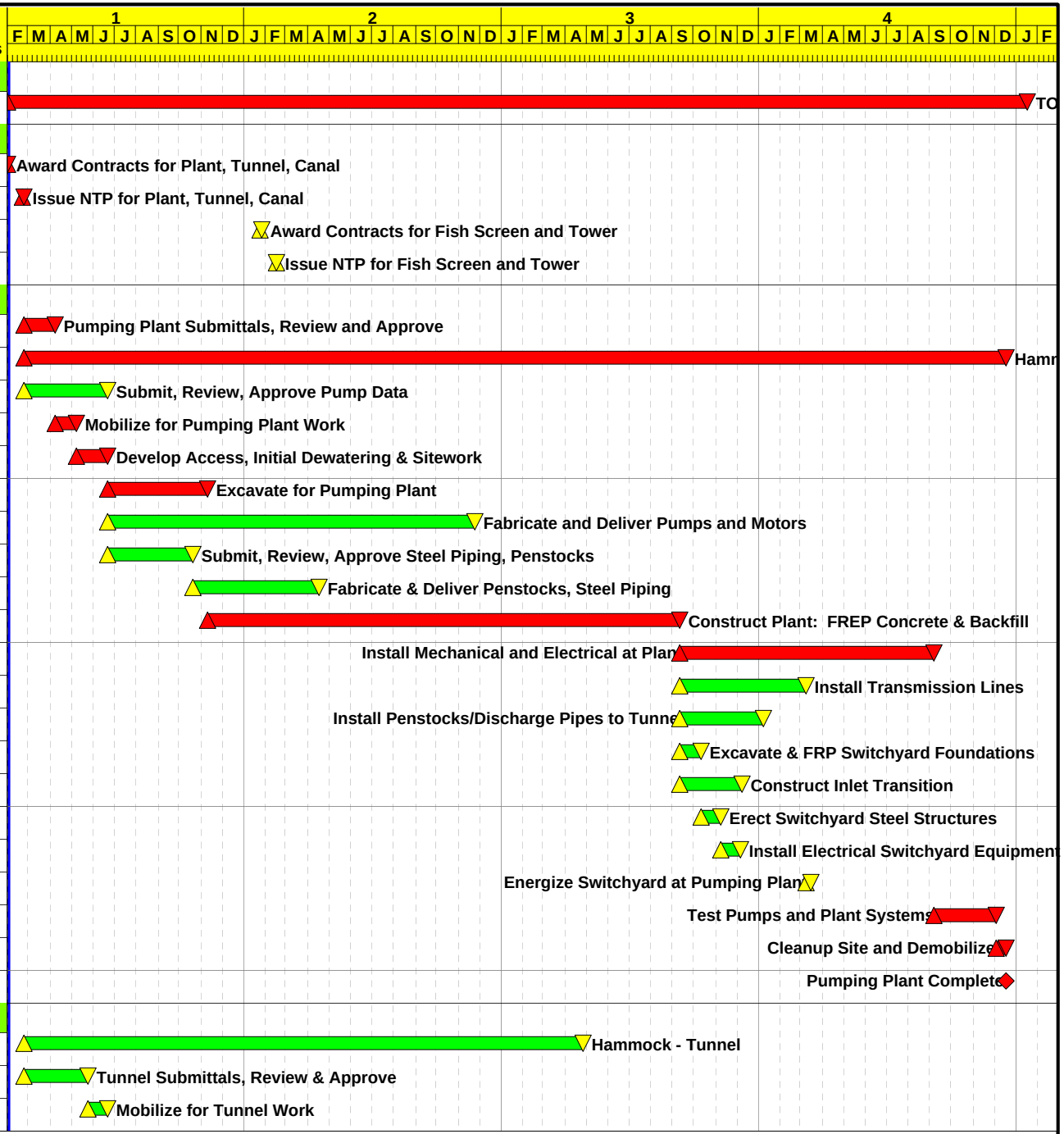
LL1F

Alternative No. 1, Option F
(1,000 cfs Pump/Turbine Plant)
Long Lake Valley - 1F - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	TOTAL PROJECT DURATION - NTP TO	1,447*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping Plant - 1,000 cfs		
1PA1100	Pumping Plant Submittals, Review and Approve	45
HAMPP	Hammock - Pumping Plant, Switchyard & Penstocks	1,394*
1PA1125	Submit, Review, Approve Pump Data	120
1PA1150	Mobilize for Pumping Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping Plant	140
1PA1225	Fabricate and Deliver Pumps and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	670
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pumping Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping Plant Complete	0
Tunnel - 1,000 cfs		
HAMT	Hammock - Tunnel	794*
1T12100	Tunnel Submittals, Review & Approve	90
1T12125	Mobilize for Tunnel Work	30



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Early Bar
Progress Bar
Critical Activity

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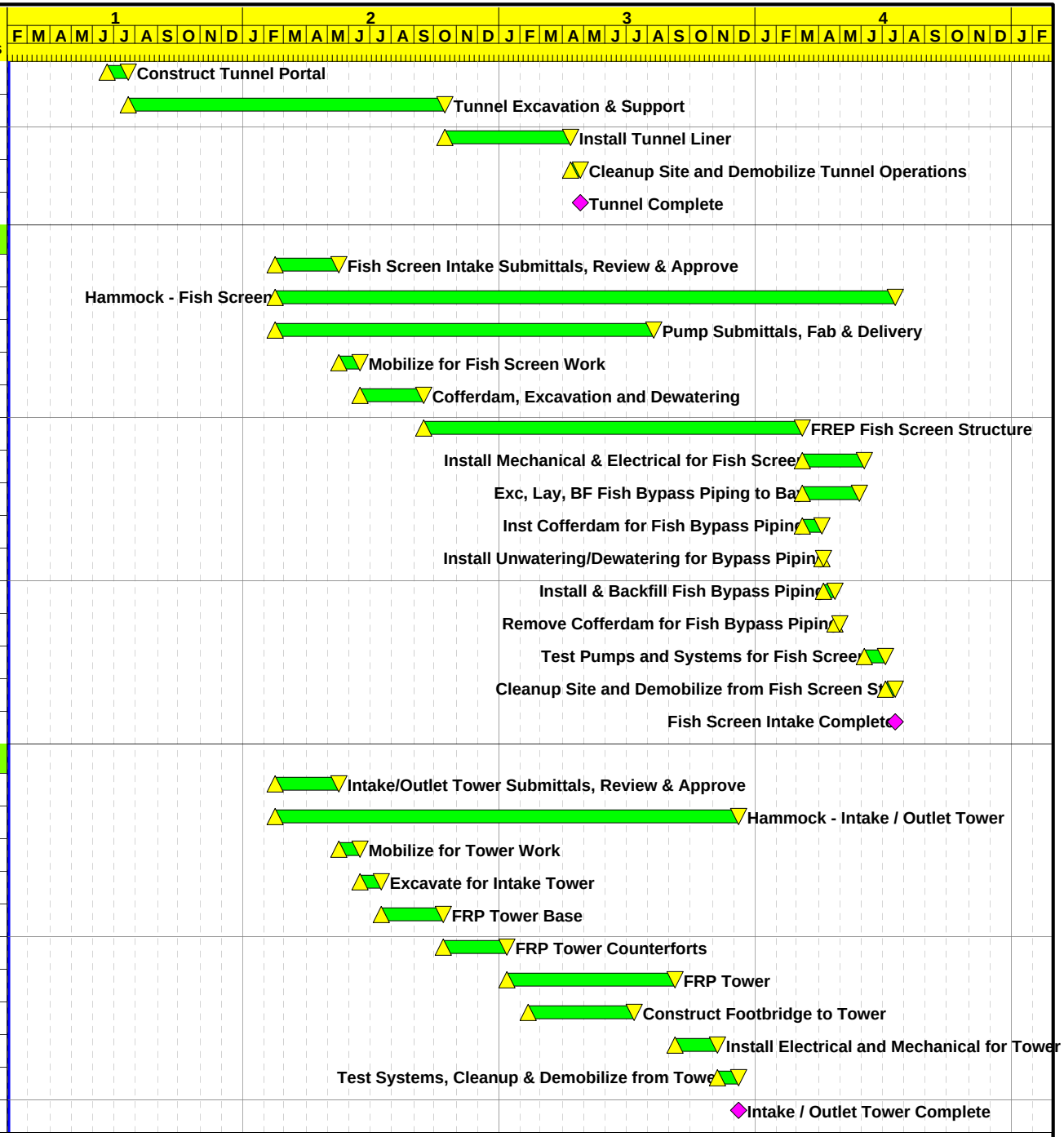
LL2A

Sheet 1 of 3

Alternative No. 2, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 2A - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	450
1T12200	Install Tunnel Liner	180
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 1,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen	884*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	90
1F15175	FREP Fish Screen Structure	540
1F15250	Install Mechanical & Electrical for Fish Screen	90
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 1,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake / Outlet Tower	660*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	90
1T14100	FRP Tower Counterforts	90
1T14125	FRP Tower	240
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0



Start Date 01FEB16
Finish Date 17JAN20
Data Date 01FEB16
Run Date 31MAR09 13:57

Early Bar
Progress Bar
Critical Activity

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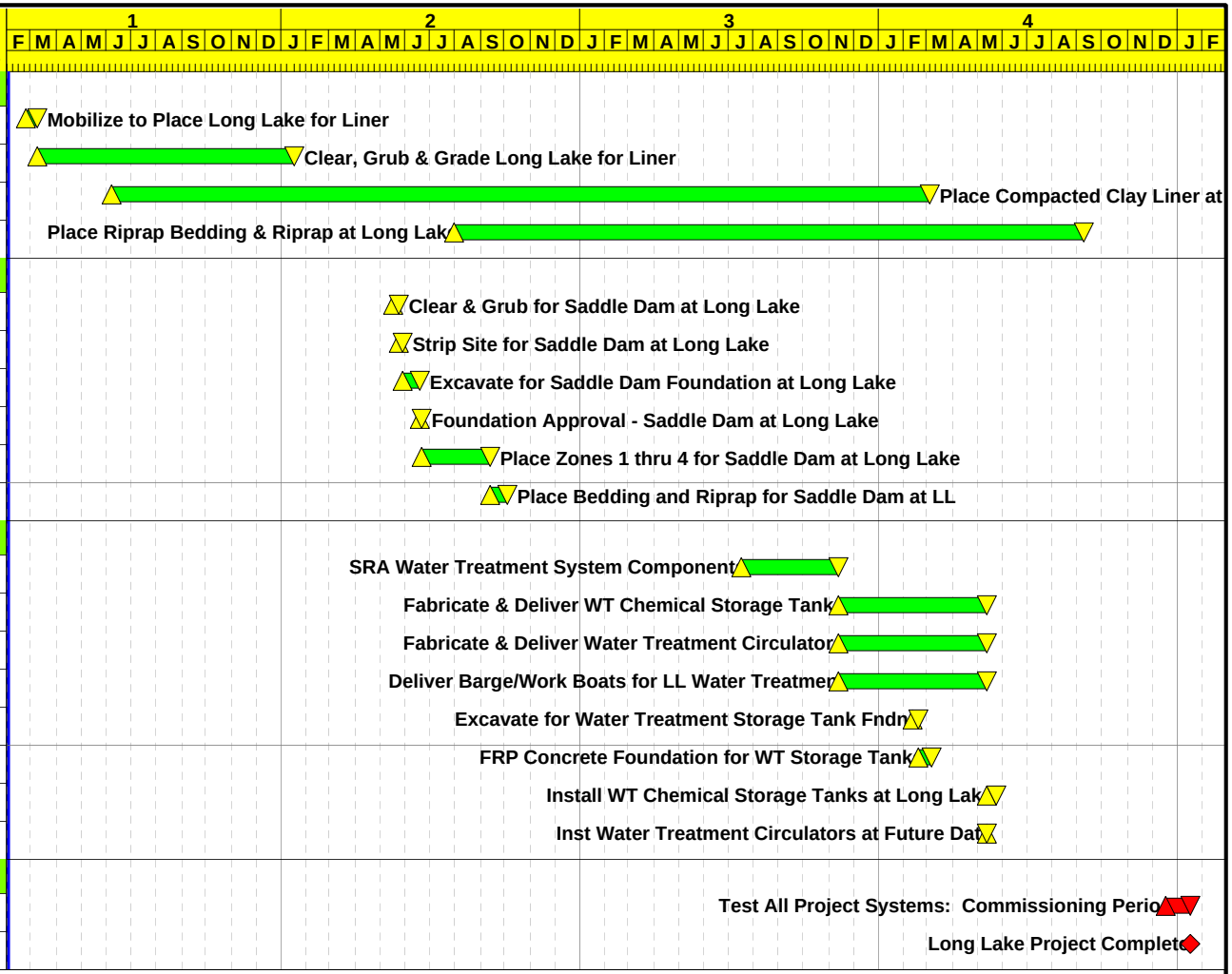
LL2A

Alternative No. 2, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 2A - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	14
1CL6120	Clear, Grub & Grade Long Lake for Liner	315
1CL6140	Place Compacted Clay Liner at Long Lake	1,000
1CL6160	Place Riprap Bedding & Riprap at Long Lake	770
Long Lake Saddle Dam		
1SD8000	Clear & Grub for Saddle Dam at Long Lake	7
1SD8025	Strip Site for Saddle Dam at Long Lake	5
1SD8050	Excavate for Saddle Dam Foundation at Long Lake	21
1SD8075	Foundation Approval - Saddle Dam at Long Lake	2
1SD8100	Place Zones 1 thru 4 for Saddle Dam at Long Lake	84
1SD8125	Place Bedding and Riprap for Saddle Dam at LL	21
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	6
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date	01FEB16
Finish Date	17JAN20
Data Date	01FEB16
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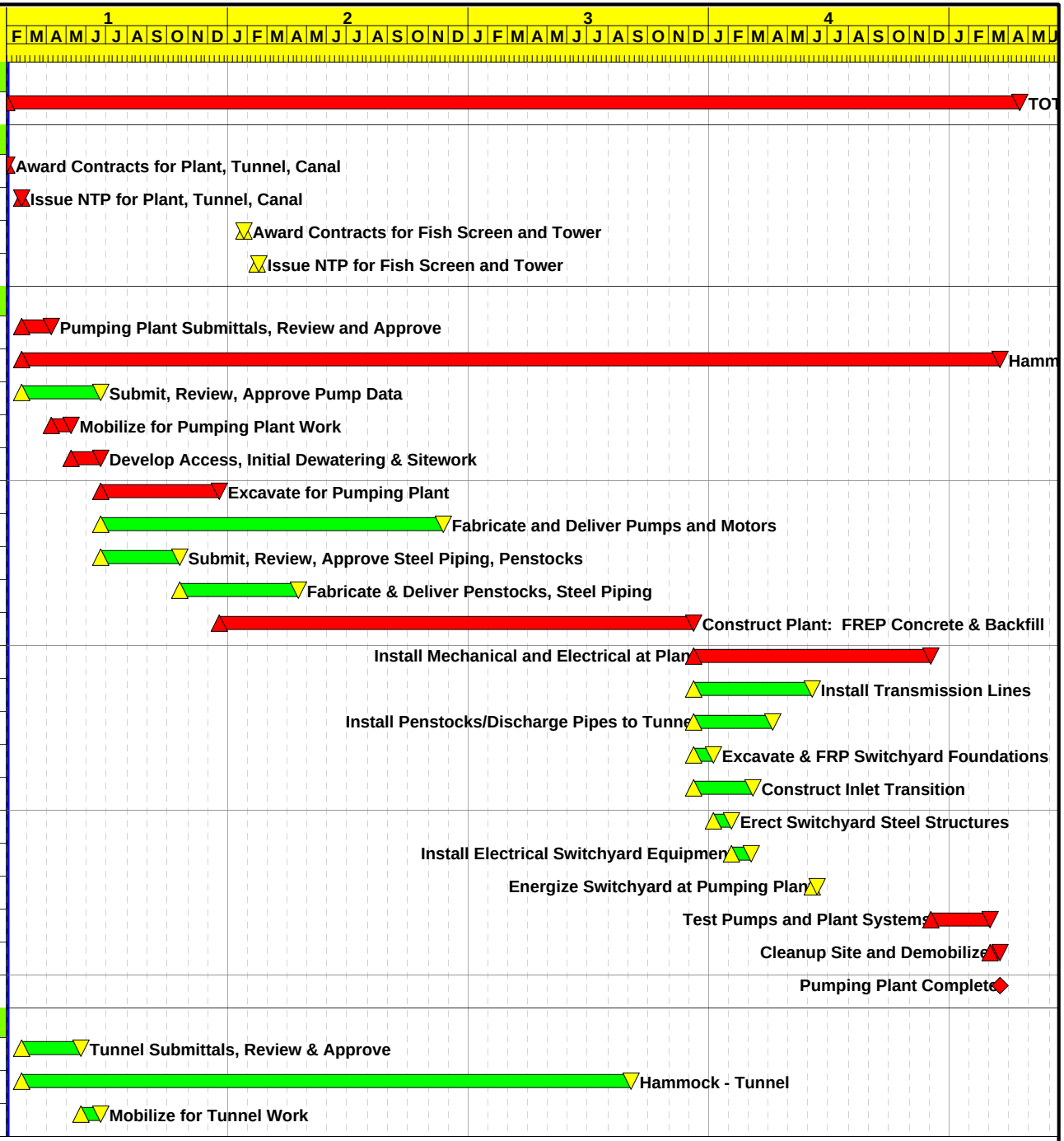
LL2A

Alternative No. 2, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 2A - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	TOTAL PROJECT DURATION - NTP TO	1,537*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping Plant - 2,000 cfs		
1PA1100	Pumping Plant Submittals, Review and Approve	45
HAMPP	Hammock - Pumping Plant	1,484*
1PA1125	Submit, Review, Approve Pump Data	120
1PA1150	Mobilize for Pumping Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping Plant	180
1PA1225	Fabricate and Deliver Pumps and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	720
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pumping Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping Plant Complete	0
Tunnel - 2,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	924*
1T12125	Mobilize for Tunnel Work	30



Start Date 01FEB16
Finish Date 16APR20
Data Date 01FEB16
Run Date 27MAR09 14:40

Early Bar
Progress Bar
Critical Activity

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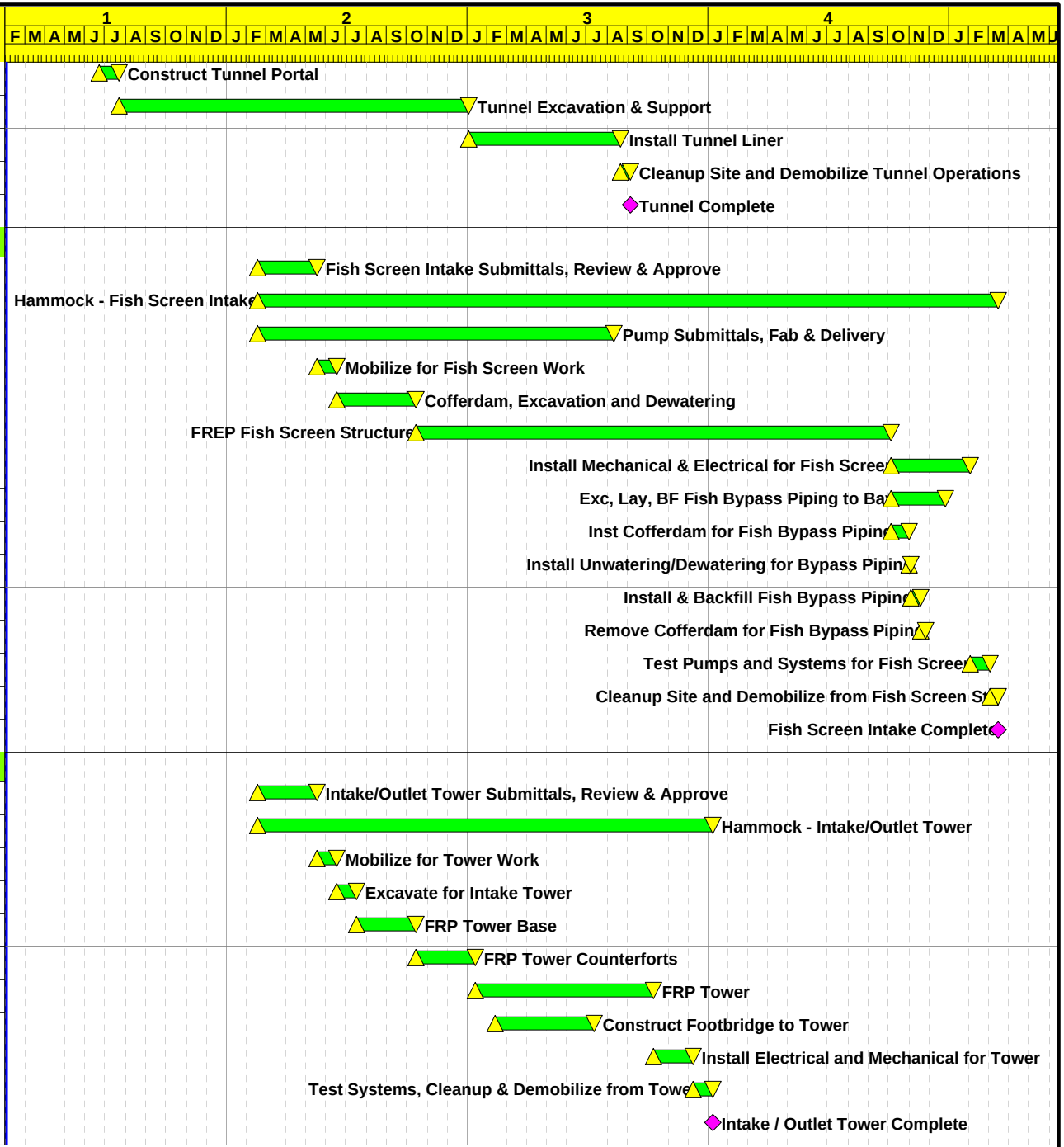
LL2B

Alternative No. 2, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 2B - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	530
1T12200	Install Tunnel Liner	230
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 2,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	1,124*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	120
1F15175	FREP Fish Screen Structure	720
1F15250	Install Mechanical & Electrical for Fish Screen	120
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 2,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	690*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	90
1T14100	FRP Tower Counterforts	90
1T14125	FRP Tower	270
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0



Start Date 01FEB16
Finish Date 16APR20
Data Date 01FEB16
Run Date 27MAR09 14:40

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Progress Bar
Critical Activity

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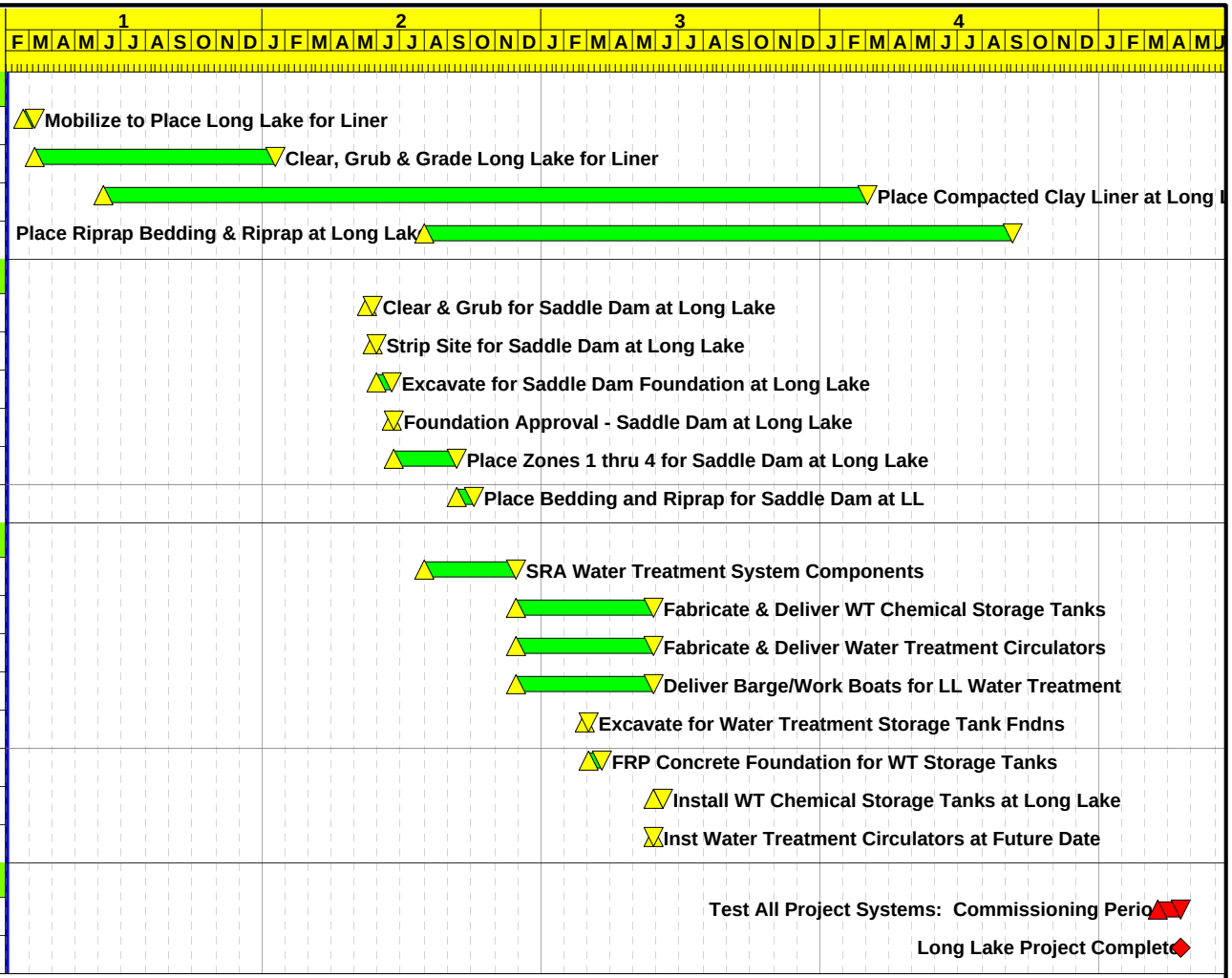
LL2B

Alternative No. 2, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 2B - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	14
1CL6120	Clear, Grub & Grade Long Lake for Liner	315
1CL6140	Place Compacted Clay Liner at Long Lake	1,000
1CL6160	Place Riprap Bedding & Riprap at Long Lake	770
Long Lake Saddle Dam		
1SD8000	Clear & Grub for Saddle Dam at Long Lake	7
1SD8025	Strip Site for Saddle Dam at Long Lake	5
1SD8050	Excavate for Saddle Dam Foundation at Long Lake	21
1SD8075	Foundation Approval - Saddle Dam at Long Lake	2
1SD8100	Place Zones 1 thru 4 for Saddle Dam at Long Lake	84
1SD8125	Place Bedding and Riprap for Saddle Dam at LL	21
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	6
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date 01FEB16
Finish Date 16APR20
Data Date 01FEB16
Run Date 27MAR09 14:40

Early Bar
Progress Bar
Critical Activity

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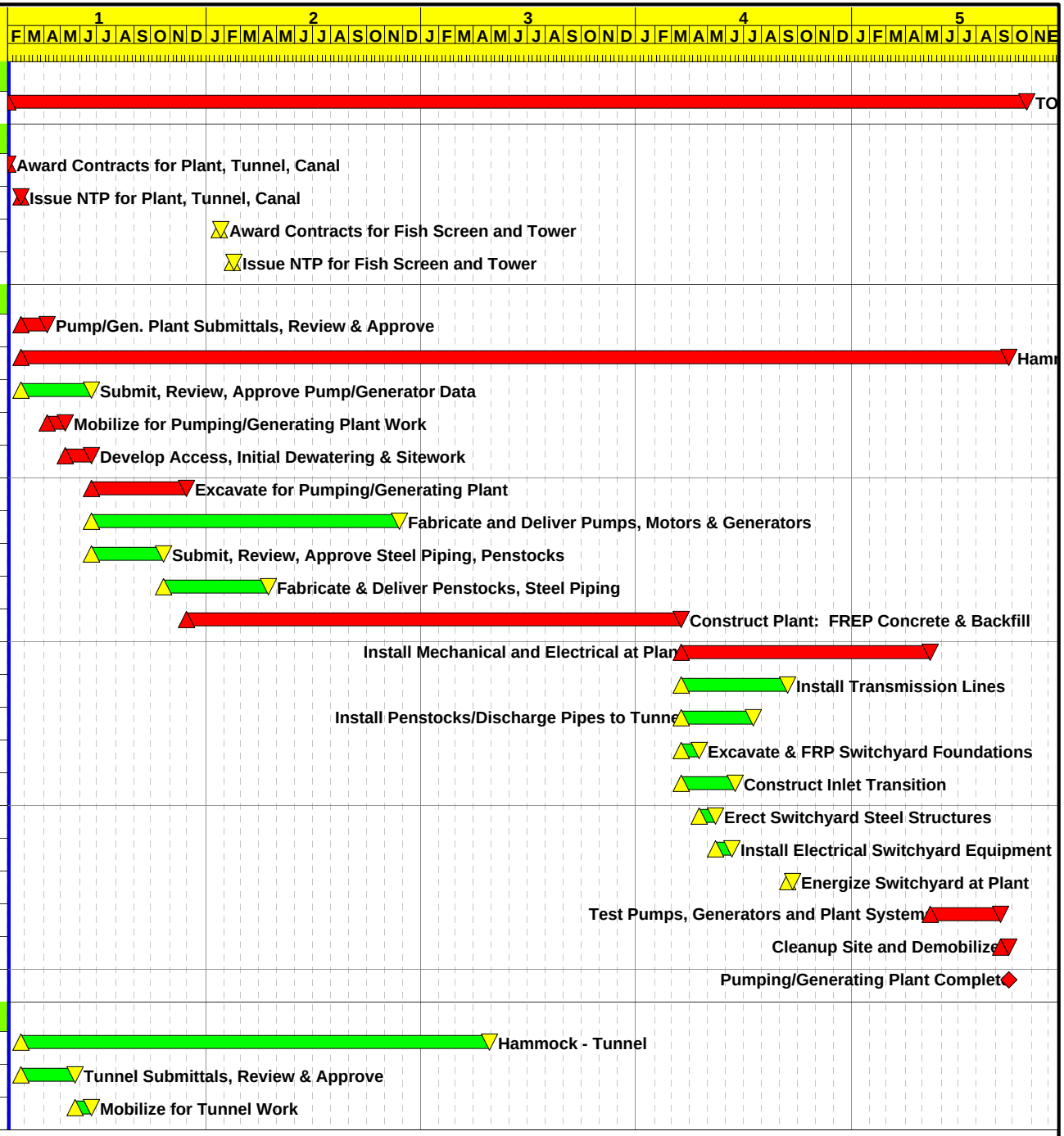
LL2B

Sheet 3 of 3

Alternative No. 2, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 2B - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	TOTAL PROJECT DURATION - NTP TO	1,727*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping and Generating Plant - 1,000 cfs		
1PA1100	Pump/Gen. Plant Submittals, Review & Approve	45
HAMPP	Hammock - Pumping Plant, Switchyard & Penstocks	1,674*
1PA1125	Submit, Review, Approve Pump/Generator Data	120
1PA1150	Mobilize for Pumping/Generating Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping/Generating Plant	160
1PA1225	Fabricate and Deliver Pumps, Motors & Generators	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	840
1PA1375	Install Mechanical and Electrical at Plant	420
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Plant	7
1PA1575	Test Pumps, Generators and Plant Systems	120
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping/Generating Plant Complete	0
Tunnel - 1,000 cfs		
HAMT	Hammock - Tunnel	794*
1T12100	Tunnel Submittals, Review & Approve	90
1T12125	Mobilize for Tunnel Work	30



Start Date 01FEB16
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Data Date 01FEB16
Run Date 31MAR09 13:59

Early Bar
Progress Bar
Critical Activity

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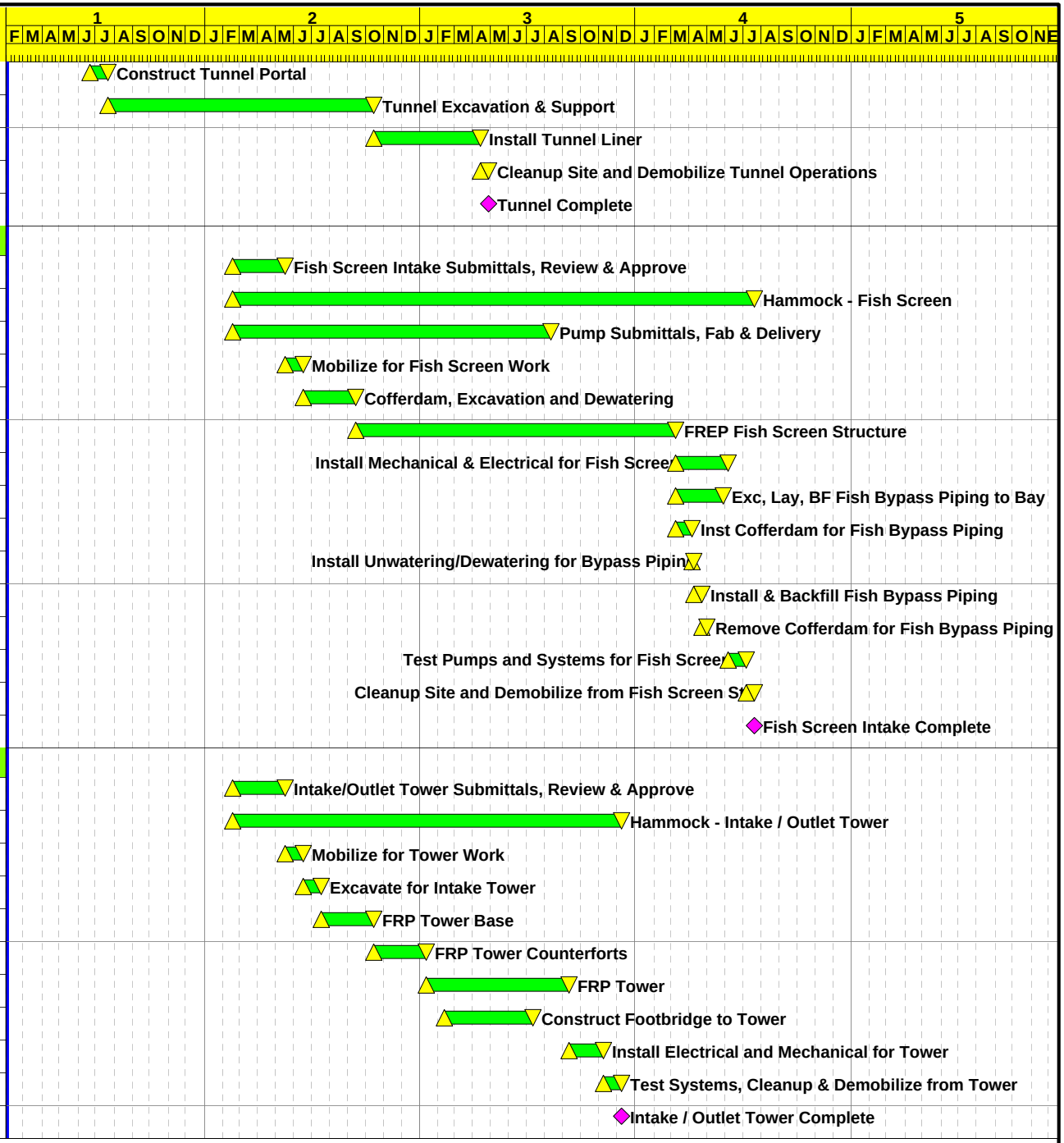
LL2C

Sheet 1 of 3

Alternative No. 2, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 2C - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	450
1T12200	Install Tunnel Liner	180
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 1,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen	884*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	90
1F15175	FREP Fish Screen Structure	540
1F15250	Install Mechanical & Electrical for Fish Screen	90
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 1,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake / Outlet Tower	660*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	90
1T14100	FRP Tower Counterforts	90
1T14125	FRP Tower	240
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0



Start Date 01FEB16
Finish Date 23OCT20
Data Date 01FEB16
Run Date 31MAR09 13:59

Early Bar
Progress Bar
Critical Activity

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LL2C

Sheet 2 of 3

Alternative No. 2, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 2C - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	14
1CL6120	Clear, Grub & Grade Long Lake for Liner	315
1CL6140	Place Compacted Clay Liner at Long Lake	1,000
1CL6160	Place Riprap Bedding & Riprap at Long Lake	770
Long Lake Saddle Dam		
1SD8000	Clear & Grub for Saddle Dam at Long Lake	7
1SD8025	Strip Site for Saddle Dam at Long Lake	5
1SD8050	Excavate for Saddle Dam Foundation at Long Lake	21
1SD8075	Foundation Approval - Saddle Dam at Long Lake	2
1SD8100	Place Zones 1 thru 4 for Saddle Dam at Long Lake	84
1SD8125	Place Bedding and Riprap for Saddle Dam at LL	21
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	6
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date 01FEB16
Finish Date 23OCT20
Data Date 01FEB16
Run Date 31MAR09 13:59

