Contents

Section *Page*

List of Figures

List of Tables

Sections 2 through 4.1 have been previously issued for review and are therefore omitted from this document.

7. San Luis Obispo County Department of Planning and Building (SLO-DPB) – Fee Schedule 2012-2013, 2012.

4.2 Offshore Modular Wedge Wire Screening Technology

The concept selected for installing the offshore modular wedge wire screening technology involves enclosing the existing intake cove to form a shoreline basin and extending a new circulating water conveyance system, either tunnel or buried piping, from the basin to the ocean. Wedge wire screen assemblies would be attached to the ocean end of this conveyance system to enable it to supply filtered seawater to the newly created intake basin, which will be sealed to prevent direct seawater inflow. (See Process Flow Diagram 25762-110-M6K-WL-00006.)

The offshore location of the wedge wire screens is dependent on local bathymetry and biological sensitivity and the need to provide adequate depth above and below the screens to maintain their hydraulic performance. The open sea oceanographic setting and geological characteristics offshore of DCPP pose significant challenges to this type of conveyance system; consequently, two alternative concepts, tunnel and buried piping, were considered. The final selection would be based on the lowest total installed cost of the system.

4.2.1 Existing Conditions and Basic Data

4.2.1.1 Seawater Level and Wave Climate Conditions

DCPP is located on a coastal terrace above a rocky shoreline with bathymetry characterized by a sloping bedrock bottom with steep relief, rocky pinnacles, and prominent rocky ridges (Figure 4.2-1). The ocean water level normally varies between 0 and +6 feet mean lower-low water (MLLW) datum. Mean sea level zero is equivalent to +2.6 feet MLLW. Maximum tidal range is approximately 9 feet and extends from 7 feet above MLLW to approximately 2 feet below MLLW. The sub-tidal zone reaches a maximum depth of approximately 60 feet below MLLW within 100 feet of shore in some areas (Figure 4.2-2).

Normal wave activity is in the 5-to-10-foot range, with storms generating waves between 20 and 30 feet. During the storm season between September 1997 and August 1998, peak swells exceeded 10 feet on 64 days. The DCPP cooling water intake is located in an area of significant production of marine algae, including surface kelp and understory algae. Kelp growth can reach 2 feet per day during the growing season between June and October. DCPP is located in a “wet marine” weather environment where ocean winds are commonly 10 to 25 miles per hour and can reach 40 to 50 miles per hour. Rainfall averages 20 inches per year, and the normal daily weather pattern is characterized by wet/foggy conditions in the morning and mild to strong winds in the afternoon (Reference 1).

Daily mean seawater temperature ranges from approximately 10.5°C (50.9°F) in May to approximately 15°C (59°F) in September. The maximum seawater temperature is approximately 18°C (64°F) (Reference 1).

4.2.1.2 Cooling Water Flow Requirements

DCPP currently uses a common shoreline intake structure to withdraw cooling water from the ocean to two independent once-through systems, one for each unit. The intake structure is protected by two breakwaters that extend offshore to form a semi-enclosed intake cove. Each unit is serviced by two single-speed circulating water pumps. The cooling water flow rate ranges for Unit 1 from 778,000 gpm to 854,000 gpm and for Unit 2 from 811,000 gpm to 895,000 gpm. In addition, for each unit, there are two auxiliary saltwater pumps that must remain operational at all times (Reference 1). The total design flow is 1,753,000 gpm.

Figure 4.2-1. DCPP Site Location Map (Contour elevations = feet below MLLW)

Figure 4.2-2. DCPP Bathymetry Map (Contour elevations = feet below MLLW)

4.2.1.3 Site Geology and Geotechnical Engineering Data

Geotechnical information is limited, and hydrographic/bathymetry, seismic, geophysical, and geotechnical subsurface investigations will be performed for final design.

The geomorphic regions in the area of DCPP offshore include the Islay shelf to the north and the Santa Rosa Reef shelf to the south (Reference 2). Both shelves have a rocky near-coast portion and a sediment-covered portion further offshore. As reflected in the contours of the seabed (Figure 4.2-1), the near-coast portion is steeper than the sediment-covered offshore portion.

Lithologically, the seabed offshore of DCPP consists of two exposed formations: (i) the Obispo Formation to the south of the breakwater and (ii) a marine-deposit-covered portion further offshore (Reference 2). The Obispo Formation (T_{mo}) is a roughly 1,300-foot-thick section of marine volcanic deposits and is exposed from the DCPP breakwater to the Shoreline fault. Regional lithology within the Obispo Formation varies considerably, but along the DCPP coastline, three subunits are recognized: (i) resistant tuff (T_{mor}), (ii) fine-grained sandstone and claystone (T_{mof}), and (iii) intrusive diabase bedrock (T_{mod}). The resistant tuff subunit (T_{mor}) is exposed along the coastline from the base of Green Peak to the south headland of Discharge Cove and is structurally repeated at the north headland of Discharge Cove. The fine-grained sandstone and claystone subunit (T_{mof}) is exposed along the coastline from the south headland of Discharge Cove to south of Crowbar Hill and is probably structurally repeated north of Crowbar Hill. This fine-grained subunit is more than 330 feet thick and consists of regularly bedded sandstone with minor shale and mudstone that coarsens gradually up-section.

The diabase bedrock subunit (T_{mod}) has intruded into the resistant tuff subunit along approximately 3,000 feet of coastline south of DCPP. This dike/sill complex is also mapped in the intertidal zone directly south of the breakwater at Intake Cove. The offshore marine deposits (Q_s) consist of sand and silty sand with minor gravel deposits that become finer grained progressively offshore. Thin dune-like sand sheets (Q_{sw}) cover parts of the sea floor beyond the Shoreline fault. These are well-defined, low, less-than-3-feet-high, dune-like features with long wave lengths, approximately 82 to 410 feet. There is evidence of their mobile, ephemeral nature. At the base of the marine sand and silt, a gravel-cobble lag is inferred to overlie the top of the bedrock. In summary, the DCPP offshore consists of diabase bedrock exposed near the existing breakwaters and covered with thin sediment further offshore. There is no available information regarding the state of weathering and strength (rippability) of the offshore diabase. If it is considered not feasible to excavate trenches in offshore rock by conventional methods, then removing rock by low-charge blasting can be the alternative. In that case, the impact of blasting on the aquatic life, the power plant, and the nearby faults should be assessed. Effects can be minimized by using multiple small charges. The same considerations apply to the tunnel or piping system that would convey water from the assemblies to the shoreline basin.

4.2.1.4 Site Seismicity

From the available information, there is indication for presence of the Shoreline fault located about 1,800 feet offshore of the DCPP. The fault is estimated to be 600 feet offshore of the DCPP inner breakwater, and for both concepts (tunnel and piping systems) the footprint of the wedge wire assembly area is very close to the Shoreline fault, if not overlapping. Based on several qualitative and indirect quantitative estimates of slip rate (the fault zone lies entirely offshore and there are no identified geomorphic features that can be reliably used as lateral offset markers), the interpreted slip rate on the Shoreline fault zone ranges from 0.02 inches/year (0.05 mm/yr) to possibly 0.04 inches/year (1 mm/yr), with a preferred range of 0.008 to 0.012 inches/year (0.2 to 0.3 mm/yr). The slip rate could also be zero (Reference 2). Thus, for both concepts (tunnel and piping), the systems/structures should be designed to withstand the ground motions from this fault and any impact of a potential slip. The extent of the fracture zone is not known at this time but can be estimated beforehand by drilling boreholes and performing geophysical tests during detail engineering studies.

4.2.2 Alternative Concept A: Offshore Tunnel

4.2.2.1 Offshore Tunnel System Description

Figures 4.2-3 through 4.2-10 and drawing 25762-110-M6K-WL-00006 show the schematic arrangement of the offshore tunnel alternative, which includes a 30-to-32-foot-diameter tunnel that would be constructed using a tunnel boring machine (TBM) to connect the main drop shaft to the offshore drop shafts. The offshore tunnel length would be approximately 1,000 feet, depending on the bathymetry, geology, and seismology conditions. The extent of tunnel lining would depend on the rock and fault conditions encountered during geological and geotechnical investigations. For the purposes of the estimate, 30 percent of the tunnel is assumed to be lined. The main drop shaft diameter would be similar to or larger than that for the tunnel to provide TBM access. A construction access shaft (not shown in the figures) may be required to facilitate construction sequencing.

The shoreline basin would be constructed by extending the existing inner breakwater westward and closing the intake cove from direct contact with the open sea. The only connection of the basin to the sea would be through the tunnel for normal operation conditions and through an emergency conduit (Figure 4.2-10) to ensure the continued supply of water for operation of the auxiliary saltwater pumps.

4.2.2.2 System Components for Offshore Tunnel Alternative

Wedge wire screen assemblies would be used as the source for intake water withdrawal for the system and would be designed to restrict the intake water velocity, mitigate potential impingement, and reduce entrainment. The total design flow would be 1.753 million gpm. Two screen slot size alternatives were considered:

a. 6-mm-slot-opening screens—Installation of the wedge wire screens would include designing, furnishing, and installing wedge wire screens at each of the vertical pipe flanges above the seabed. Thirty 8-foot-nominal-diameter, 35-foot-long wedge wire screens would be required.

b. 2-mm-slot-opening screens—Installation of the wedge wire screens would include designing, furnishing, and installing wedge wire screens at each of the vertical pipe flanges above the seabed. Forty-eight 8-foot-nominal-diameter, 35-foot-long wedge wire screens would be required.

Connection piping (laterals) would be buried or partially trenched, and anchored to the seabed.

Offshore intake drop shafts – The five (for 6-mm slot openings) or six (for 2-mm slot openings) shafts connecting the wedge wire screen manifolds to the offshore intake tunnel would have 12-foot finished inside diameters and would be located approximately 1,000 feet offshore. The shafts would receive water inflow from the wedge wire screen connection piping (laterals). The shafts would be sealed to allow only water flow from the connection piping. An access opening would be provided in the shaft cover to permit inspection and maintenance access. The work would include rock excavation down to the tunnel intersection, spoil disposal, and shaft lining as required.

Offshore intake tunnel – The tunnel would extend from the offshore intake drop shafts to the onshore main drop shaft, with an estimated length of approximately 1,000 feet. The tunnel would be designed to convey the total intake water requirements. The work would include the excavation of the tunnel in rock, spoil disposal, tunnel support, and internal tunnel lining (grouting and reinforcement of walls) as required (for budgetary price, 30 percent of tunnel length was assumed to be lined).

Onshore main drop shaft – This shaft would be constructed in the existing shoreline basin (intake cove) and intersect with the offshore intake tunnel. The shaft would be sized to accommodate DCPP water flow requirements. The design, fabrication, and installation of screens and debris protection at the top of the shaft would also be provided. The work would include rock excavation down to the tunnel intersection, spoil disposal, and shaft lining as required.

Breakwater – An enclosed shoreline basin would be constructed by extending the east portion of the existing breakwater. The design and materials of the breakwater extension would be similar to those of the existing restored breakwater.

The existing and new breakwaters would be sealed to prevent entry of fish, eggs, and larvae. Engineering evaluations would be made to provide assurance that such measure would not undermine the stability of the breakwater during wave attacks, since pervious breakwaters reduce the magnitude of the impact force.

Emergency backup water supply – Precast reinforced concrete box culverts, including vertical concrete walls and stop logs, would be designed and installed within the new portion of the breakwater. Their design would facilitate stop log installation and removal. The conceptual sketch of this structure is shown in Figure 4.2-10.

It would be necessary to stockpile excavated/dredged tunnel, shaft, and lateral-placement material either on the DCPP site or within a maximum of 5 miles off site. An access road to the existing east breakwater would also need to be constructed. Dredging activities should have minimal impact on the aquatic life.

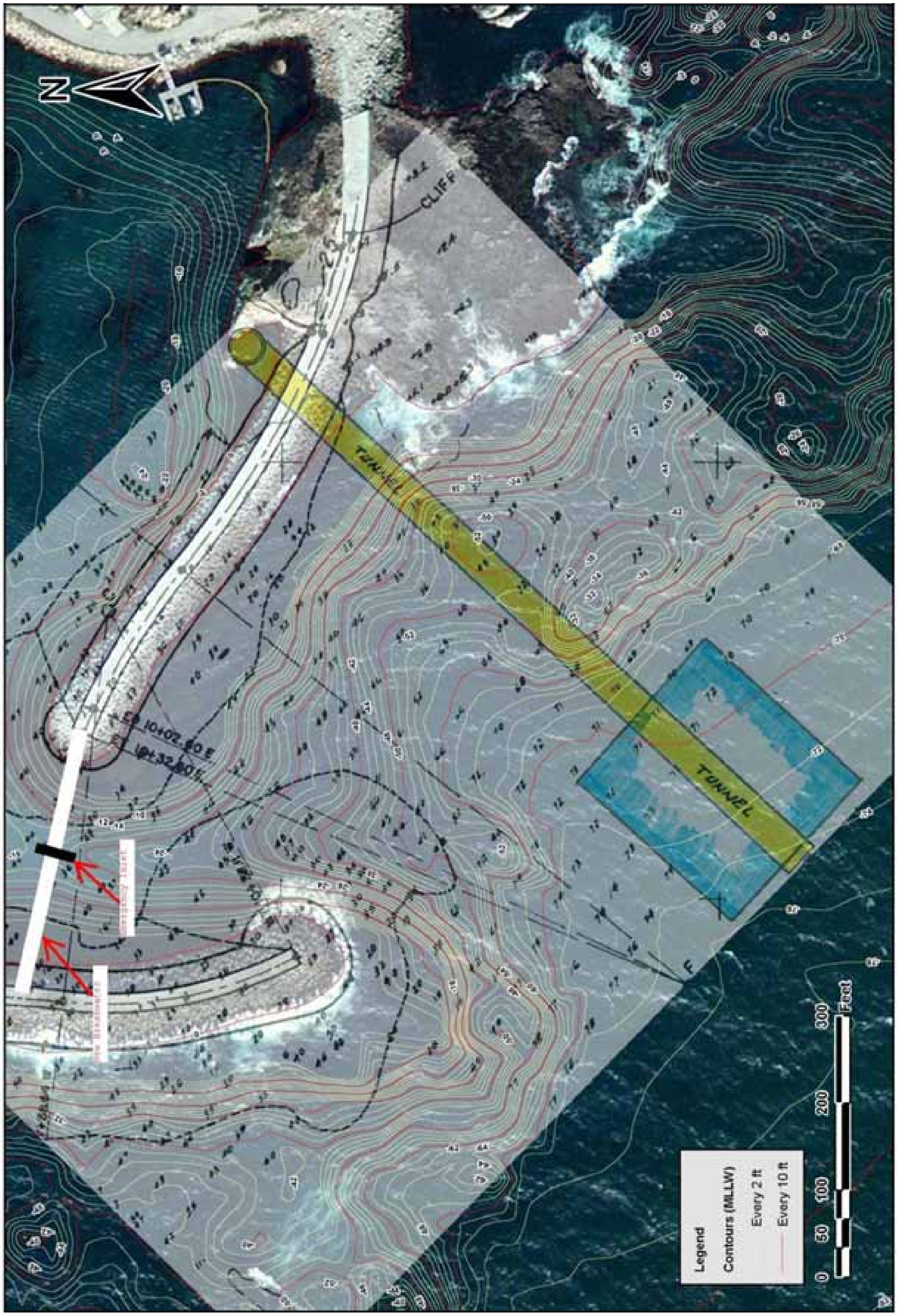


Figure 4.2-3. DCPP Bathymetry/Tunnel for 6-mm-Slot Screen Layout (Contour elevations = feet below MLLW)

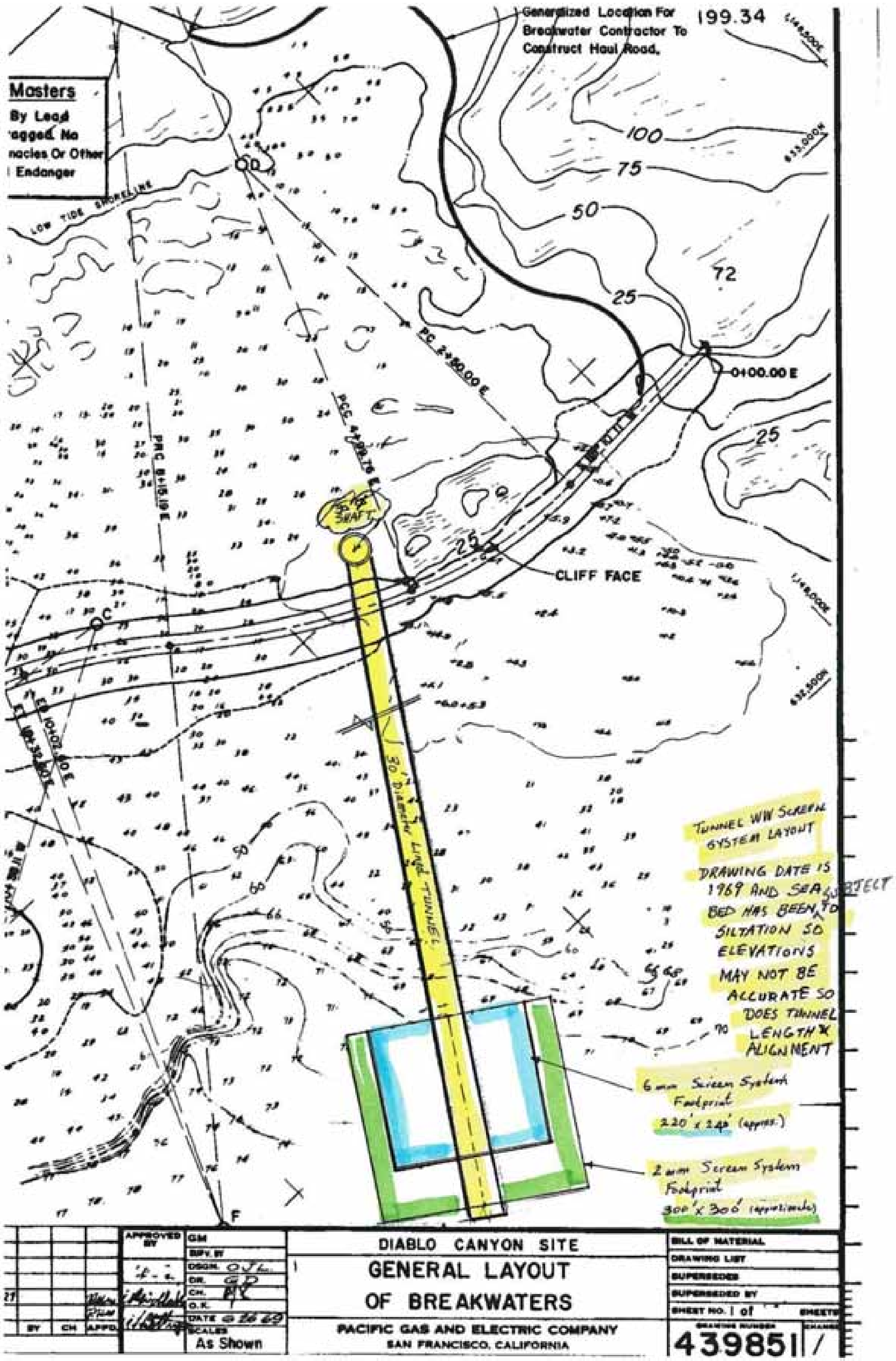


Figure 4.2-4. DCPP General Layout of Breakwaters

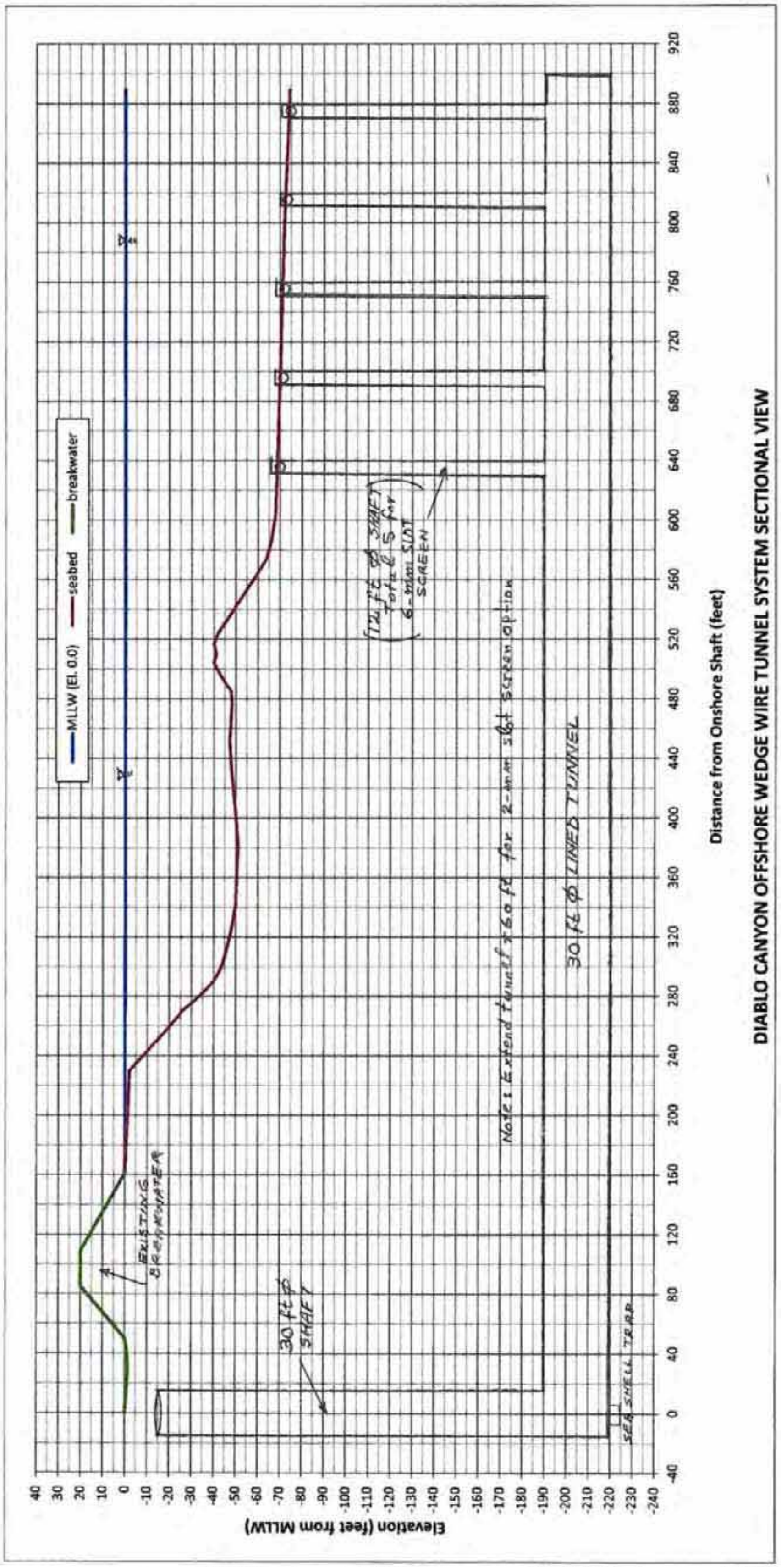
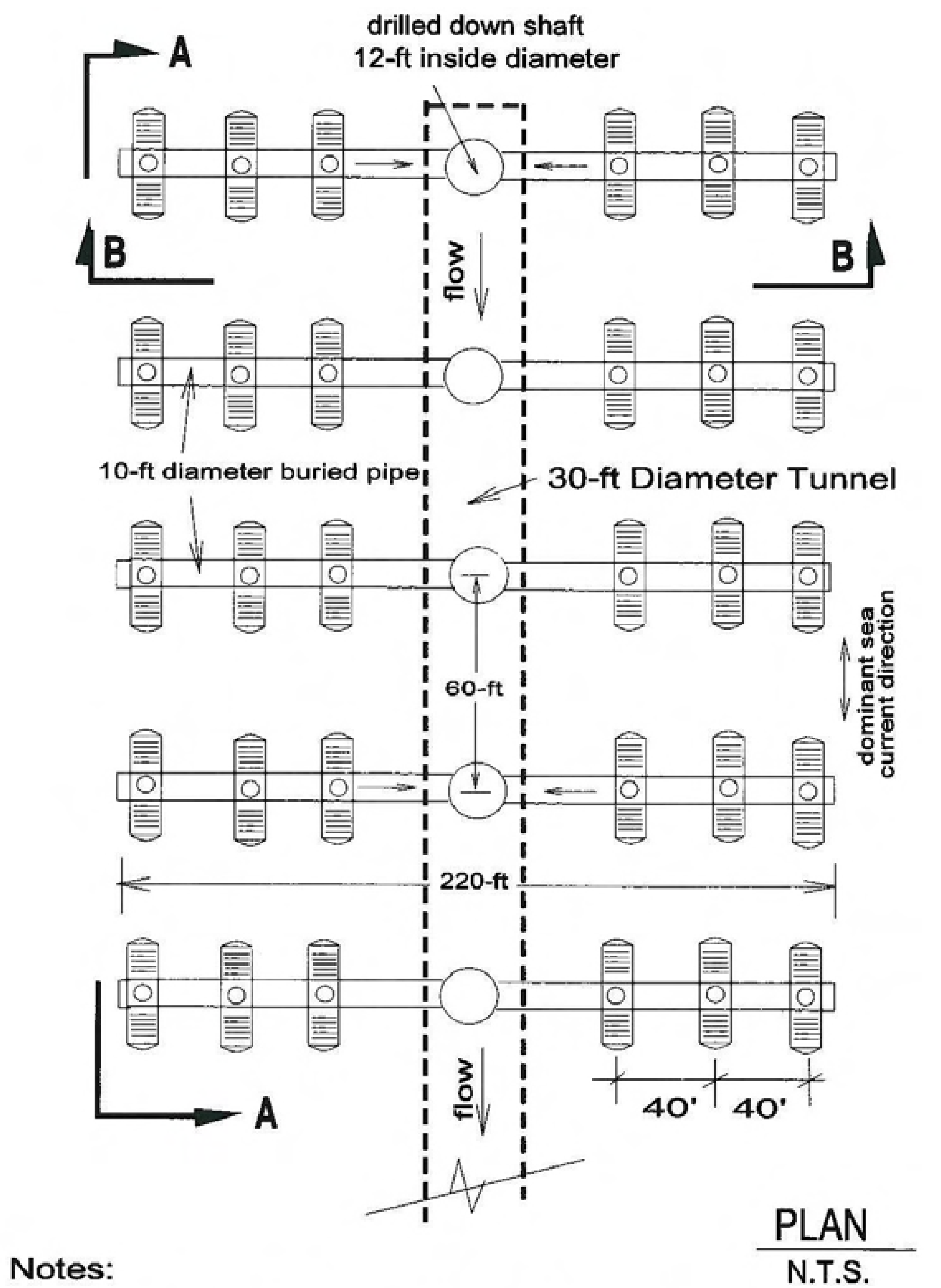