Early Bar
Progress Bar
Critical Activity

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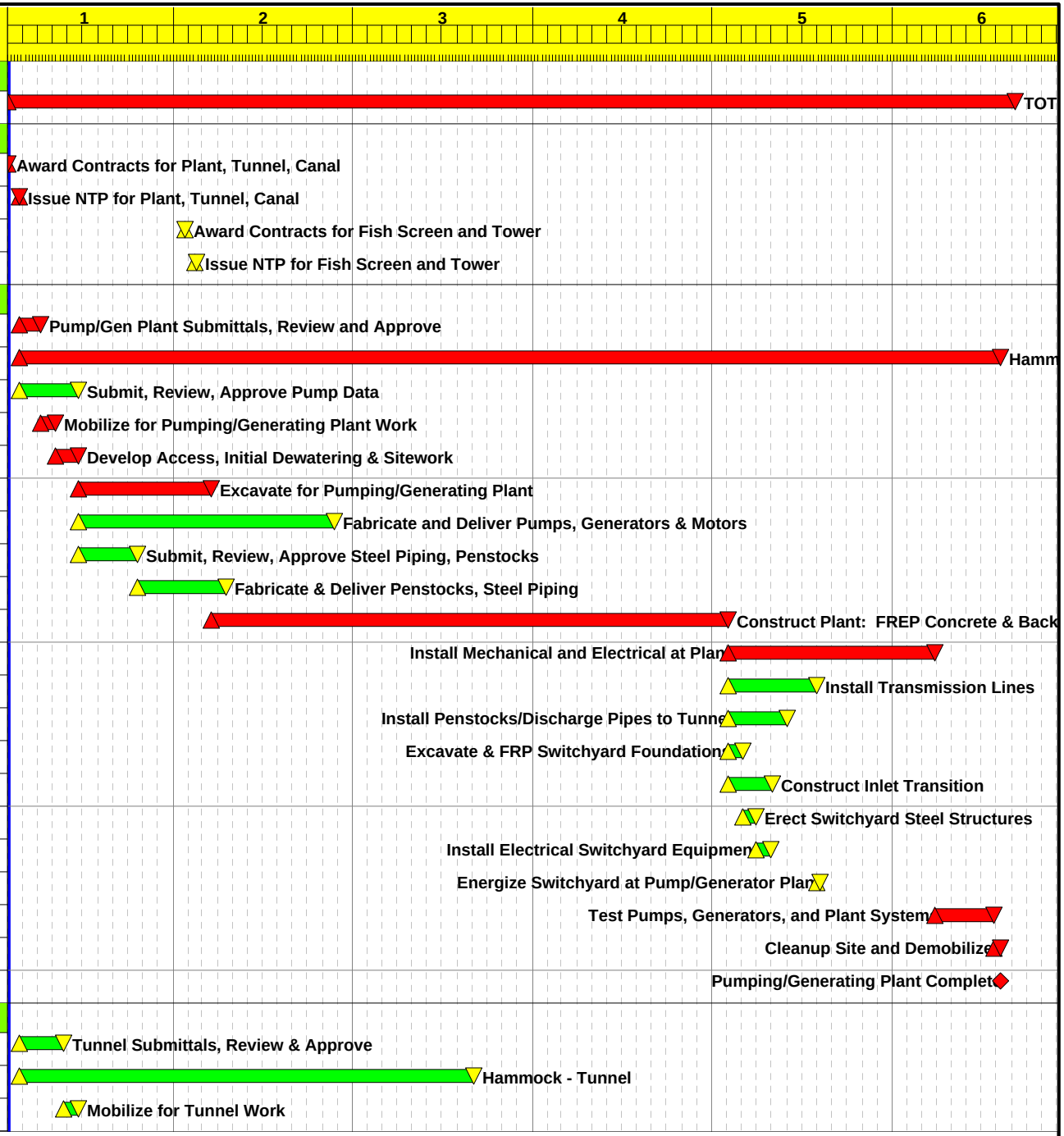
LL2C

Sheet 3 of 3

Alternative No. 2, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 2C - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	TOTAL PROJECT DURATION - NTP TO	2,047*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping and Generating Plant - 2,000 cfs		
1PA1100	Pump/Gen Plant Submittals, Review and Approve	45
HAMPP	Hammock - Pumping Plant	1,994*
1PA1125	Submit, Review, Approve Pump Data	120
1PA1150	Mobilize for Pumping/Generating Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping/Generating Plant	270
1PA1225	Fabricate and Deliver Pumps, Generators & Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	1,050
1PA1375	Install Mechanical and Electrical at Plant	420
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pump/Generator Plant	7
1PA1575	Test Pumps, Generators, and Plant Systems	120
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping/Generating Plant Complete	0
Tunnel - 2,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	924*
1T12125	Mobilize for Tunnel Work	30



Start Date 01FEB16
Finish Date 08SEP21
Data Date 01FEB16
Run Date 31MAR09 13:55

Early Bar
Progress Bar
Critical Activity

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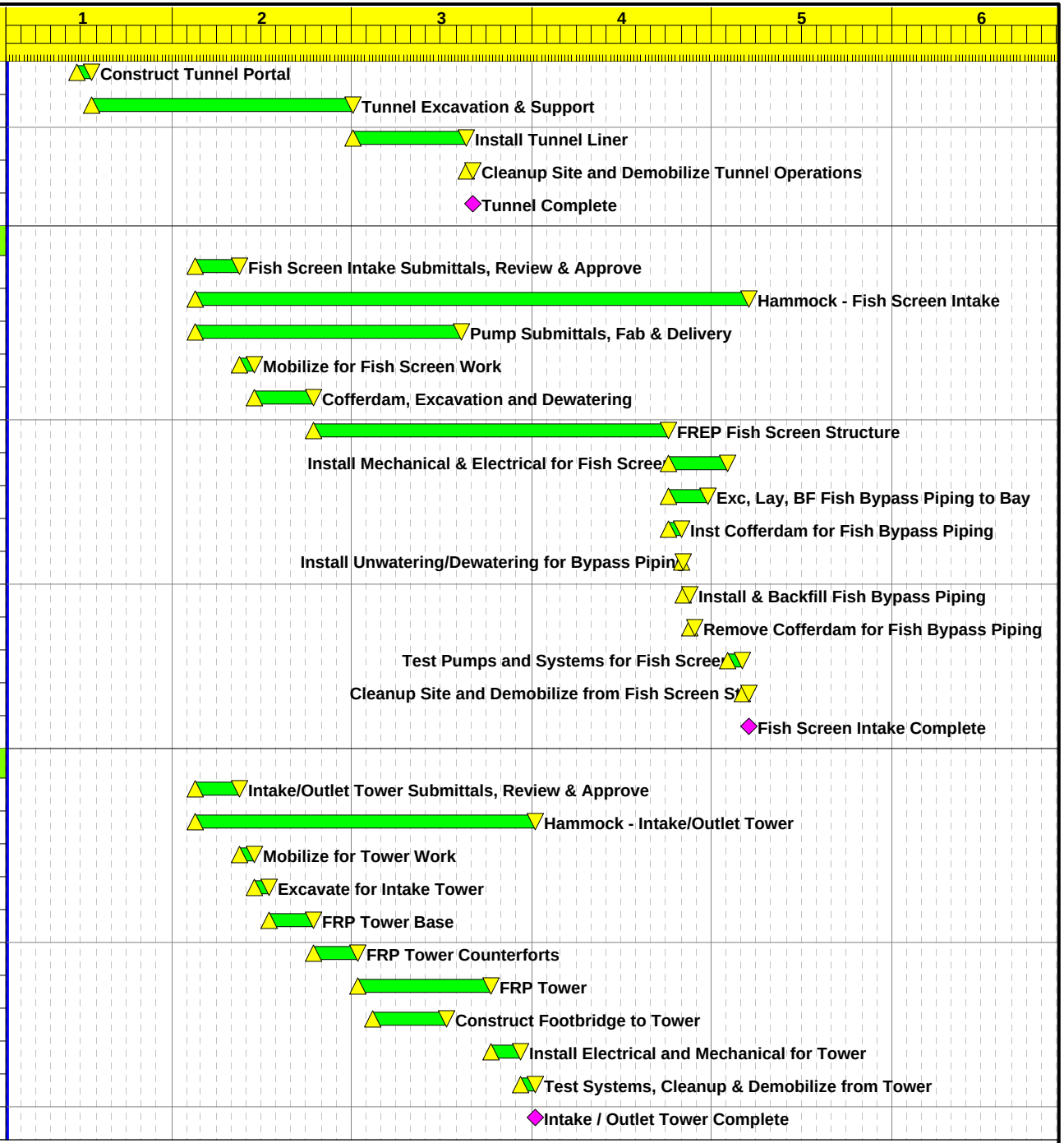
LL2D

Sheet 1 of 3

Alternative No. 2, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 2D - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	530
1T12200	Install Tunnel Liner	230
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 2,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	1,124*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	120
1F15175	FREP Fish Screen Structure	720
1F15250	Install Mechanical & Electrical for Fish Screen	120
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 2,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	690*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	90
1T14100	FRP Tower Counterforts	90
1T14125	FRP Tower	270
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0



Start Date 01FEB16
Finish Date 08SEP21
Data Date 01FEB16
Run Date 31MAR09 13:55

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Progress Bar
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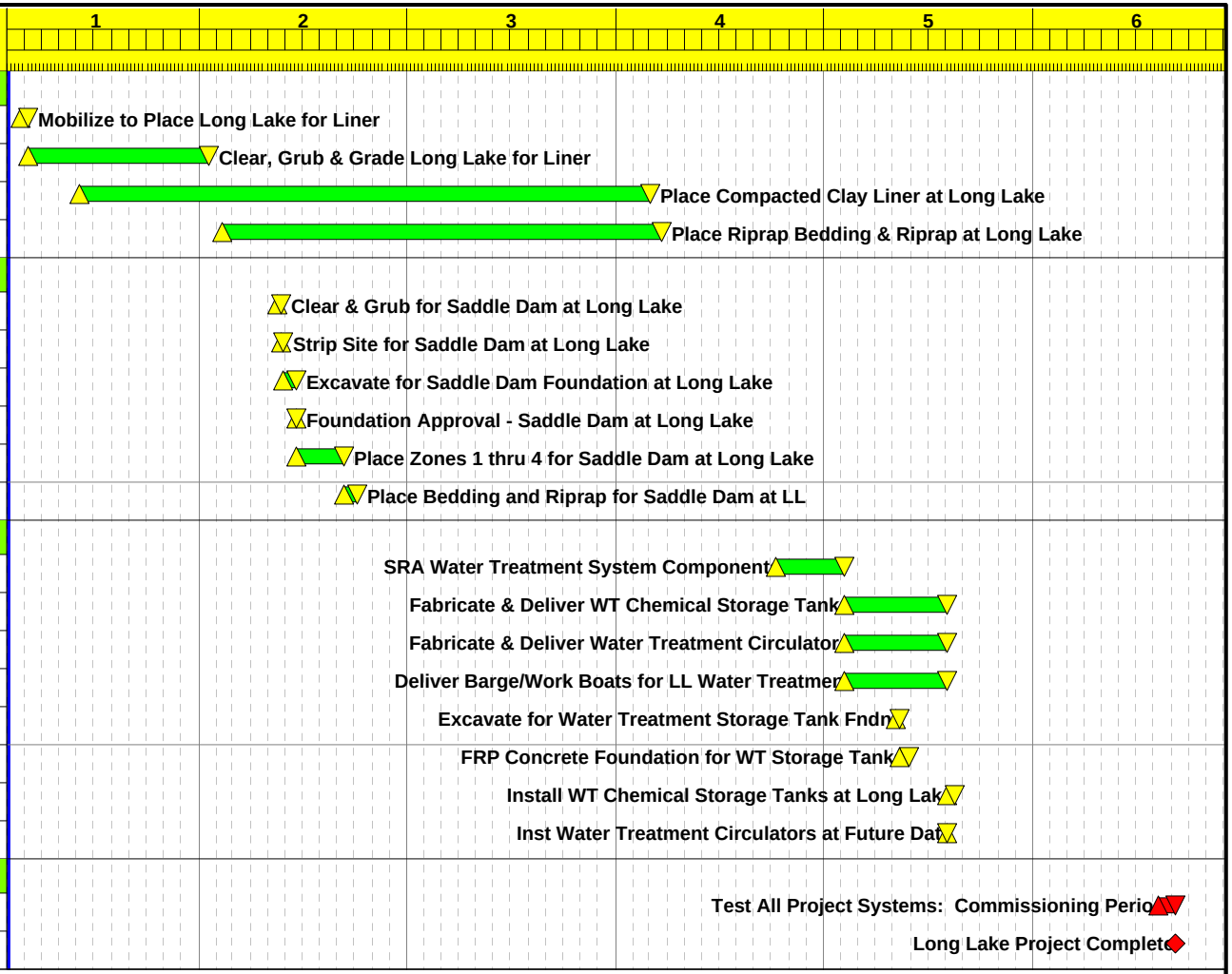
LL2D

Alternative No. 2, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 2D - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	14
1CL6120	Clear, Grub & Grade Long Lake for Liner	315
1CL6140	Place Compacted Clay Liner at Long Lake	1,000
1CL6160	Place Riprap Bedding & Riprap at Long Lake	770
Long Lake Saddle Dam		
1SD8000	Clear & Grub for Saddle Dam at Long Lake	7
1SD8025	Strip Site for Saddle Dam at Long Lake	5
1SD8050	Excavate for Saddle Dam Foundation at Long Lake	21
1SD8075	Foundation Approval - Saddle Dam at Long Lake	2
1SD8100	Place Zones 1 thru 4 for Saddle Dam at Long Lake	84
1SD8125	Place Bedding and Riprap for Saddle Dam at LL	21
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	6
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date 01FEB16
Finish Date 08SEP21
Data Date 01FEB16
Run Date 31MAR09 13:55

Early Bar
Progress Bar
Critical Activity

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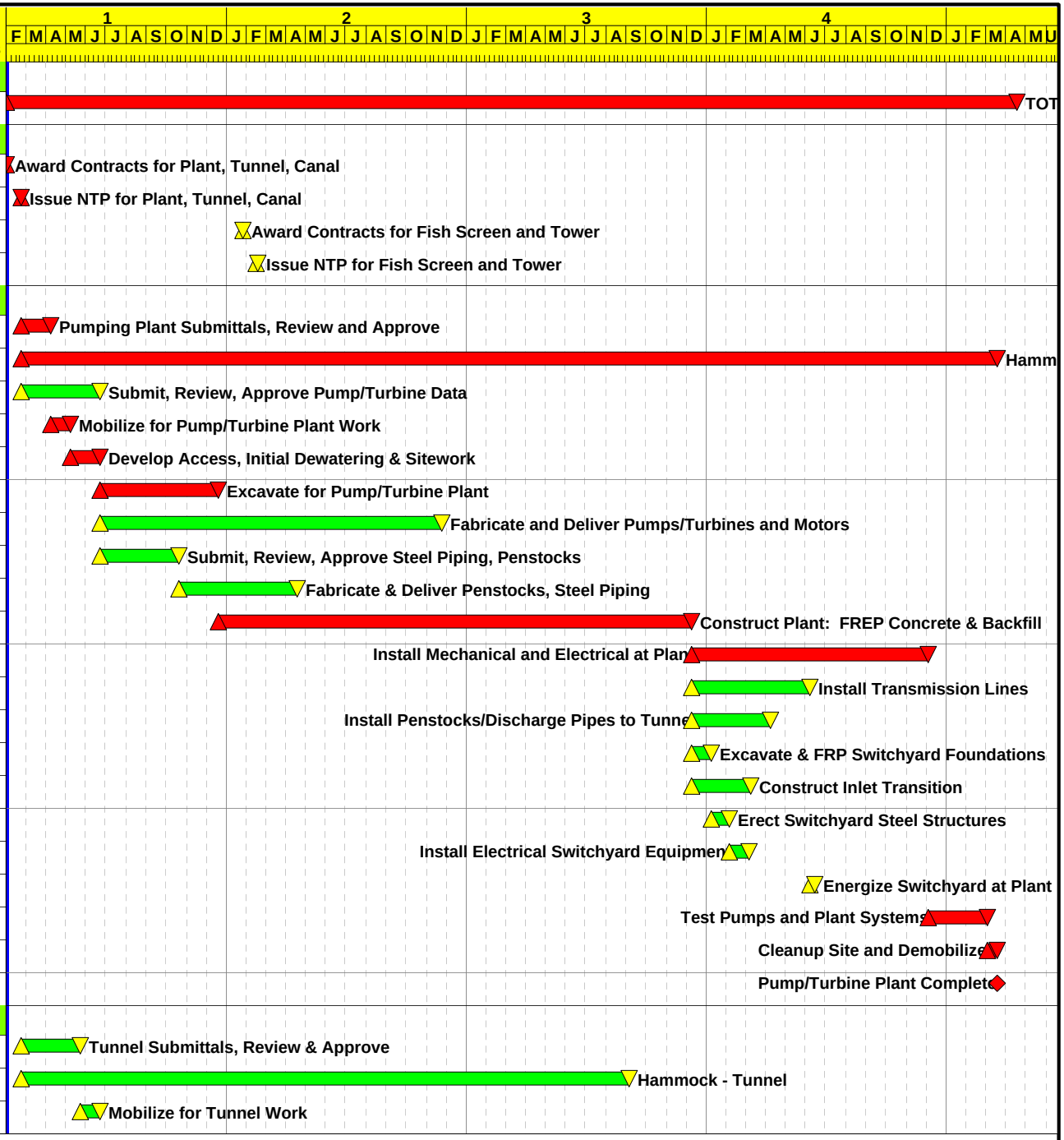
LL2D

Sheet 3 of 3

Alternative No. 2, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 2D - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	TOTAL PROJECT DURATION - NTP TO COMPLETION	1,537*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pump/Turbine Plant - 2,000 cfs		
1PA1100	Pumping Plant Submittals, Review and Approve	45
HAMPP	Hammock - Pumping Plant	1,484*
1PA1125	Submit, Review, Approve Pump/Turbine Data	120
1PA1150	Mobilize for Pump/Turbine Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pump/Turbine Plant	180
1PA1225	Fabricate and Deliver Pumps/Turbines and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	720
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pump/Turbine Plant Complete	0
Tunnel - 2,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	924*
1T12125	Mobilize for Tunnel Work	30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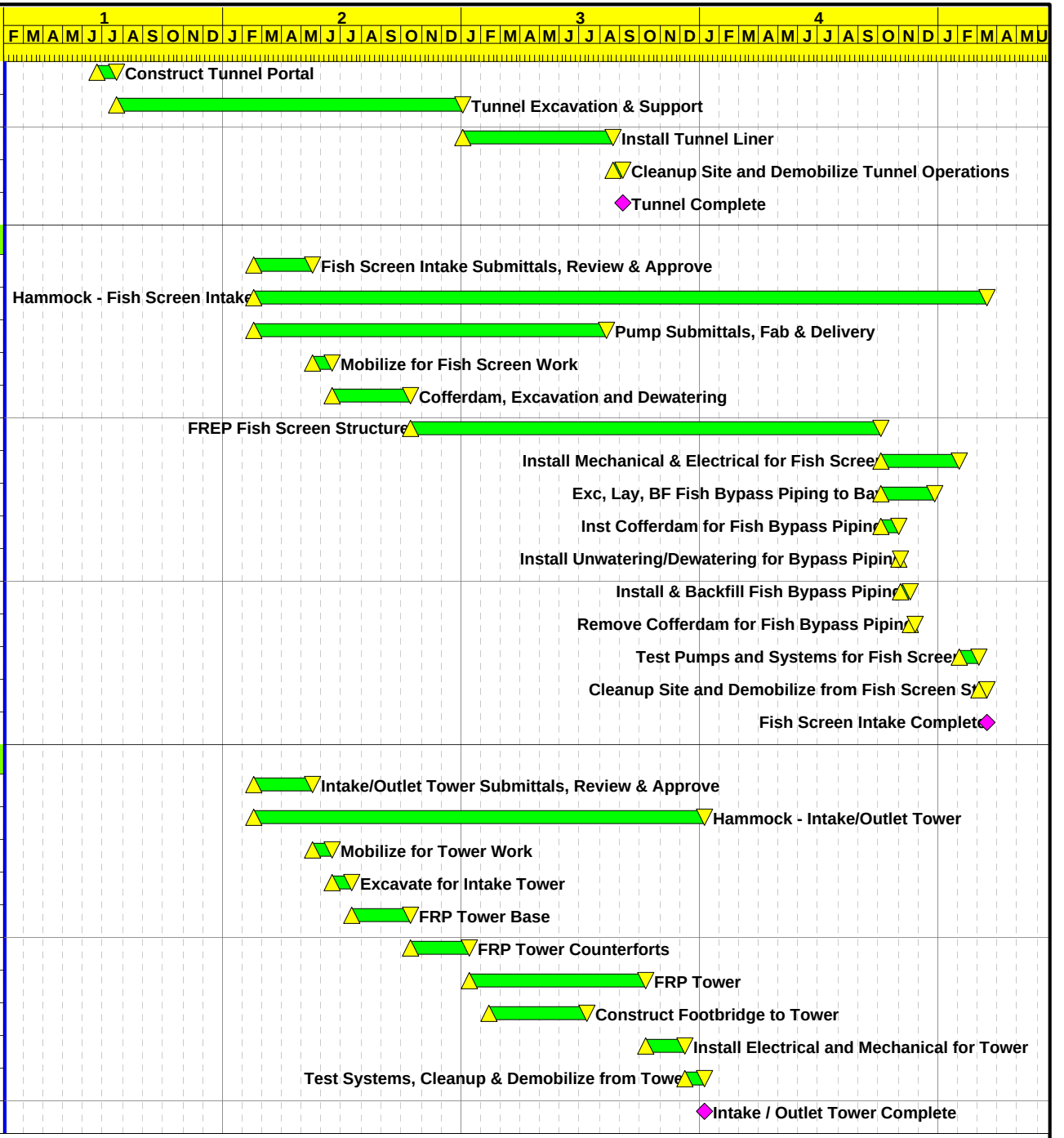
Activity ID	Activity Description	Duration Cal Days
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	530
1T12200	Install Tunnel Liner	230
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 2,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	1,124*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	120
1F15175	FREP Fish Screen Structure	720
1F15250	Install Mechanical & Electrical for Fish Screen	120
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 2,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	690*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	90
1T14100	FRP Tower Counterforts	90
1T14125	FRP Tower	270
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0



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Early Bar
Progress Bar
Critical Activity

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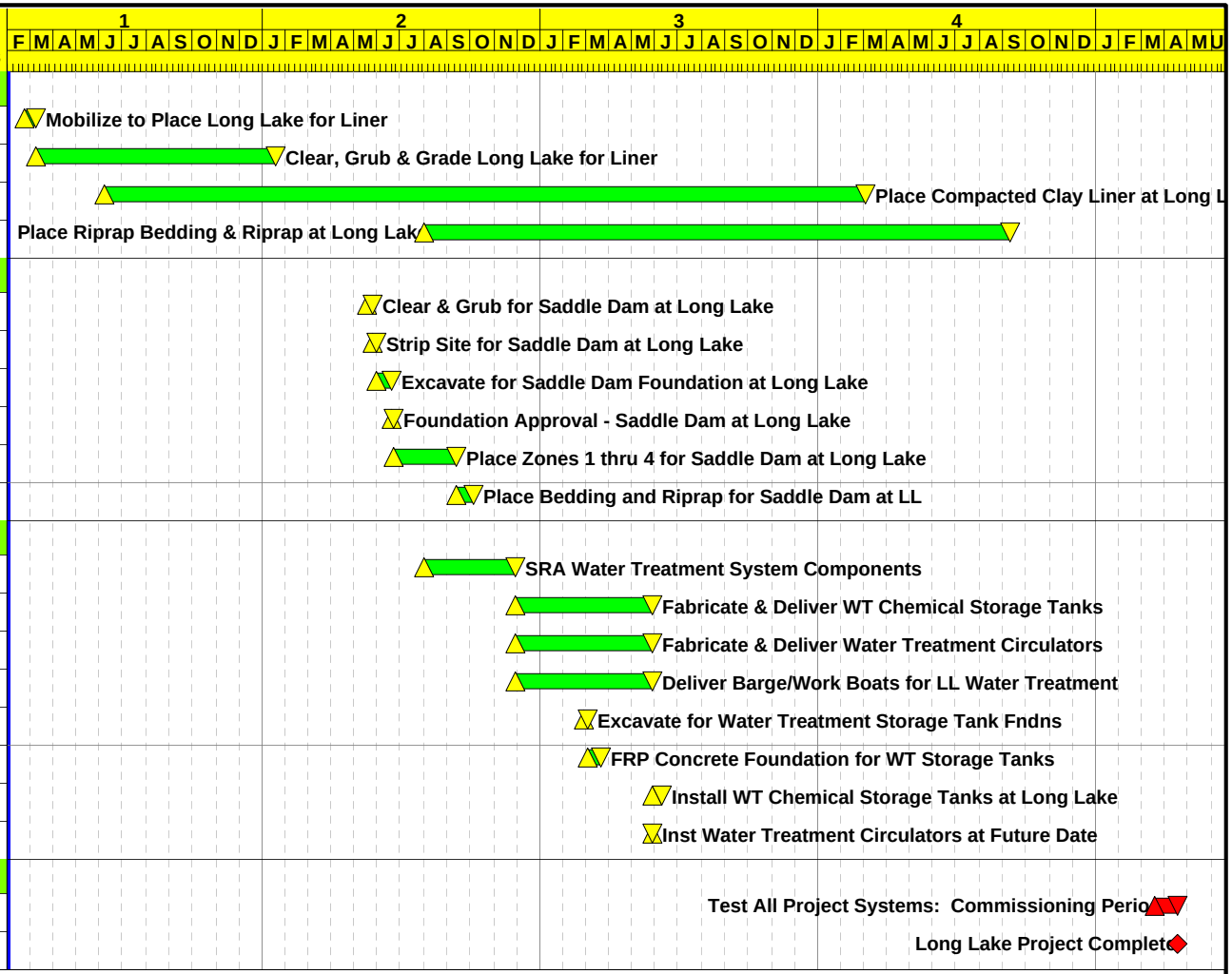
LL2E

Alternative No. 2, Option E
(2,000 cfs Pump/Turbine Plant)
Long Lake Valley - 2E - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	14
1CL6120	Clear, Grub & Grade Long Lake for Liner	315
1CL6140	Place Compacted Clay Liner at Long Lake	1,000
1CL6160	Place Riprap Bedding & Riprap at Long Lake	770
Long Lake Saddle Dam		
1SD8000	Clear & Grub for Saddle Dam at Long Lake	7
1SD8025	Strip Site for Saddle Dam at Long Lake	5
1SD8050	Excavate for Saddle Dam Foundation at Long Lake	21
1SD8075	Foundation Approval - Saddle Dam at Long Lake	2
1SD8100	Place Zones 1 thru 4 for Saddle Dam at Long Lake	84
1SD8125	Place Bedding and Riprap for Saddle Dam at LL	21
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	6
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



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Finish Date 16APR20
Data Date 01FEB16
Run Date 31MAR09 14:00

Early Bar
Progress Bar
Critical Activity

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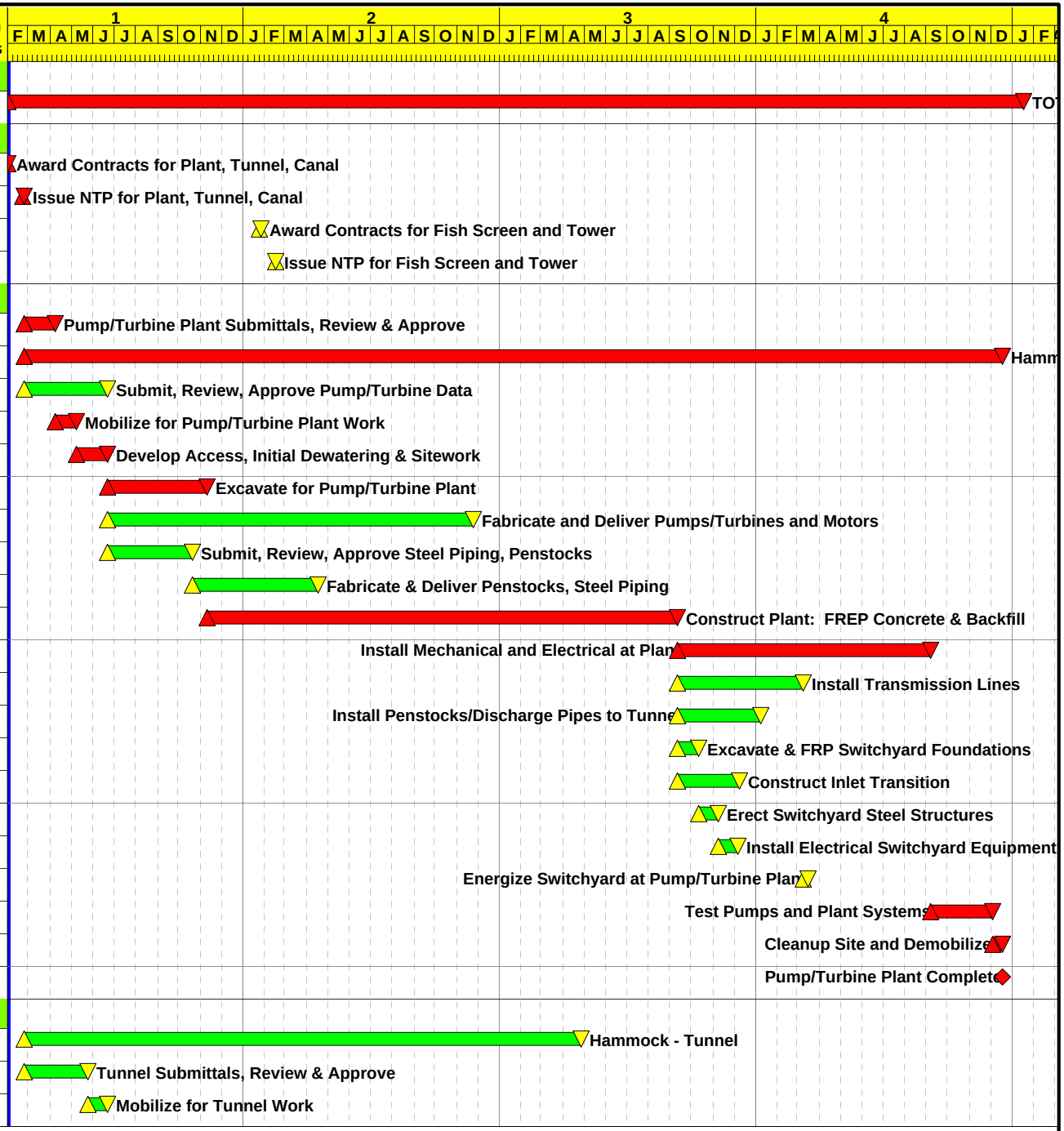
LL2E

Sheet 3 of 3

Alternative No. 2, Option E
(2,000 cfs Pump/Turbine Plant)
Long Lake Valley - 2E - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	TOTAL PROJECT DURATION - NTP TO	1,447*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pump/Turbine Plant - 1,000 cfs		
1PA1100	Pump/Turbine Plant Submittals, Review & Approve	45
HAMPP	Hammock - Pumping Plant, Switchyard & Penstocks	1,394*
1PA1125	Submit, Review, Approve Pump/Turbine Data	120
1PA1150	Mobilize for Pump/Turbine Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pump/Turbine Plant	140
1PA1225	Fabricate and Deliver Pumps/Turbines and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	670
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pump/Turbine Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pump/Turbine Plant Complete	0
Tunnel - 1,000 cfs		
HAMT	Hammock - Tunnel	794*
1T12100	Tunnel Submittals, Review & Approve	90
1T12125	Mobilize for Tunnel Work	30



Start Date 01FEB16
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Data Date 01FEB16
Run Date 31MAR09 14:03

Early Bar
Progress Bar
Critical Activity

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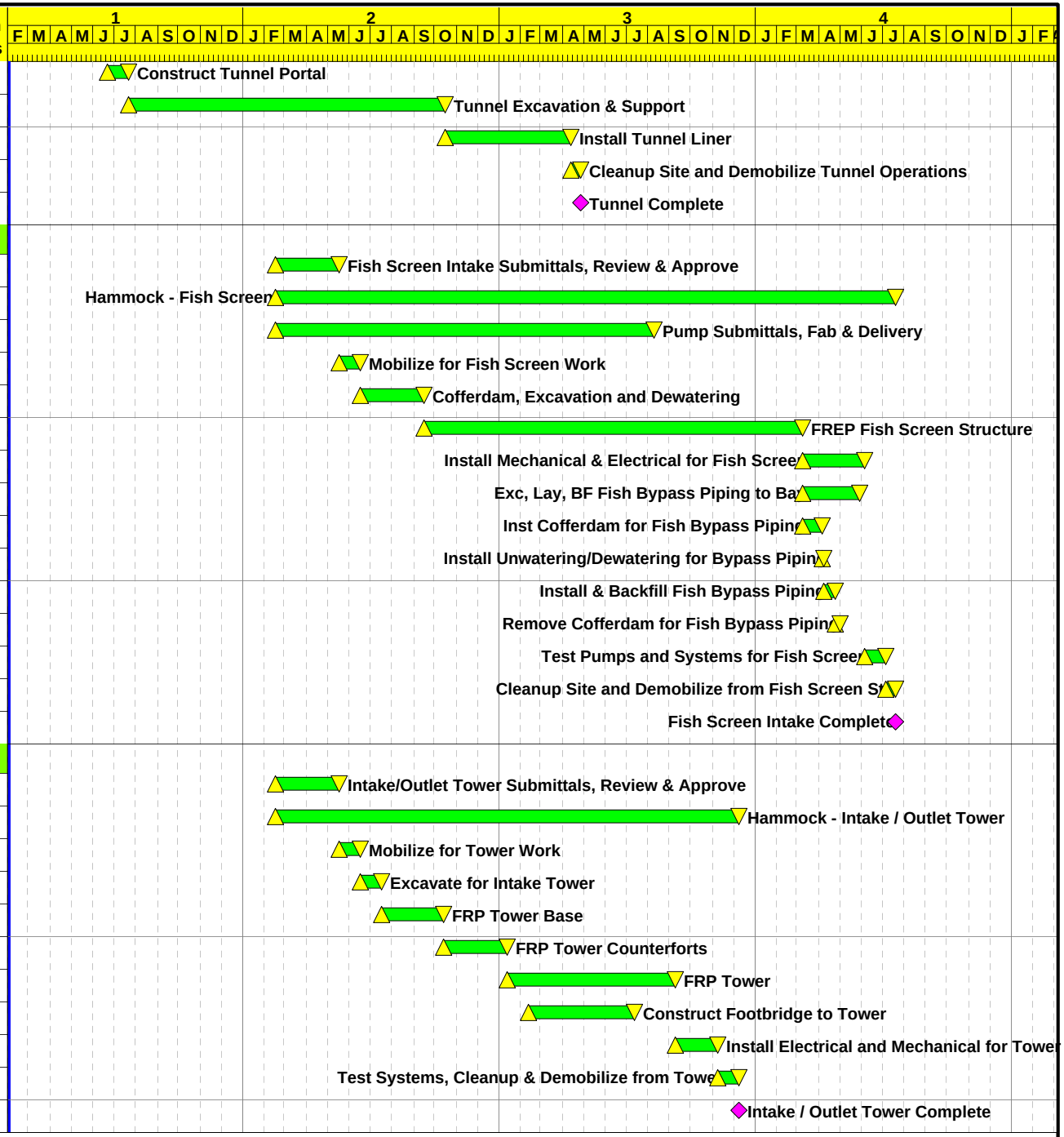
LL2F

Alternative No. 1, Option F
(1,000 cfs Pump/Turbine Plant)
Long Lake Valley - 2F - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	450
1T12200	Install Tunnel Liner	180
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 1,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen	884*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	90
1F15175	FREP Fish Screen Structure	540
1F15250	Install Mechanical & Electrical for Fish Screen	90
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 1,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake / Outlet Tower	660*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	90
1T14100	FRP Tower Counterforts	90
1T14125	FRP Tower	240
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0



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Early Bar
Progress Bar
Critical Activity

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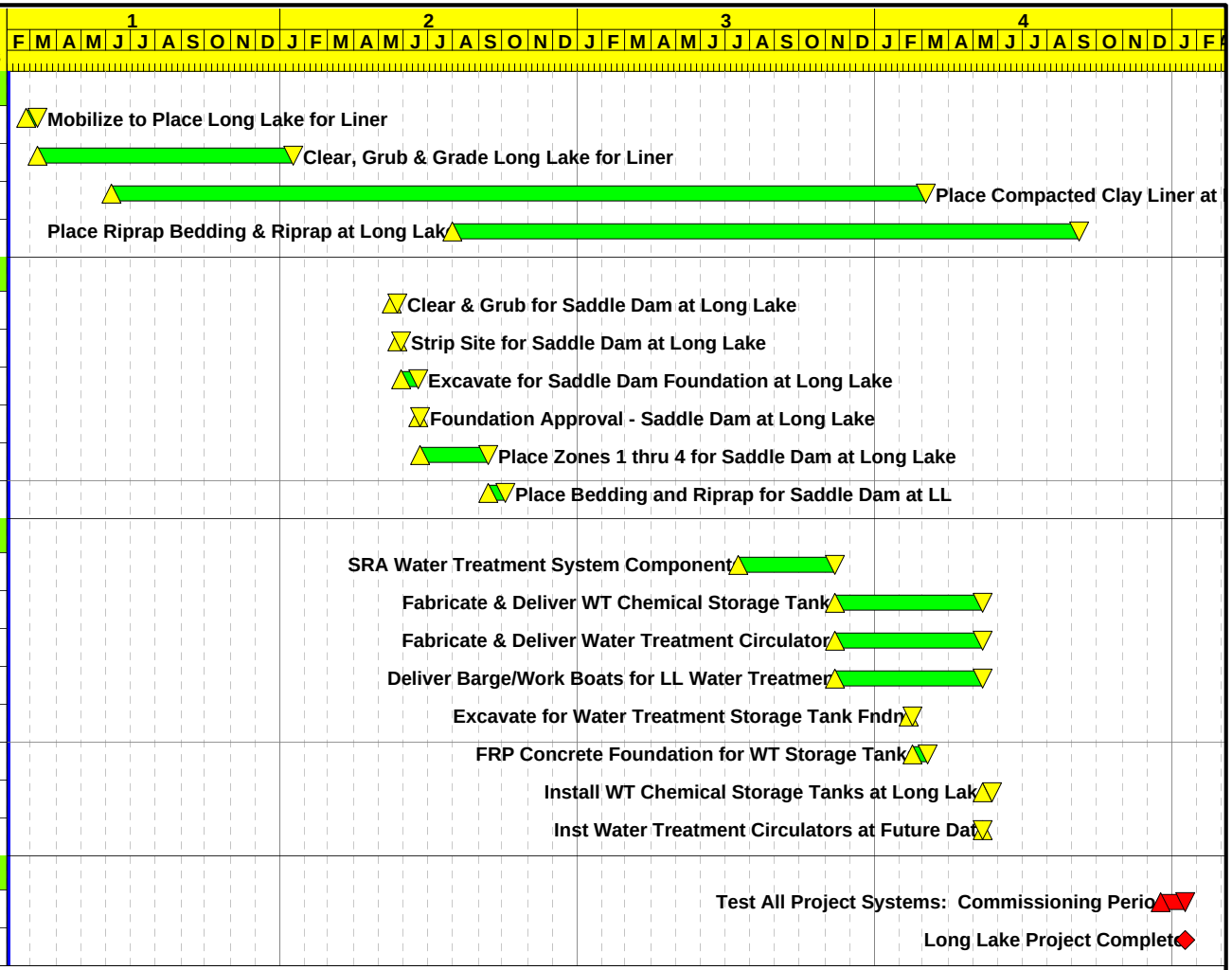
LL2F