Figure 4.2-5. DCPP Offshore Wedge Wire Tunnel System (Sectional View)



Notes:

1. Total Thirty (30) 8-ft diameter 6-mm Slot Wedge-Wire Tee-Screens
2. 6-mm Wedge Wire Screens, Z-Alloy Material, with End Cones
3. The total design flow is 1.753 million gpm.
4. Riprap placement on area over buried pipes and under the screens.

Figure 4.2-6. DCPP 6-mm-Slot Wedge Wire Screen Intake System (Plan View)

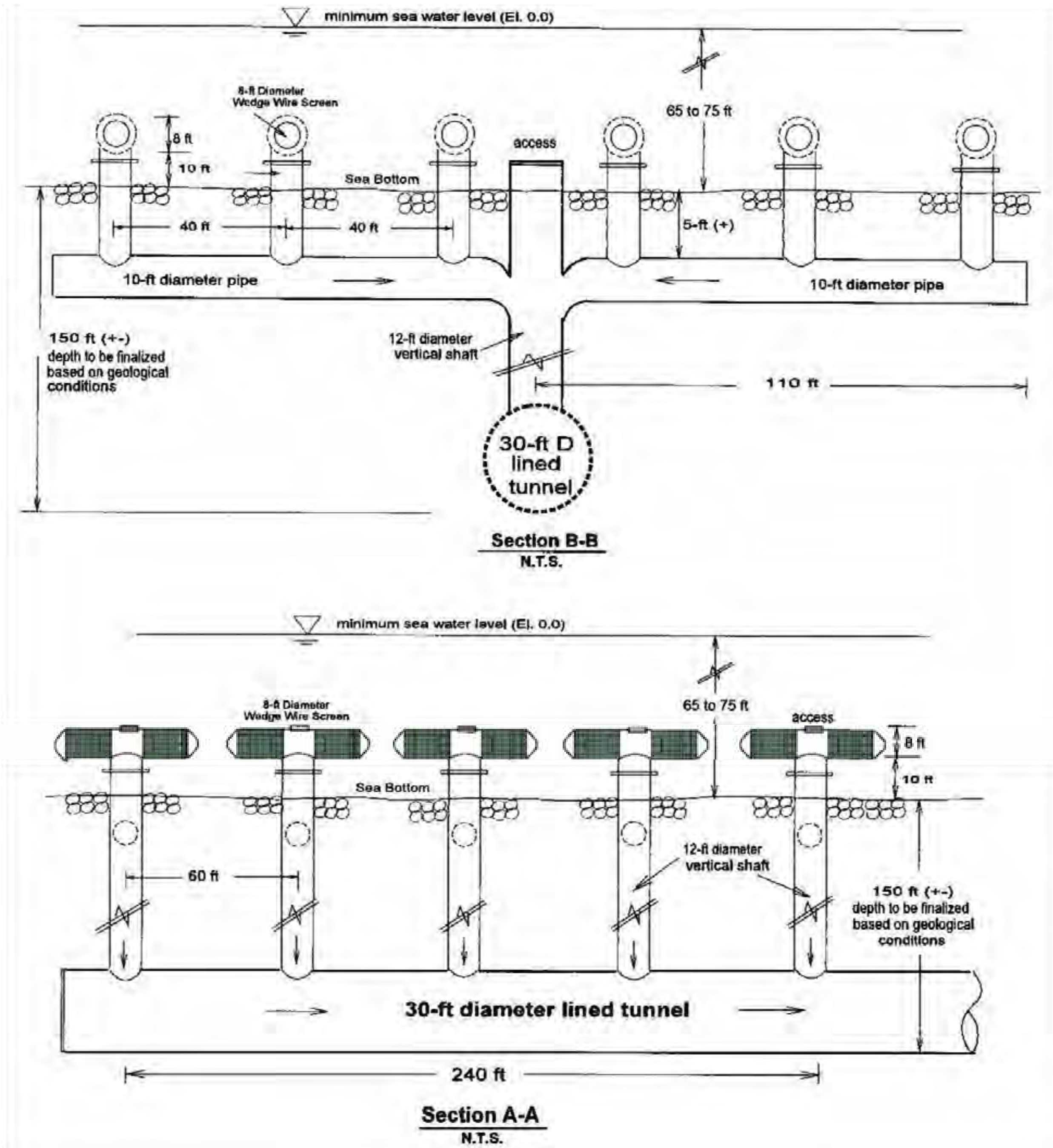
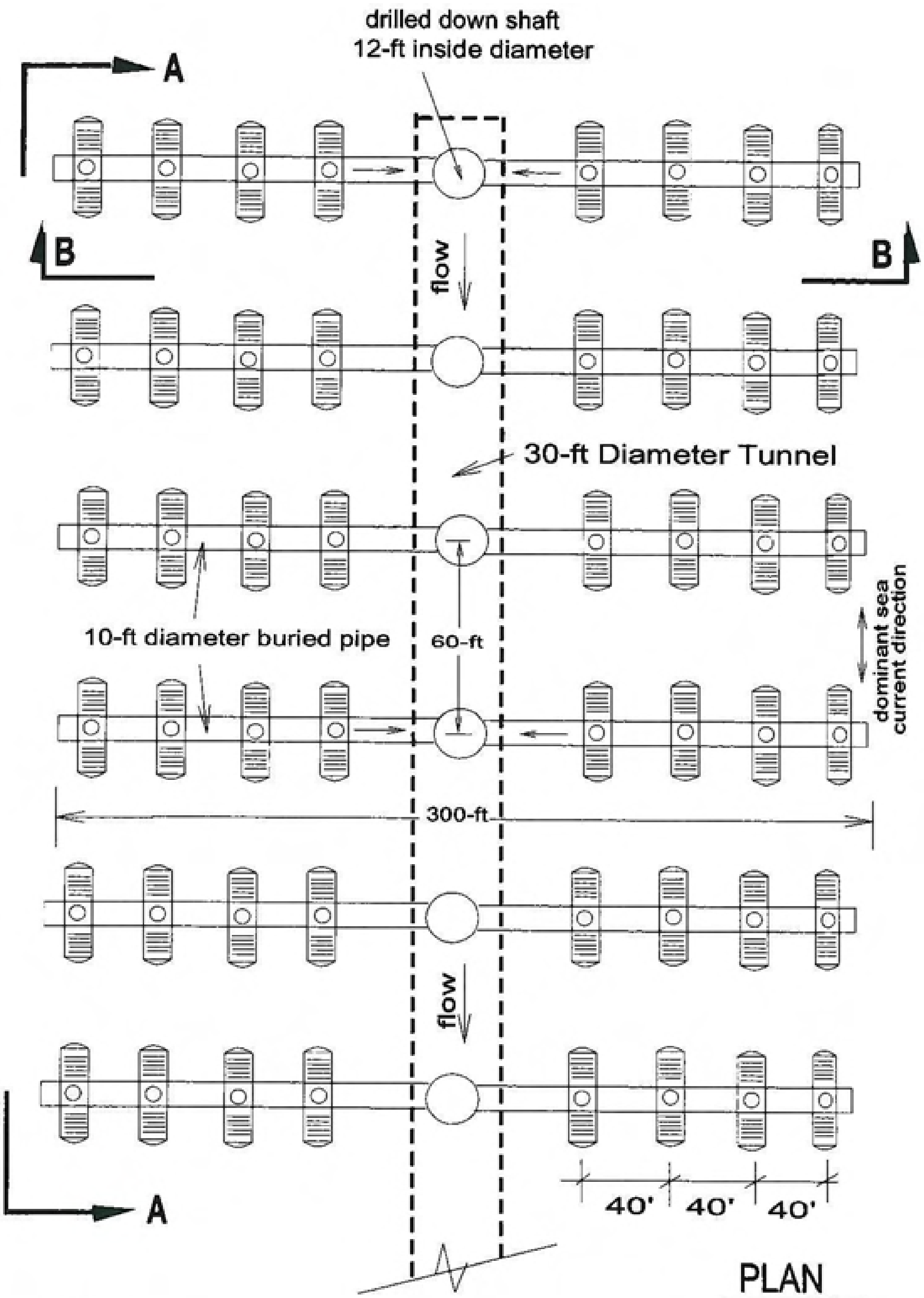


Figure 4.2-7. DCPP 6-mm-Slot Wedge Wire Screen Intake System (Sectional Views)



Notes:

1. Total Forty Eight (48) 8-ft diameter 2-mm Wedge-Wire Tee-Screens
2. 2-mm Wedge Wire Screens, Z-Alloy Material, with End Cones
3. The total design flow is 1.753 million gpm.
4. Riprap placement on area over buried pipes and under the screens.