Sheet 2 of 3

Alternative No. 1, Option F
(1,000 cfs Pump/Turbine Plant)
Long Lake Valley - 2F - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	14
1CL6120	Clear, Grub & Grade Long Lake for Liner	315
1CL6140	Place Compacted Clay Liner at Long Lake	1,000
1CL6160	Place Riprap Bedding & Riprap at Long Lake	770
Long Lake Saddle Dam		
1SD8000	Clear & Grub for Saddle Dam at Long Lake	7
1SD8025	Strip Site for Saddle Dam at Long Lake	5
1SD8050	Excavate for Saddle Dam Foundation at Long Lake	21
1SD8075	Foundation Approval - Saddle Dam at Long Lake	2
1SD8100	Place Zones 1 thru 4 for Saddle Dam at Long Lake	84
1SD8125	Place Bedding and Riprap for Saddle Dam at LL	21
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	5
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



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Data Date 01FEB16
Run Date 31MAR09 14:03

Early Bar
Progress Bar
Critical Activity

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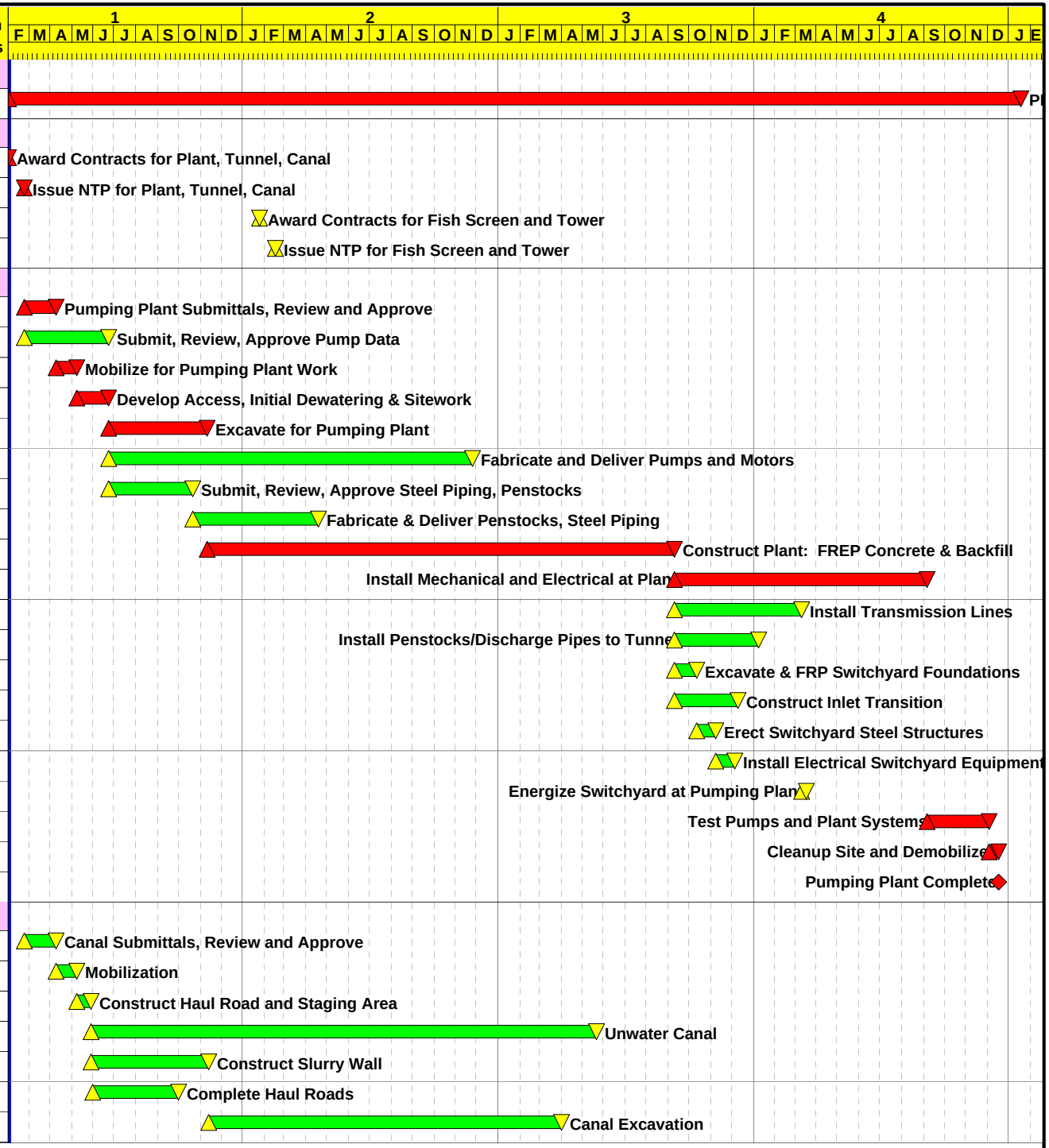
LL2F

Alternative No. 1, Option F
(1,000 cfs Pump/Turbine Plant)
Long Lake Valley - 2F - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	1,447*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping Plant - 1,000 cfs		
1PA1100	Pumping Plant Submittals, Review and Approve	45
1PA1125	Submit, Review, Approve Pump Data	120
1PA1150	Mobilize for Pumping Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping Plant	140
1PA1225	Fabricate and Deliver Pumps and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	670
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pumping Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping Plant Complete	0
Canal - 1,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Unwater Canal	509*
1C13150	Construct Slurry Wall	167
1C13075	Complete Haul Roads	87
1C13175	Canal Excavation	292



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Early Bar
Progress Bar
Critical Activity

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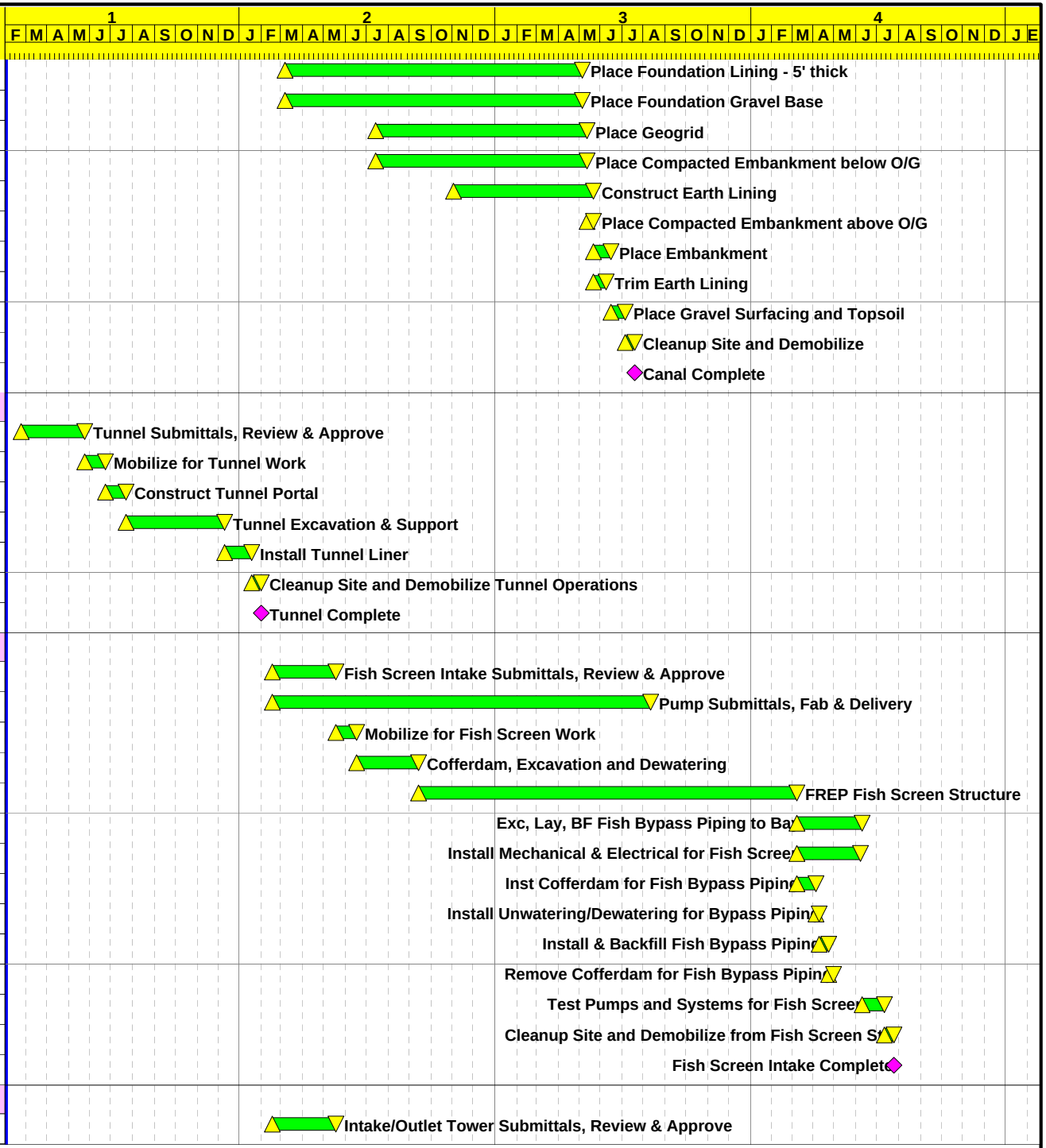
LL3A

Alternative No. 3, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 3A - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assumed 3.5 months of weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
1C13200	Place Foundation Lining - 5' thick	319
1C13225	Place Foundation Gravel Base	319*
1C13250	Place Geogrid	196*
1C13275	Place Compacted Embankment below O/G	196
1C13300	Construct Earth Lining	93
1C13325	Place Compacted Embankment above O/G	9
1C13350	Place Embankment	27
1C13375	Trim Earth Lining	18
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 1,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	140
1T12200	Install Tunnel Liner	40
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 1,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	90
1F15175	FREP Fish Screen Structure	540
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	94
1F15250	Install Mechanical & Electrical for Fish Screen	90
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 1,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90



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Run Date 27MAR09 15:05

Early Bar
Progress Bar
Critical Activity

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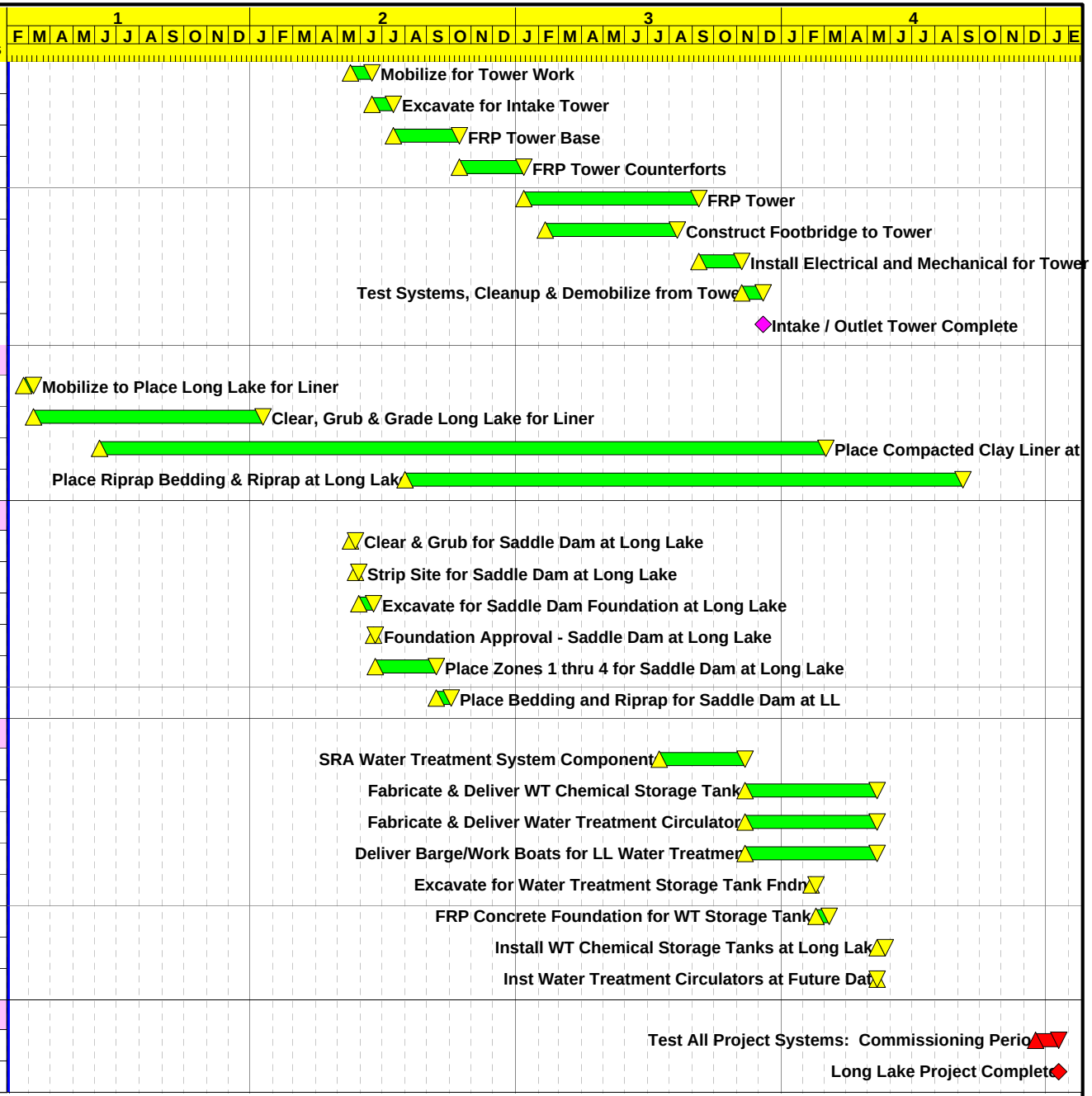
LL3A

Alternative No. 3, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 3A - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assumed 3.5 months of weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	90
1T14100	FRP Tower Counterforts	90
1T14125	FRP Tower	240
1T14150	Construct Footbridge to Tower	180
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	14
1CL6120	Clear, Grub & Grade Long Lake for Liner	315
1CL6140	Place Compacted Clay Liner at Long Lake	1,000
1CL6160	Place Riprap Bedding & Riprap at Long Lake	770
Long Lake Saddle Dam		
1SD8000	Clear & Grub for Saddle Dam at Long Lake	7
1SD8025	Strip Site for Saddle Dam at Long Lake	5
1SD8050	Excavate for Saddle Dam Foundation at Long Lake	21
1SD8075	Foundation Approval - Saddle Dam at Long Lake	2
1SD8100	Place Zones 1 thru 4 for Saddle Dam at Long Lake	84
1SD8125	Place Bedding and Riprap for Saddle Dam at LL	21
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	6
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



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Run Date 27MAR09 15:05

Early Bar
Progress Bar
Critical Activity

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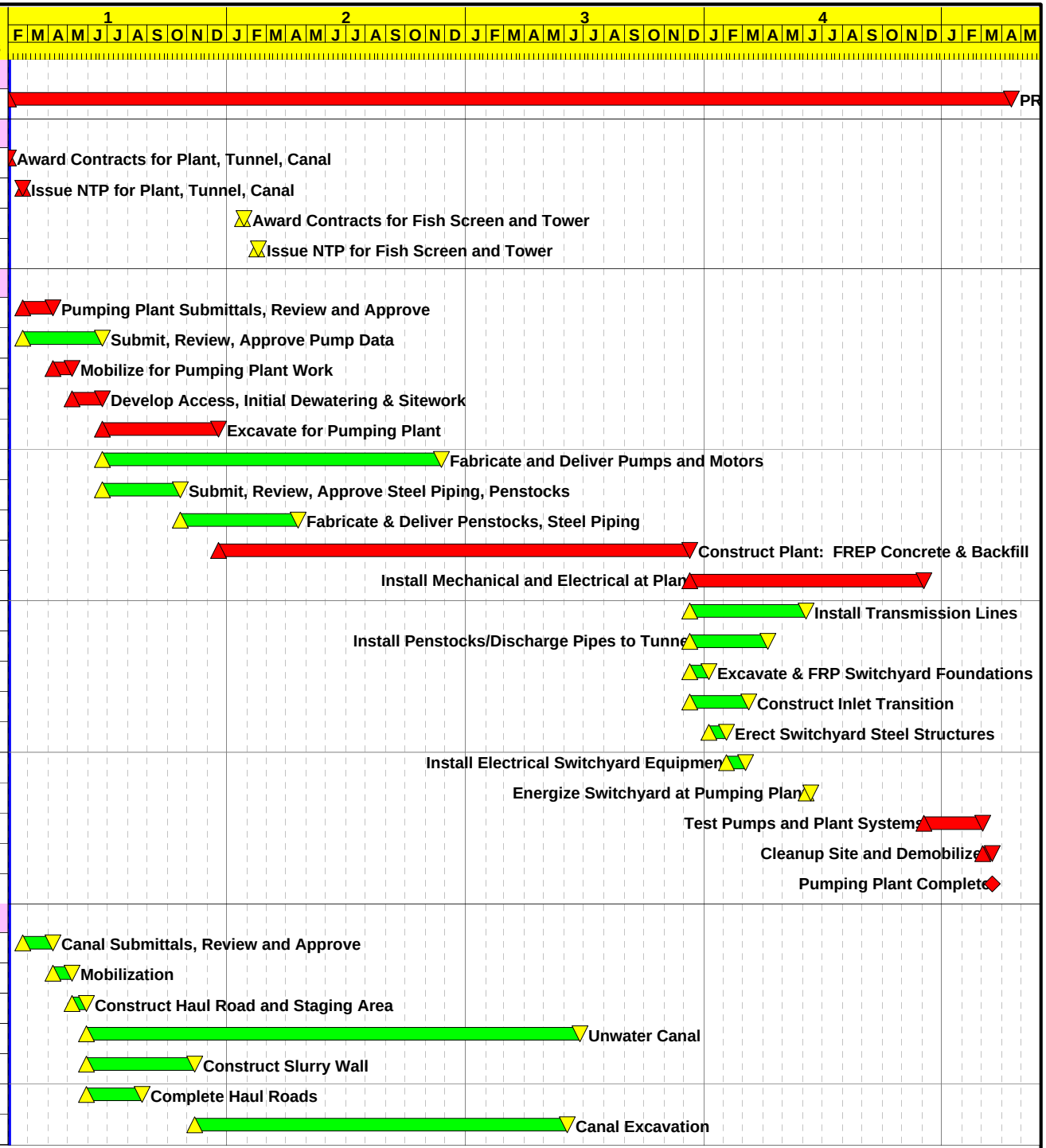
LL3A

Alternative No. 3, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 3A - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assumed 3.5 months of weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	1,537*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping Plant - 2,000 cfs		
1PA1100	Pumping Plant Submittals, Review and Approve	45
1PA1125	Submit, Review, Approve Pump Data	120
1PA1150	Mobilize for Pumping Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping Plant	180
1PA1225	Fabricate and Deliver Pumps and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	720
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pumping Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping Plant Complete	0
Canal - 2,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Unwater Canal	545*
1C13150	Construct Slurry Wall	167
1C13075	Complete Haul Roads	87
1C13175	Canal Excavation	359



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Early Bar
Progress Bar
Critical Activity

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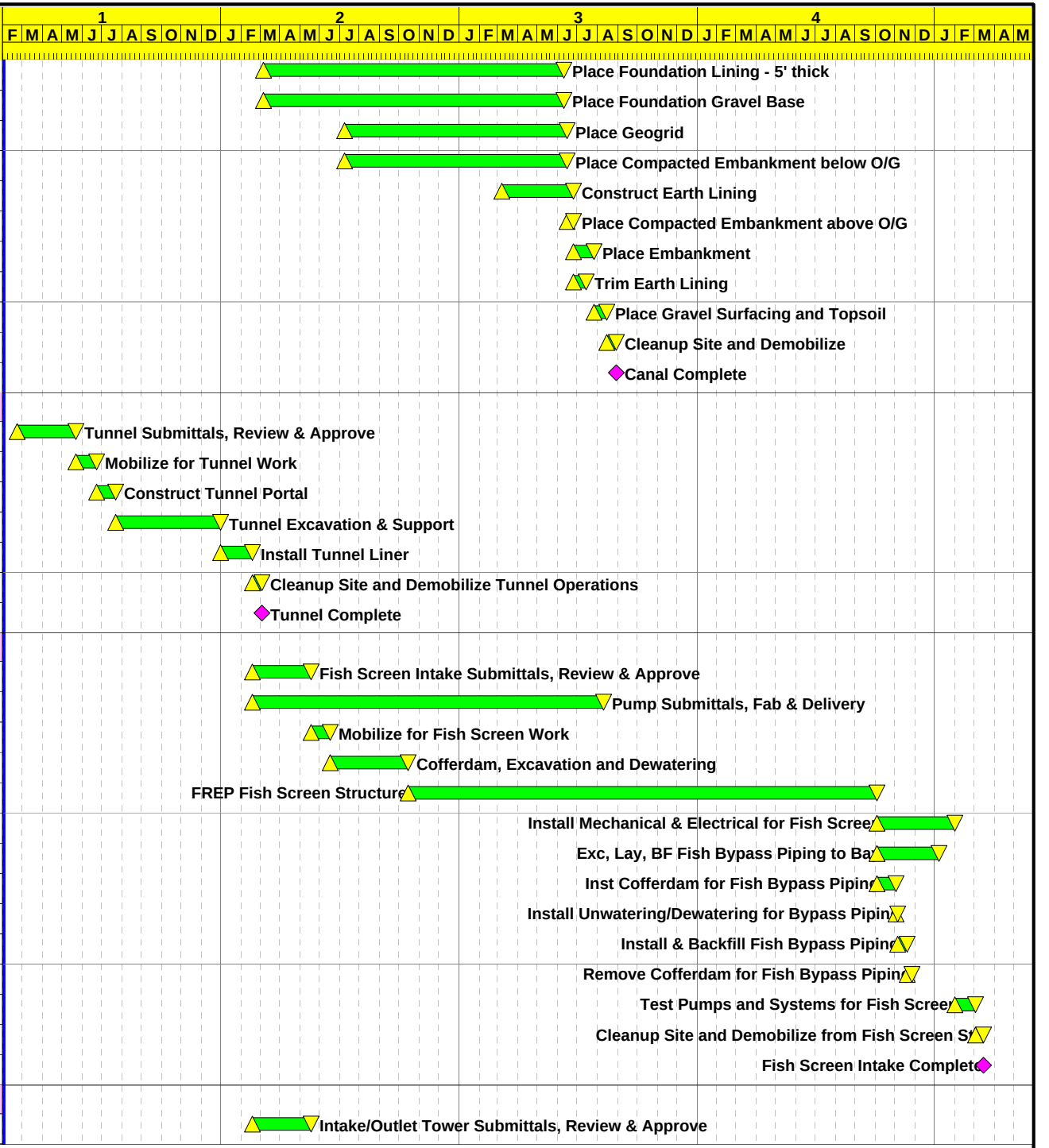
LL3B

Alternative No. 3, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 3B - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
1C13200	Place Foundation Lining - 5' thick	355
1C13225	Place Foundation Gravel Base	355*
1C13250	Place Geogrid	236*
1C13275	Place Compacted Embankment below O/G	236
1C13300	Construct Earth Lining	110
1C13325	Place Compacted Embankment above O/G	9
1C13350	Place Embankment	31
1C13375	Trim Earth Lining	18
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 2,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	160
1T12200	Install Tunnel Liner	50
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 2,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	120
1F15175	FREP Fish Screen Structure	720
1F15250	Install Mechanical & Electrical for Fish Screen	120
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	94
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 2,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90



Start Date 01FEB16
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Early Bar
Progress Bar
Critical Activity

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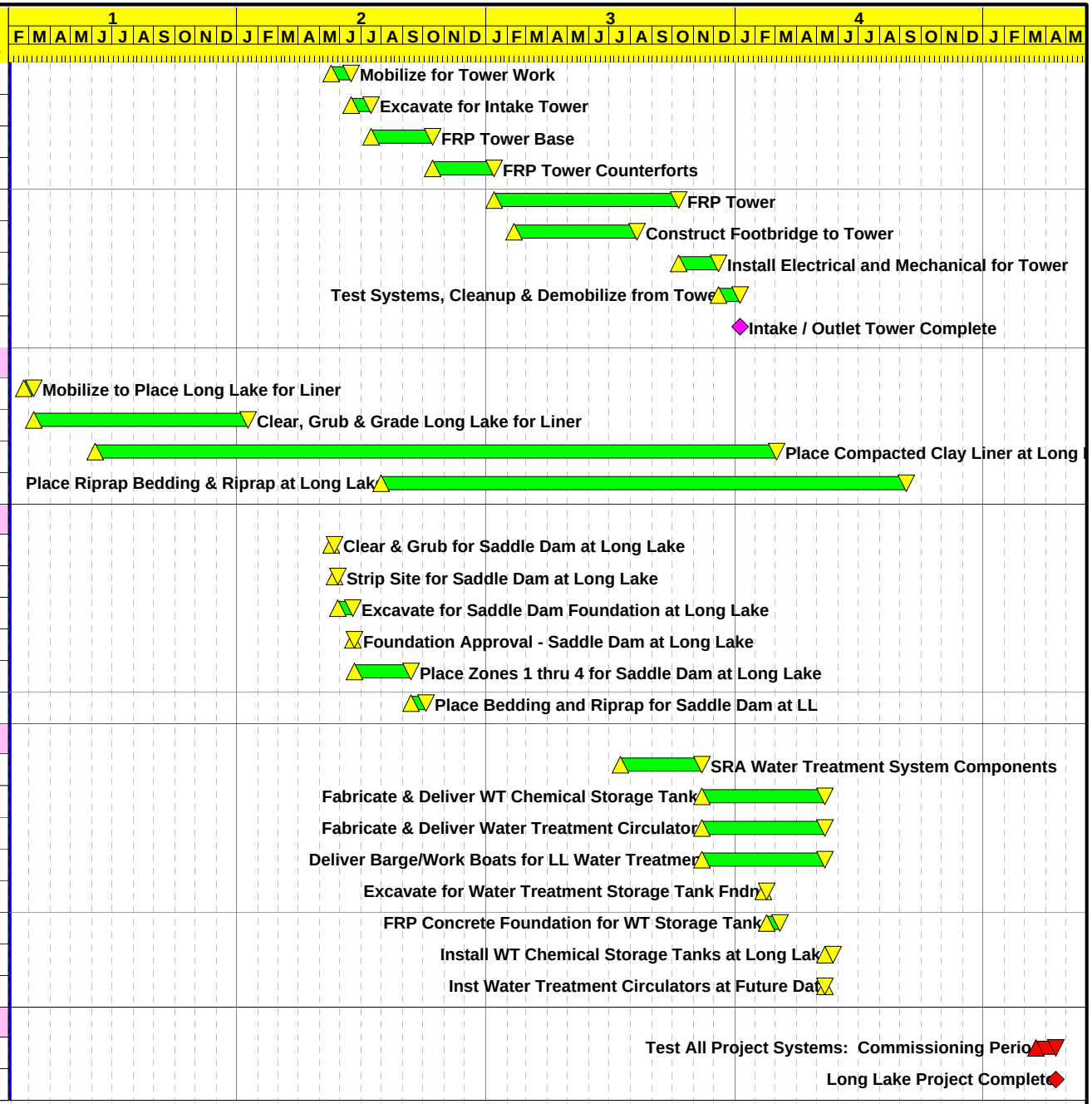
LL3B

Alternative No. 3, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 3B - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	90
1T14100	FRP Tower Counterforts	90
1T14125	FRP Tower	270
1T14150	Construct Footbridge to Tower	180
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	14
1CL6120	Clear, Grub & Grade Long Lake for Liner	315
1CL6140	Place Compacted Clay Liner at Long Lake	1,000
1CL6160	Place Riprap Bedding & Riprap at Long Lake	770
Long Lake Saddle Dam		
1SD8000	Clear & Grub for Saddle Dam at Long Lake	7
1SD8025	Strip Site for Saddle Dam at Long Lake	5
1SD8050	Excavate for Saddle Dam Foundation at Long Lake	21
1SD8075	Foundation Approval - Saddle Dam at Long Lake	2
1SD8100	Place Zones 1 thru 4 for Saddle Dam at Long Lake	84
1SD8125	Place Bedding and Riprap for Saddle Dam at LL	21
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	6
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



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Early Bar
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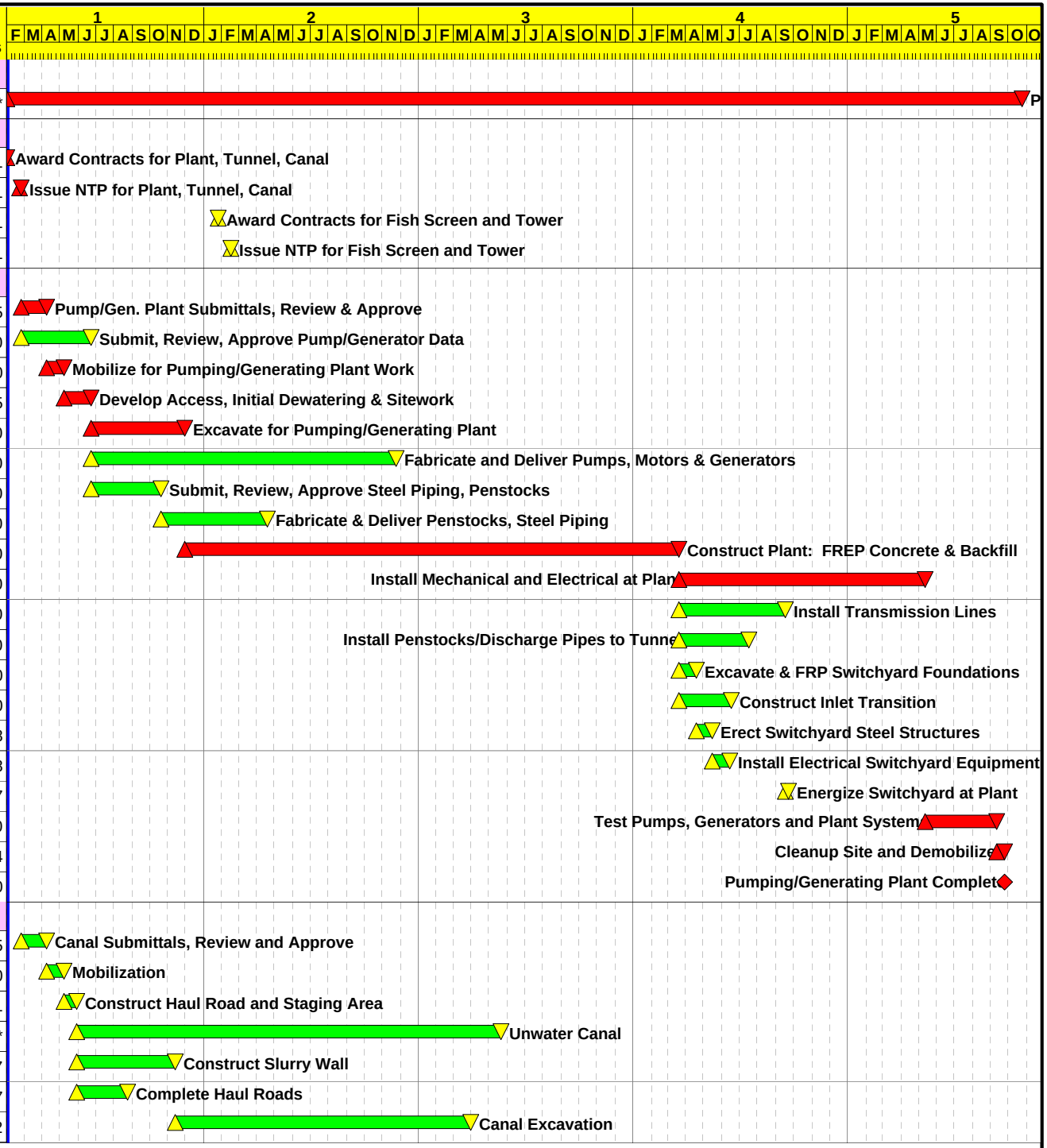
LL3B

Alternative No. 3, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 3B - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	1,727*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping and Generating Plant - 1,000 cfs		
1PA1100	Pump/Gen. Plant Submittals, Review & Approve	45
1PA1125	Submit, Review, Approve Pump/Generator Data	120
1PA1150	Mobilize for Pumping/Generating Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping/Generating Plant	160
1PA1225	Fabricate and Deliver Pumps, Motors & Generators	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	840
1PA1375	Install Mechanical and Electrical at Plant	420
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Plant	7
1PA1575	Test Pumps, Generators and Plant Systems	120
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping/Generating Plant Complete	0
Canal - 1,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Unwater Canal	509*
1C13150	Construct Slurry Wall	167
1C13075	Complete Haul Roads	87
1C13175	Canal Excavation	292



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Run Date 27MAR09 14:44

Early Bar
Progress Bar
Critical Activity

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LL3C

Alternative No. 3, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 3C - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	Note: Assume 3.5 months for weather impacts fo		
	canal work each year.		

Activity ID	Activity Description	Duration Cal Days
1C13200	Place Foundation Lining - 5' thick	319
1C13225	Place Foundation Gravel Base	319*
1C13250	Place Geogrid	196*
1C13275	Place Compacted Embankment below O/G	196
1C13300	Construct Earth Lining	93
1C13325	Place Compacted Embankment above O/G	9
1C13350	Place Embankment	27
1C13375	Trim Earth Lining	18
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 1,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	140
1T12200	Install Tunnel Liner	40
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 1,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	90
1F15175	FREP Fish Screen Structure	540
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	94
1F15250	Install Mechanical & Electrical for Fish Screen	90
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 1,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90



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Early Bar
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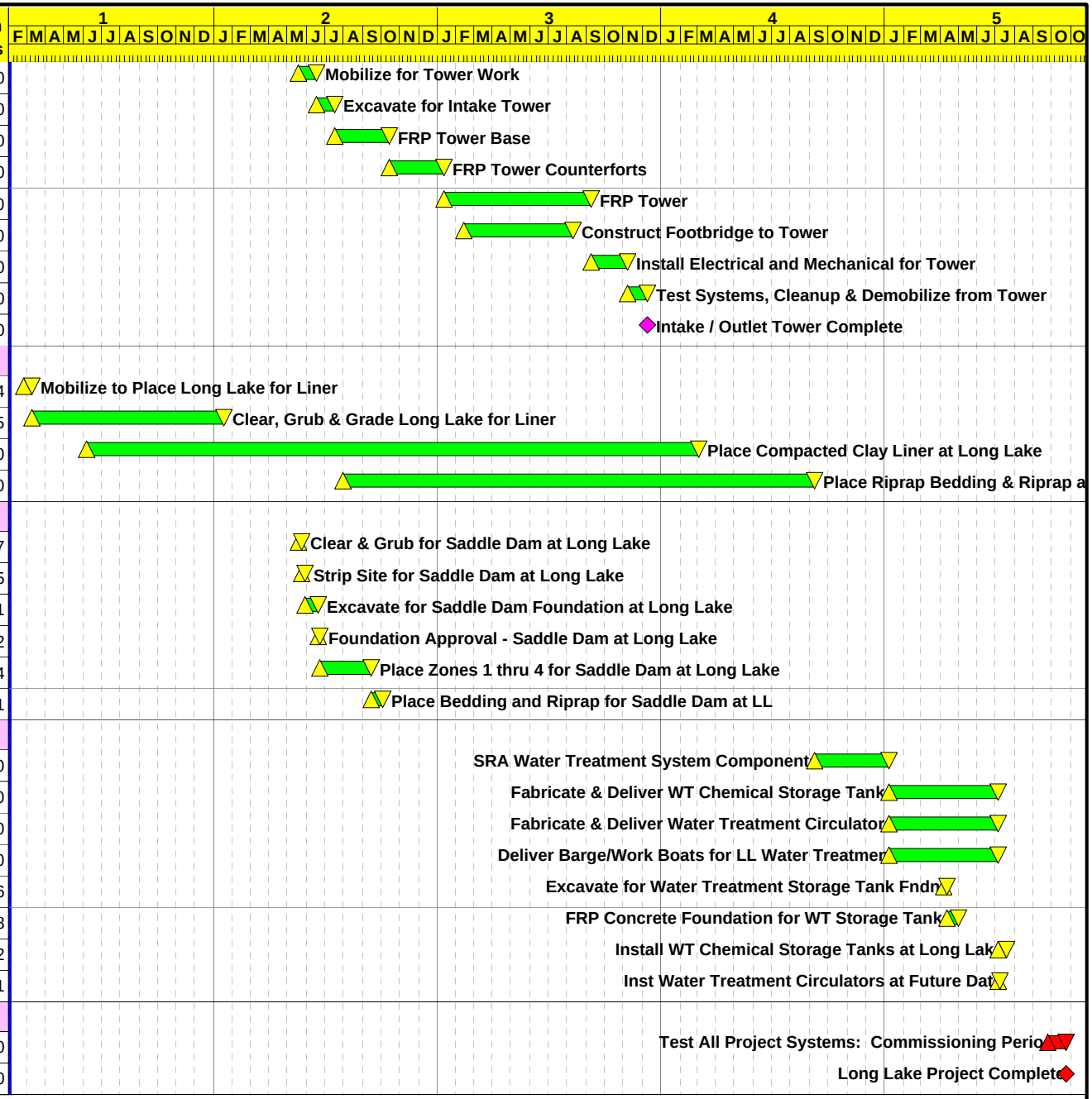
LL3C

Alternative No. 3, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 3C - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	Note: Assume 3.5 months for weather impacts fo		
	canal work each year.		