Figure 4.2-8. DCPP 2-mm-Slot Wedge Wire Screen Intake System (Plan View)

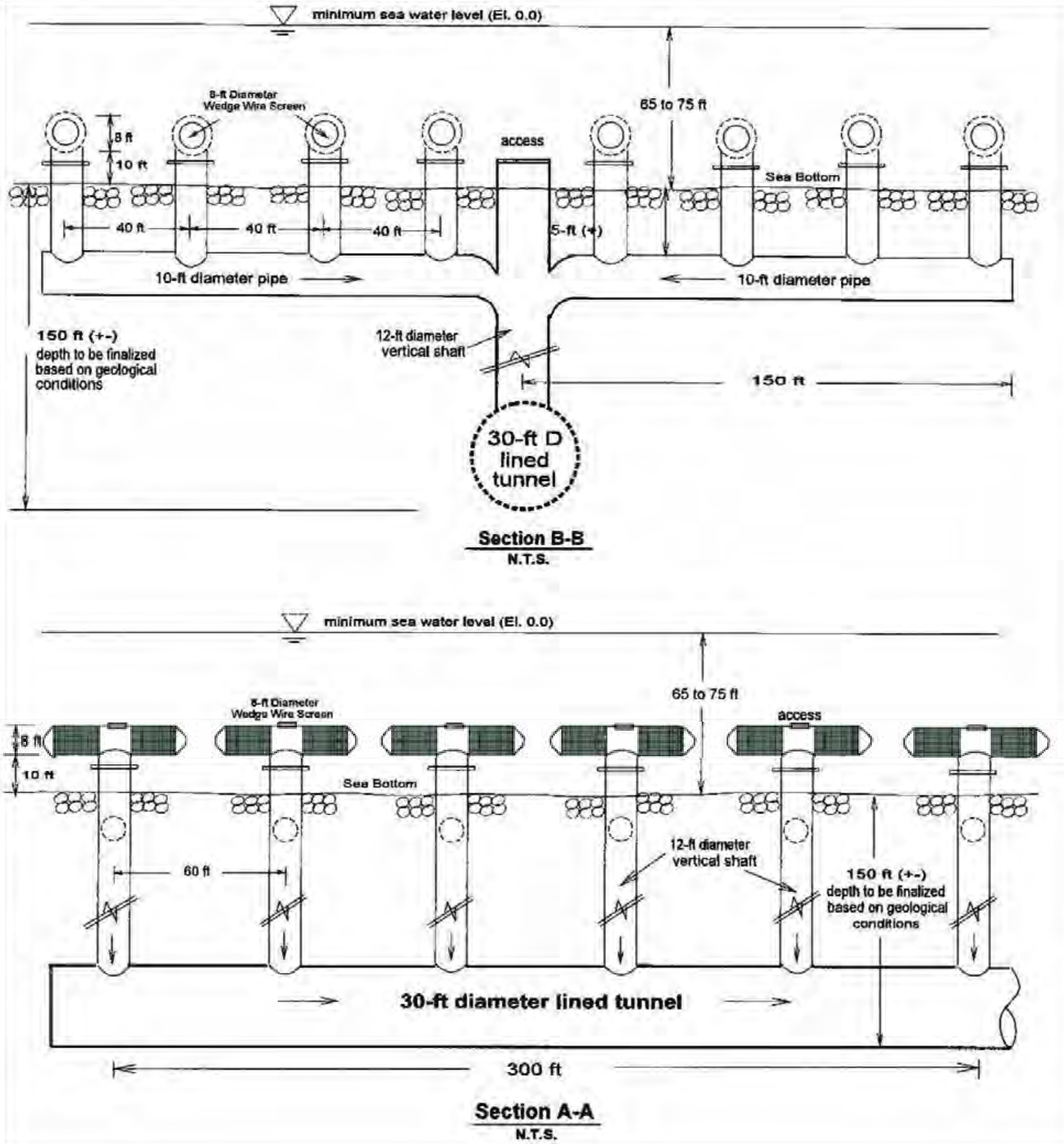
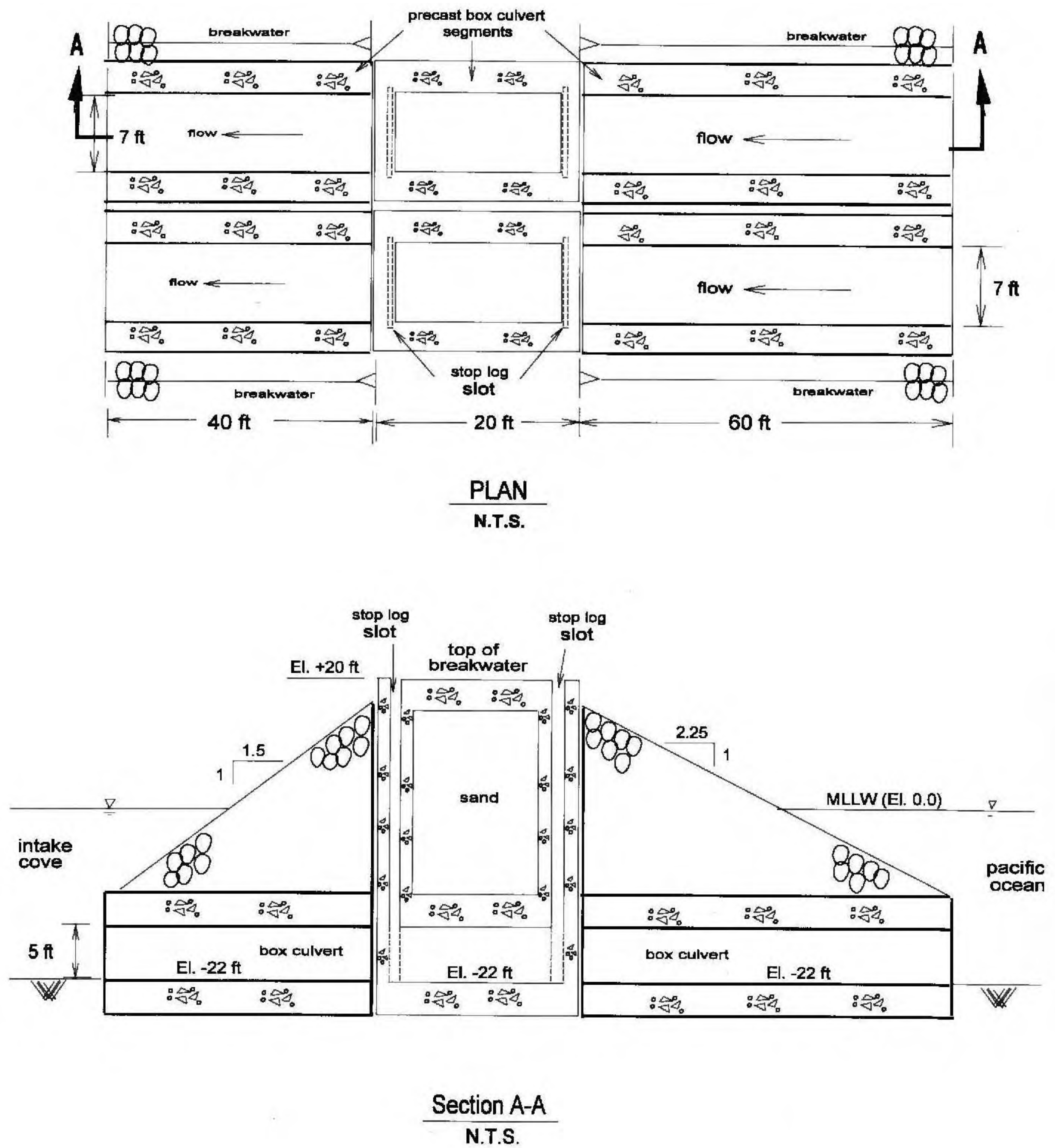


Figure 4.2-9. DCPP 2-mm-Slot Wedge Wire Screen Intake System (Sectional Views)



Note: Emergency cooling intake structure will be located inside the new breakwater.

Figure 4.2-10. DCPP Emergency Cooling Water Intake Structure Details

4.2.2.3 Engineering Requirements for Offshore Tunnel

The final depth of the tunnel below seabed and its alignment would be based on an evaluation of local geological conditions. The tunnel would extend from the inner side of the eastern breakwater to the offshore wedge wire screen assemblies. Drop shafts would connect the assemblies to the tunnel. To connect the drop shafts to the assemblies, 10-foot-diameter horizontal pipe manifolds would be buried in trenches 15 feet below the seabed. The alternative to trenching would be to anchor the 10-foot-diameter pipe manifolds to the seabed (secured and covered with a rock mound on top). This alternative would have to take the following, at a minimum, into consideration: minimum available water depth, seabed movement sediment and debris (kelp), seabed geology, and wave action. For the purpose of the estimate, the tunnel option was considered. The 6-mm wedge wire screen assemblies would require a footprint of about 220 feet by 240 feet in which the multiple trenches would be opened to a depth of 15 feet below the seabed. The 2-mm wedge wire system would require a footprint of approximately 300 feet by 300 feet.

For the tunneling concept, depending on the site conditions evaluation, various remediation techniques can be considered to deal with fault zones involving soil/rock under water pressure. One solution may be to seal and strengthen the ground ahead of the working face. In deep tunnels, a permanent strengthening and sealing is often required and can be obtained by grouting. Injecting grout that subsequently hardens into the ground increases the ground's strength, stiffness, and imperviousness. The result is a treated region of ground with improved properties surrounding the opening. After a TBM is used to excavate a hollow cylinder, the inner surface of the excavated area is supported by a temporary or permanent lining. In practice, grouted bodies with a diameter corresponding to two or at most three times the tunnel diameter have proved adequate. To minimize the impact of a potential shear and consequent disruption of water flow to the plant, installing a pipe inside the tunnel can also be considered.

Warning buoys would be installed in the area of the wedge wire screen array to avoid shipping impacts on the screens.

Drawing 25762-110-P1K-WL-00060 was developed to aid in obtaining budgetary information from specialty contractors for the installation of the offshore work.

4.2.3 Alternative Concept B: Multiple Offshore Buried Pipes

4.2.3.1 Offshore Buried Pipe System Description

The buried pipe alternative consists of multiple offshore buried pipes that collectively supply water to the shoreline basin formed by the breakwater enclosure. Each buried pipe would be connected to its own dedicated offshore wedge wire assembly.

Figures 4.2-11 through 4.2-18 show the schematic arrangement of the buried pipe alternative. The pipes would pass underneath the new breakwater to supply filtered water to the enclosed basin. On the discharge side, each pipe would have a headwall to mitigate erosion concerns and minimize pipe movement.

The shoreline basin would be constructed by extending the existing inner breakwater westward to close the intake cove from direct contact with the open sea. The only connection of this basin to the sea would be through the buried pipes. Similar to the tunnel alternative, emergency gates would be provided to ensure the continued supply of water to the intake to maintain the safe operation of the service water pumps if screen clogging is imminent under high-debris load conditions.

4.2.3.2 System Components for Offshore Buried Pipes Alternative

Wedge wire screen assemblies (see Figures 4.2-14 through 4.2-18) **–** Wedge wire assemblies would be used as the intake water source for the system and would be designed to restrict the intake water velocity and mitigate potential impingement. The total design flow is 1.753 million gpm. The screen assemblies would use a system design intended for applications consistent with the project environmental conditions:

a. 6-mm-slot-opening screens – Installation of the wedge wire screens would include designing, furnishing, and installing wedge wire screens at each of the vertical pipe flanges above the seabed. The conceptual design requires thirty 8-foot-nominal-diameter, 35-foot-long wedge wire screens. Three wedge wire screens would be connected to each 9-foot-diameter pipe via a flanged connection.

b. 2-mm-slot-opening screens – Installation of the wedge wire screens would include designing, furnishing, and installing wedge wire screens at each of the vertical pipe flanges above the seabed. The preliminary design requires forty-eight 8-foot-nominal-diameter 35-foot-long wedge wire screens. Four or five wedge wire screens would be connected to each 9-foot-diameter pipe via a flanged connection.

Pipes – Ten 9-foot-diameter pipes with an average length of 450 feet for 6-mm slot screens and 600 feet for 2-mm slot screens would be designed, procured, and installed to convey water from the screens to the enclosed shoreline basin. Whether the pipes were trenched or anchored would depend on location, seabed profile, geotechnical conditions, and which would cause the least environmental impact. Pipe material would be FRP.

New breakwater – The new breakwater, located west of the existing one, would be designed and constructed to provide an enclosure to the shoreline basin (intake cove). Design and construction would be based on duplicating the existing breakwater.

The existing and new breakwaters would be sealed on the basin side to exclude fish, eggs, and larvae from entering the basin. Engineering evaluations would be made to provide assurance that such measure would not undermine the stability of the breakwater during wave attacks, since pervious breakwaters are designed to reduce the magnitude of the impact force.