Activity ID	Activity Description	Duration Cal Days
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	90
1T14100	FRP Tower Counterforts	90
1T14125	FRP Tower	240
1T14150	Construct Footbridge to Tower	180
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	14
1CL6120	Clear, Grub & Grade Long Lake for Liner	315
1CL6140	Place Compacted Clay Liner at Long Lake	1,000
1CL6160	Place Riprap Bedding & Riprap at Long Lake	770
Long Lake Saddle Dam		
1SD8000	Clear & Grub for Saddle Dam at Long Lake	7
1SD8025	Strip Site for Saddle Dam at Long Lake	5
1SD8050	Excavate for Saddle Dam Foundation at Long Lake	21
1SD8075	Foundation Approval - Saddle Dam at Long Lake	2
1SD8100	Place Zones 1 thru 4 for Saddle Dam at Long Lake	84
1SD8125	Place Bedding and Riprap for Saddle Dam at LL	21
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	6
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



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Early Bar
Progress Bar
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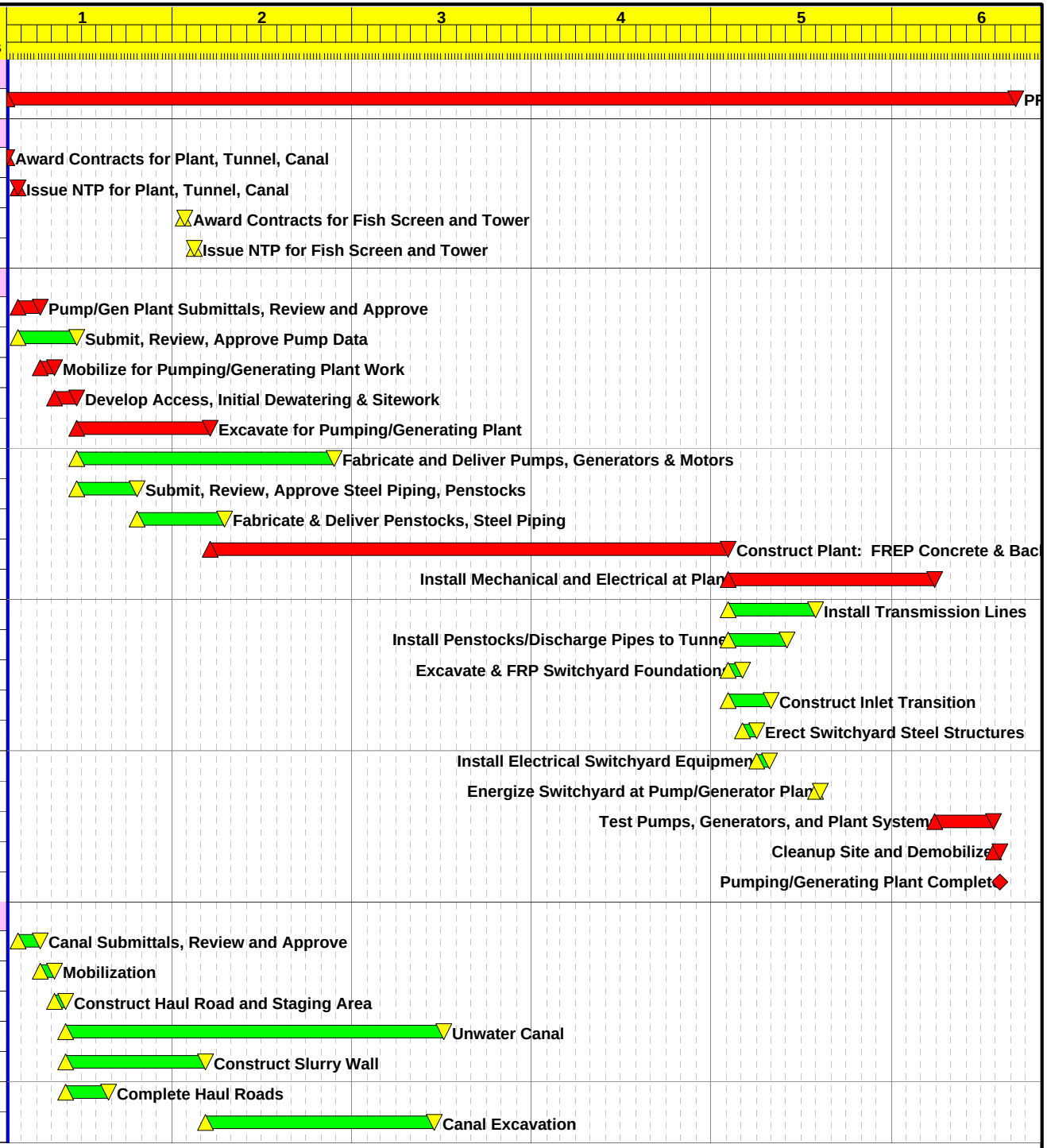
LL3C

Alternative No. 3, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 3C - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	Note: Assume 3.5 months for weather impacts fo		
	canal work each year.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	2,047*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping and Generating Plant - 2,000 cfs		
1PA1100	Pump/Gen Plant Submittals, Review and Approve	45
1PA1125	Submit, Review, Approve Pump Data	120
1PA1150	Mobilize for Pumping/Generating Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping/Generating Plant	270
1PA1225	Fabricate and Deliver Pumps, Generators & Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	1,050
1PA1375	Install Mechanical and Electrical at Plant	420
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pump/Generator Plant	7
1PA1575	Test Pumps, Generators, and Plant Systems	120
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping/Generating Plant Complete	0
Canal - 2,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Unwater Canal	555*
1C13150	Construct Slurry Wall	177
1C13075	Complete Haul Roads	87
1C13175	Canal Excavation	359



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Data Date 01FEB16
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Early Bar
Progress Bar
Critical Activity

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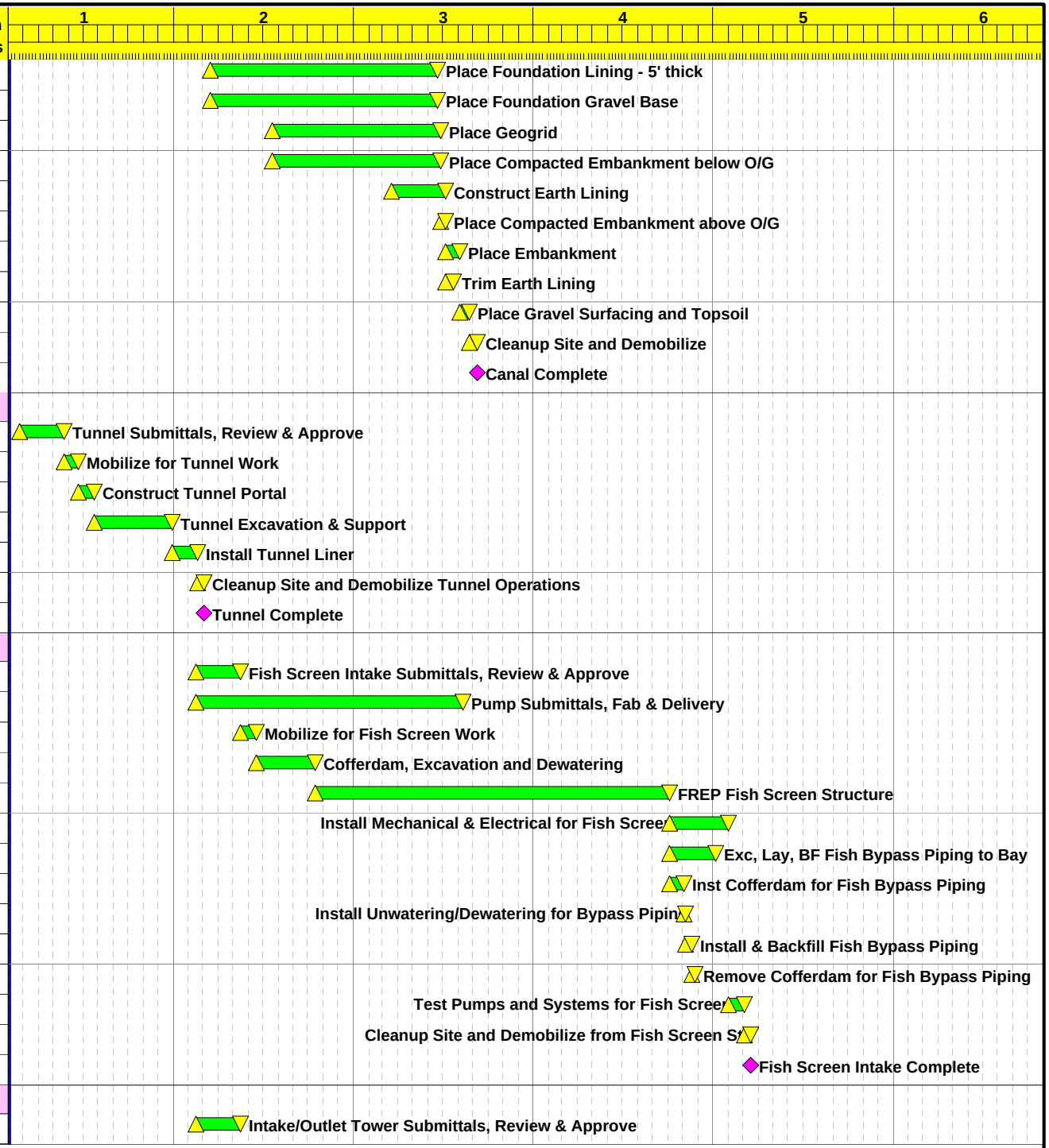
LL3D

Alternative No.3, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 3D - 500 TAF
Summary Construction Schedule

Sheet 1 of 3

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
1C13200	Place Foundation Lining - 5' thick	355
1C13225	Place Foundation Gravel Base	355*
1C13250	Place Geogrid	236*
1C13275	Place Compacted Embankment below O/G	236
1C13300	Construct Earth Lining	110
1C13325	Place Compacted Embankment above O/G	9
1C13350	Place Embankment	31
1C13375	Trim Earth Lining	18
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 2,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	160
1T12200	Install Tunnel Liner	50
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 2,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	120
1F15175	FREP Fish Screen Structure	720
1F15250	Install Mechanical & Electrical for Fish Screen	120
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	94
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 2,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90



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Early Bar
Progress Bar
Critical Activity

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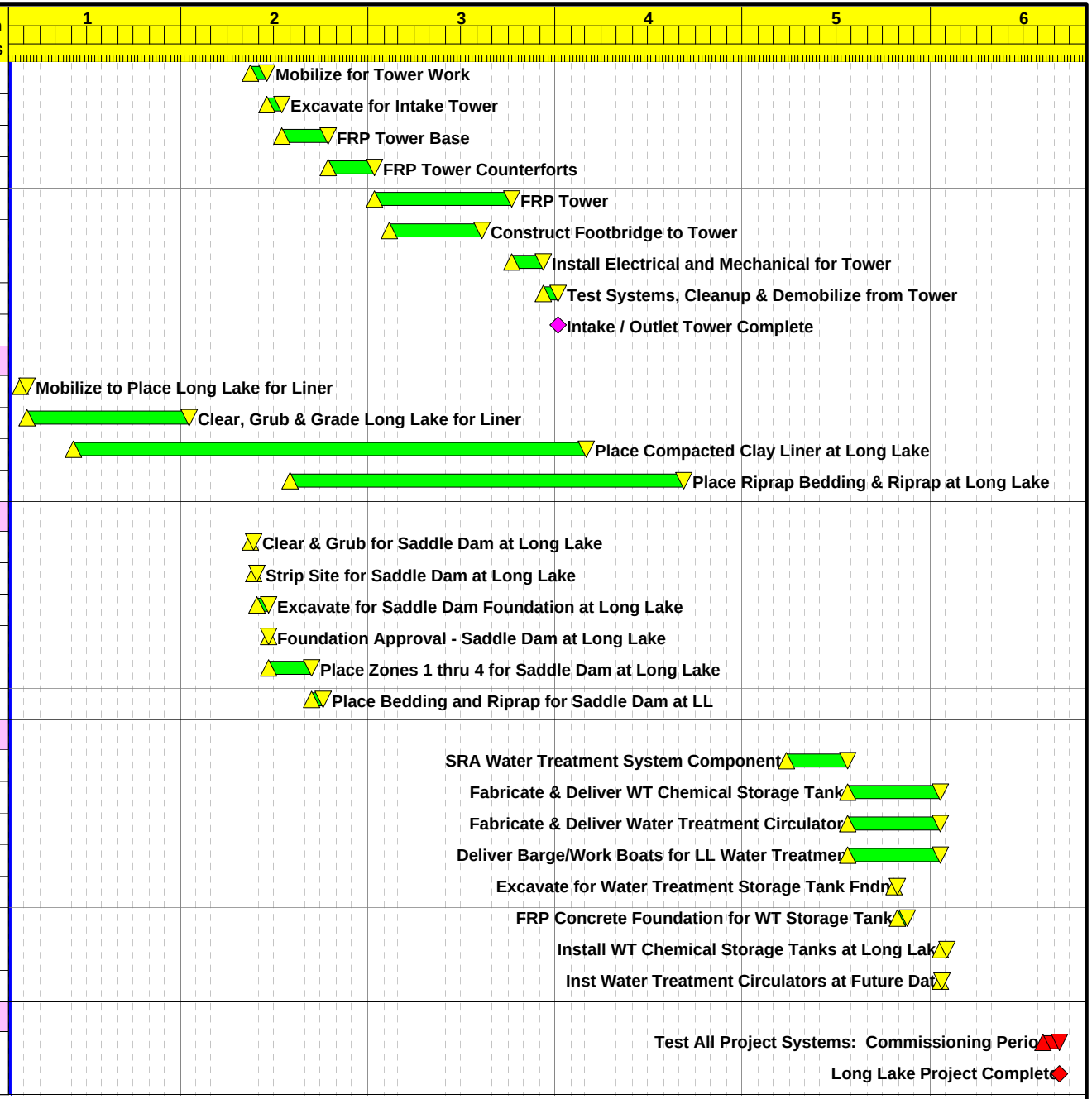
LL3D

Alternative No.3, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 3D - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	90
1T14100	FRP Tower Counterforts	90
1T14125	FRP Tower	270
1T14150	Construct Footbridge to Tower	180
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	14
1CL6120	Clear, Grub & Grade Long Lake for Liner	315
1CL6140	Place Compacted Clay Liner at Long Lake	1,000
1CL6160	Place Riprap Bedding & Riprap at Long Lake	770
Long Lake Saddle Dam		
1SD8000	Clear & Grub for Saddle Dam at Long Lake	7
1SD8025	Strip Site for Saddle Dam at Long Lake	5
1SD8050	Excavate for Saddle Dam Foundation at Long Lake	21
1SD8075	Foundation Approval - Saddle Dam at Long Lake	2
1SD8100	Place Zones 1 thru 4 for Saddle Dam at Long Lake	84
1SD8125	Place Bedding and Riprap for Saddle Dam at LL	21
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	6
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



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Early Bar
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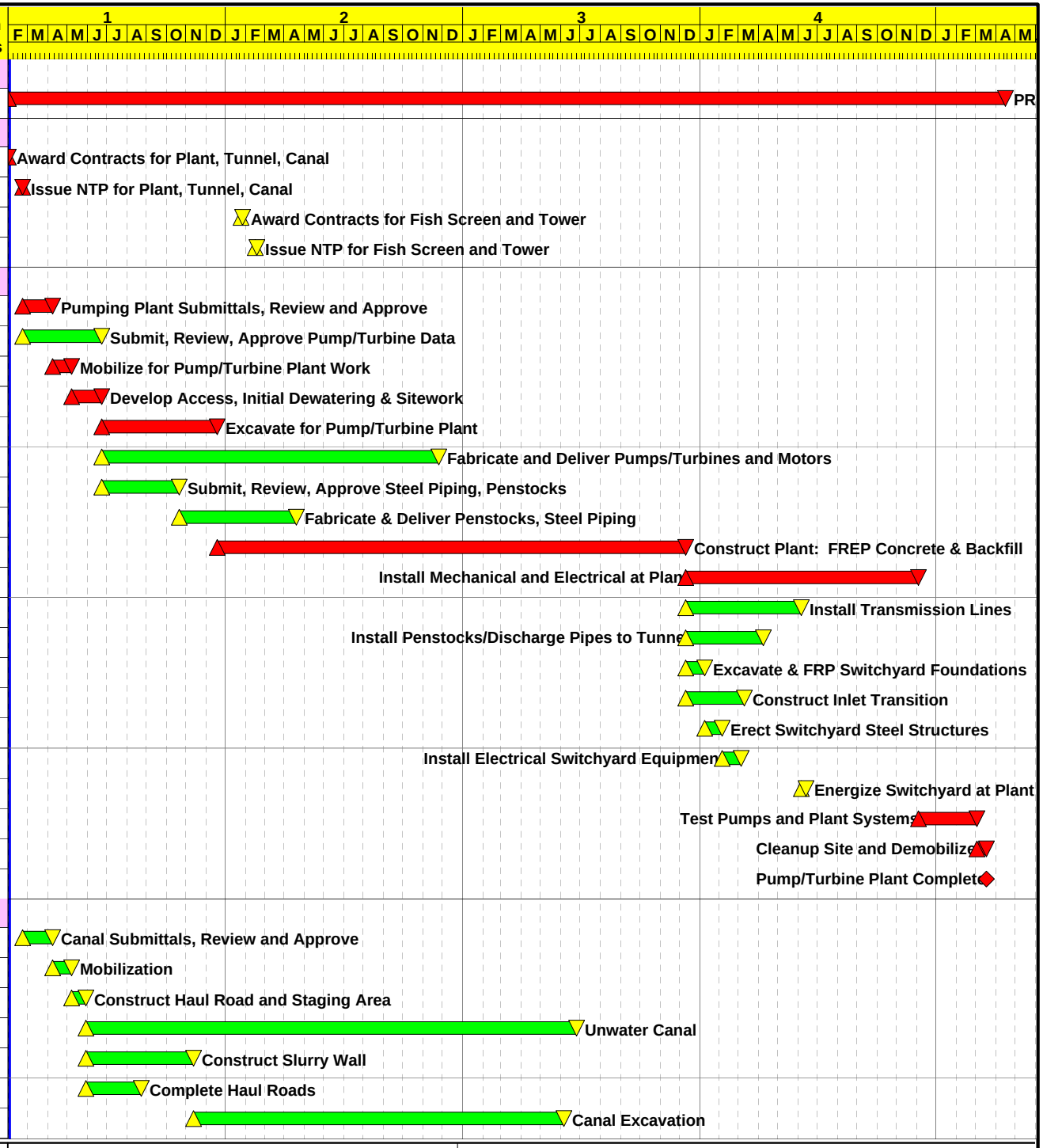
LL3D

Alternative No.3, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 3D - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of weather impacts		
	each year for winter canal work.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	1,537*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pump/Turbine Plant - 2,000 cfs		
1PA1100	Pumping Plant Submittals, Review and Approve	45
1PA1125	Submit, Review, Approve Pump/Turbine Data	120
1PA1150	Mobilize for Pump/Turbine Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pump/Turbine Plant	180
1PA1225	Fabricate and Deliver Pumps/Turbines and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	720
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pump/Turbine Plant Complete	0
Canal - 2,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Unwater Canal	545*
1C13150	Construct Slurry Wall	167
1C13075	Complete Haul Roads	87
1C13175	Canal Excavation	359



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Data Date 01FEB16
Run Date 27MAR09 14:45

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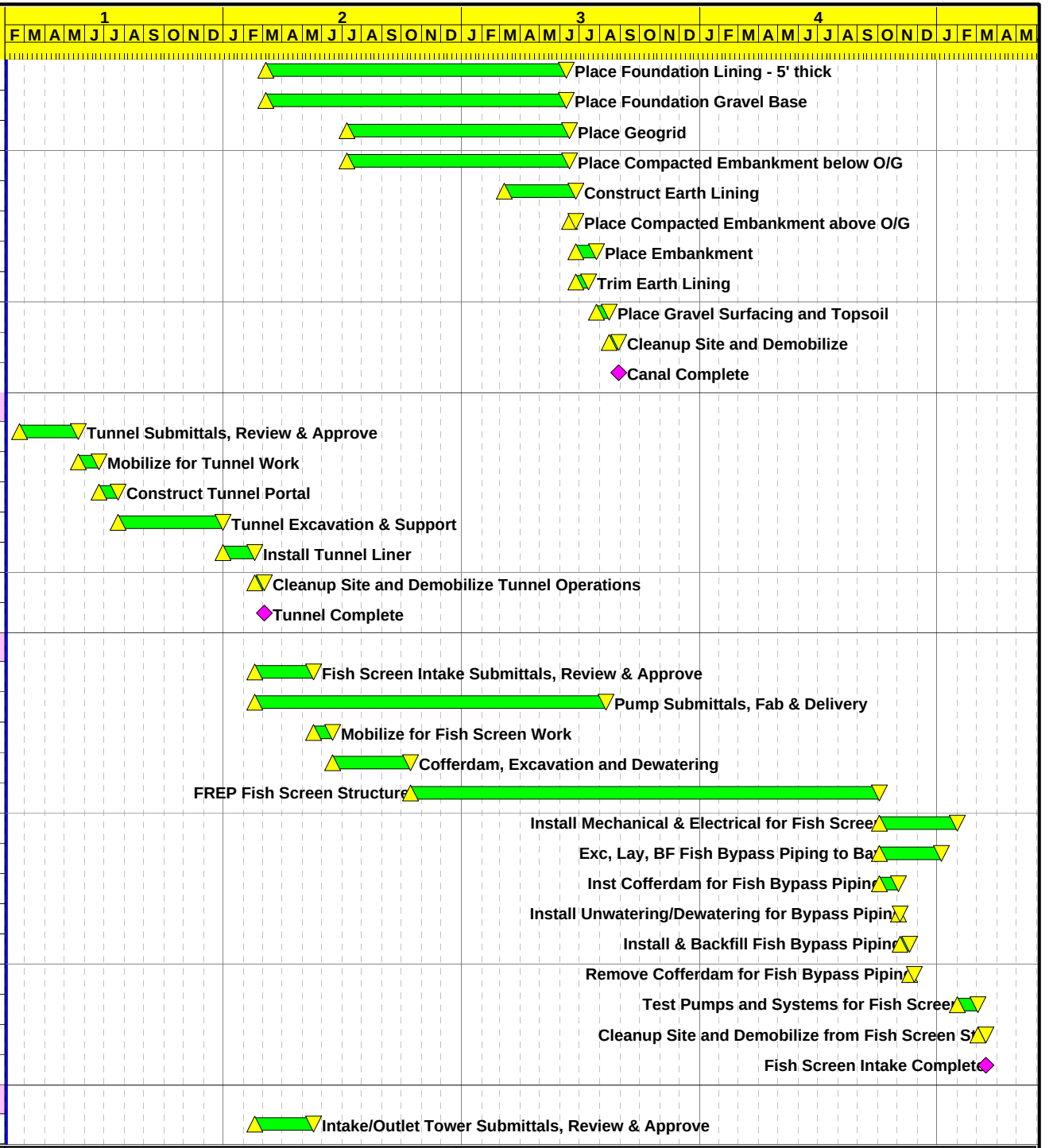
LL3E

Alternative No. 3, Option E
(2,000 cfs Pump/Turbine Plant)
Long Lake Valley - 3E - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of winter weather		
	impacts to canal work each year.		

Activity ID	Activity Description	Duration Cal Days
1C13200	Place Foundation Lining - 5' thick	355
1C13225	Place Foundation Gravel Base	355*
1C13250	Place Geogrid	236*
1C13275	Place Compacted Embankment below O/G	236
1C13300	Construct Earth Lining	110
1C13325	Place Compacted Embankment above O/G	9
1C13350	Place Embankment	31
1C13375	Trim Earth Lining	18
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 2,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	160
1T12200	Install Tunnel Liner	50
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 2,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	120
1F15175	FREP Fish Screen Structure	720
1F15250	Install Mechanical & Electrical for Fish Screen	120
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	94
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 2,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90



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Early Bar
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Critical Activity

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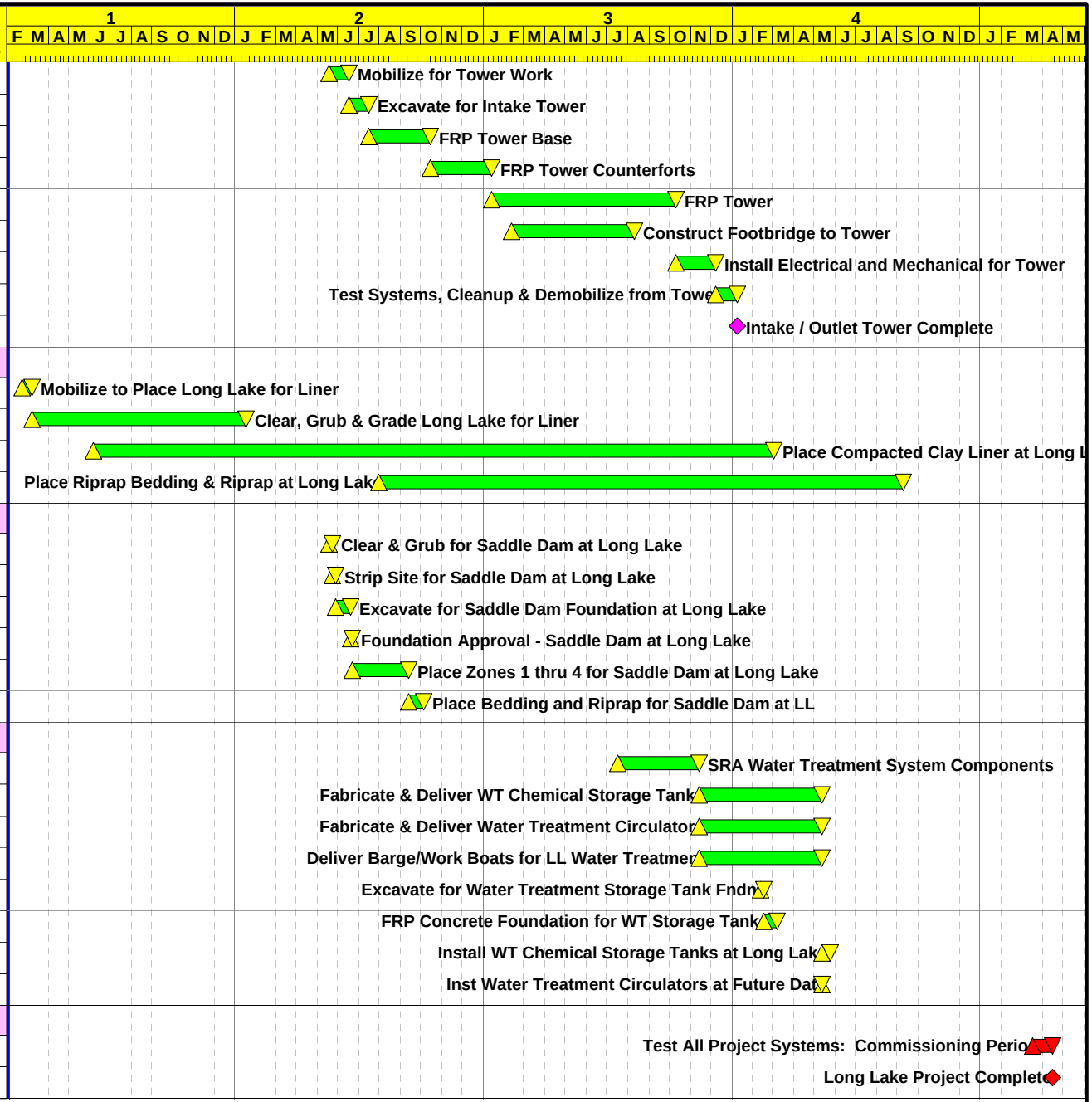
LL3E

Alternative No. 3, Option E
(2,000 cfs Pump/Turbine Plant)
Long Lake Valley - 3E - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of winter weather		
	impacts to canal work each year.		

Activity ID	Activity Description	Duration Cal Days
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	90
1T14100	FRP Tower Counterforts	90
1T14125	FRP Tower	270
1T14150	Construct Footbridge to Tower	180
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	14
1CL6120	Clear, Grub & Grade Long Lake for Liner	315
1CL6140	Place Compacted Clay Liner at Long Lake	1,000
1CL6160	Place Riprap Bedding & Riprap at Long Lake	770
Long Lake Saddle Dam		
1SD8000	Clear & Grub for Saddle Dam at Long Lake	7
1SD8025	Strip Site for Saddle Dam at Long Lake	5
1SD8050	Excavate for Saddle Dam Foundation at Long Lake	21
1SD8075	Foundation Approval - Saddle Dam at Long Lake	2
1SD8100	Place Zones 1 thru 4 for Saddle Dam at Long Lake	84
1SD8125	Place Bedding and Riprap for Saddle Dam at LL	21
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	6
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



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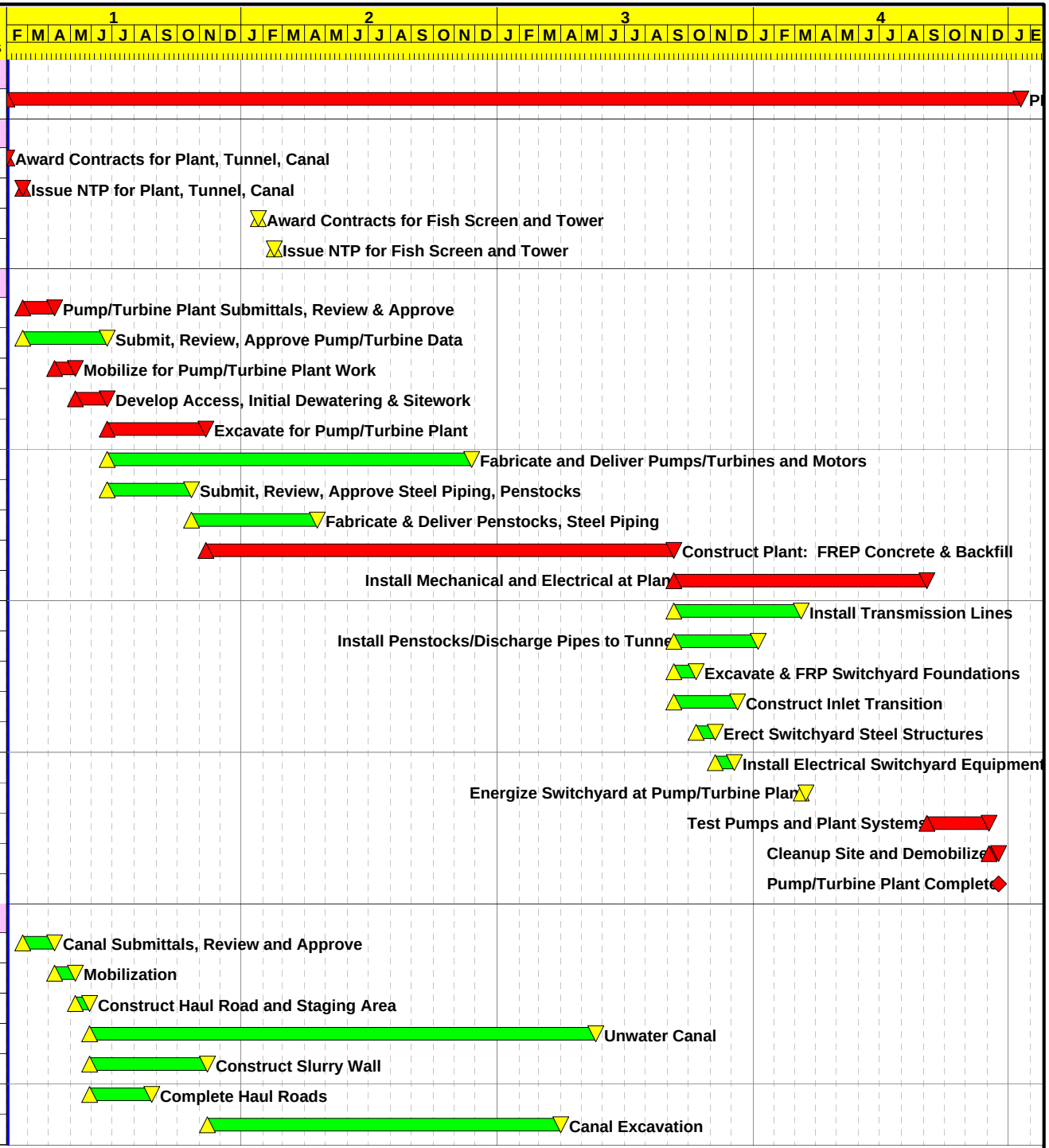
LL3E

Alternative No. 3, Option E
(2,000 cfs Pump/Turbine Plant)
Long Lake Valley - 3E - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of winter weather		
	impacts to canal work each year.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	1,447*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pump/Turbine Plant - 1,000 cfs		
1PA1100	Pump/Turbine Plant Submittals, Review & Approve	45
1PA1125	Submit, Review, Approve Pump/Turbine Data	120
1PA1150	Mobilize for Pump/Turbine Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pump/Turbine Plant	140
1PA1225	Fabricate and Deliver Pumps/Turbines and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	670
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pump/Turbine Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pump/Turbine Plant Complete	0
Canal - 1,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Unwater Canal	509*
1C13150	Construct Slurry Wall	167
1C13075	Complete Haul Roads	87
1C13175	Canal Excavation	292



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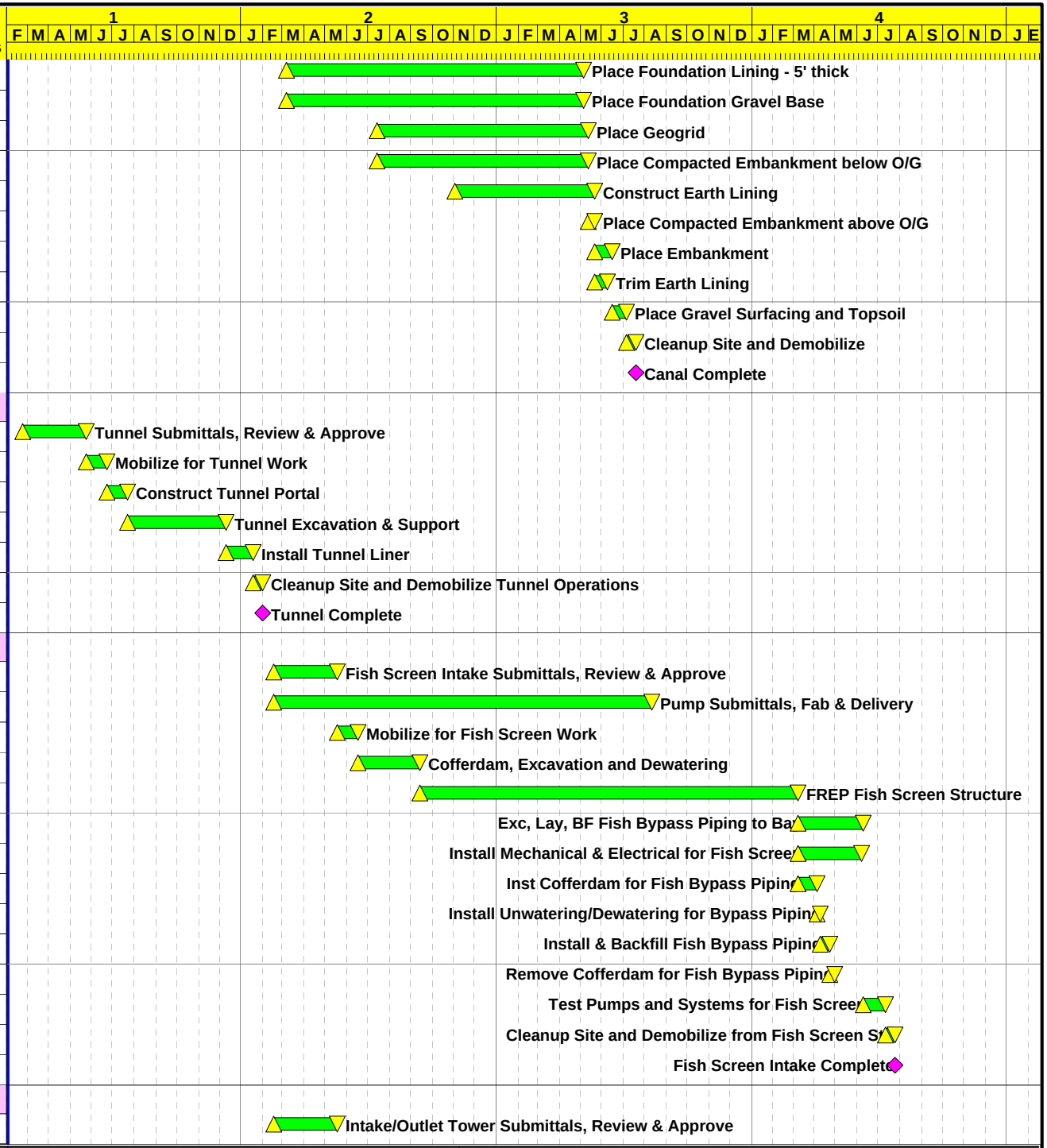
LL3F

Alternative No. 3, Option F
(1,000 cfs Pump/Turbine Plant)
Long Lake Valley - 3F - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of winter weather		
	impacts to canal work each year.		