Emergency backup water supply – Precast reinforced concrete box culverts, including vertical concrete walls and stop logs, would be designed and installed within the new portion of breakwater. Their design would facilitate stop log installation and removal. The conceptual sketch of this structure is shown on Figure 4.2-10.

Headwalls – Ten precast reinforced concrete headwalls would be designed and installed at each pipe outlet located on the inner side of the new breakwater.

It would be necessary to stockpile excavated/dredged tunnel, shaft, and lateral-placement material either on the DCPP site or within a maximum of 5 miles off site. An access road to the existing east breakwater would also need to be constructed. Dredging activities should have minimal impact on the aquatic life.

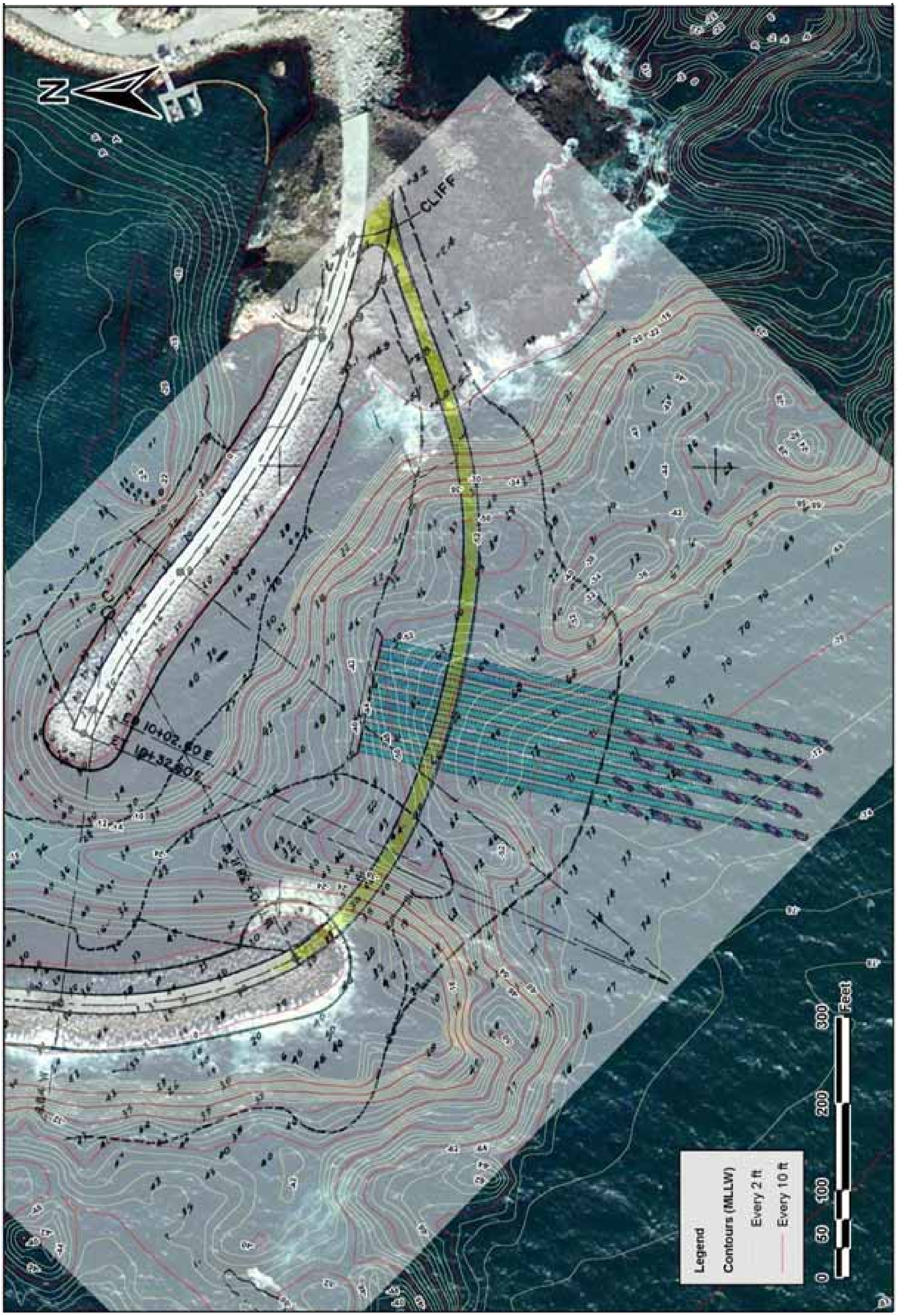


Figure 4.2-11. DCPP Bathymetry/Buried Pipe Layout with 6-mm-Slot Screens (Contour elevations = feet below MLLW)

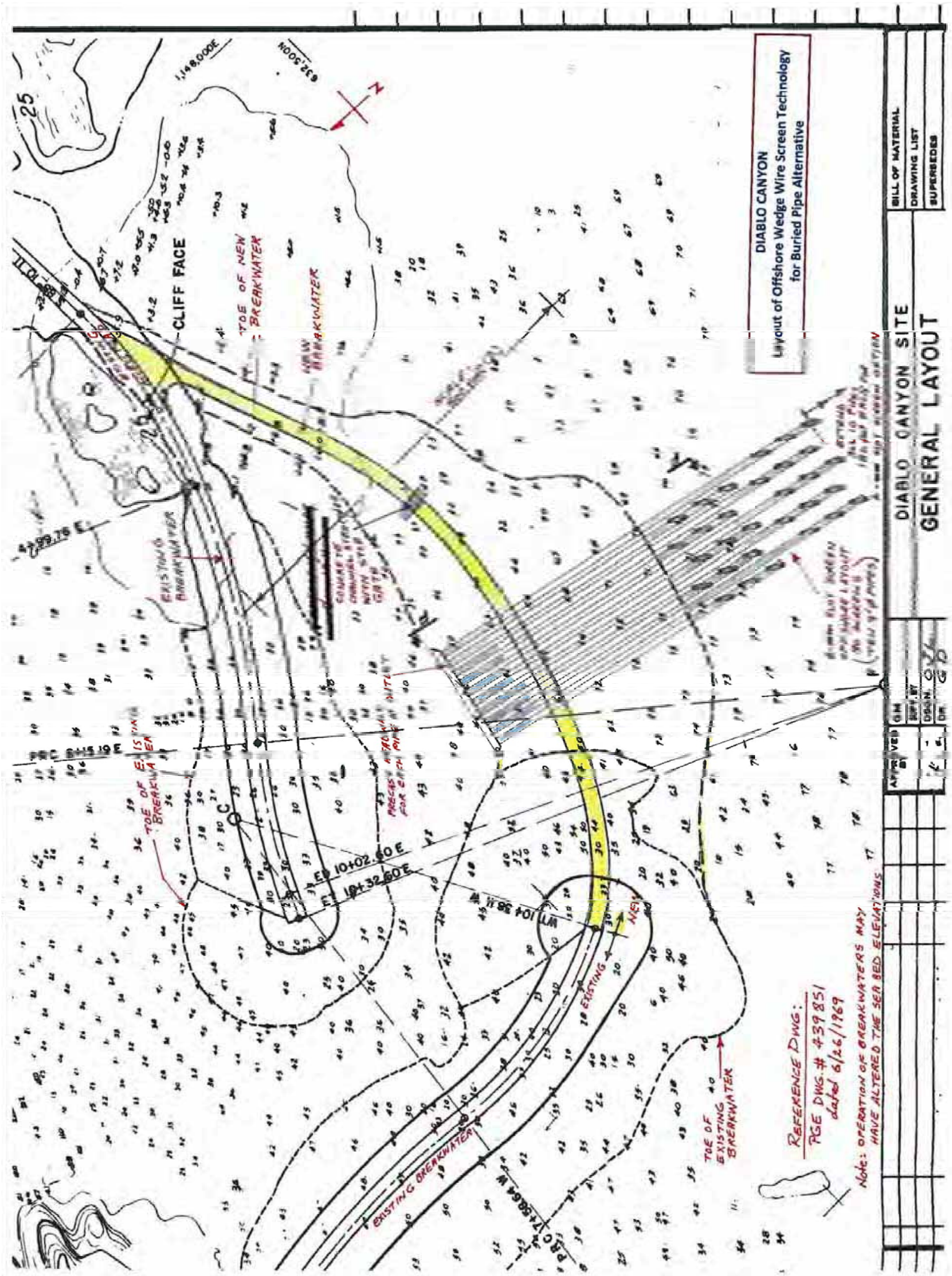


Figure 4.2-12. DCPP Layout of Offshore Wire Wedge Screen Technology (Buried Pipe Alternative)