Activity ID	Activity Description	Duration Cal Days
1C13200	Place Foundation Lining - 5' thick	319
1C13225	Place Foundation Gravel Base	319*
1C13250	Place Geogrid	196*
1C13275	Place Compacted Embankment below O/G	196
1C13300	Construct Earth Lining	93
1C13325	Place Compacted Embankment above O/G	9
1C13350	Place Embankment	27
1C13375	Trim Earth Lining	18
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 1,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	140
1T12200	Install Tunnel Liner	40
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 1,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	90
1F15175	FREP Fish Screen Structure	540
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	94
1F15250	Install Mechanical & Electrical for Fish Screen	90
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 1,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90



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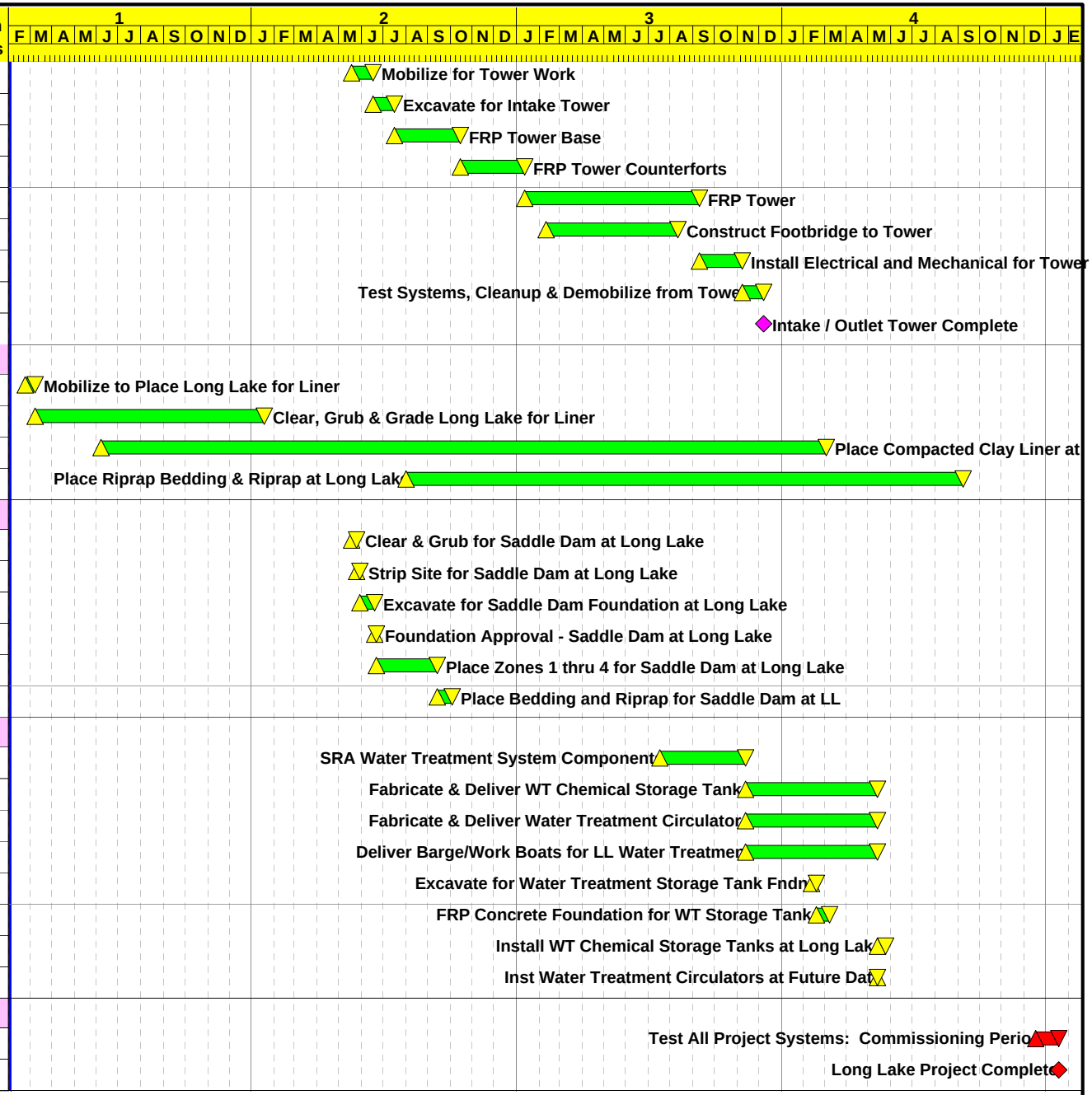
LL3F

Alternative No. 3, Option F
(1,000 cfs Pump/Turbine Plant)
Long Lake Valley - 3F - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of winter weather		
	impacts to canal work each year.		

Activity ID	Activity Description	Duration Cal Days
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	90
1T14100	FRP Tower Counterforts	90
1T14125	FRP Tower	240
1T14150	Construct Footbridge to Tower	180
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	14
1CL6120	Clear, Grub & Grade Long Lake for Liner	315
1CL6140	Place Compacted Clay Liner at Long Lake	1,000
1CL6160	Place Riprap Bedding & Riprap at Long Lake	770
Long Lake Saddle Dam		
1SD8000	Clear & Grub for Saddle Dam at Long Lake	7
1SD8025	Strip Site for Saddle Dam at Long Lake	5
1SD8050	Excavate for Saddle Dam Foundation at Long Lake	21
1SD8075	Foundation Approval - Saddle Dam at Long Lake	2
1SD8100	Place Zones 1 thru 4 for Saddle Dam at Long Lake	84
1SD8125	Place Bedding and Riprap for Saddle Dam at LL	21
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	6
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



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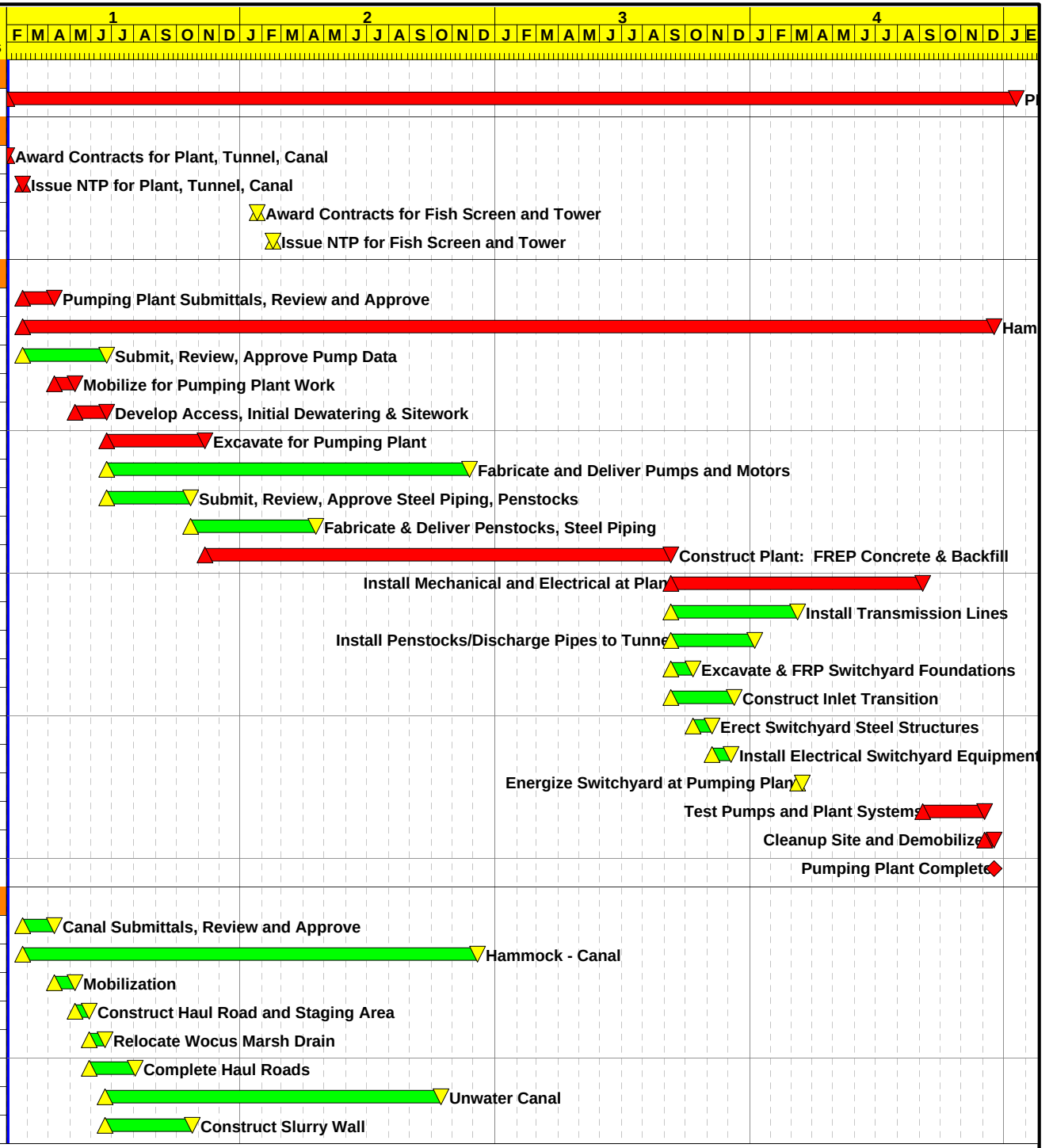
LL3F

Alternative No. 3, Option F
(1,000 cfs Pump/Turbine Plant)
Long Lake Valley - 3F - 500 TAF
Summary Construction Schedule

Sheet 3 of 3

Date	Revision	Checked	Approved
	NOTE: Assume 3.5 months of winter weather		
	impacts to canal work each year.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	1,447*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping Plant - 1,000 cfs		
1PA1100	Pumping Plant Submittals, Review and Approve	45
HAMPP	Hammock - Pumping Plant	1,394*
1PA1125	Submit, Review, Approve Pump Data	120
1PA1150	Mobilize for Pumping Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping Plant	140
1PA1225	Fabricate and Deliver Pumps and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	670
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pumping Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping Plant Complete	0
Canal - 1,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
HAMC	Hammock - Canal	653*
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Relocate Wocus Marsh Drain	23
1C13075	Complete Haul Roads	64
1C13125	Unwater Canal	374*
1C13150	Construct Slurry Wall	123



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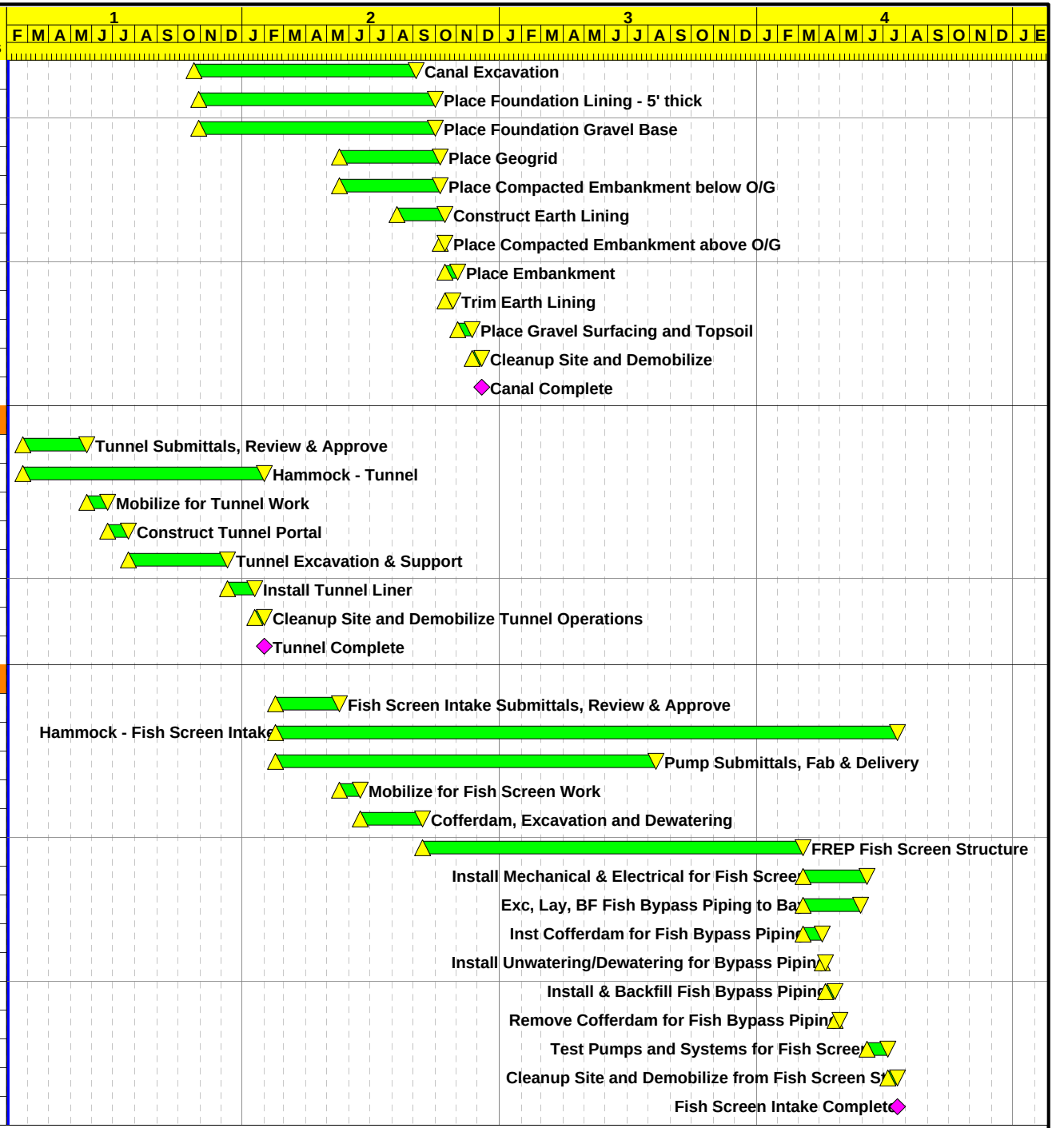
LL4A

Alternative No. 4, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 4A - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: For Canal work, assume 3.5 months of winter weather impacts.		

Activity ID	Activity Description	Duration Cal Days
1C13175	Canal Excavation	210
1C13200	Place Foundation Lining - 5' thick	231
1C13225	Place Foundation Gravel Base	231*
1C13250	Place Geogrid	143*
1C13275	Place Compacted Embankment below O/G	143
1C13300	Construct Earth Lining	67
1C13325	Place Compacted Embankment above O/G	6
1C13350	Place Embankment	20
1C13375	Trim Earth Lining	13
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 1,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	344*
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	140
1T12200	Install Tunnel Liner	40
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 1,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	884*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	90
1F15175	FREP Fish Screen Structure	540
1F15250	Install Mechanical & Electrical for Fish Screen	90
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0



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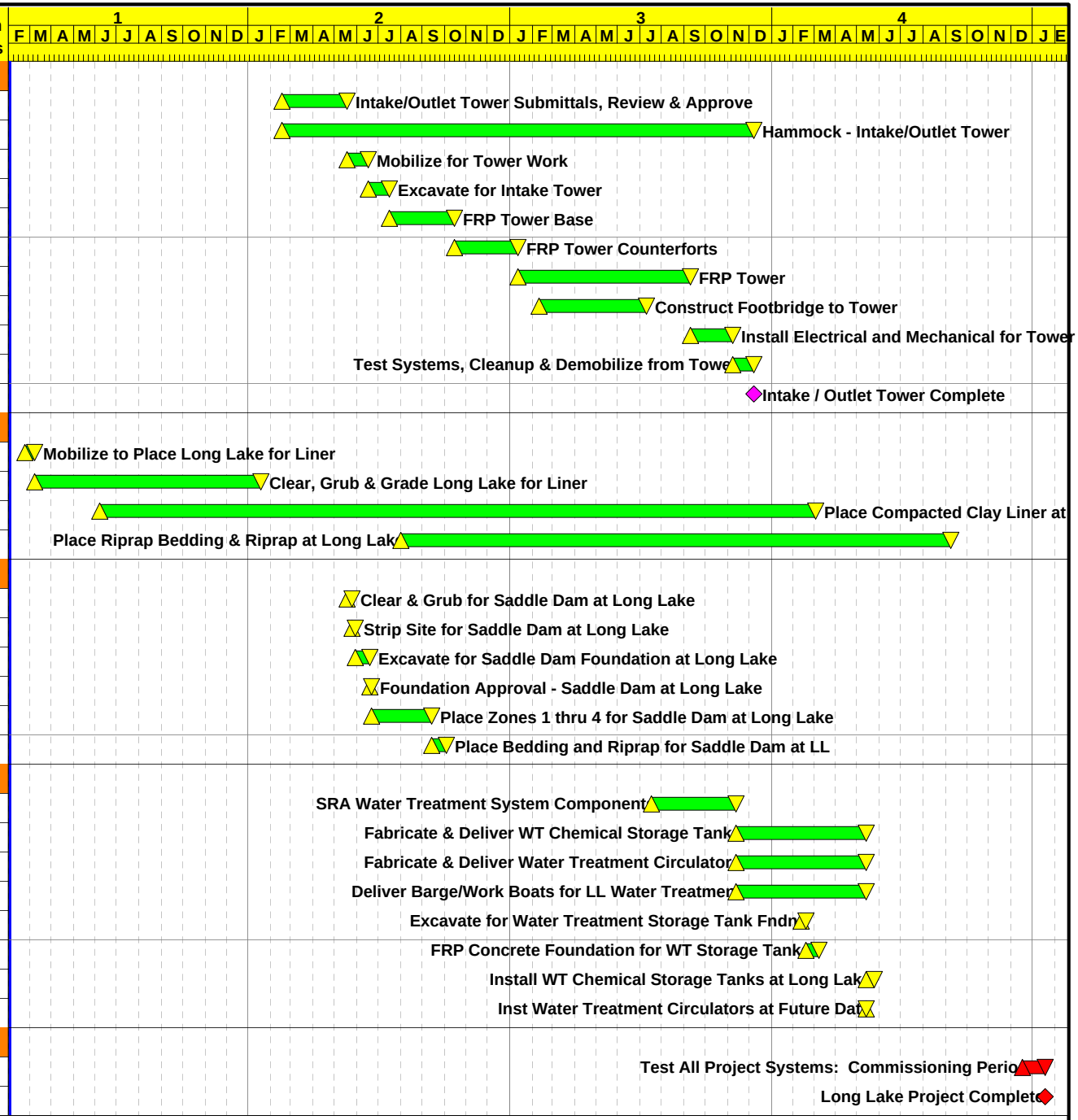
LL4A

Alternative No. 4, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 4A - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: For Canal work, assume 3.5 months		
	of winter weather impacts.		

Activity ID	Activity Description	Duration Cal Days
Intake/Outlet Tower - 1,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	660*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	90
1T14100	FRP Tower Counterforts	90
1T14125	FRP Tower	240
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	14
1CL6120	Clear, Grub & Grade Long Lake for Liner	315
1CL6140	Place Compacted Clay Liner at Long Lake	1,000
1CL6160	Place Riprap Bedding & Riprap at Long Lake	770
Long Lake Saddle Dam		
1SD8000	Clear & Grub for Saddle Dam at Long Lake	7
1SD8025	Strip Site for Saddle Dam at Long Lake	5
1SD8050	Excavate for Saddle Dam Foundation at Long Lake	21
1SD8075	Foundation Approval - Saddle Dam at Long Lake	2
1SD8100	Place Zones 1 thru 4 for Saddle Dam at Long Lake	84
1SD8125	Place Bedding and Riprap for Saddle Dam at LL	21
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	6
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



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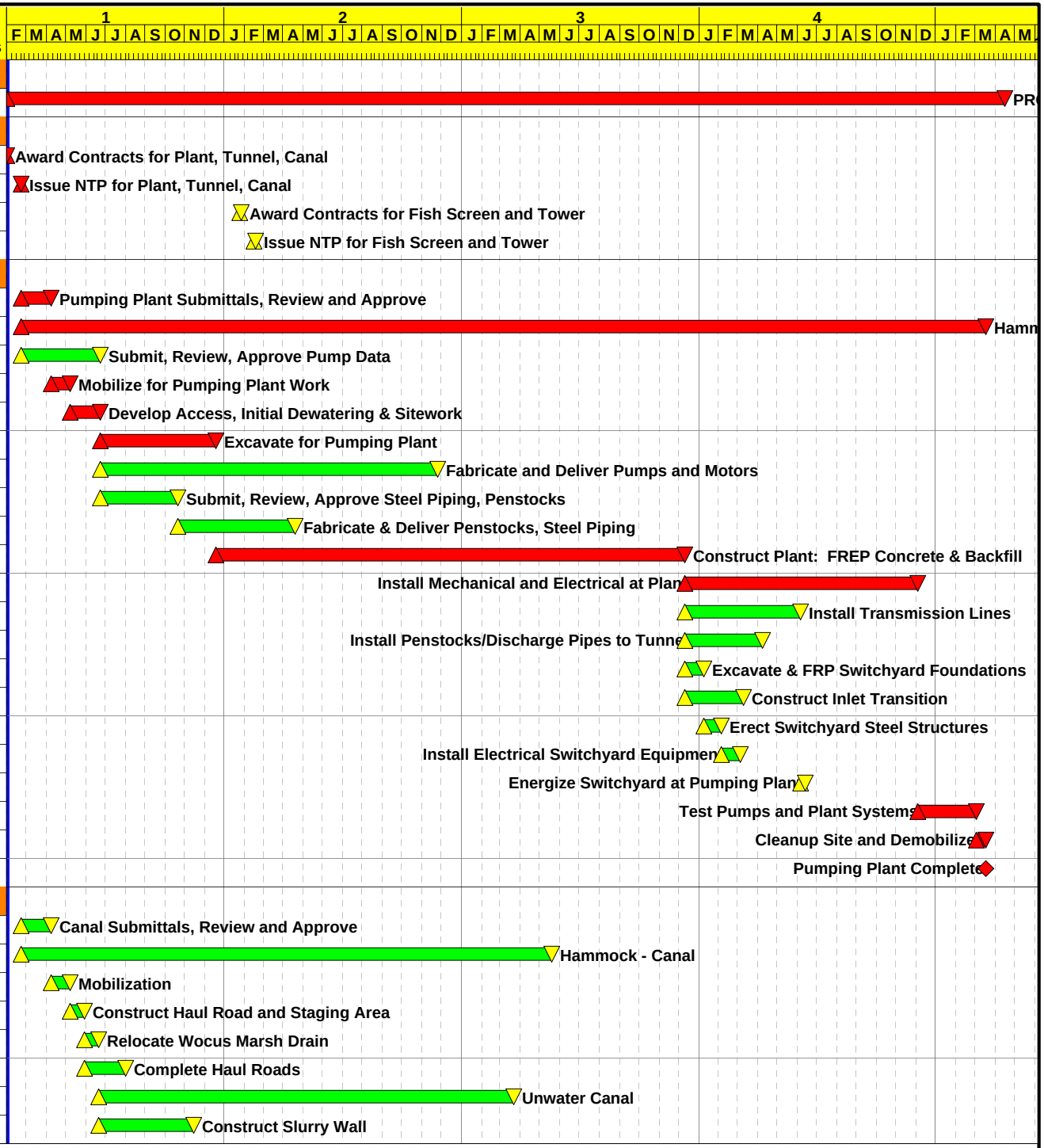
LL4A

Alternative No. 4, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 4A - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: For Canal work, assume 3.5 months		
	of winter weather impacts.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	1,537*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping Plant - 2,000 cfs		
1PA1100	Pumping Plant Submittals, Review and Approve	45
HAMPP	Hammock - Pumping Plant	1,484*
1PA1125	Submit, Review, Approve Pump Data	120
1PA1150	Mobilize for Pumping Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping Plant	180
1PA1225	Fabricate and Deliver Pumps and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	720
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pumping Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping Plant Complete	0
Canal - 2,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
HAMC	Hammock - Canal	817*
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Relocate Wocus Marsh Drain	23
1C13075	Complete Haul Roads	64
1C13125	Unwater Canal	426*
1C13150	Construct Slurry Wall	146



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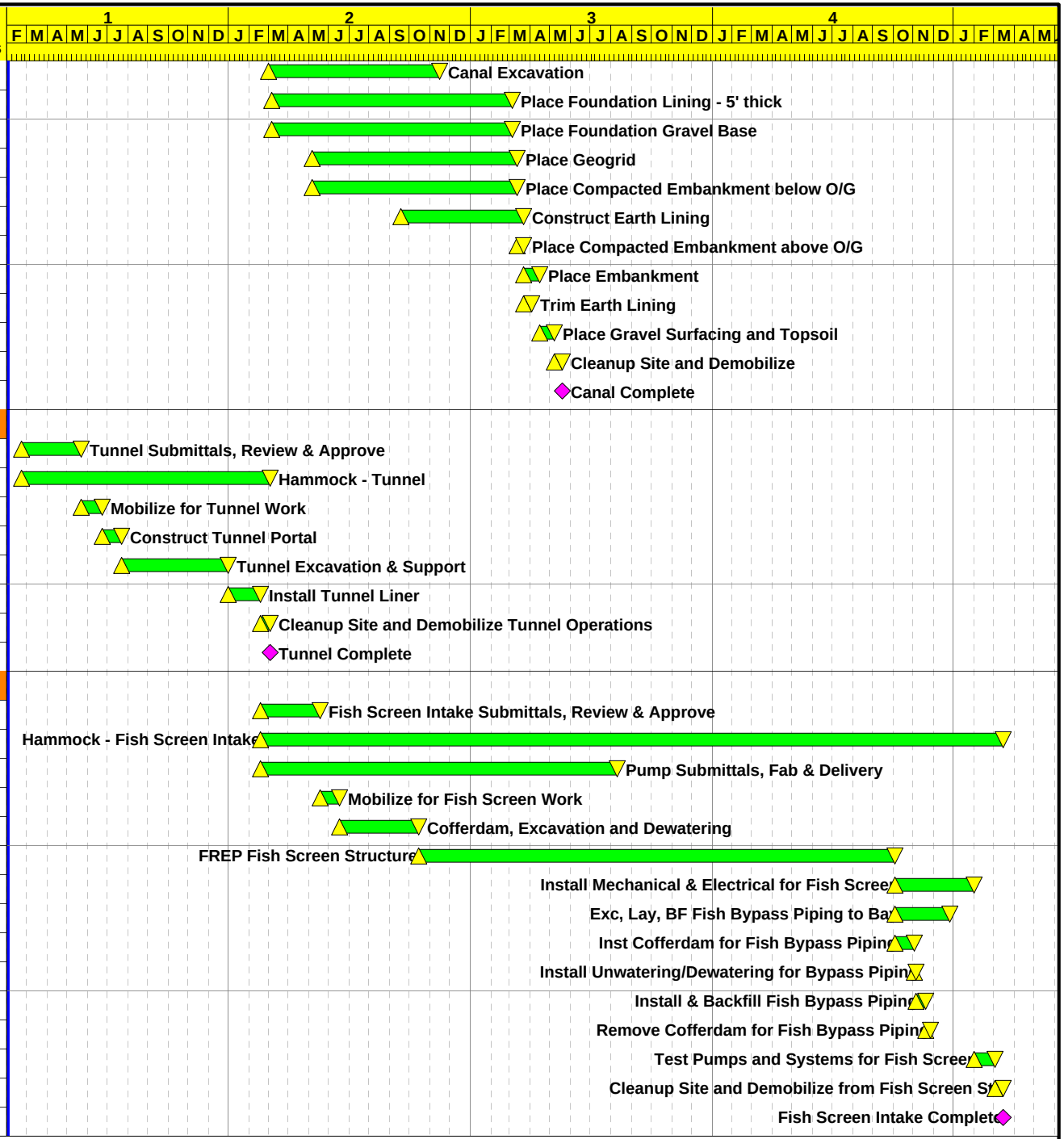
LL4B

Alternative No. 4, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 4B - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: For Canal Work, assume 3.5 months of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
1C13175	Canal Excavation	259
1C13200	Place Foundation Lining - 5' thick	257
1C13225	Place Foundation Gravel Base	257*
1C13250	Place Geogrid	205*
1C13275	Place Compacted Embankment below O/G	205
1C13300	Construct Earth Lining	80
1C13325	Place Compacted Embankment above O/G	9
1C13350	Place Embankment	26
1C13375	Trim Earth Lining	13
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 2,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	374*
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	160
1T12200	Install Tunnel Liner	50
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 2,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	1,124*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	120
1F15175	FREP Fish Screen Structure	720
1F15250	Install Mechanical & Electrical for Fish Screen	120
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0



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Early Bar
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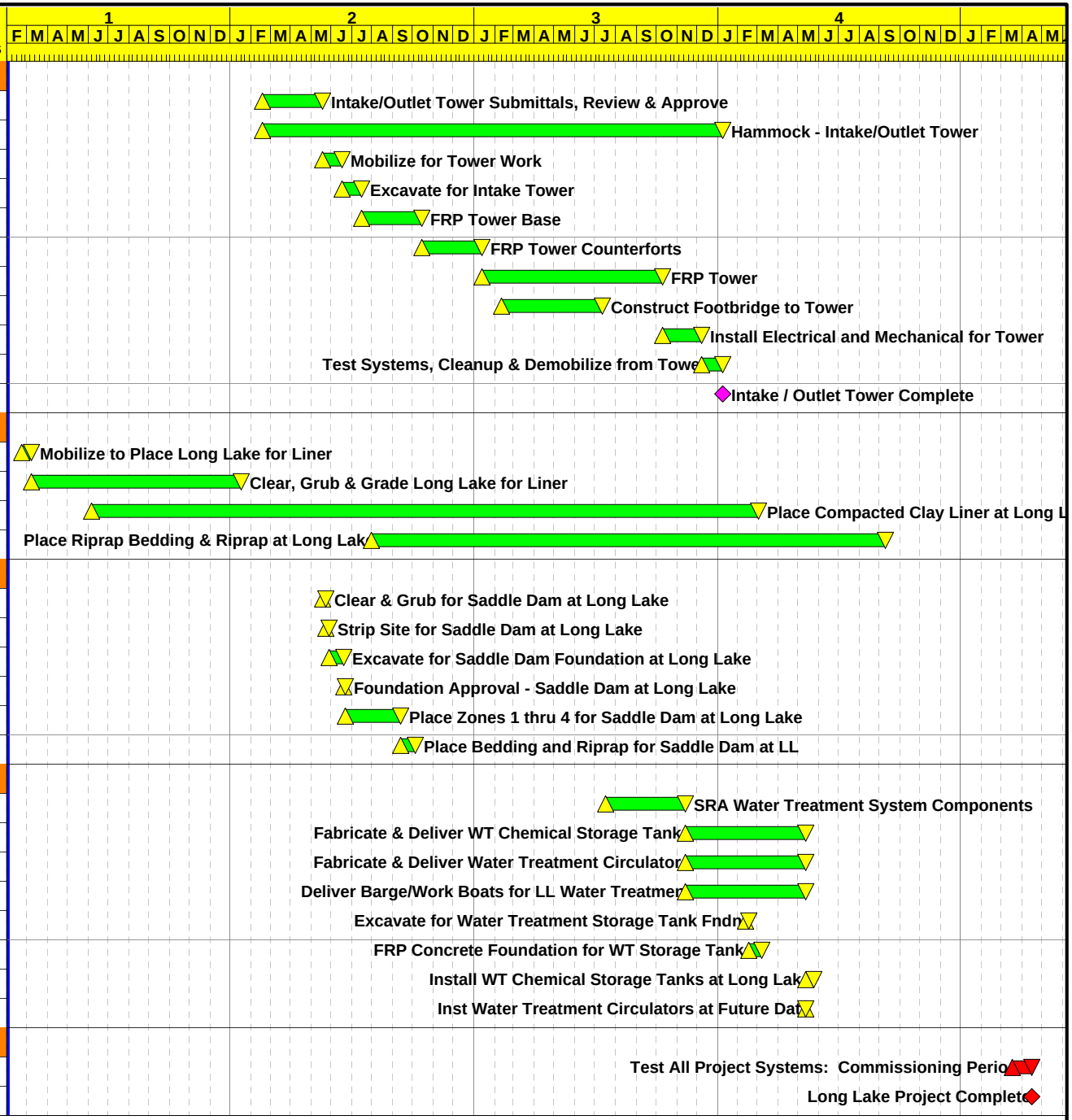
LL4B

Alternative No. 4, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 4B - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: For Canal Work, assume 3.5 months of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
Intake/Outlet Tower - 2,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	690*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	90
1T14100	FRP Tower Counterforts	90
1T14125	FRP Tower	270
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	14
1CL6120	Clear, Grub & Grade Long Lake for Liner	315
1CL6140	Place Compacted Clay Liner at Long Lake	1,000
1CL6160	Place Riprap Bedding & Riprap at Long Lake	770
Long Lake Saddle Dam		
1SD8000	Clear & Grub for Saddle Dam at Long Lake	7
1SD8025	Strip Site for Saddle Dam at Long Lake	5
1SD8050	Excavate for Saddle Dam Foundation at Long Lake	21
1SD8075	Foundation Approval - Saddle Dam at Long Lake	2
1SD8100	Place Zones 1 thru 4 for Saddle Dam at Long Lake	84
1SD8125	Place Bedding and Riprap for Saddle Dam at LL	21
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	6
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



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Early Bar
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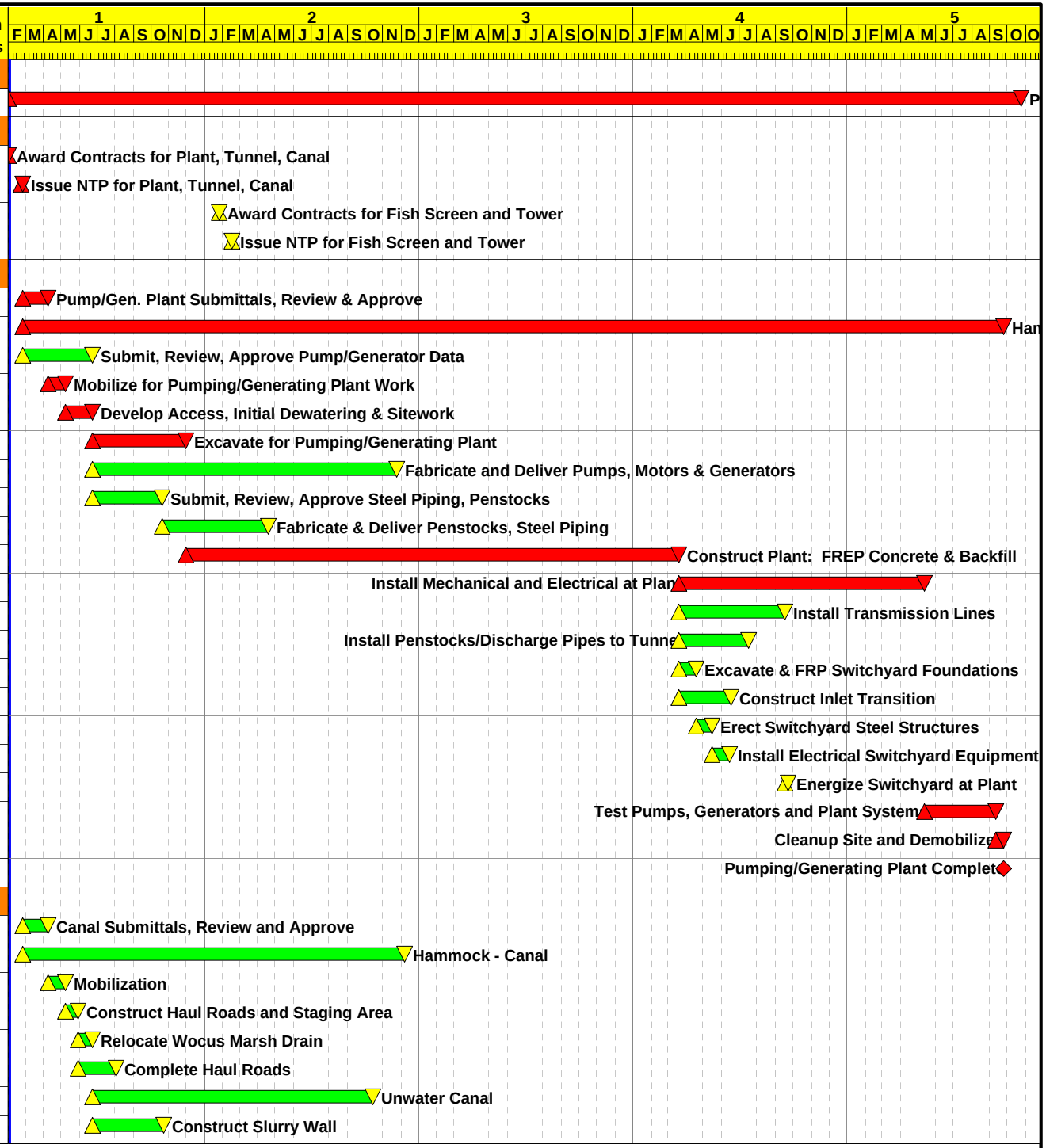
LL4B

Alternative No. 4, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 4B - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: For Canal Work, assume 3.5 months of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	1,727*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping and Generating Plant - 1,000 cfs		
1PA1100	Pump/Gen. Plant Submittals, Review & Approve	45
HAMPP	Hammock - Pumping Plant	1,674*
1PA1125	Submit, Review, Approve Pump/Generator Data	120
1PA1150	Mobilize for Pumping/Generating Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping/Generating Plant	160
1PA1225	Fabricate and Deliver Pumps, Motors & Generators	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	840
1PA1375	Install Mechanical and Electrical at Plant	420
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Plant	7
1PA1575	Test Pumps, Generators and Plant Systems	120
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping/Generating Plant Complete	0
Canal - 1,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
HAMC	Hammock - Canal	653*
1C13025	Mobilization	30
1C13050	Construct Haul Roads and Staging Area	21
1C13100	Relocate Wocus Marsh Drain	23
1C13075	Complete Haul Roads	64
1C13125	Unwater Canal	374*
1C13150	Construct Slurry Wall	123