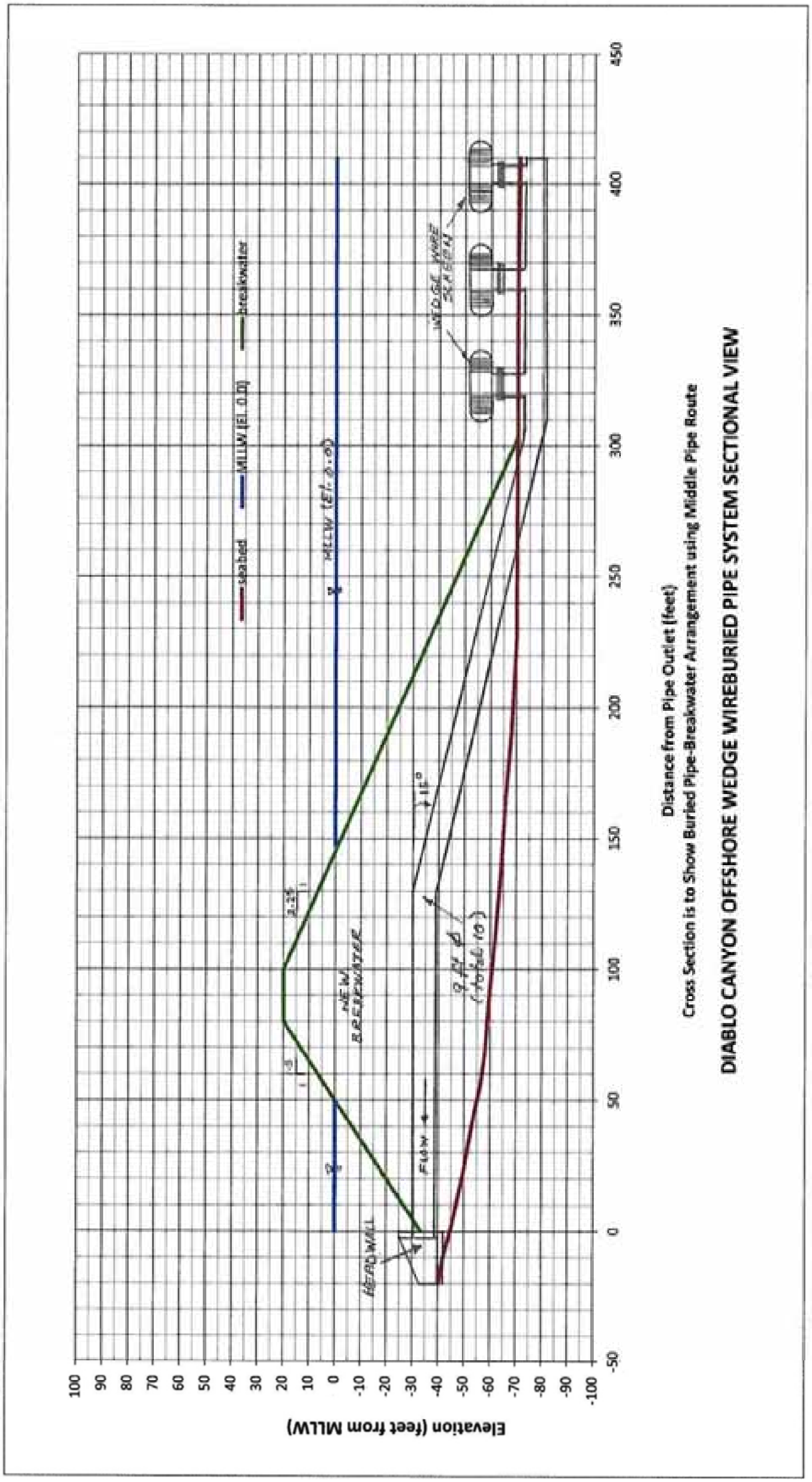
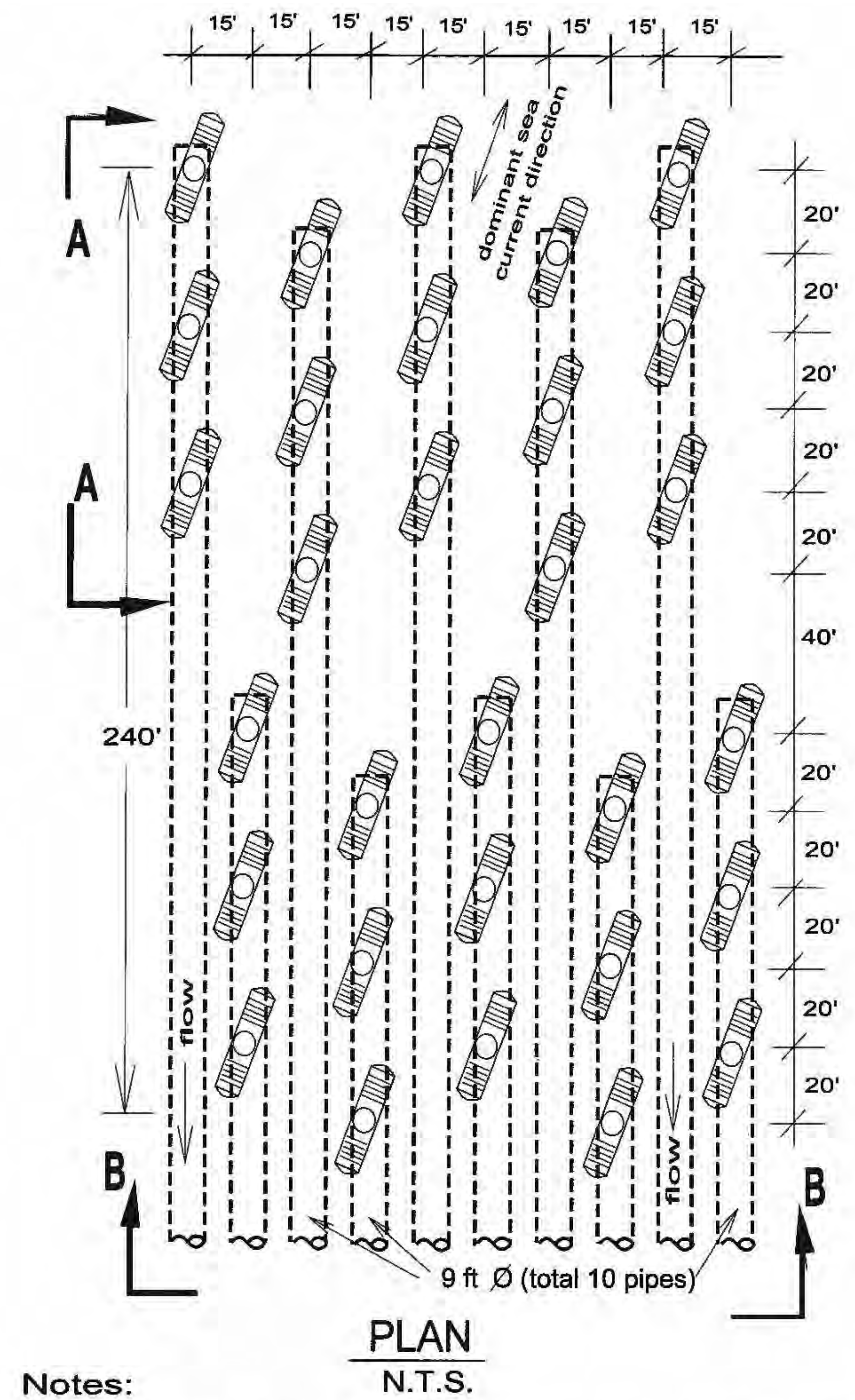


Figure 4.2-13. DCPP Offshore Wedge Wire Buried Pipe System (Sectional View)



Notes:

1. Total Thirty (30) 8-ft diameter 6-mm Slot Wedge-Wire Tee-Screens
2. 6-mm Wedge Wire Screens, Z-Alloy Material, with End Cones
3. The total design flow is 1.753 million gpm.
4. Riprap placement on area over buried pipes and under the screens.

Figure 4.2-14. DCPP 6-mm-Slot Wedge Wire Screen Intake System (Plan View)

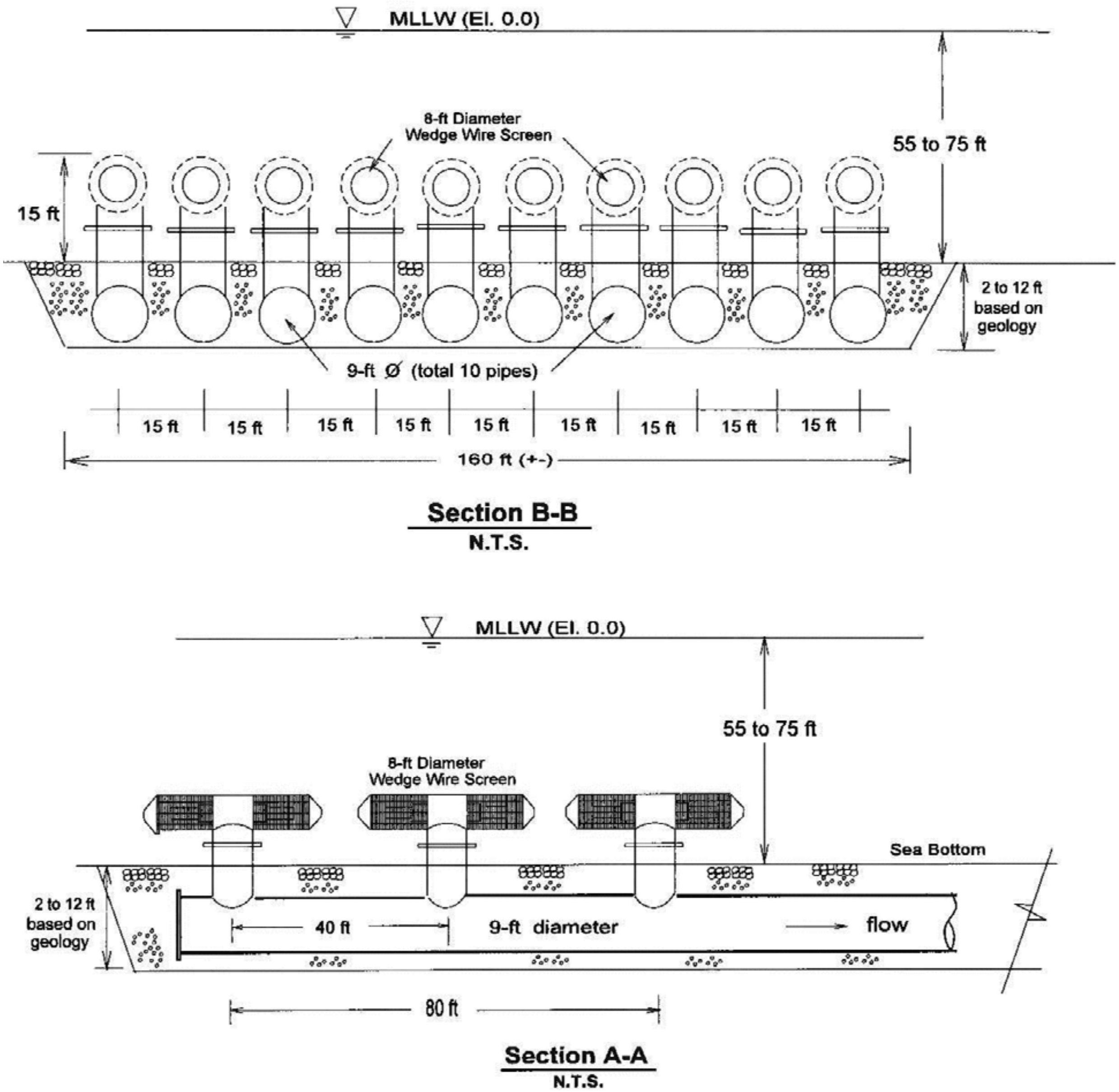
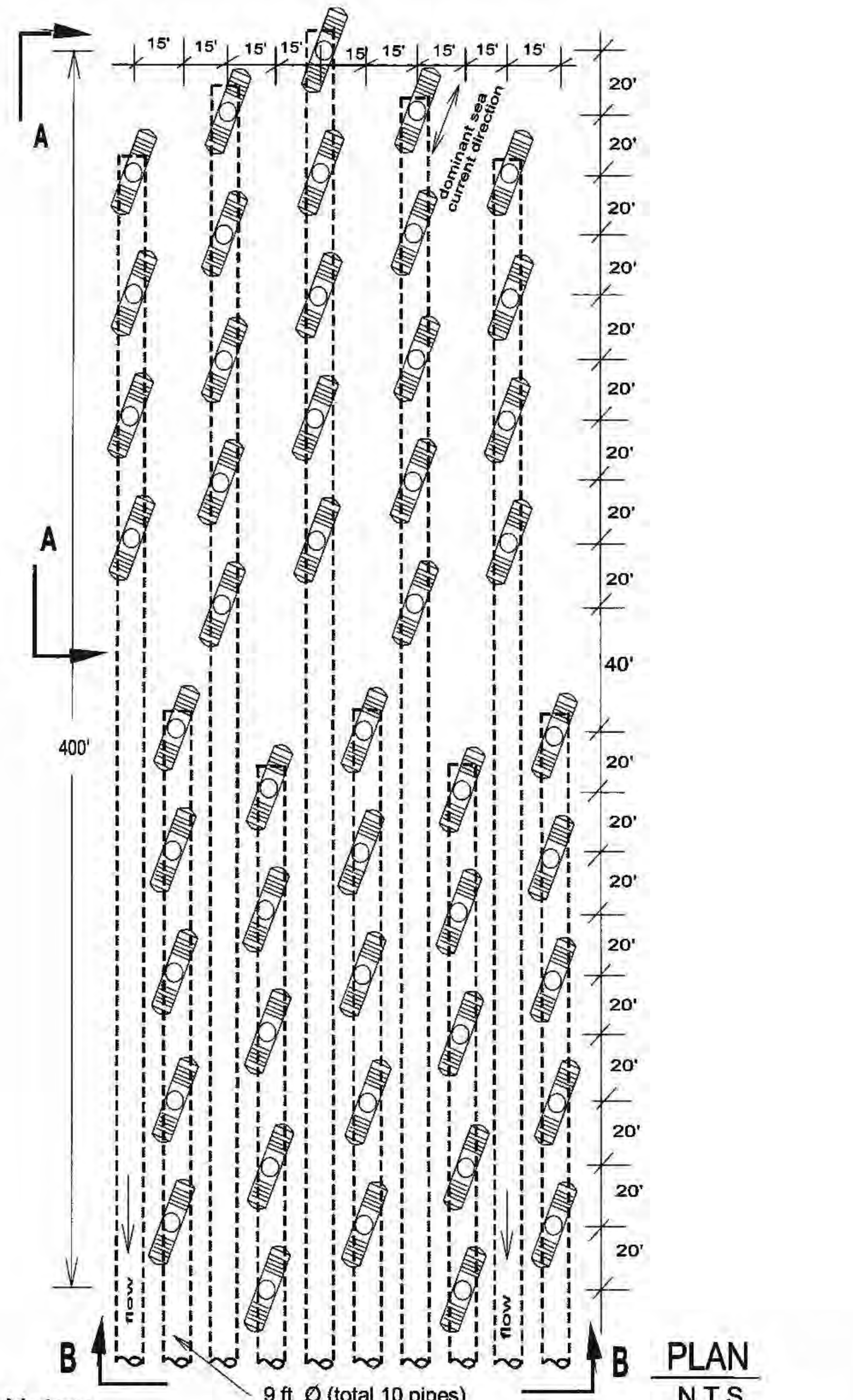


Figure 4.2-15. DCPP 6-mm-Slot Wedge Wire Screen Intake Assembly (Sectional Views)



Notes:

1. Total Forty Eight (48) 8-ft diameter 2-mm Slot Wedge-Wire Tee-Screens
2. 2-mm Wedge Wire Screens, Z-Alloy Material, with End Cones
3. The total design flow is 1.753 million gpm.
4. Riprap placement on area over buried pipes and under the screens.

Figure 4.2-16. DCPP 2-mm-Slot Wedge Wire Screen Intake System (Plan View)

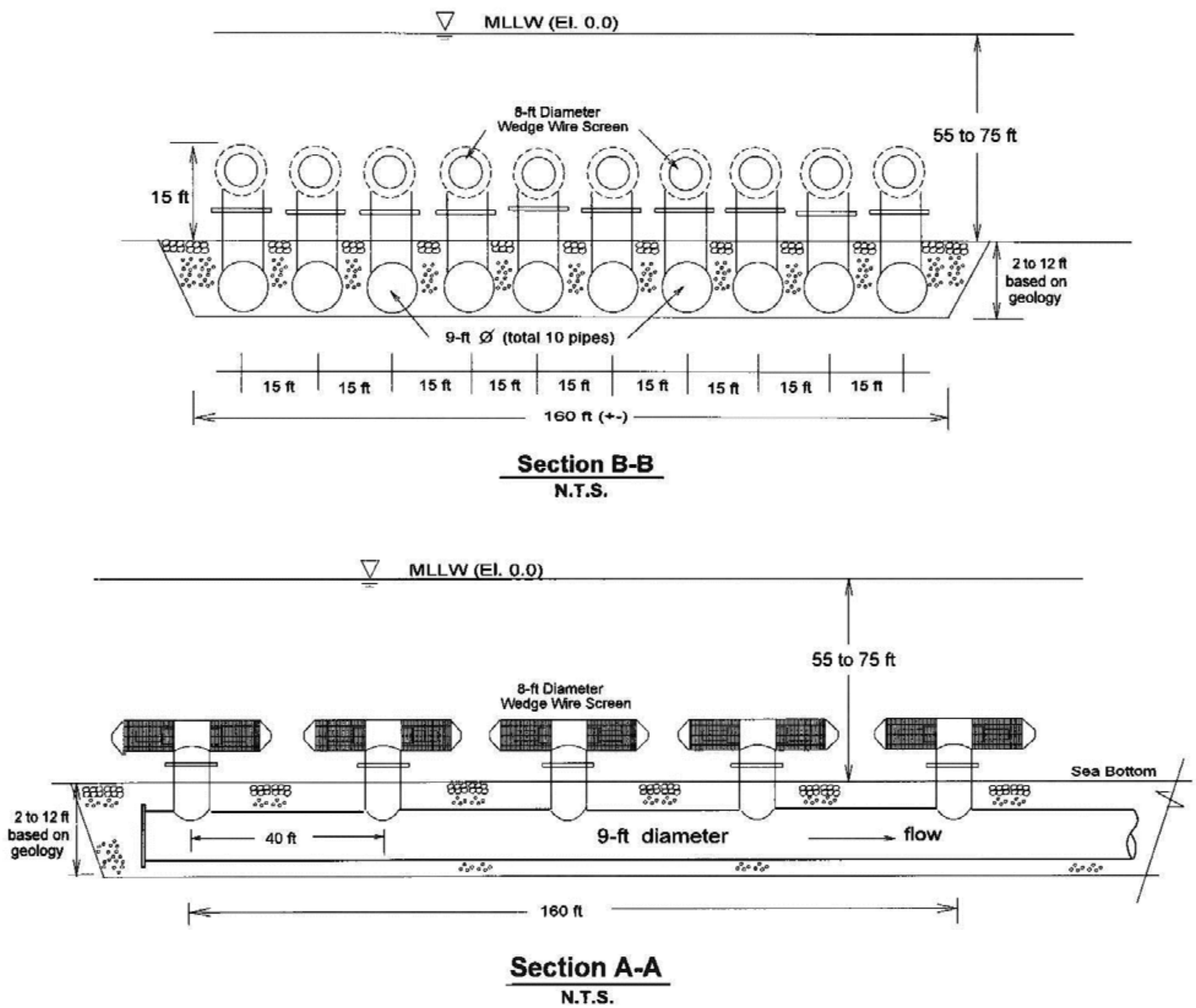


Figure 4.2-17. DCPP 2-mm-Slot Wedge Wire Screen Intake Assembly (Sectional Views)

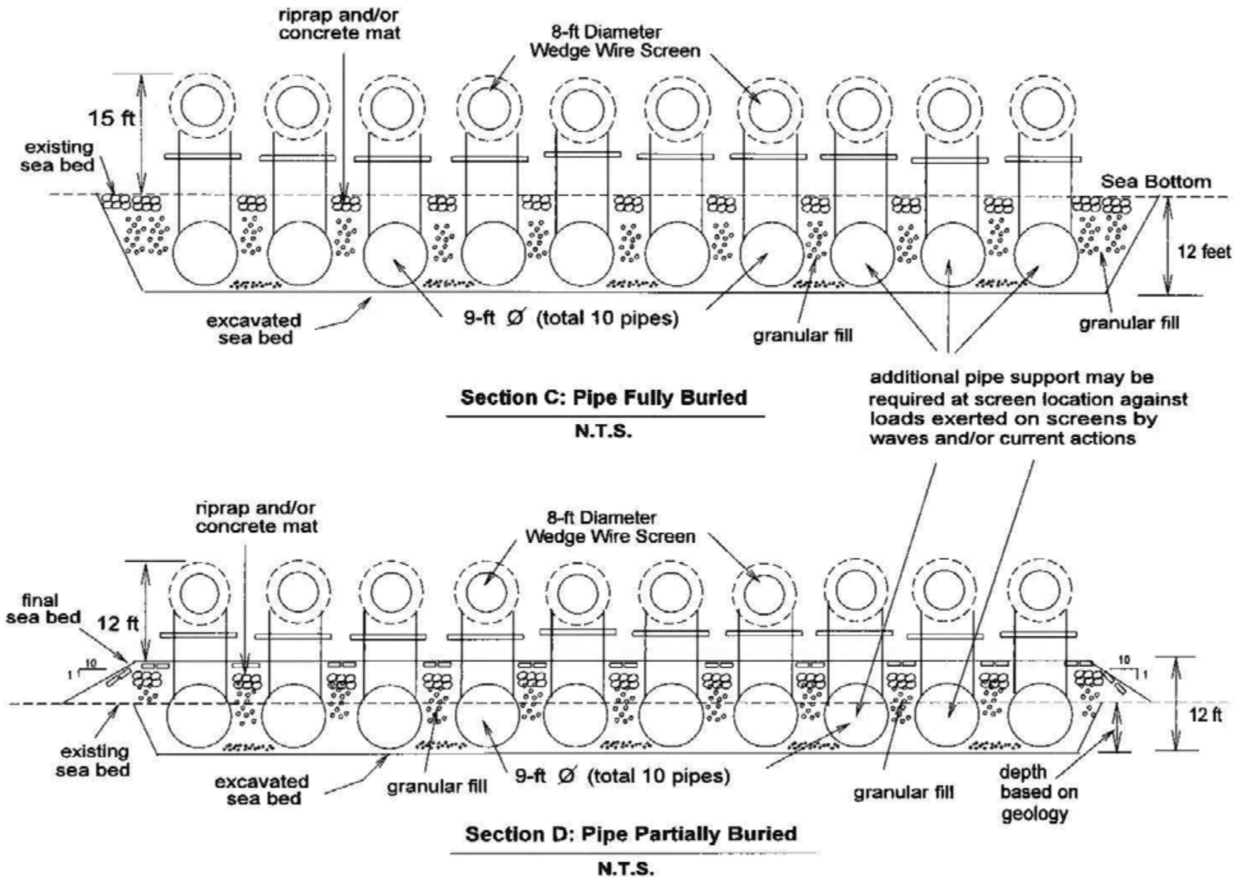


Figure 4.2-18. DCPP Potential Buried Pipe Trench Scenarios (Based on Seabed Geology)

4.2.3.3 Engineering Requirements for Offshore Buried Pipes Alternative

For the offshore buried pipe alternative, the wedge wire assembly requirements are the same as those discussed for the offshore tunnel concept, with the exception of pipe manifold size and flow conveyance system to the intake cove. The 2-mm or 6-mm wedge wire screen assemblies would be buried in trenches (or anchored to the seabed) depending on the minimum available water depth, seabed geology, and wave action. The alignment of the buried pipes can be adjusted based on local geological conditions. Based on the geotechnical information, the pipes could be either clustered in two groups of five, with each group buried in a trench approximately 80 feet wide, or all placed together in a single 160-foot-wide trench. The trench(es) would terminate at the shoreline basin (intake cove), the pipes would be installed, and then the new breakwater would be constructed over them. The portion of the pipes running beneath the breakwater would be supported above the seabed, after suitable bedding is prepared, rather than being placed in a trench.

To create a suitable support system for either the buried pipes or the wedge wire assembly trenches, seabed strengthening may be required, depending on the extent of the fracture zone. This is expected to be a relatively minimal effort, compared to the concept involving tunnel grouting.

Warning buoys would be installed in the area of the wedge wire screen array to avoid shipping impacts on the screens.

Drawing 25762-110-P1K-WL-00061 was developed to aid in obtaining budgetary information from specialty contractors for the installation of the offshore work.

4.2.4 Wedge Wire Screening Technology and Design Requirements

4.2.4.1 Wedge Wire Screens Details

The wedge wire screens considered for this evaluation are T-type circular cylinder screens that are 8 feet in diameter (Figures 4.2-19 through 4.2-21). The 8-foot screen is currently the largest size commercially available with operating experience. Considering the large cooling water withdrawal flow requirement, the high-capacity/high-performance screens are recommended to achieve a more evenly distributed flow across the screen face. The design would be based on a maximum slot flow-through velocity of 0.5 fps. Potential debris loading in a marine environment favors larger screen slot sizes, while fish, egg, and larvae exclusion favors smaller slot sizes that increase the blockage potential. Due to this conflicting requirement, two slot sizes (6 mm and 2 mm) are being considered for in situ testing at the site. The smaller the screen slot size, the higher the number of screens required. To meet DCPP flow requirements, forty-eight 2-mm-slot screens or thirty 6-mm-slot screens would be needed. In situ screen testing would be conducted for both slot sizes to evaluate entrainment and impingement performance versus debris clogging and biofouling.

The screen arrays would be located on the seabed at approximately the location shown on Figures 4.2-3 and 4.2-11. The bottom faces of the screens would be 7 feet above the finished seabed level. The distances shown on Figures 4.2-6 through 4.2-9 and 4.2-14 through 4.2-18 are centerline distances. As shown in the conceptual sketches for the tunnel, the screens would be grouped into five or six assemblies connected to five or six 12-foot-diameter drop shafts via 10-foot-diameter laterals. Most likely, it would be necessary to install orifice plates fabricated from biofouling-resistant material at the outlet flanges of each screen to balance flow. No air-burst system or other means of removing aquatic debris, aquatic organisms, and sediment that may accumulate on the screen surfaces would be required. The screens would be bolted to the manifold risers using frangible bolts designed to break on impact from ship hulls or anchors. The laterals would be either trenched or anchored to the seabed, depending on location and geological condition of the seabed. Adequate rip-rap or concrete mats would be provided around the completed installation to prevent erosion. The entire screen assembly would be constructed of copper-nickel alloys that resist biofouling and would be field tested before final selection.