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Early Bar
Progress Bar
Critical Activity

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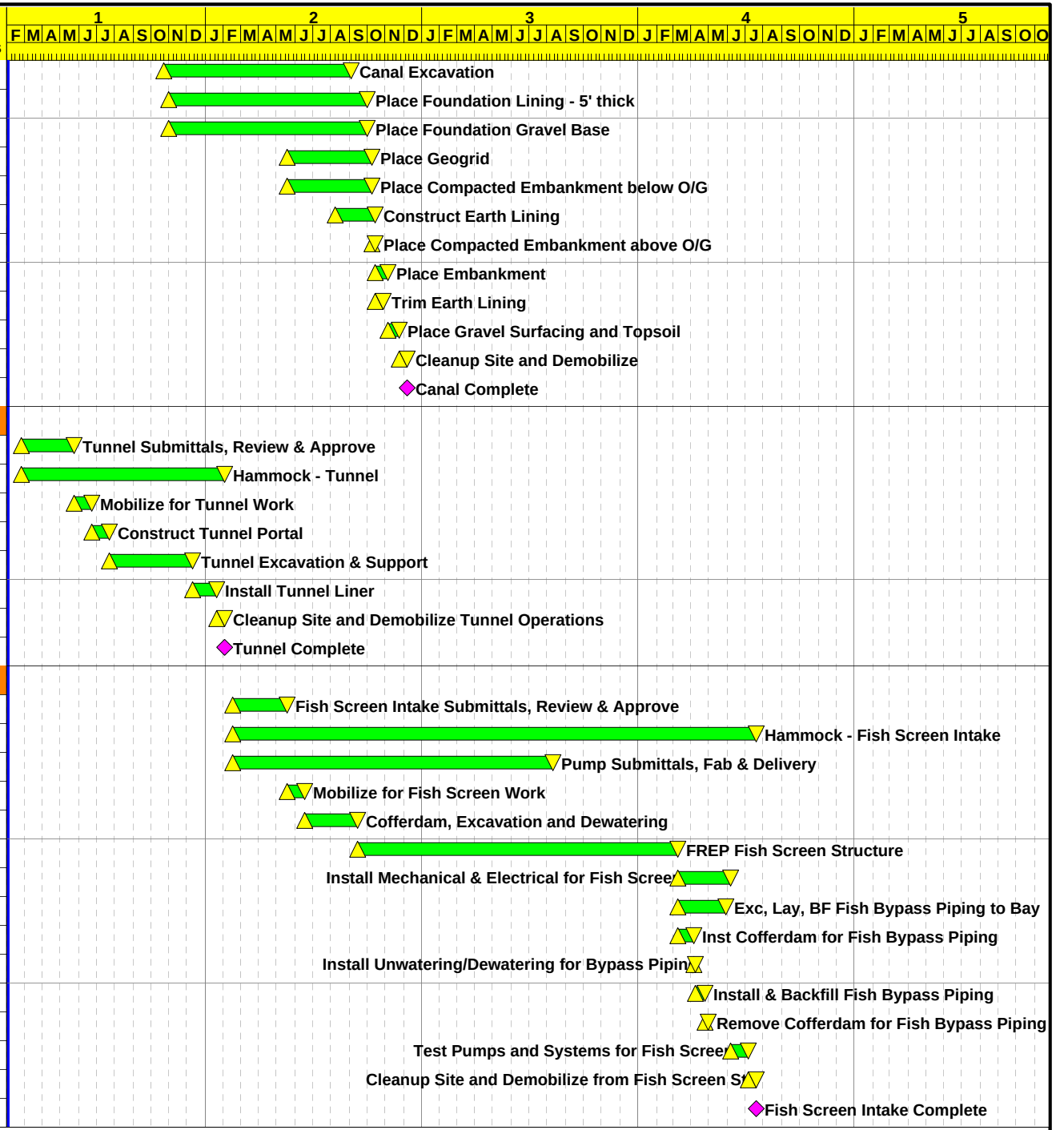
LL4C

Alternative No. 4, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 4C - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: For canal work, assume 3.5 months of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
1C13175	Canal Excavation	210
1C13200	Place Foundation Lining - 5' thick	231
1C13225	Place Foundation Gravel Base	231*
1C13250	Place Geogrid	143*
1C13275	Place Compacted Embankment below O/G	143
1C13300	Construct Earth Lining	67
1C13325	Place Compacted Embankment above O/G	6
1C13350	Place Embankment	20
1C13375	Trim Earth Lining	13
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 1,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	344*
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	140
1T12200	Install Tunnel Liner	40
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 1,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	884*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	90
1F15175	FREP Fish Screen Structure	540
1F15250	Install Mechanical & Electrical for Fish Screen	90
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0



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Early Bar
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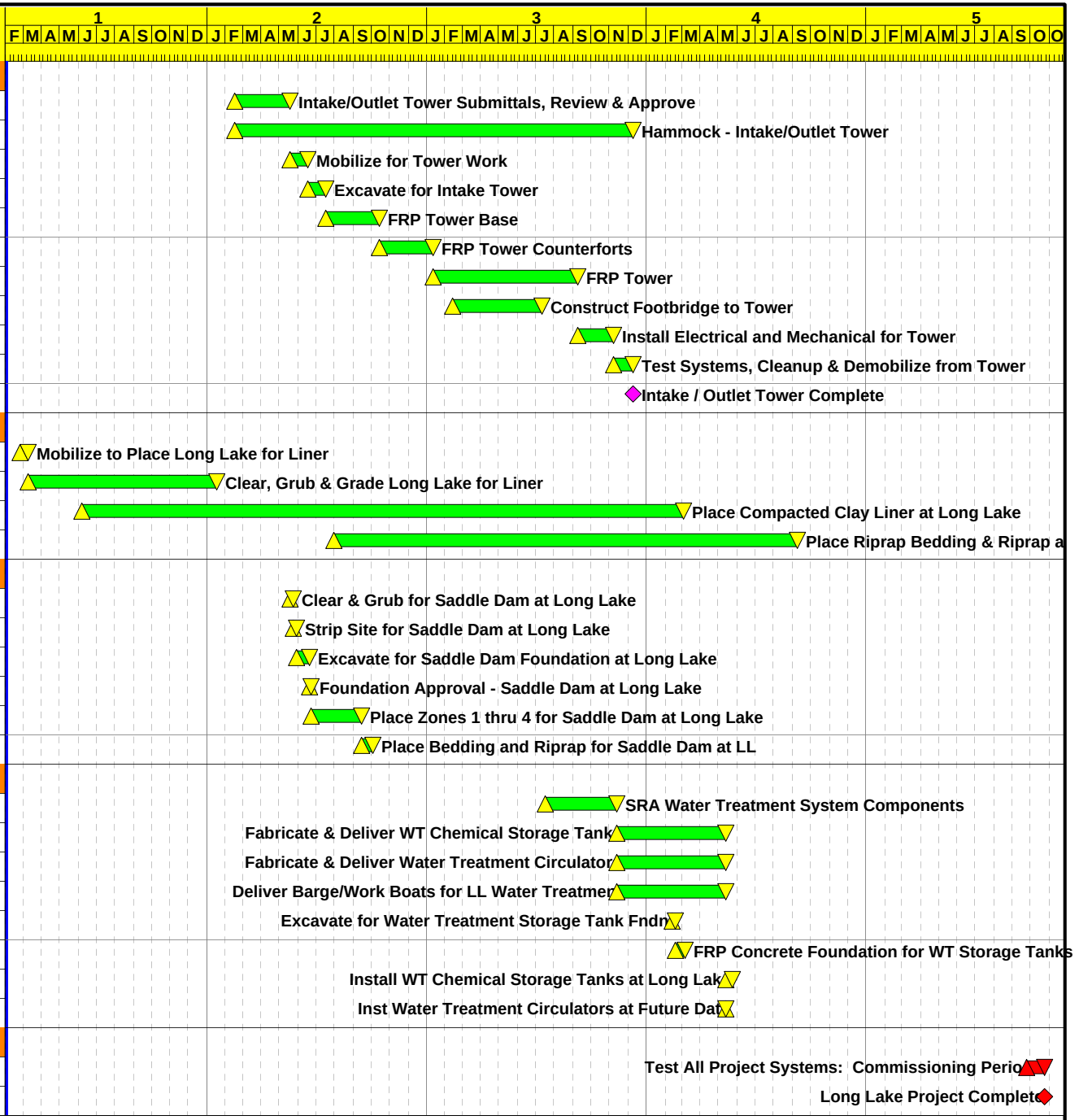
LL4C

Alternative No. 4, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 4C - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: For canal work, assume 3.5 months of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
Intake/Outlet Tower - 1,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	660*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	90
1T14100	FRP Tower Counterforts	90
1T14125	FRP Tower	240
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	14
1CL6120	Clear, Grub & Grade Long Lake for Liner	315
1CL6140	Place Compacted Clay Liner at Long Lake	1,000
1CL6160	Place Riprap Bedding & Riprap at Long Lake	770
Long Lake Saddle Dam		
1SD8000	Clear & Grub for Saddle Dam at Long Lake	7
1SD8025	Strip Site for Saddle Dam at Long Lake	5
1SD8050	Excavate for Saddle Dam Foundation at Long Lake	21
1SD8075	Foundation Approval - Saddle Dam at Long Lake	2
1SD8100	Place Zones 1 thru 4 for Saddle Dam at Long Lake	84
1SD8125	Place Bedding and Riprap for Saddle Dam at LL	21
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	6
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



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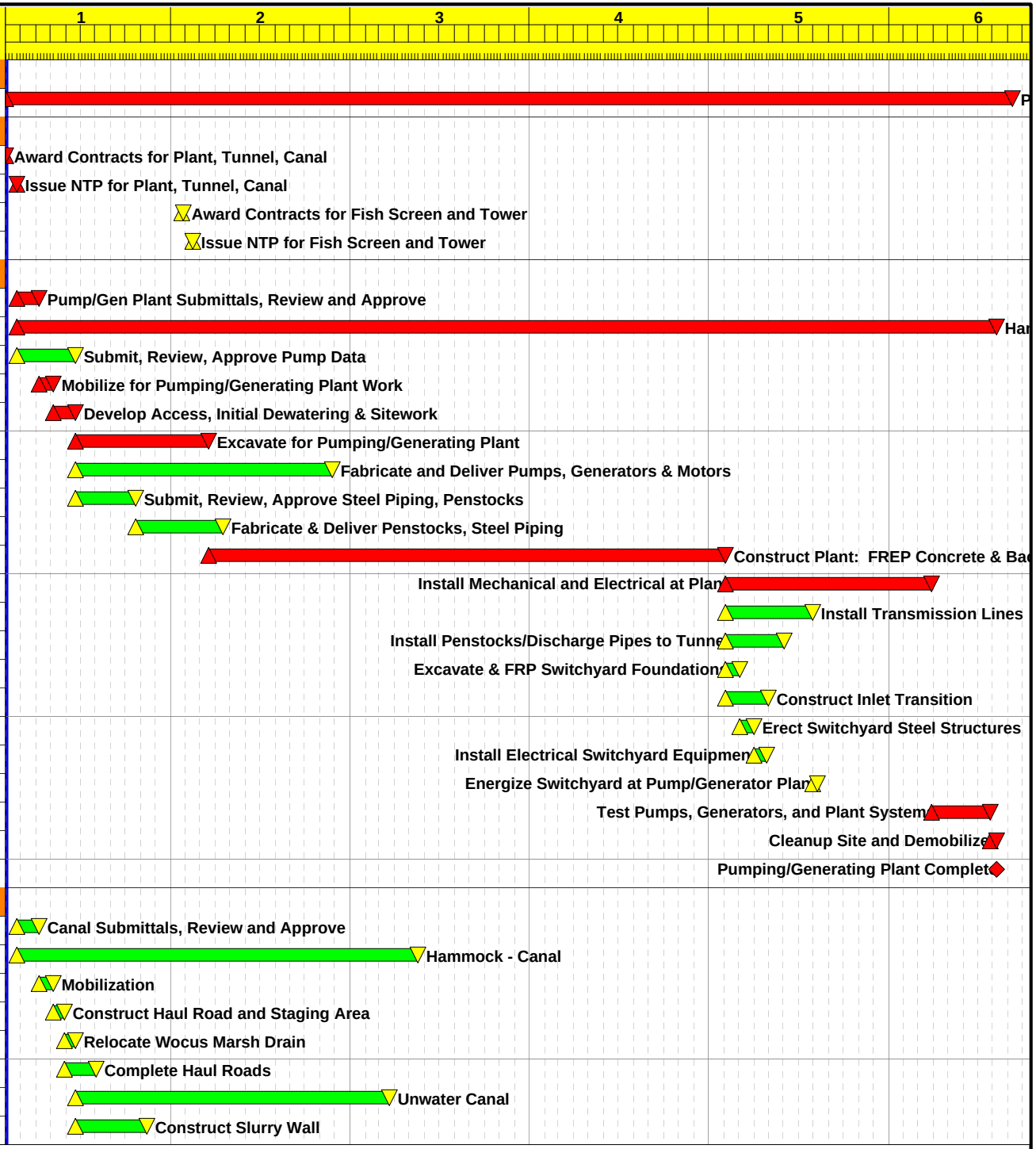
LL4C

Alternative No. 4, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 4C - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: For canal work, assume 3.5 months of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	2,047*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping and Generating Plant - 2,000 cfs		
1PA1100	Pump/Gen Plant Submittals, Review and Approve	45
HAMPP	Hammock - Pumping Plant	1,994*
1PA1125	Submit, Review, Approve Pump Data	120
1PA1150	Mobilize for Pumping/Generating Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping/Generating Plant	270
1PA1225	Fabricate and Deliver Pumps, Generators & Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	1,050
1PA1375	Install Mechanical and Electrical at Plant	420
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pump/Generator Plant	7
1PA1575	Test Pumps, Generators, and Plant Systems	120
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping/Generating Plant Complete	0
Canal - 2,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
HAMC	Hammock - Canal	817*
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Relocate Wocus Marsh Drain	23
1C13075	Complete Haul Roads	64
1C13125	Unwater Canal	426*
1C13150	Construct Slurry Wall	146



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Early Bar
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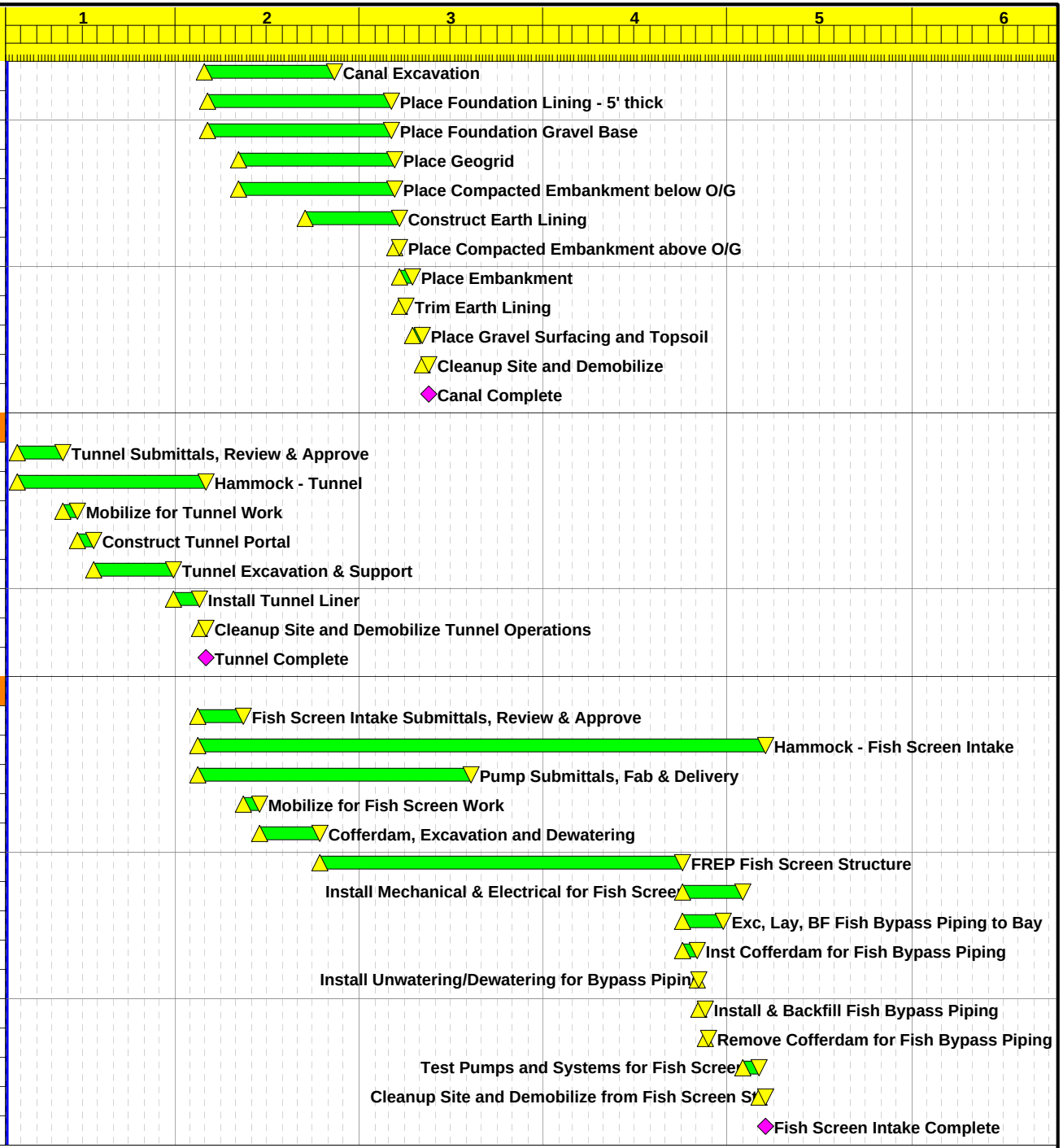
LL4D

Alternative No. 4, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 4D - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: For canal work, assumer 3.5 months		
	of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
1C13175	Canal Excavation	259
1C13200	Place Foundation Lining - 5' thick	257
1C13225	Place Foundation Gravel Base	257*
1C13250	Place Geogrid	205*
1C13275	Place Compacted Embankment below O/G	205
1C13300	Construct Earth Lining	80
1C13325	Place Compacted Embankment above O/G	9
1C13350	Place Embankment	26
1C13375	Trim Earth Lining	13
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 2,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	374*
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	160
1T12200	Install Tunnel Liner	50
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 2,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	1,124*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	120
1F15175	FREP Fish Screen Structure	720
1F15250	Install Mechanical & Electrical for Fish Screen	120
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0



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Early Bar
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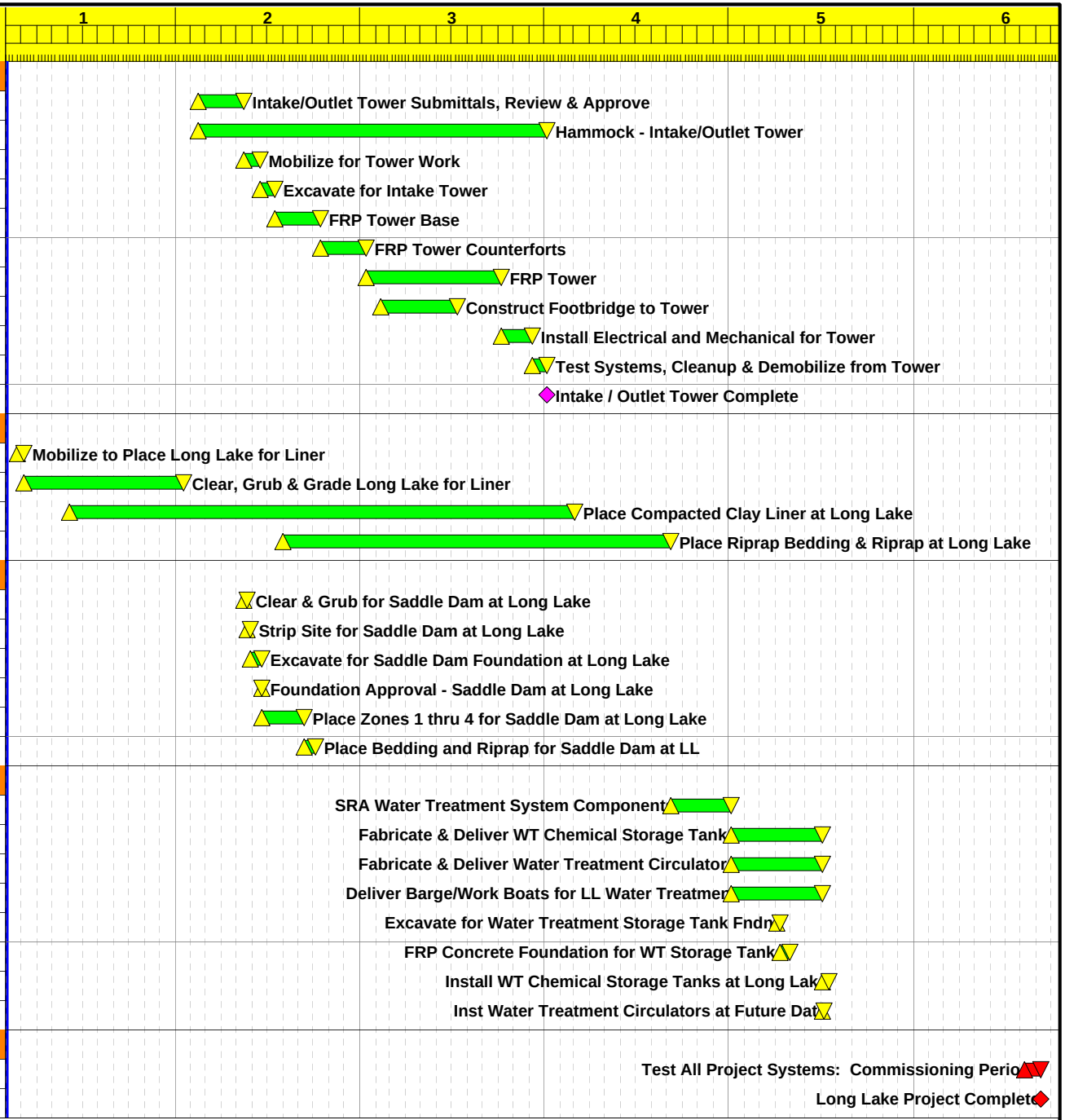
LL4D

Alternative No. 4, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 4D - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: For canal work, assumer 3.5 months		
	of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
Intake/Outlet Tower - 2,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	690*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	90
1T14100	FRP Tower Counterforts	90
1T14125	FRP Tower	270
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake CLay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	14
1CL6120	Clear, Grub & Grade Long Lake for Liner	315
1CL6140	Place Compacted Clay Liner at Long Lake	1,000
1CL6160	Place Riprap Bedding & Riprap at Long Lake	770
Long Lake Saddle Dam		
1SD8000	Clear & Grub for Saddle Dam at Long Lake	7
1SD8025	Strip Site for Saddle Dam at Long Lake	5
1SD8050	Excavate for Saddle Dam Foundation at Long Lake	21
1SD8075	Foundation Approval - Saddle Dam at Long Lake	2
1SD8100	Place Zones 1 thru 4 for Saddle Dam at Long Lake	84
1SD8125	Place Bedding and Riprap for Saddle Dam at LL	21
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	6
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



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Early Bar
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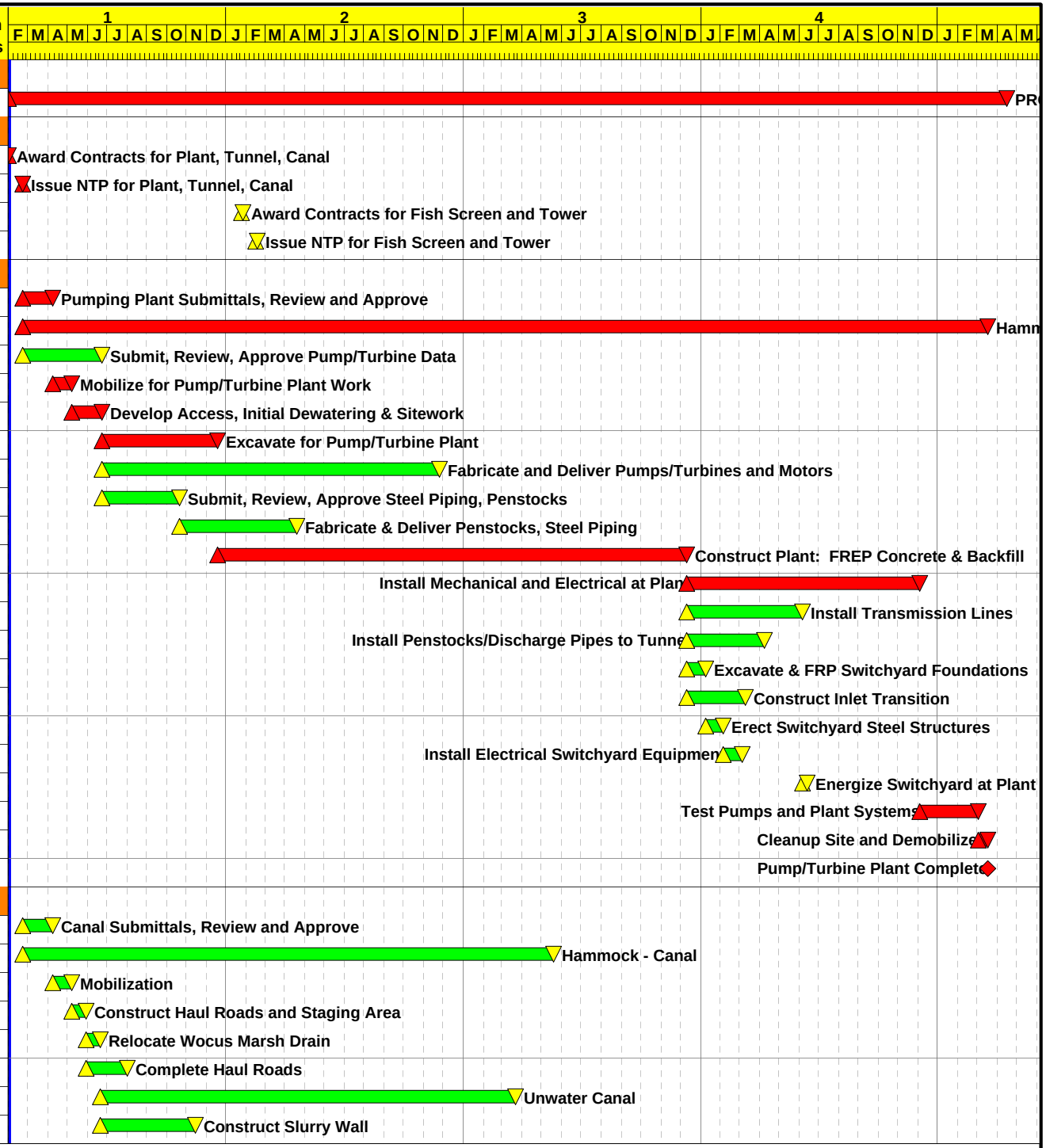
LL4D

Alternative No. 4, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 4D - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: For canal work, assumer 3.5 months		
	of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	1,537*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pump/Turbine Plant - 2,000 cfs		
1PA1100	Pumping Plant Submittals, Review and Approve	45
HAMPP	Hammock - Pumping Plant	1,484*
1PA1125	Submit, Review, Approve Pump/Turbine Data	120
1PA1150	Mobilize for Pump/Turbine Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pump/Turbine Plant	180
1PA1225	Fabricate and Deliver Pumps/Turbines and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	720
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pump/Turbine Plant Complete	0
Canal - 2,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
HAMC	Hammock - Canal	817*
1C13025	Mobilization	30
1C13050	Construct Haul Roads and Staging Area	21
1C13100	Relocate Wocus Marsh Drain	23
1C13075	Complete Haul Roads	64
1C13125	Unwater Canal	426*
1C13150	Construct Slurry Wall	146



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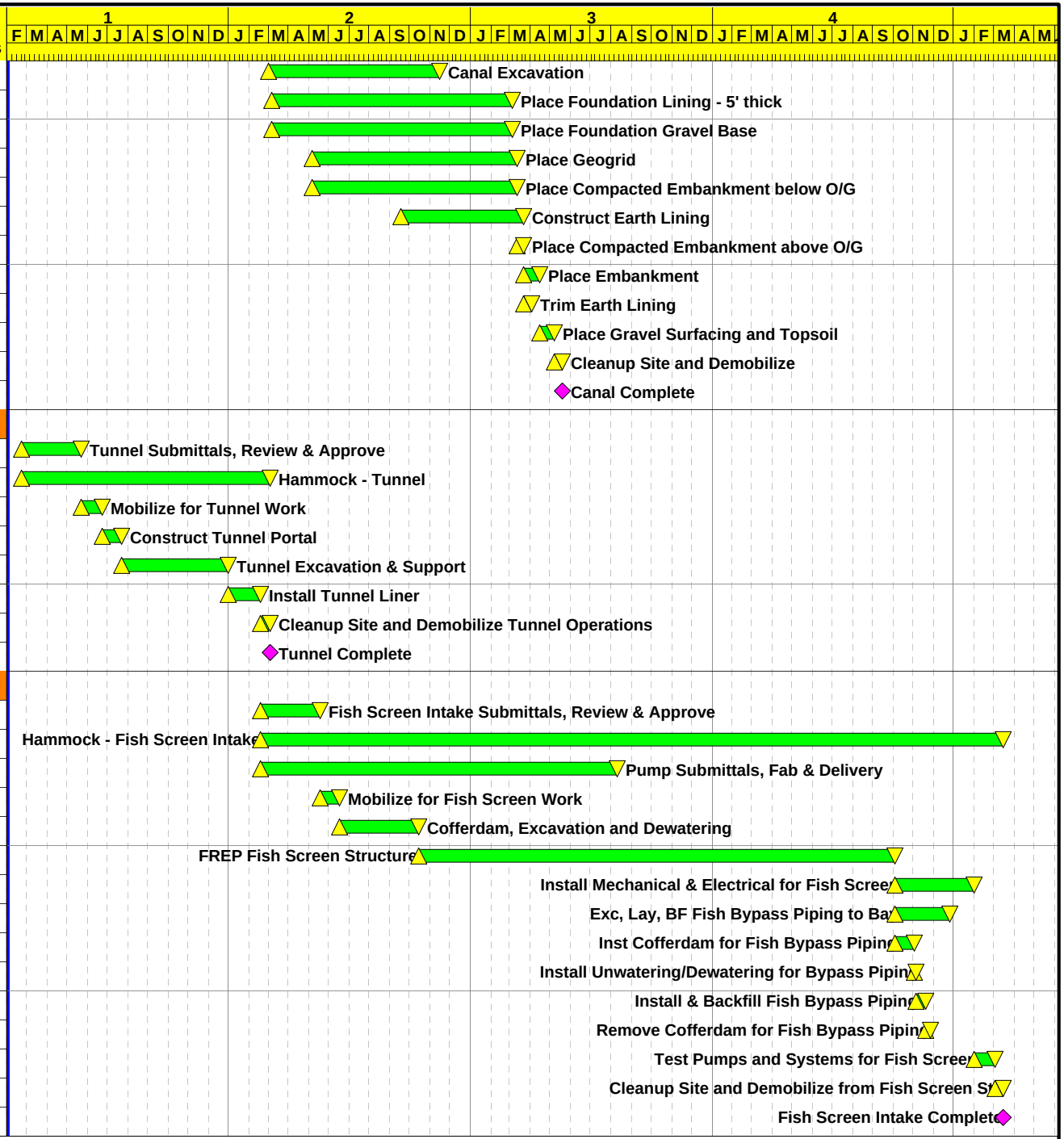
LL4E

Alternative No. 4, Option E
(2,000 cfs Pump/Turbine Plant)
Long Lake Valley - 4E - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: For canaly work, assume 3.5 months		
	of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
1C13175	Canal Excavation	259
1C13200	Place Foundation Lining - 5' thick	257
1C13225	Place Foundation Gravel Base	257*
1C13250	Place Geogrid	205*
1C13275	Place Compacted Embankment below O/G	205
1C13300	Construct Earth Lining	80
1C13325	Place Compacted Embankment above O/G	9
1C13350	Place Embankment	26
1C13375	Trim Earth Lining	13
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 2,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	374*
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	160
1T12200	Install Tunnel Liner	50
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 2,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	1,124*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	120
1F15175	FREP Fish Screen Structure	720
1F15250	Install Mechanical & Electrical for Fish Screen	120
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0



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Early Bar
Progress Bar
Critical Activity

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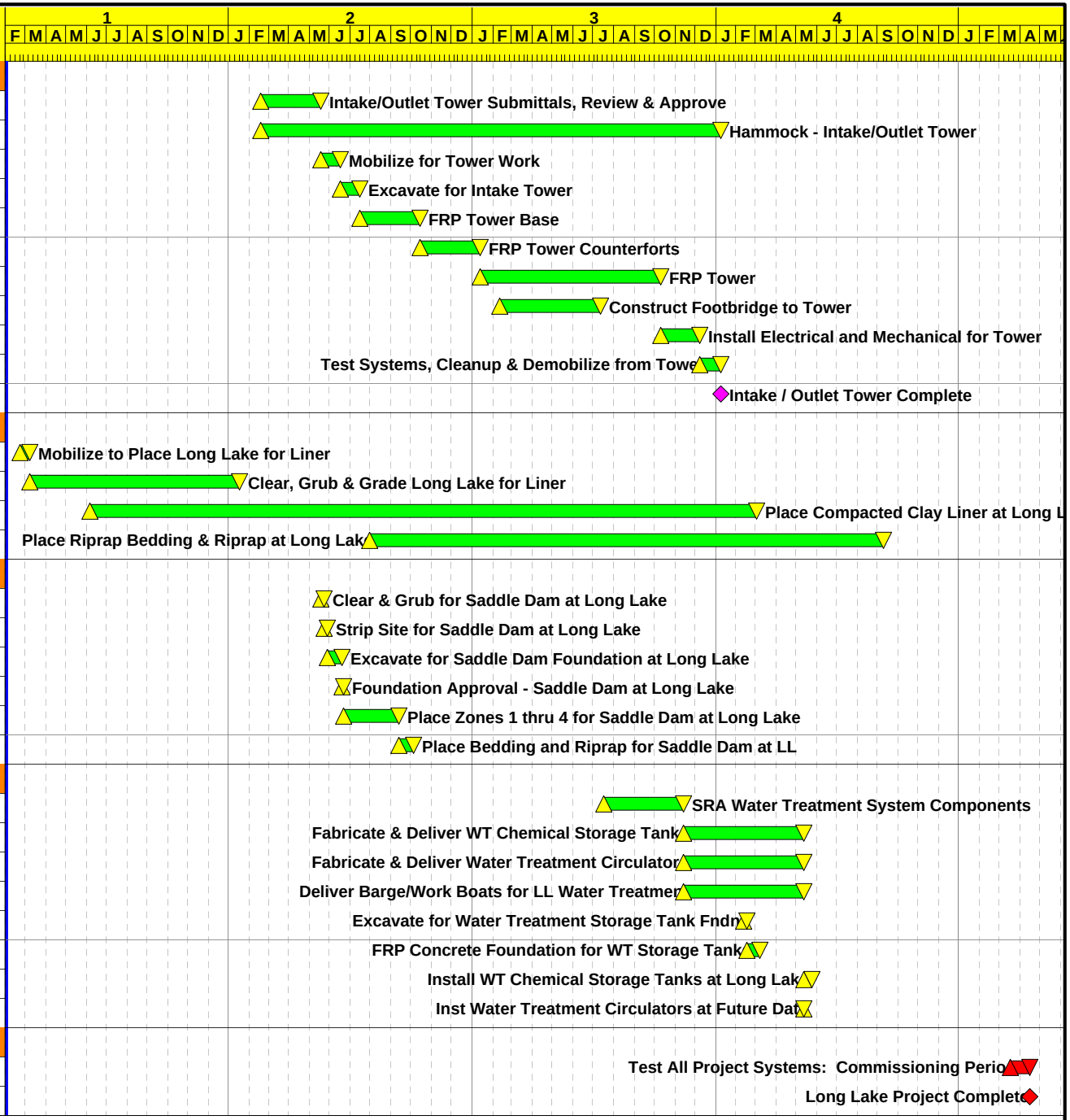
LL4E

Alternative No. 4, Option E
(2,000 cfs Pump/Turbine Plant)
Long Lake Valley - 4E - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: For canaly work, assume 3.5 months		
	of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
Intake/Outlet Tower - 2,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	690*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	90
1T14100	FRP Tower Counterforts	90
1T14125	FRP Tower	270
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	14
1CL6120	Clear, Grub & Grade Long Lake for Liner	315
1CL6140	Place Compacted Clay Liner at Long Lake	1,000
1CL6160	Place Riprap Bedding & Riprap at Long Lake	770
Long Lake Saddle Dam		
1SD8000	Clear & Grub for Saddle Dam at Long Lake	7
1SD8025	Strip Site for Saddle Dam at Long Lake	5
1SD8050	Excavate for Saddle Dam Foundation at Long Lake	21
1SD8075	Foundation Approval - Saddle Dam at Long Lake	2
1SD8100	Place Zones 1 thru 4 for Saddle Dam at Long Lake	84
1SD8125	Place Bedding and Riprap for Saddle Dam at LL	21
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	6
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



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Early Bar
Progress Bar
Critical Activity

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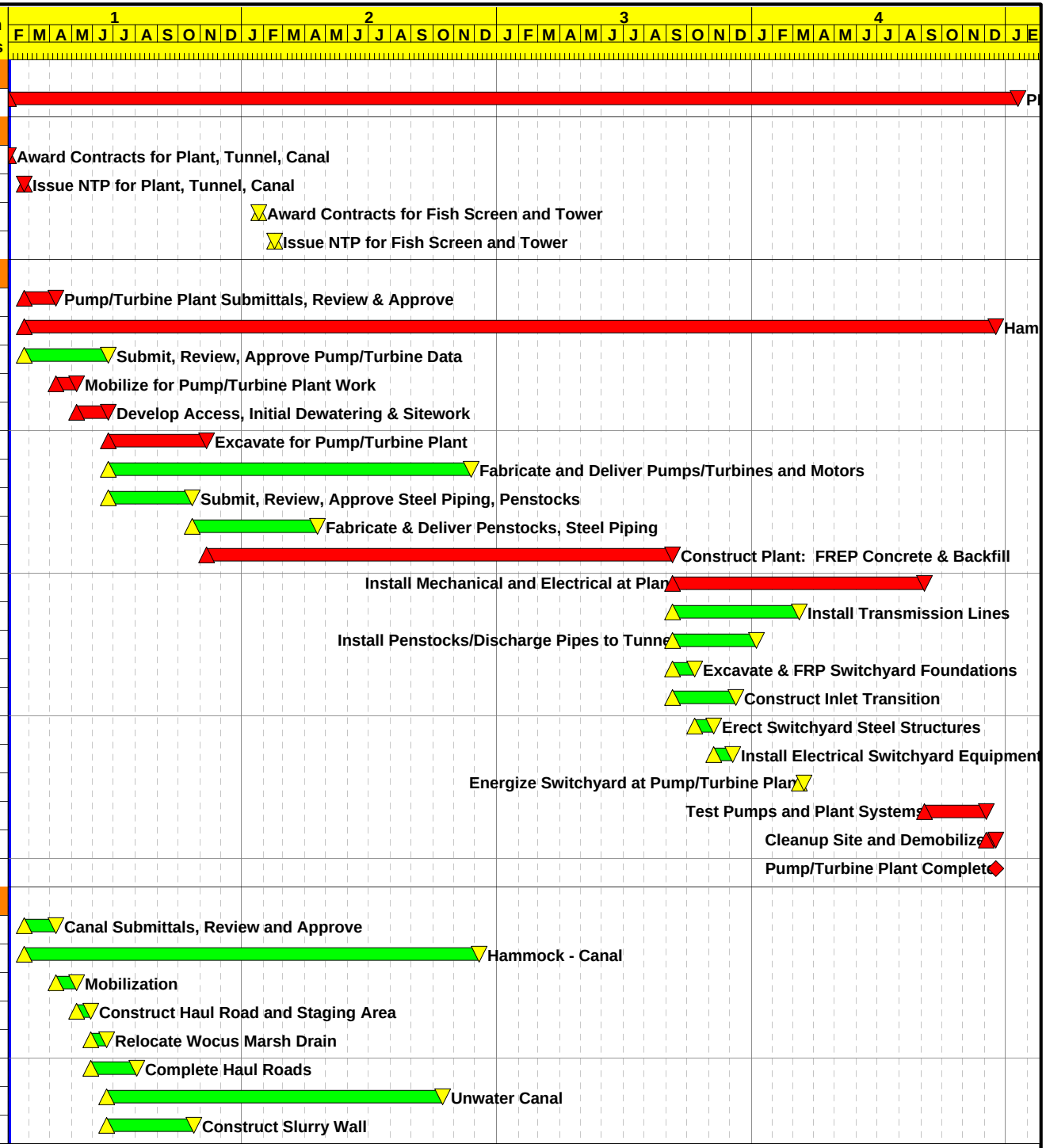
LL4E

Alternative No. 4, Option E
(2,000 cfs Pump/Turbine Plant)
Long Lake Valley - 4E - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	NOTE: For canaly work, assume 3.5 months		
	of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	1,447*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pump/Turbine Plant - 1,000 cfs		
1PA1100	Pump/Turbine Plant Submittals, Review & Approve	45
HAMPP	Hammock - Pumping Plant	1,394*
1PA1125	Submit, Review, Approve Pump/Turbine Data	120
1PA1150	Mobilize for Pump/Turbine Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pump/Turbine Plant	140
1PA1225	Fabricate and Deliver Pumps/Turbines and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	670
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pump/Turbine Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pump/Turbine Plant Complete	0
Canal - 1,000 cfs		
1C13000	Canal Submittals, Review and Approve	45
HAMC	Hammock - Canal	653*
1C13025	Mobilization	30
1C13050	Construct Haul Road and Staging Area	21
1C13100	Relocate Wocus Marsh Drain	23
1C13075	Complete Haul Roads	64
1C13125	Unwater Canal	374*
1C13150	Construct Slurry Wall	123



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Early Bar
Progress Bar
Critical Activity

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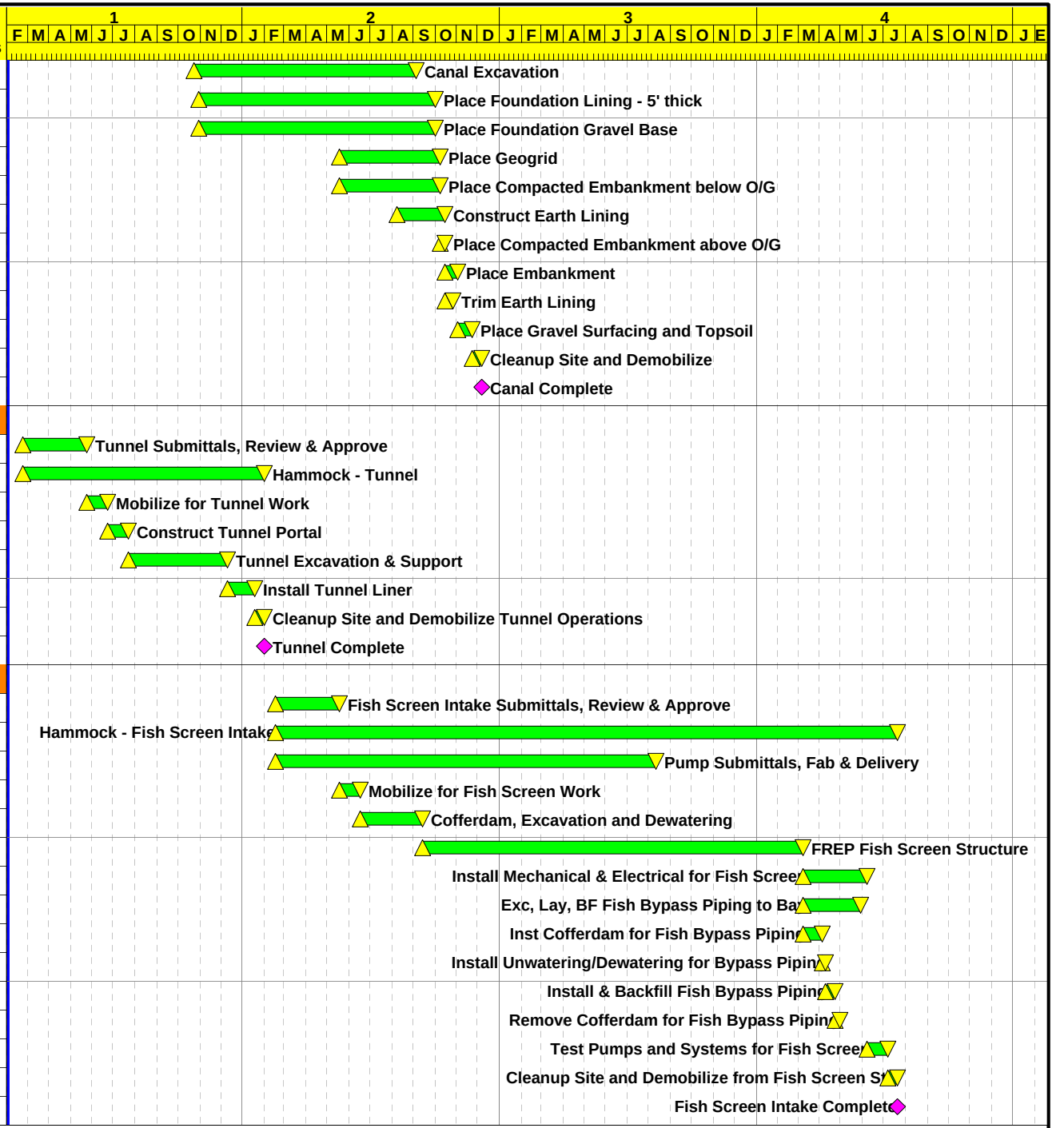
LL4F

Alternative No. 4, Option F
(1,000 cfs Pump/Turbine Plant)
Long Lake Valley - 4F - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	Note: For Canal work, assume 3.5 months of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
1C13175	Canal Excavation	210
1C13200	Place Foundation Lining - 5' thick	231
1C13225	Place Foundation Gravel Base	231*
1C13250	Place Geogrid	143*
1C13275	Place Compacted Embankment below O/G	143
1C13300	Construct Earth Lining	67
1C13325	Place Compacted Embankment above O/G	6
1C13350	Place Embankment	20
1C13375	Trim Earth Lining	13
1C13400	Place Gravel Surfacing and Topsoil	20
1C13425	Cleanup Site and Demobilize	14
1C13450	Canal Complete	0
Tunnel - 1,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	344*
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	140
1T12200	Install Tunnel Liner	40
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 1,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	884*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	90
1F15175	FREP Fish Screen Structure	540
1F15250	Install Mechanical & Electrical for Fish Screen	90
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	82
1F15400	Inst Cofferdam for Fish Bypass Piping	28
1F15425	Install Unwatering/Dewatering for Bypass Piping	3
1F15450	Install & Backfill Fish Bypass Piping	15
1F15475	Remove Cofferdam for Fish Bypass Piping	7
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0



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Finish Date 17JAN20
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Early Bar
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Critical Activity

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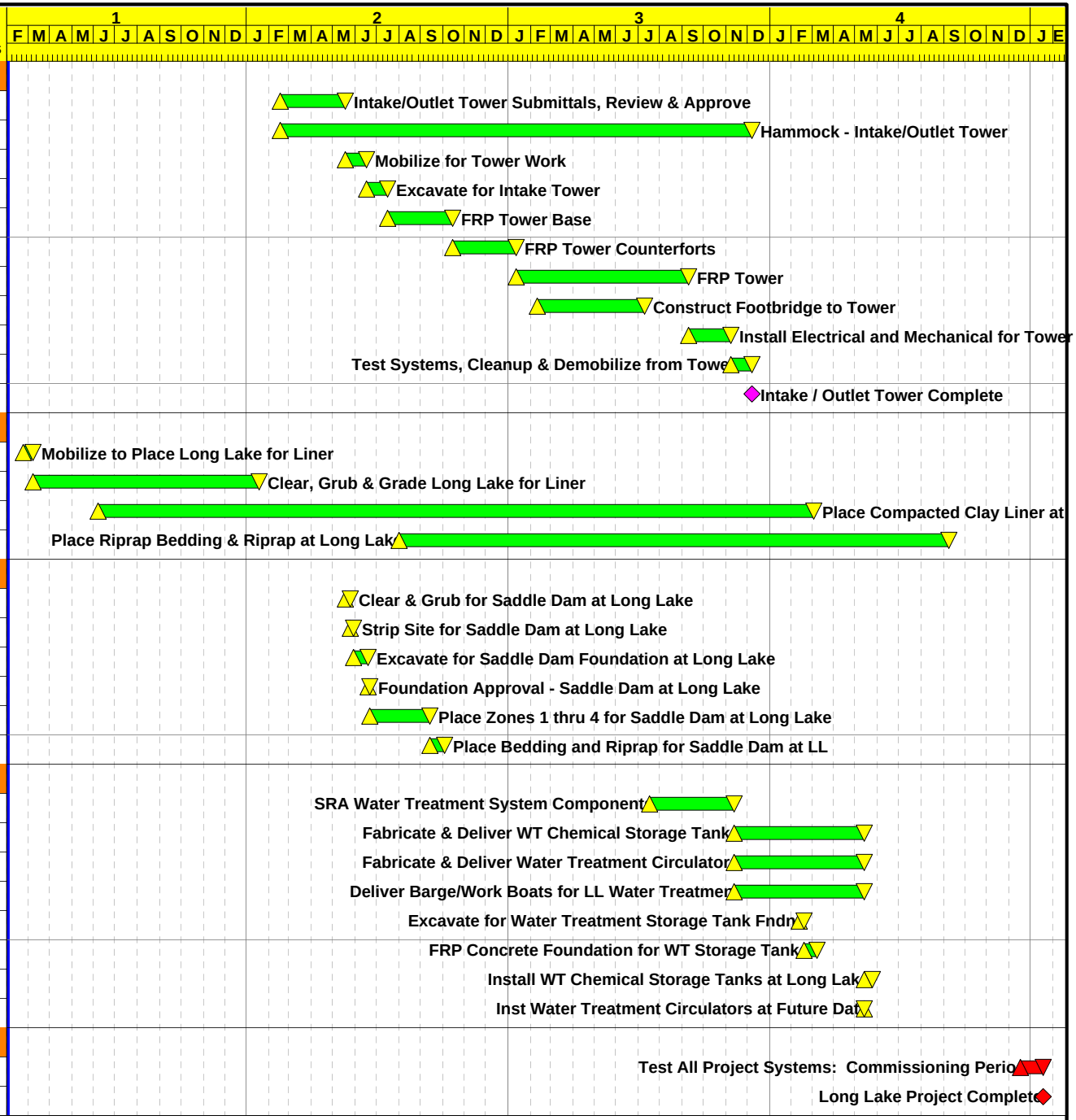
LL4F

Alternative No. 4, Option F
(1,000 cfs Pump/Turbine Plant)
Long Lake Valley - 4F - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	Note: For Canal work, assume 3.5 months of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
Intake/Outlet Tower - 1,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	660*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30
1T14075	FRP Tower Base	90
1T14100	FRP Tower Counterforts	90
1T14125	FRP Tower	240
1T14150	Construct Footbridge to Tower	150
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	14
1CL6120	Clear, Grub & Grade Long Lake for Liner	315
1CL6140	Place Compacted Clay Liner at Long Lake	1,000
1CL6160	Place Riprap Bedding & Riprap at Long Lake	770
Long Lake Saddle Dam		
1SD8000	Clear & Grub for Saddle Dam at Long Lake	7
1SD8025	Strip Site for Saddle Dam at Long Lake	5
1SD8050	Excavate for Saddle Dam Foundation at Long Lake	21
1SD8075	Foundation Approval - Saddle Dam at Long Lake	2
1SD8100	Place Zones 1 thru 4 for Saddle Dam at Long Lake	84
1SD8125	Place Bedding and Riprap for Saddle Dam at LL	21
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	6
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



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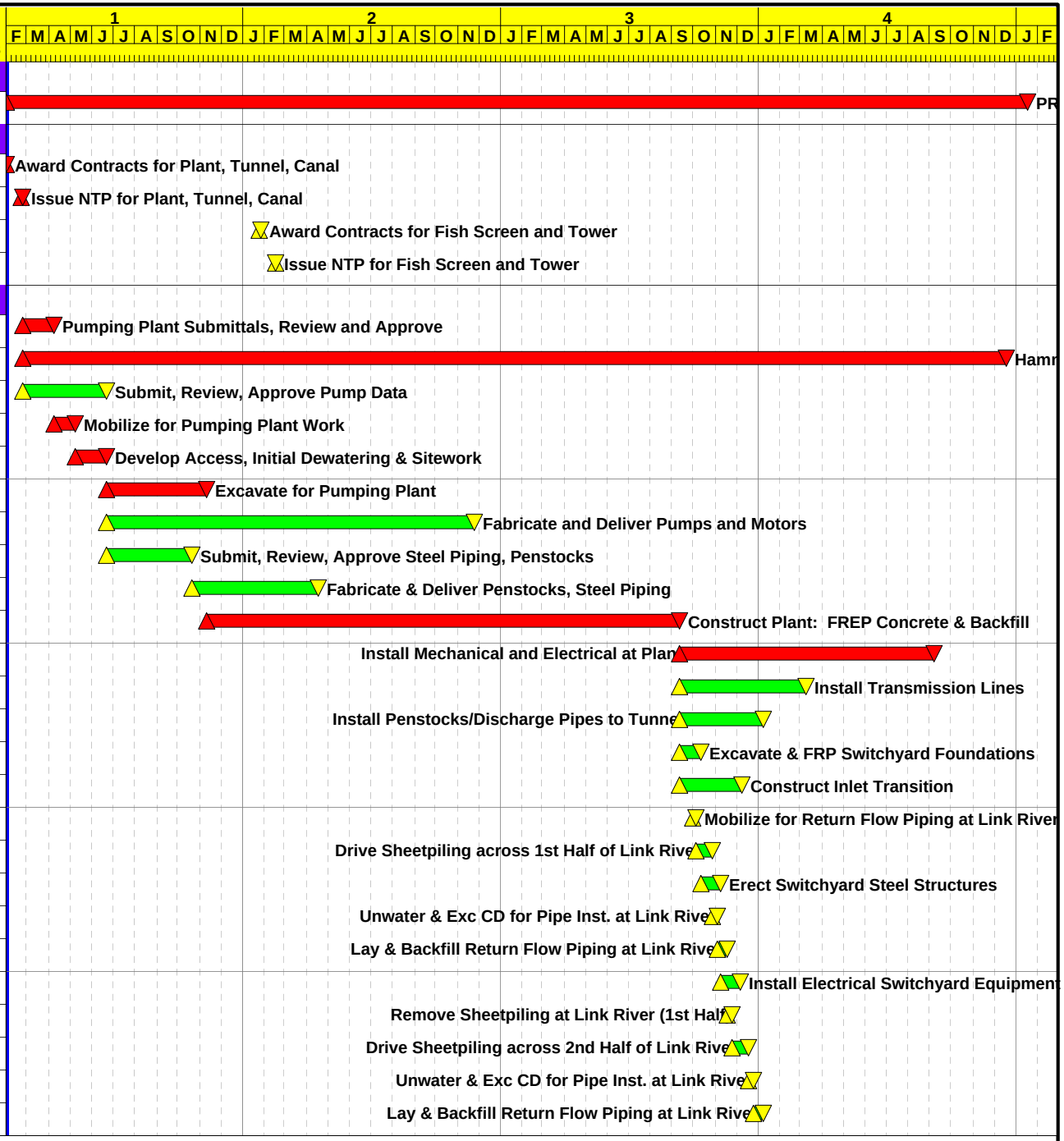
LL4F

Alternative No. 4, Option F
(1,000 cfs Pump/Turbine Plant)
Long Lake Valley - 4F - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved
	Note: For Canal work, assume 3.5 months of winter weather impacts each year.		

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	1,447*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping Plant - 1,000 cfs		
1PA1100	Pumping Plant Submittals, Review and Approve	45
HAMPP	Hammock - Pumping Plant	1,394*
1PA1125	Submit, Review, Approve Pump Data	120
1PA1150	Mobilize for Pumping Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping Plant	140
1PA1225	Fabricate and Deliver Pumps and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	670
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
RFP1700	Mobilize for Return Flow Piping at Link River	3
RFP1725	Drive Sheetpiling across 1st Half of Link River	25
1PA1500	Erect Switchyard Steel Structures	28
RFP1750	Unwater & Exc CD for Pipe Inst. at Link River	7
RFP1775	Lay & Backfill Return Flow Piping at Link River	12
1PA1525	Install Electrical Switchyard Equipment	28
RFP1800	Remove Sheetpiling at Link River (1st Half)	7
RFP1850	Drive Sheetpiling across 2nd Half of Link River	25
RFP1875	Unwater & Exc CD for Pipe Inst. at Link River	7
RFP1900	Lay & Backfill Return Flow Piping at Link River	12



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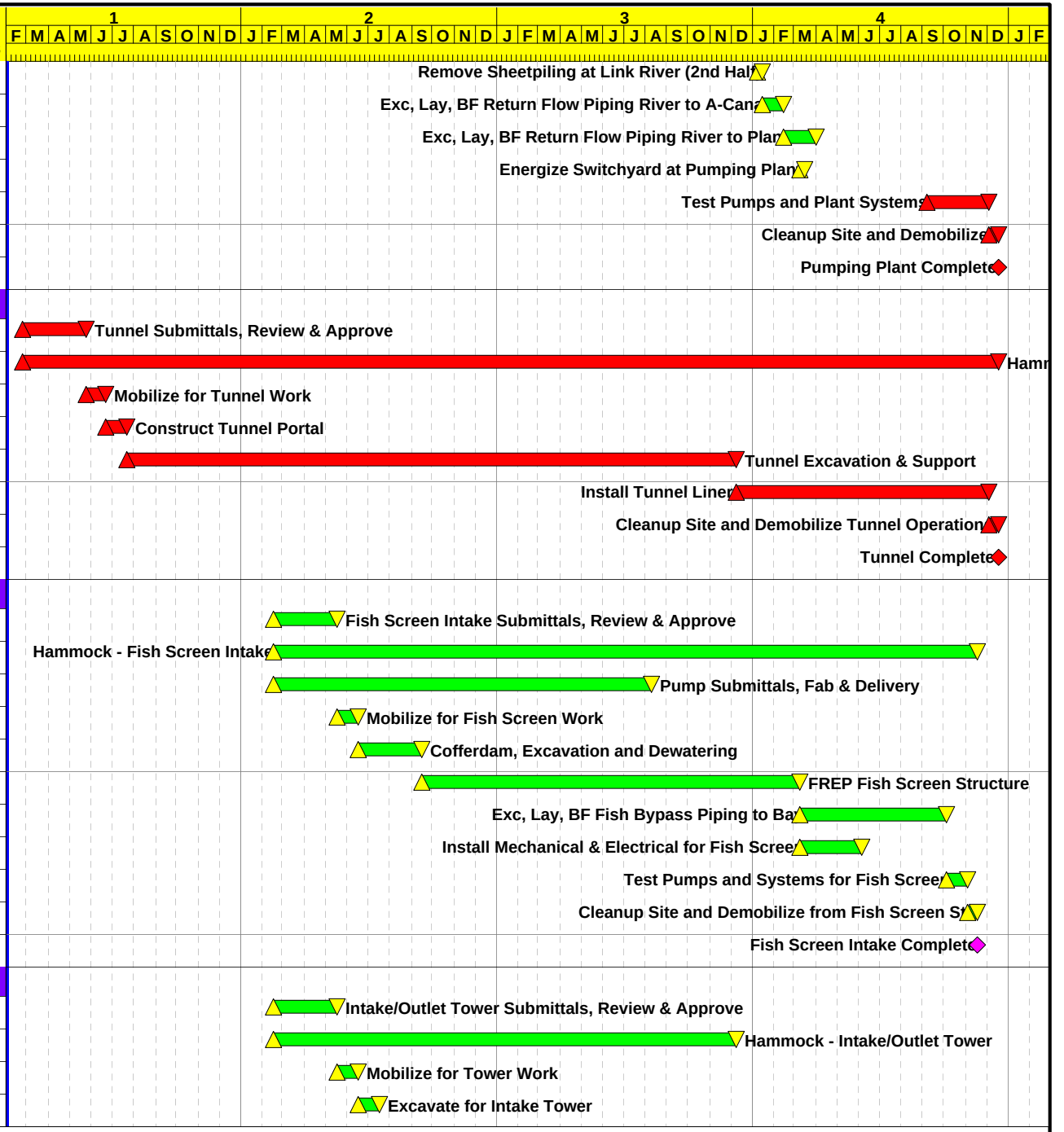
LL5A

Alternative No. 5, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 5A - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
RFP1925	Remove Sheetpiling at Link River (2nd Half)	7
RFP1950	Exc, Lay, BF Return Flow Piping River to A-Canal	32
RFP1975	Exc, Lay, BF Return Flow Piping River to Plant	45
1PA1550	Energize Switchyard at Pumping Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping Plant Complete	0
Tunnel - 1,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	1,394*
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	870
1T12200	Install Tunnel Liner	360
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 1,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	1,004*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	90
1F15175	FREP Fish Screen Structure	540
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	210
1F15250	Install Mechanical & Electrical for Fish Screen	90
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 1,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	660*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30



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Early Bar
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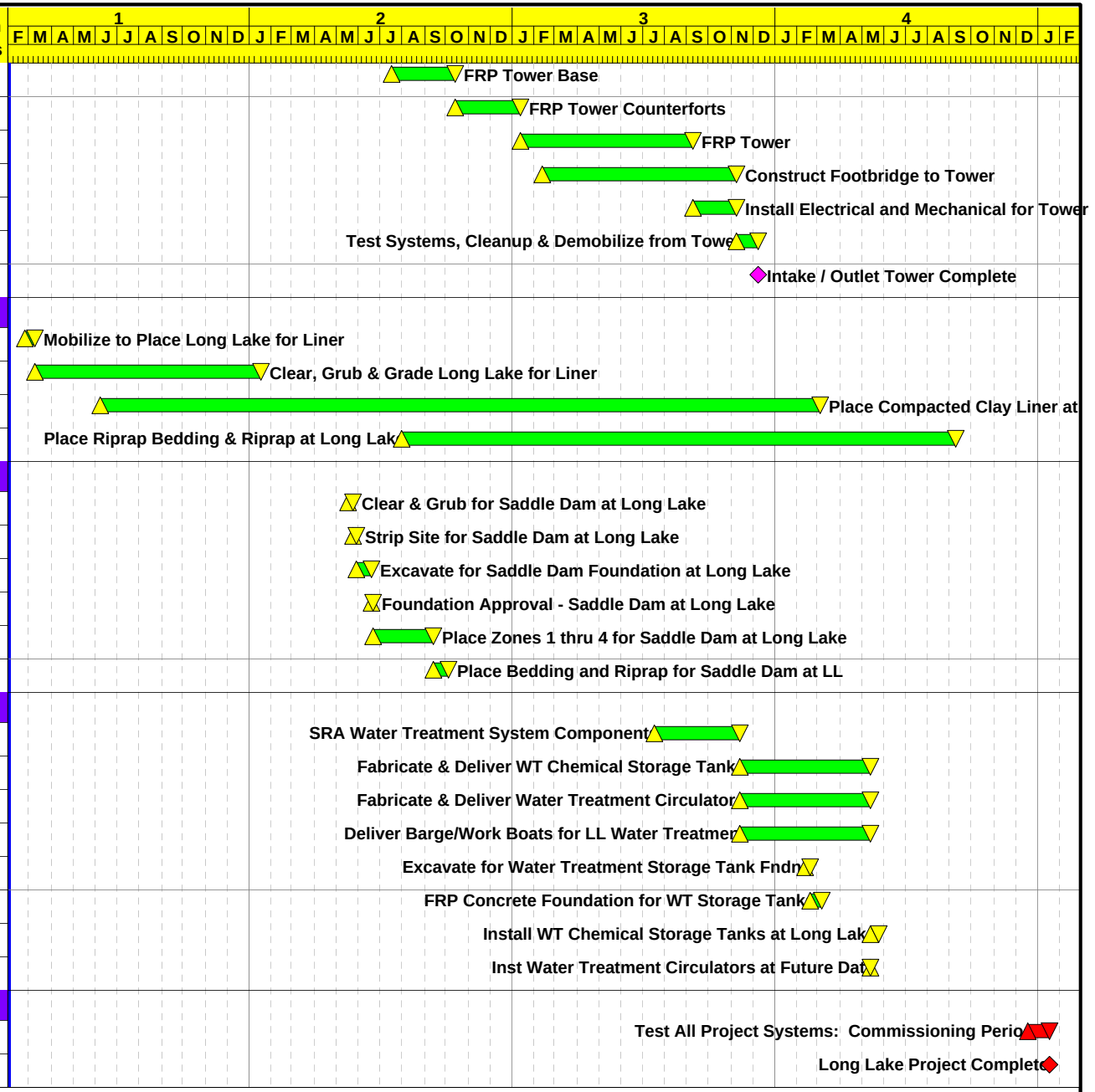
LL5A

Alternative No. 5, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 5A - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
1T14075	FRP Tower Base	90
1T14100	FRP Tower Counterforts	90
1T14125	FRP Tower	240
1T14150	Construct Footbridge to Tower	270
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	14
1CL6120	Clear, Grub & Grade Long Lake for Liner	315
1CL6140	Place Compacted Clay Liner at Long Lake	1,000
1CL6160	Place Riprap Bedding & Riprap at Long Lake	770
Long Lake Saddle Dam		
1SD8000	Clear & Grub for Saddle Dam at Long Lake	7
1SD8025	Strip Site for Saddle Dam at Long Lake	5
1SD8050	Excavate for Saddle Dam Foundation at Long Lake	21
1SD8075	Foundation Approval - Saddle Dam at Long Lake	2
1SD8100	Place Zones 1 thru 4 for Saddle Dam at Long Lake	84
1SD8125	Place Bedding and Riprap for Saddle Dam at LL	21
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	6
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date 01FEB16
Finish Date 17JAN20
Data Date 01FEB16
Run Date 27MAR09 14:50

Early Bar
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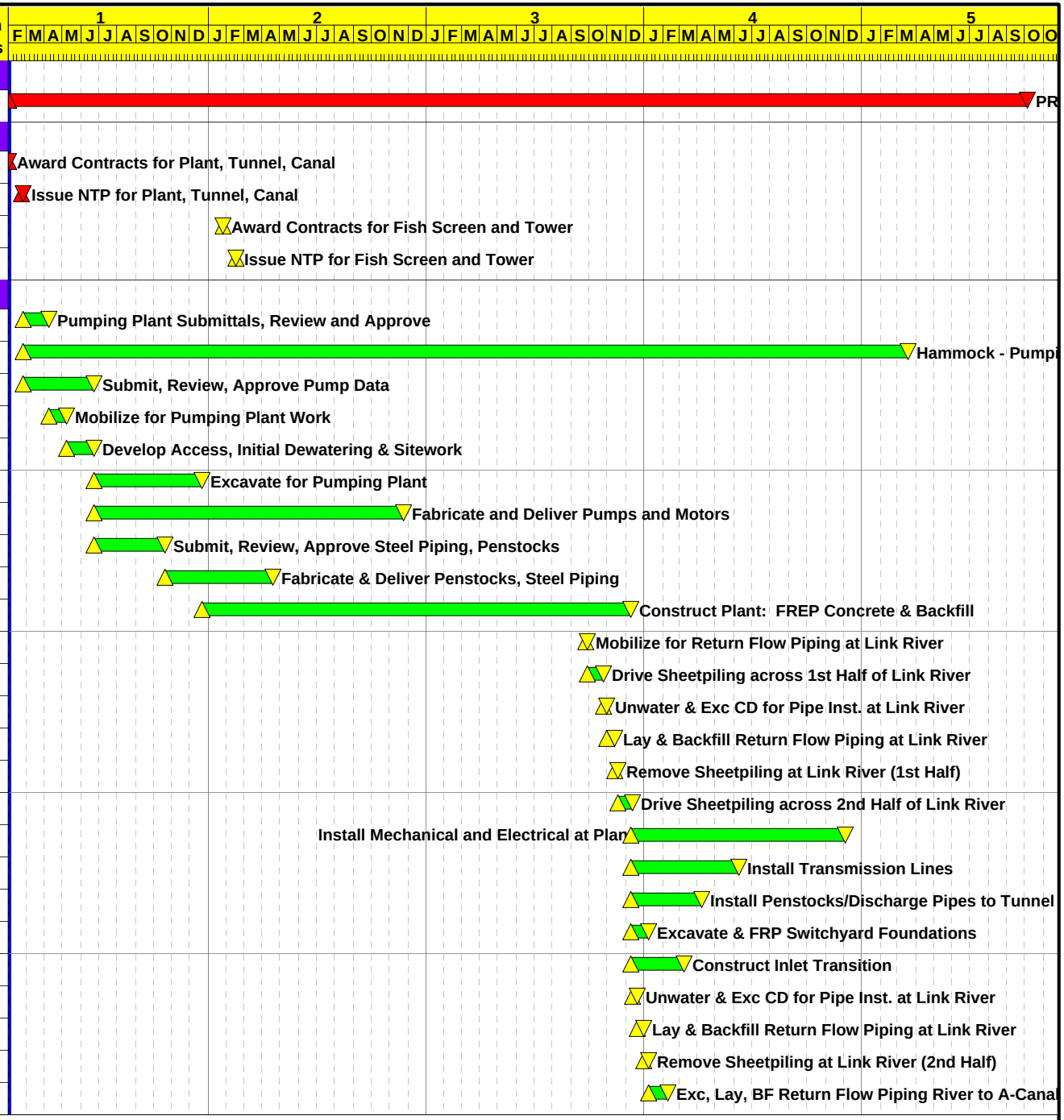
LL5A

Alternative No. 5, Option A
(1,000 cfs Pumping Plant)
Long Lake Valley - 5A - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	1,707*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping Plant - 2,000 cfs		
1PA1100	Pumping Plant Submittals, Review and Approve	45
HAMPP	Hammock - Pumping Plant	1,484*
1PA1125	Submit, Review, Approve Pump Data	120
1PA1150	Mobilize for Pumping Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping Plant	180
1PA1225	Fabricate and Deliver Pumps and Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	720
RFP1700	Mobilize for Return Flow Piping at Link River	3
RFP1725	Drive Sheetpiling across 1st Half of Link River	25
RFP1750	Unwater & Exc CD for Pipe Inst. at Link River	7
RFP1775	Lay & Backfill Return Flow Piping at Link River	12
RFP1800	Remove Sheetpiling at Link River (1st Half)	7
RFP1850	Drive Sheetpiling across 2nd Half of Link River	25
1PA1375	Install Mechanical and Electrical at Plant	360
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
RFP1875	Unwater & Exc CD for Pipe Inst. at Link River	7
RFP1900	Lay & Backfill Return Flow Piping at Link River	12
RFP1925	Remove Sheetpiling at Link River (2nd Half)	7
RFP1950	Exc, Lay, BF Return Flow Piping River to A-Canal	32



Start Date 01FEB16
Finish Date 03OCT20
Data Date 01FEB16
Run Date 27MAR09 14:55

Early Bar
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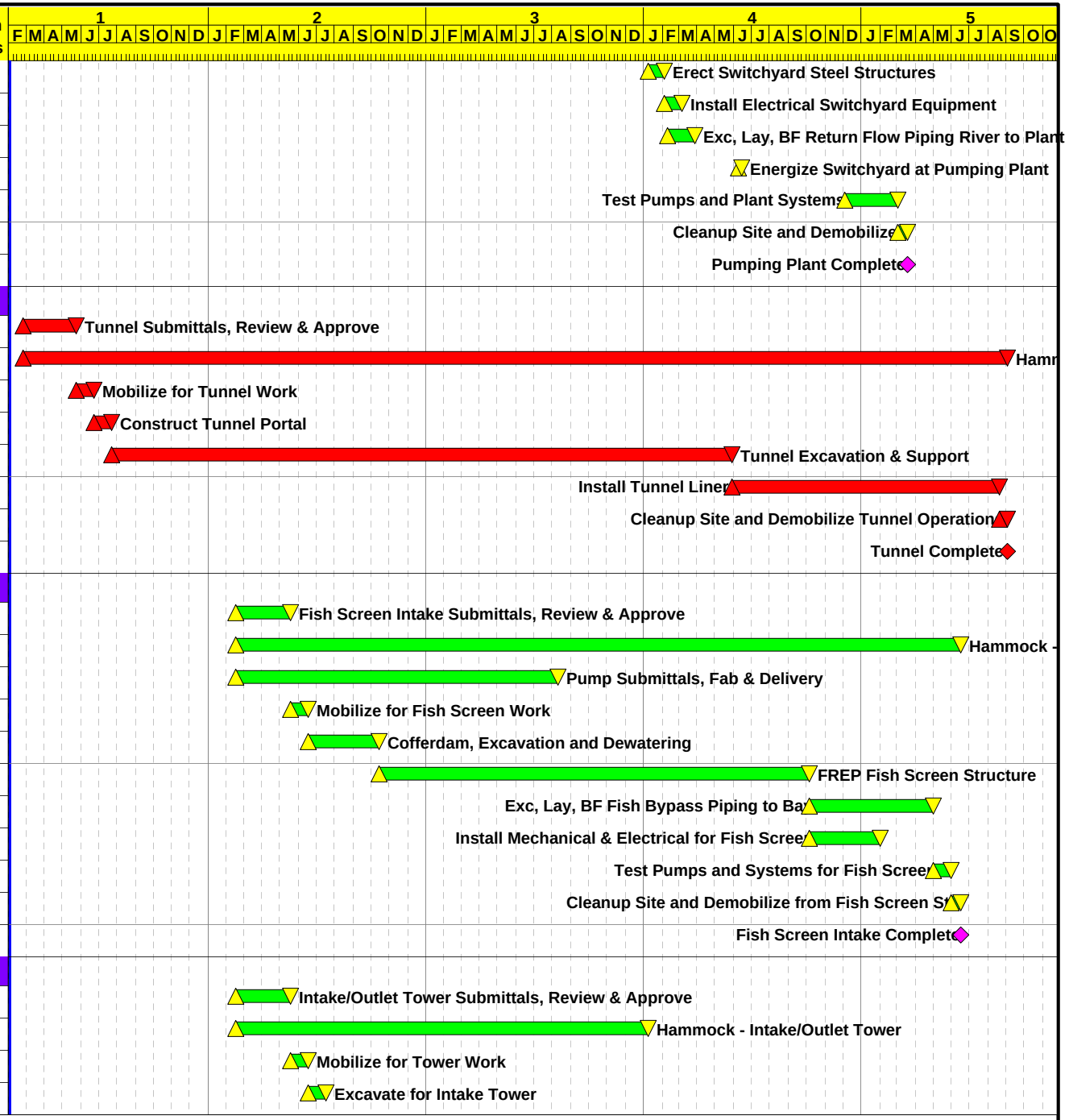
LL5B

Sheet 1 of 3

Alternative No. 5, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 5B - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
RFP1975	Exc, Lay, BF Return Flow Piping River to Plant	45
1PA1550	Energize Switchyard at Pumping Plant	7
1PA1575	Test Pumps and Plant Systems	90
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping Plant Complete	0
Tunnel - 2,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	1,654*
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	1,040
1T12200	Install Tunnel Liner	450
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 2,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	1,214*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	120
1F15175	FREP Fish Screen Structure	720
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	210
1F15250	Install Mechanical & Electrical for Fish Screen	120
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 2,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	690*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30



Start Date 01FEB16
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Early Bar
Progress Bar
Critical Activity

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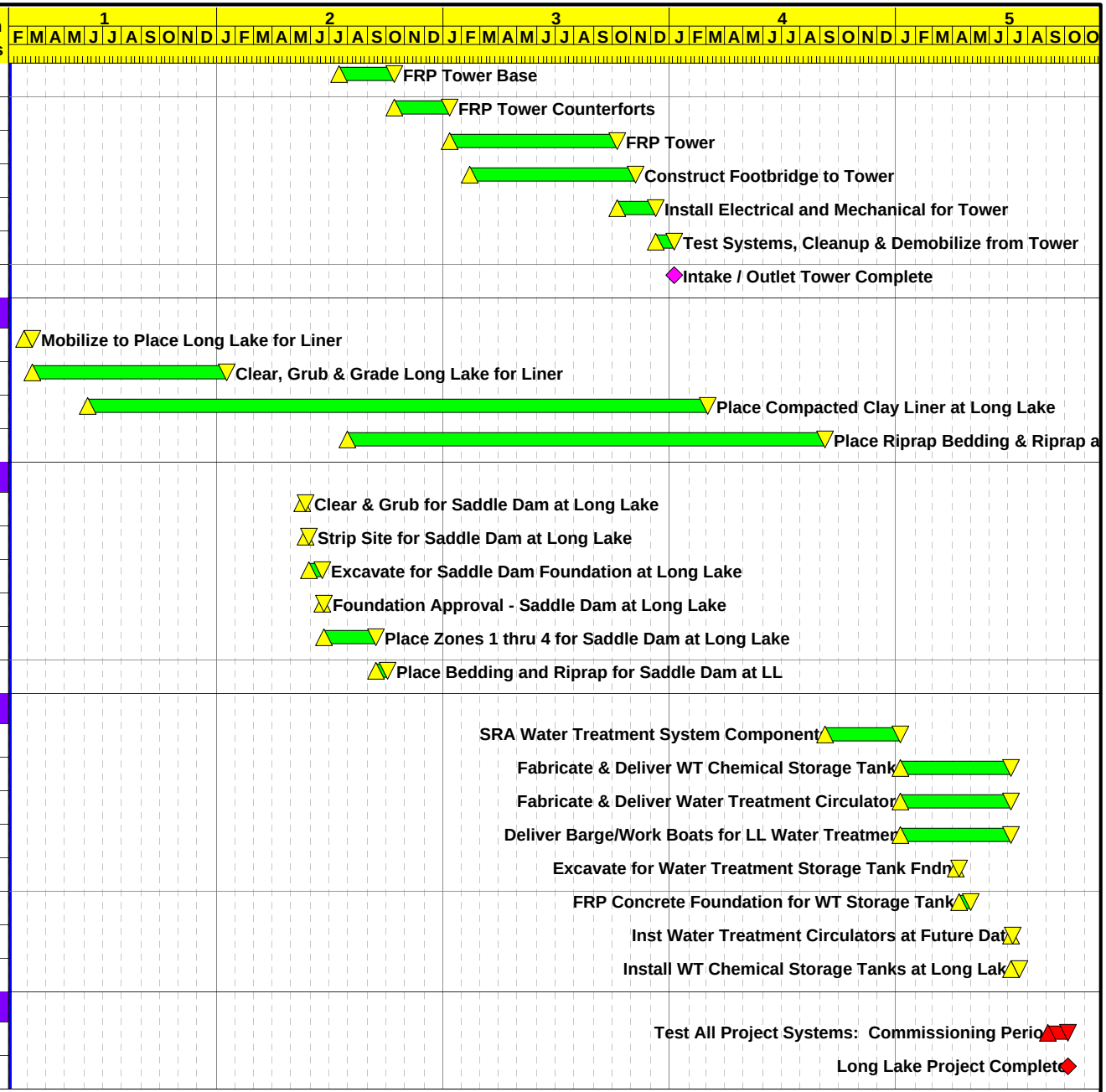
LL5B

Sheet 2 of 3

Alternative No. 5, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 5B - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
1T14075	FRP Tower Base	90
1T14100	FRP Tower Counterforts	90
1T14125	FRP Tower	270
1T14150	Construct Footbridge to Tower	270
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	14
1CL6120	Clear, Grub & Grade Long Lake for Liner	315
1CL6140	Place Compacted Clay Liner at Long Lake	1,000
1CL6160	Place Riprap Bedding & Riprap at Long Lake	770
Long Lake Saddle Dam		
1SD8000	Clear & Grub for Saddle Dam at Long Lake	7
1SD8025	Strip Site for Saddle Dam at Long Lake	5
1SD8050	Excavate for Saddle Dam Foundation at Long Lake	21
1SD8075	Foundation Approval - Saddle Dam at Long Lake	2
1SD8100	Place Zones 1 thru 4 for Saddle Dam at Long Lake	84
1SD8125	Place Bedding and Riprap for Saddle Dam at LL	21
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	6
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7300	Inst Water Treatment Circulators at Future Date	1
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date 01FEB16
Finish Date 03OCT20
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Run Date 27MAR09 14:55

Early Bar
Progress Bar
Critical Activity

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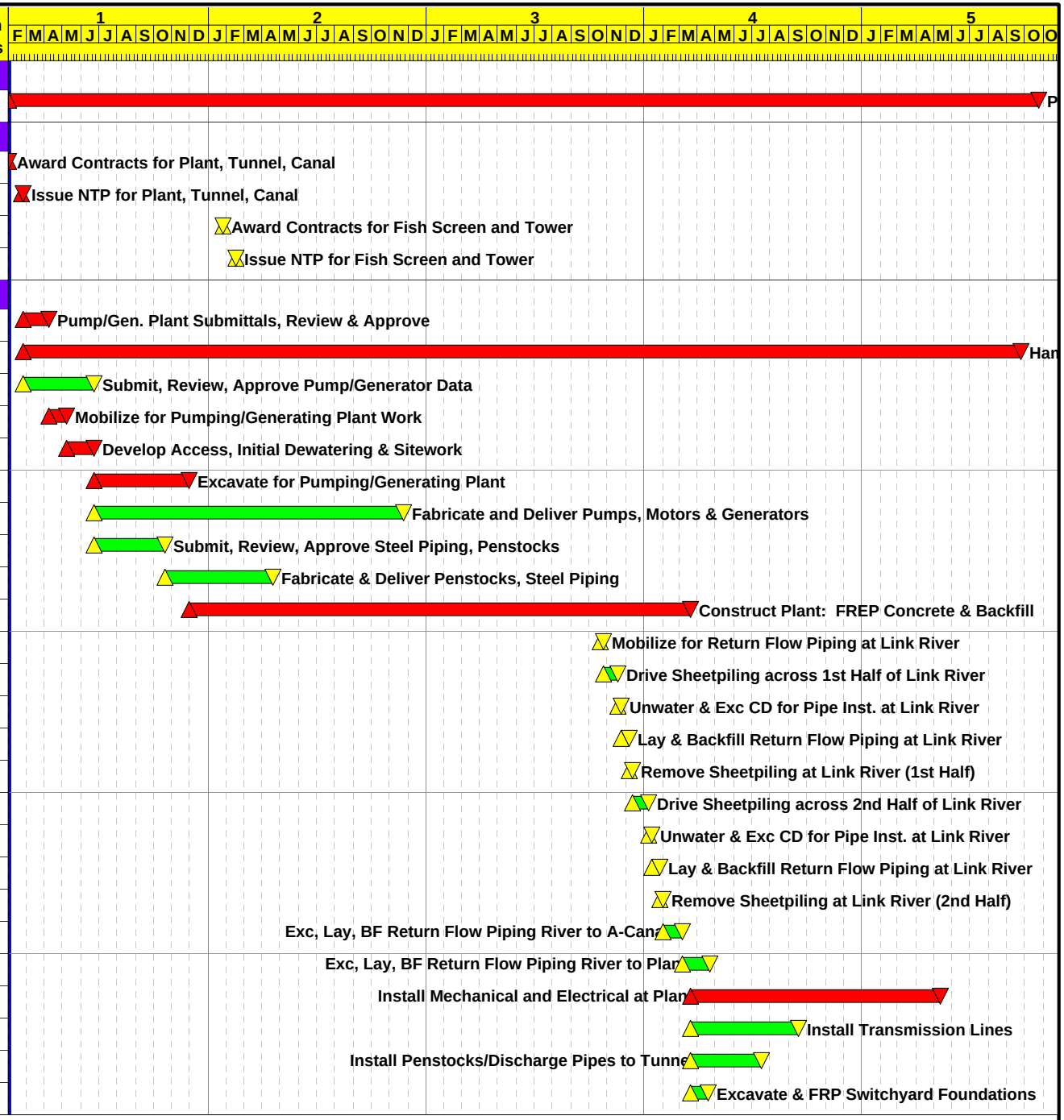
LL5B

Sheet 3 of 3

Alternative No. 5, Option B
(2,000 cfs Pumping Plant)
Long Lake Valley - 5B - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	1,727*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping and Generating Plant - 1,000 cfs		
1PA1100	Pump/Gen. Plant Submittals, Review & Approve	45
HAMPP	Hammock - Pumping Plant	1,674*
1PA1125	Submit, Review, Approve Pump/Generator Data	120
1PA1150	Mobilize for Pumping/Generating Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping/Generating Plant	160
1PA1225	Fabricate and Deliver Pumps, Motors & Generators	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	840
RFP1700	Mobilize for Return Flow Piping at Link River	3
RFP1725	Drive Sheetpiling across 1st Half of Link River	25
RFP1750	Unwater & Exc CD for Pipe Inst. at Link River	7
RFP1775	Lay & Backfill Return Flow Piping at Link River	12
RFP1800	Remove Sheetpiling at Link River (1st Half)	7
RFP1850	Drive Sheetpiling across 2nd Half of Link River	25
RFP1875	Unwater & Exc CD for Pipe Inst. at Link River	7
RFP1900	Lay & Backfill Return Flow Piping at Link River	12
RFP1925	Remove Sheetpiling at Link River (2nd Half)	7
RFP1950	Exc, Lay, BF Return Flow Piping River to A-Canal	32
RFP1975	Exc, Lay, BF Return Flow Piping River to Plant	45
1PA1375	Install Mechanical and Electrical at Plant	420
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30



Start Date 01FEB16
Finish Date 23OCT20
Data Date 01FEB16
Run Date 27MAR09 14:59

Early Bar
Progress Bar
Critical Activity

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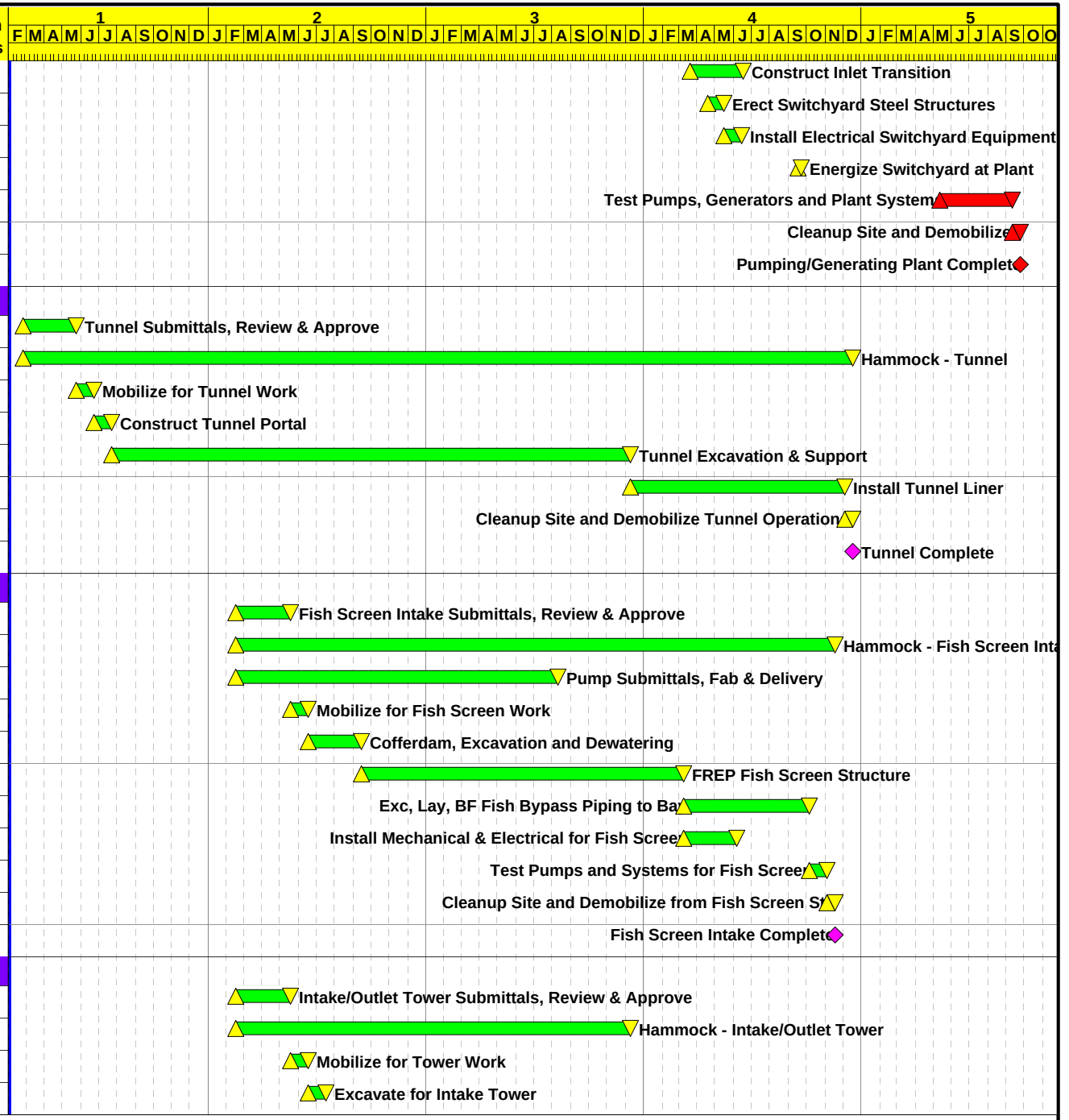
LL5C

Sheet 1 of 3

Alternative No. 5, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 5C - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
1PA1475	Construct Inlet Transition	90
1PA1500	Erect Switchyard Steel Structures	28
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Plant	7
1PA1575	Test Pumps, Generators and Plant Systems	120
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping/Generating Plant Complete	0
Tunnel - 1,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	1,394*
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	870
1T12200	Install Tunnel Liner	360
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 1,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	1,004*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	90
1F15175	FREP Fish Screen Structure	540
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	210
1F15250	Install Mechanical & Electrical for Fish Screen	90
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 1,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	660*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30



Start Date 01FEB16
Finish Date 23OCT20
Data Date 01FEB16
Run Date 27MAR09 14:59

Early Bar
Progress Bar
Critical Activity

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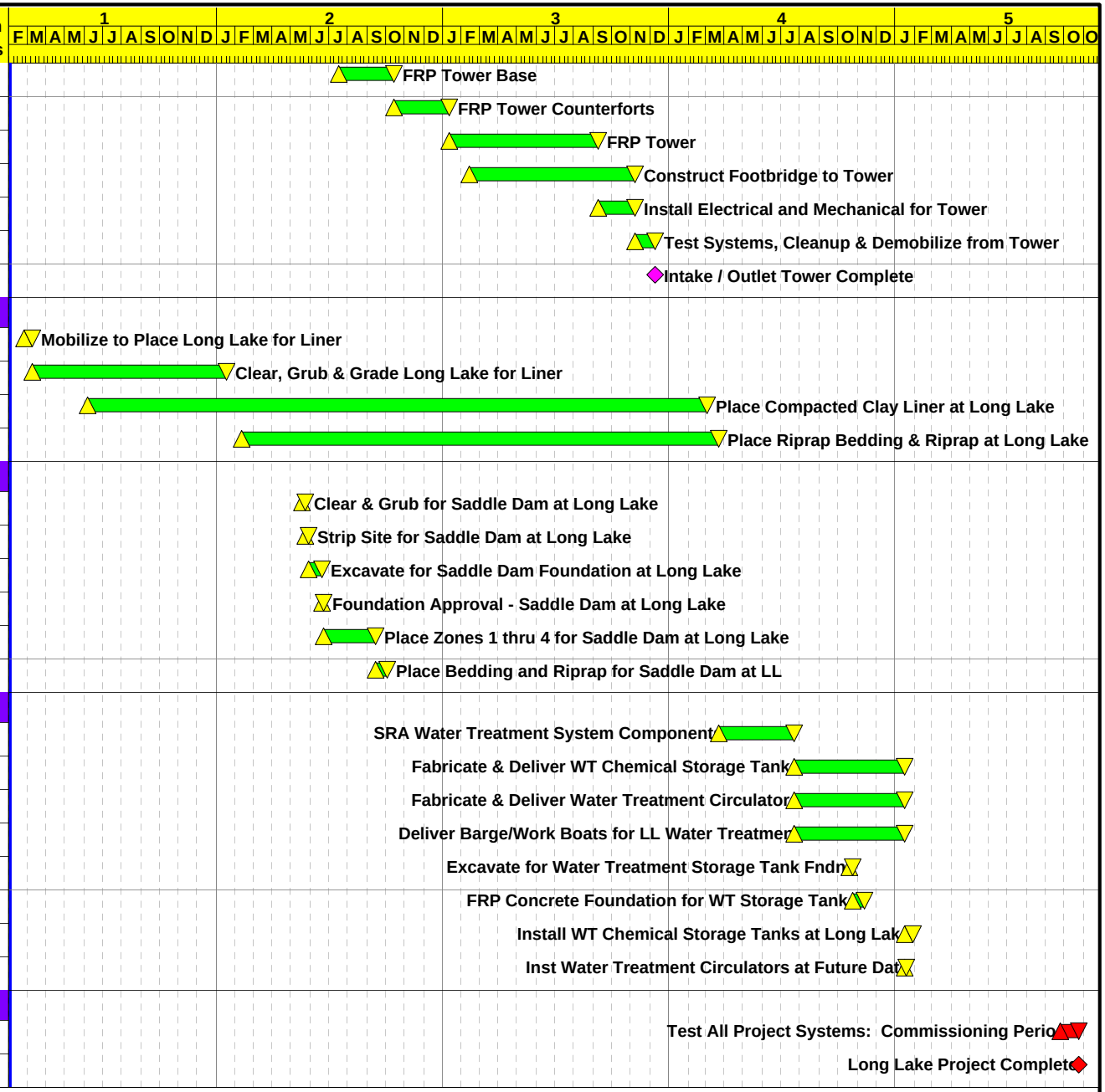
LL5C

Sheet 2 of 3

Alternative No. 5, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 5C - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
1T14075	FRP Tower Base	90
1T14100	FRP Tower Counterforts	90
1T14125	FRP Tower	240
1T14150	Construct Footbridge to Tower	270
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	14
1CL6120	Clear, Grub & Grade Long Lake for Liner	315
1CL6140	Place Compacted Clay Liner at Long Lake	1,000
1CL6160	Place Riprap Bedding & Riprap at Long Lake	770
Long Lake Saddle Dam		
1SD8000	Clear & Grub for Saddle Dam at Long Lake	7
1SD8025	Strip Site for Saddle Dam at Long Lake	5
1SD8050	Excavate for Saddle Dam Foundation at Long Lake	21
1SD8075	Foundation Approval - Saddle Dam at Long Lake	2
1SD8100	Place Zones 1 thru 4 for Saddle Dam at Long Lake	84
1SD8125	Place Bedding and Riprap for Saddle Dam at LL	21
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	6
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



Start Date 01FEB16
Finish Date 23OCT20
Data Date 01FEB16
Run Date 27MAR09 14:59

Early Bar
Progress Bar
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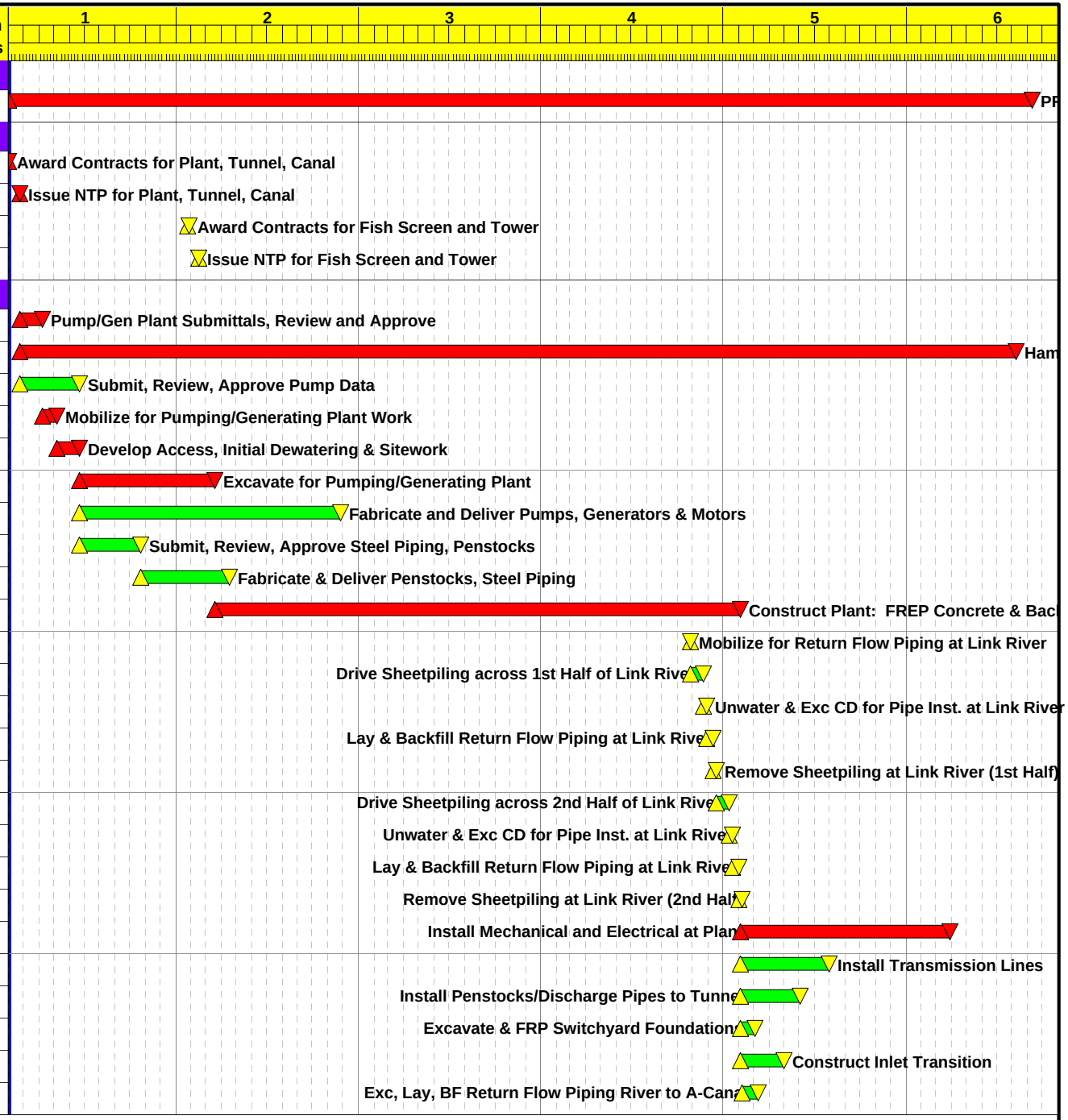
LL5C

Sheet 3 of 3

Alternative No. 5, Option C
(1,000 cfs Pumping and Generating Plant)
Long Lake Valley - 5C - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
TOTAL PROJECT DURATION		
1A50	PROJECT DURATION - NTP TO COMPLETION	2,047*
Award Contracts, Issue Notice to Proceed		
1A10	Award Contracts for Plant, Tunnel, Canal	1
1A20	Issue NTP for Plant, Tunnel, Canal	1
1A30	Award Contracts for Fish Screen and Tower	1
1A40	Issue NTP for Fish Screen and Tower	1
Pumping and Generating Plant - 2,000 cfs		
1PA1100	Pump/Gen Plant Submittals, Review and Approve	45
HAMPP	Hammock - Pumping Plant	1,994*
1PA1125	Submit, Review, Approve Pump Data	120
1PA1150	Mobilize for Pumping/Generating Plant Work	30
1PA1175	Develop Access, Initial Dewatering & Sitework	45
1PA1200	Excavate for Pumping/Generating Plant	270
1PA1225	Fabricate and Deliver Pumps, Generators & Motors	520
1PA1275	Submit, Review, Approve Steel Piping, Penstocks	120
1PA1300	Fabricate & Deliver Penstocks, Steel Piping	180
1PA1350	Construct Plant: FREP Concrete & Backfill	1,050
RFP1700	Mobilize for Return Flow Piping at Link River	3
RFP1725	Drive Sheetpiling across 1st Half of Link River	25
RFP1750	Unwater & Exc CD for Pipe Inst. at Link River	7
RFP1775	Lay & Backfill Return Flow Piping at Link River	12
RFP1800	Remove Sheetpiling at Link River (1st Half)	7
RFP1850	Drive Sheetpiling across 2nd Half of Link River	25
RFP1875	Unwater & Exc CD for Pipe Inst. at Link River	7
RFP1900	Lay & Backfill Return Flow Piping at Link River	12
RFP1925	Remove Sheetpiling at Link River (2nd Half)	7
1PA1375	Install Mechanical and Electrical at Plant	420
1PA1400	Install Transmission Lines	180
1PA1450	Install Penstocks/Discharge Pipes to Tunnel	120
1PA1425	Excavate & FRP Switchyard Foundations	30
1PA1475	Construct Inlet Transition	90
RFP1950	Exc, Lay, BF Return Flow Piping River to A-Canal	32



Start Date 01FEB16
Finish Date 08SEP21
Data Date 01FEB16
Run Date 31MAR09 13:51

Early Bar
Progress Bar
Critical Activity

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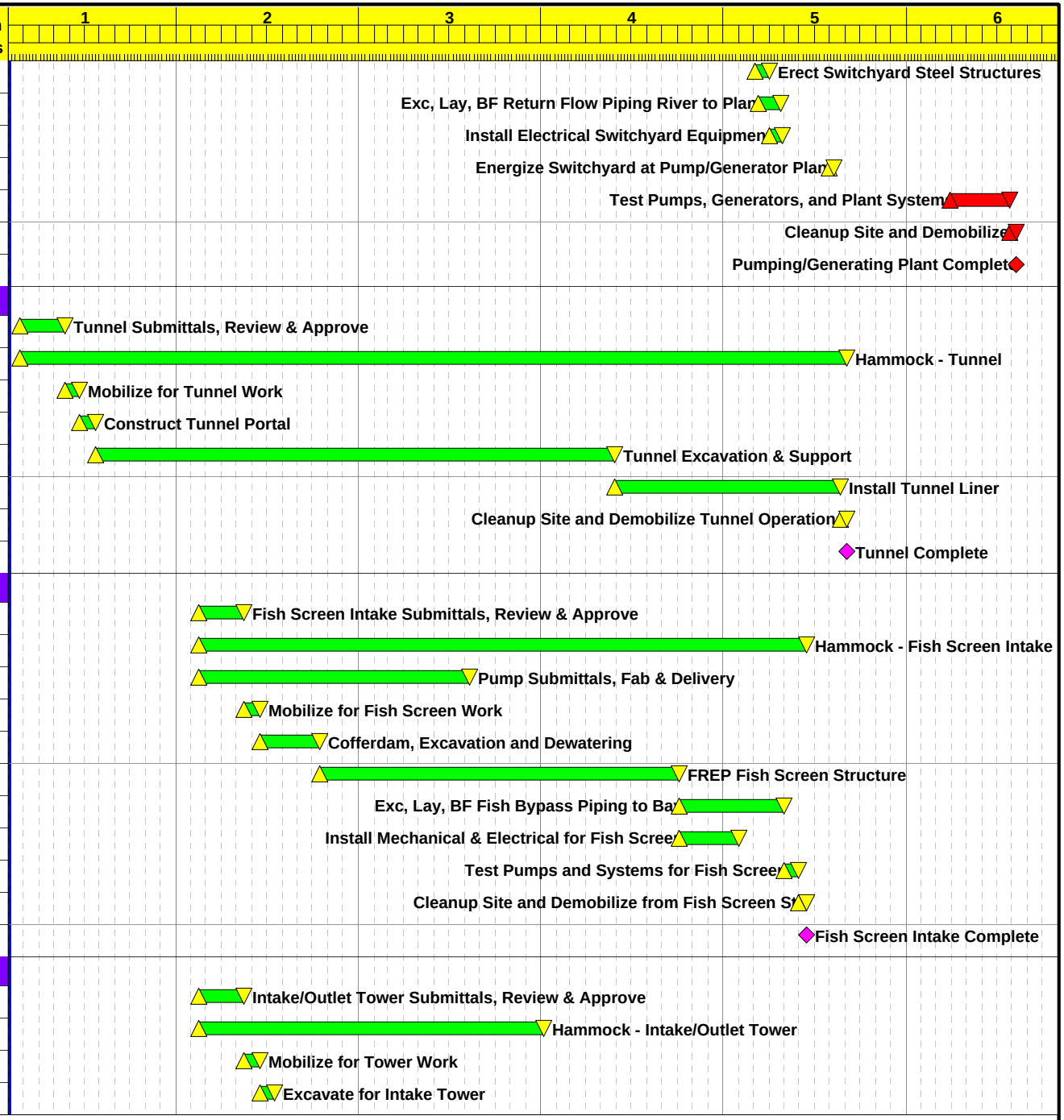
LL5D

Sheet 1 of 3

Alternative No. 5, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 5D - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
1PA1500	Erect Switchyard Steel Structures	28
RFP1975	Exc, Lay, BF Return Flow Piping River to Plant	45
1PA1525	Install Electrical Switchyard Equipment	28
1PA1550	Energize Switchyard at Pump/Generator Plant	7
1PA1575	Test Pumps, Generators, and Plant Systems	120
1PA1600	Cleanup Site and Demobilize	14
1PA1625	Pumping/Generating Plant Complete	0
Tunnel - 2,000 cfs		
1T12100	Tunnel Submittals, Review & Approve	90
HAMT	Hammock - Tunnel	1,654*
1T12125	Mobilize for Tunnel Work	30
1T12150	Construct Tunnel Portal	30
1T12175	Tunnel Excavation & Support	1,040
1T12200	Install Tunnel Liner	450
1T12225	Cleanup Site and Demobilize Tunnel Operations	14
1T12250	Tunnel Complete	0
Fish Screen Intake - 2,000 cfs		
1F15100	Fish Screen Intake Submittals, Review & Approve	90
HAMFS	Hammock - Fish Screen Intake	1,214*
1F15200	Pump Submittals, Fab & Delivery	540
1F15125	Mobilize for Fish Screen Work	30
1F15150	Cofferdam, Excavation and Dewatering	120
1F15175	FREP Fish Screen Structure	720
1F15260	Exc, Lay, BF Fish Bypass Piping to Bay	210
1F15250	Install Mechanical & Electrical for Fish Screen	120
1F15300	Test Pumps and Systems for Fish Screen	30
1F15350	Cleanup Site and Demobilize from Fish Screen Str	14
1F15375	Fish Screen Intake Complete	0
Intake/Outlet Tower - 2,000 cfs		
1T14000	Intake/Outlet Tower Submittals, Review & Approve	90
HAMIOT	Hammock - Intake/Outlet Tower	690*
1T14025	Mobilize for Tower Work	30
1T14050	Excavate for Intake Tower	30



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Data Date 01FEB16
Run Date 31MAR09 13:51

Early Bar
Progress Bar
Critical Activity

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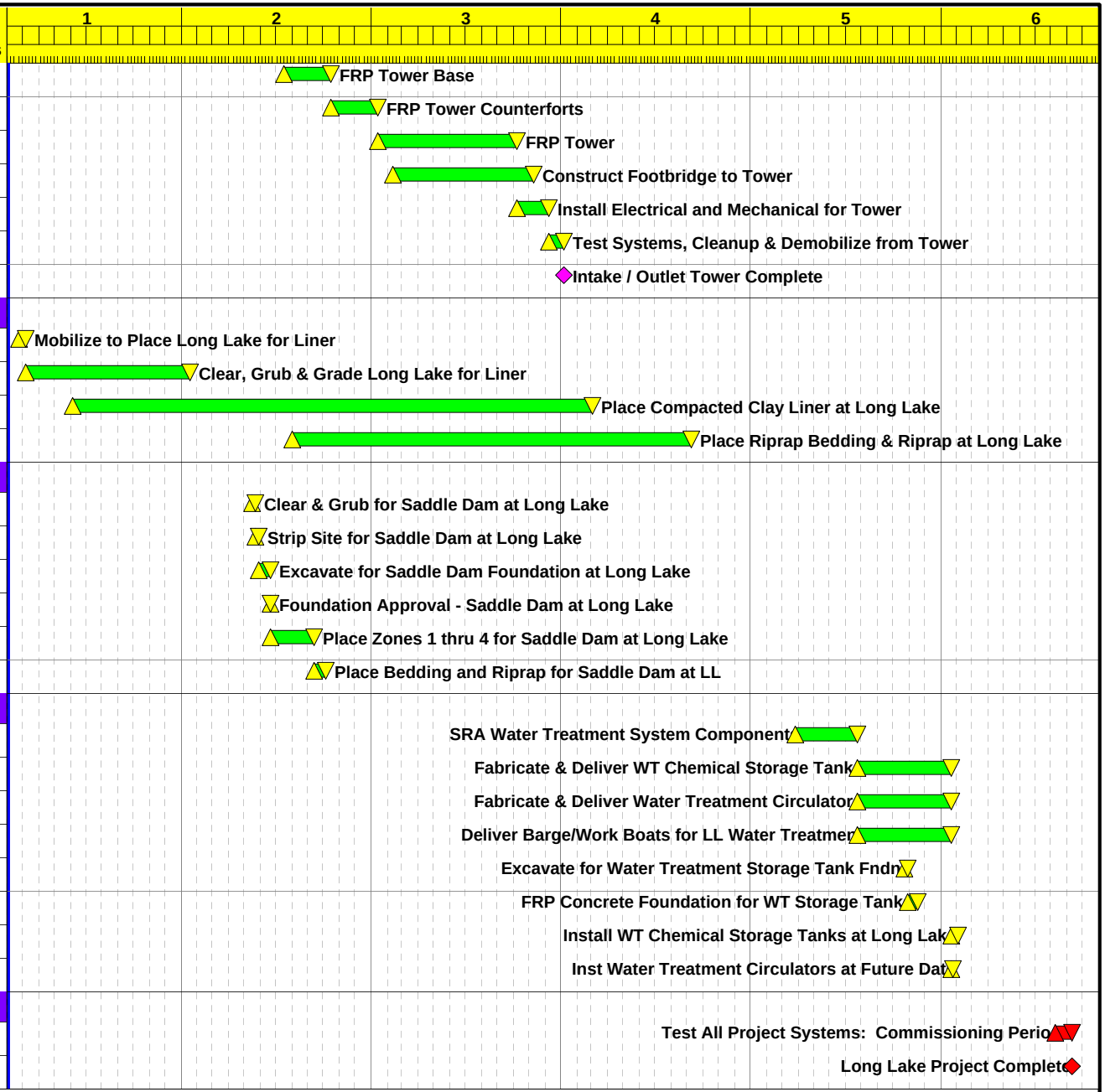
LL5D

Sheet 2 of 3

Alternative No. 5, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 5D - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved

Activity ID	Activity Description	Duration Cal Days
1T14075	FRP Tower Base	90
1T14100	FRP Tower Counterforts	90
1T14125	FRP Tower	270
1T14150	Construct Footbridge to Tower	270
1T14175	Install Electrical and Mechanical for Tower	60
1T14200	Test Systems, Cleanup & Demobilize from Tower	30
1T14225	Intake / Outlet Tower Complete	0
Long Lake Clay Liner		
1CL6100	Mobilize to Place Long Lake for Liner	14
1CL6120	Clear, Grub & Grade Long Lake for Liner	315
1CL6140	Place Compacted Clay Liner at Long Lake	1,000
1CL6160	Place Riprap Bedding & Riprap at Long Lake	770
Long Lake Saddle Dam		
1SD8000	Clear & Grub for Saddle Dam at Long Lake	7
1SD8025	Strip Site for Saddle Dam at Long Lake	5
1SD8050	Excavate for Saddle Dam Foundation at Long Lake	21
1SD8075	Foundation Approval - Saddle Dam at Long Lake	2
1SD8100	Place Zones 1 thru 4 for Saddle Dam at Long Lake	84
1SD8125	Place Bedding and Riprap for Saddle Dam at LL	21
Water Treatment		
1WT7100	SRA Water Treatment System Components	120
1WT7140	Fabricate & Deliver WT Chemical Storage Tanks	180
1WT7120	Fabricate & Deliver Water Treatment Circulators	180
1WT7160	Deliver Barge/Work Boats for LL Water Treatment	180
1WT7180	Excavate for Water Treatment Storage Tank Fndns	6
1WT7200	FRP Concrete Foundation for WT Storage Tanks	18
1WT7220	Install WT Chemical Storage Tanks at Long Lake	12
1WT7300	Inst Water Treatment Circulators at Future Date	1
Test Project		
1A500	Test All Project Systems: Commissioning Period	30
1A600	Long Lake Project Complete	0



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Finish Date 08SEP21
Data Date 01FEB16
Run Date 31MAR09 13:51

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Progress Bar
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LL5D

Sheet 3 of 3

Alternative No. 5, Option D
(2,000 cfs Pumping and Generating Plant)
Long Lake Valley - 5D - 500 TAF
Summary Construction Schedule

Date	Revision	Checked	Approved