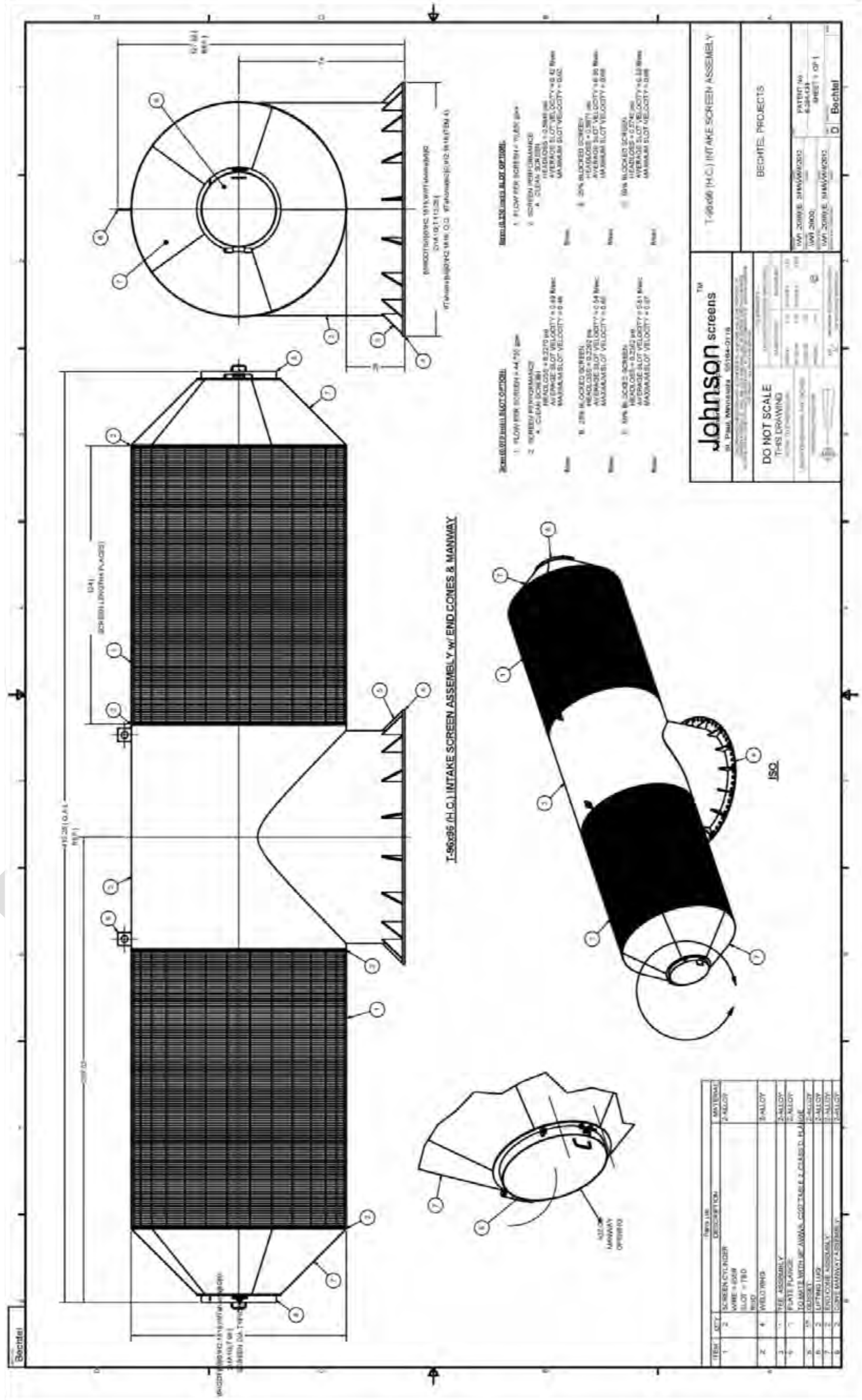
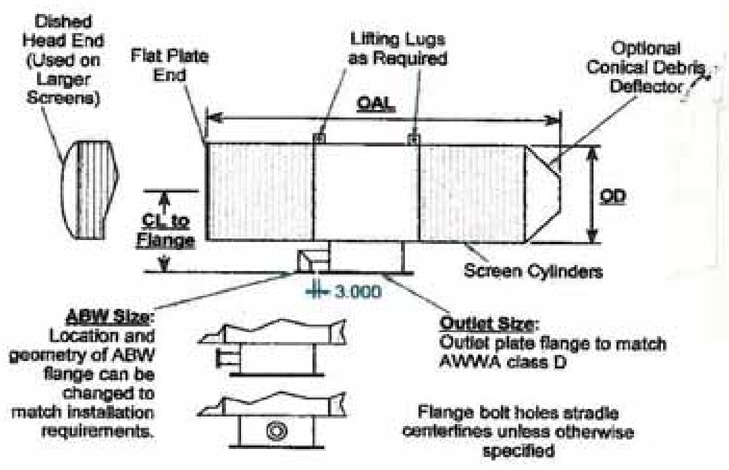


Figure 4.2-19. DCPP Intake Screen Assembly



Dimension/Sizes	Value	Unit	Comments
Model	T96HCE		
OD	96.00	in	Nominal See note 1
OAL	416.00	in	Nominal See note 1
CL to Flange	96.00	in	Nominal See note 1
Outlet Connection Size	96PS		See note 2
ABW Connection Size	none		See note 2
Estimated Weight	28080	lbs	
Left End Closure	Cone		
Right End Closure	Cone		

Screen Specifications			
Slot Opening	0.236	in	
Open Area Percentage	72.62%		
L/D Ratio	1.300		
Effective Screen Length	125.00	in	
Wire Type	93		

Design:			
Depth	40	Ft	Hydrostatic Load
Collapse Rating	17.34	psi	
Material	ZALLOY		SS or Z-Alloy

Flow Capacities:			
Flow/Screen	70833.33333	GPM	See note 3
Maximum Slot Velocity	0.50	fps	See note 3
Average Slot Velocity	0.42	fps	See note 3
Estimated DP/Screen	0.0032	psi	Thru clean screen surface only-See note 4
Estimated DP/Assy	0.5646	psi	Through entire clean assembly - See note 4

PATENT # #6,051,131

Notes:

1 Dimensions shown are nominal. All screens are made to order, and can be adapted to a wide variety of installation requirements.

2 These are based on the size of the connecting and abw pipe and may vary from the values listed in the technical brochure.

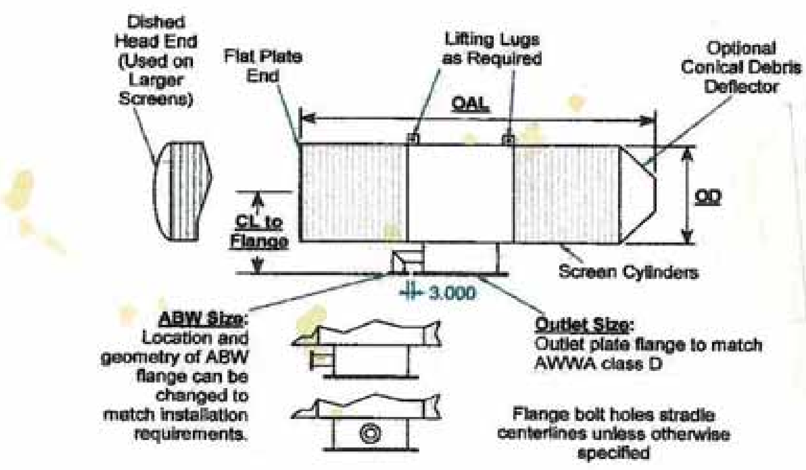
3 Capacities based on use of patented Johnson flow modifier design.

4 Pressure drops below .1 psi should be considered an order of magnitude only, as testing data for these low values is not available.

The concepts and assemblies shown should be considered proprietary and should not be copied, redistributed without the permission of US Filter/Johnson Screens. All dimensions are preliminary, changes may be made and can effect final price and configurati

Johnson screens 1950 Old Hwy. 8, New Brighton, MN 55112 (651)-638-3218 (Phone), (651)-638-3177 (Fax)	Model T96HCE Preliminary Intake Screen Specification SONGS/Diablo Canyon Projects Screens - 6 mm slot	Date: 1/3/2013

Figure 4.2-20. DCPP Preliminary Intake Screen Specifications (6-mm Slots)



Dimension/Sizes	Value	Unit	Comments
Model	T96HCE		
OD	96.00	in	Nominal See note 1
OAL	416.00	in	Nominal See note 1
CL to Flange	96.00	in	Nominal See note 1
Outlet Connection Size	96PS		See note 2
ABW Connection Size	none		See note 2
Estimated Weight	28670	lbs	
Left End Closure	Cone		
Right End Closure	Cone		

Screen Specifications			
Slot Opening	0.079	in	
Open Area Percentage	47.02%		
L/D Ratio	1.300		
Effective Screen Length	125.00	in	
Wire Type	93		

Design:			
Depth	40	Ft	Hydrostatic Load
Collapse Rating	17.34	psi	
Material	ZALLOY		SS or Z-Alloy

Flow Capacities:			
Flow/Screen	44736.84211	GPM	See note 3
Maximum Slot Velocity	0.49	fps	See note 3
Average Slot Velocity	0.40	fps	See note 3
Estimated DP/Screen	0.0031	psi	Thru clean screen surface only-See note 4
Estimated DP/Assy	0.2270	psi	Through entire clean assembly - See note 4

PATENT # #6,051,131

Notes:

1 Dimensions shown are nominal. All screens are made to order, and can be adapted to a wide variety of installation requirements.

2 These are based on the size of the connecting and abw pipe and may vary from the values listed in the technical brochure.

3 Capacities based on use of patented Johnson flow modifier design.

4 Pressure drops below .1 psi should be considered an order of magnitude only, as testing data for these low values is not available.

The concepts and assemblies shown should be considered proprietary and should not be copied, redistributed without the permission of US Filter/Johnson Screens. All dimensions are preliminary, changes may be made and can effect final price and configurati

Johnson Screens 1950 Old Hwy. 8, New Brighton, MN 55112 (651)-638-3218 (Phone), (651)-638-3177 (Fax)	**Model T96HCE** **Preliminary Intake Screen Specification** **SONGS/Diablo Canyon Projects** **Screens - 2 mm slot**	**Date:** **1/3/2013**

Figure 4.2-21. DCPP Preliminary Intake Screen Specifications (2-mm Slots)

4.2.4.2 Wedge Wire Screen Performance

The inherent engineering design features of wedge wire screens give them the ability to effectively minimize impingement mortality and reduce entrainment. These features include:

- Wedge wire screens provide passive screening with no moving parts.
- Screen surface velocity is uniform across the entire screen surface.
- A decelerating inward screen velocity avoids suction force.
- Screen flow-through velocity is on the order of sea current velocity.
- The screen design avoids the formation of swirling flows around the screen.
- Screens are installed above the sea bottom with no impact to benthic life.
- The screen cylindrical shape prevents attachment of debris to lower parts of the screen surface.
- Installing the screens in deeper seas (about 70-foot water depth) helps them experience substantially reduced wave action, resulting in a nearly uniform sea current velocity field around them most of the time.
- Cylindrical T-shaped wedge wire screens with end cones installed parallel to the sea currents assist in diverting floating debris from the screen surface.

4.2.5 Comparison of Offshore Modular Wedge Wire System Alternatives

Constructability and installation cost will determine the preferred alternative since the operational reliability would be the same for either tunnel or buried pipes. Screen performance and maintenance requirements are identical for both. Plant downtime during construction would be about the same since the existing system would remain operational until either alternative is constructed and in place.

Both alternatives would have the same environmental compliance.

The DCPP site has a fractured rocky shoreline with a bathymetry characterized by a sloping bedrock bottom with steep relief, rocky pinnacles, and prominent rocky ridges. These features may limit sea-bottom excavation for the pipe alternative. Similarly, the near-shore seismic fault zones would affect tunnel construction and, thus, the feasibility of the tunnel alternative. Detailed offshore geotechnical investigations and construction-method evaluations should be pursued to select the most viable alternative, considering the effect of a hypothetical offshore seismic event effect on either.

4.2.6 Final Offshore Modular Wedge Wire Screening Technology Selection

The use of offshore wedge wire screens at the DCPP site would require a due diligence survey and field testing investigation before implementation. The following efforts should be considered as part of this multidisciplinary investigation:

- Collect historic operating plant data—records, photos, reports, and fact sheets—to understand 20-plus years of operating experience.
- Collect and evaluate nearby plant experiences using wedge wire screens.
- Perform an aquatic field survey of the sea bottom to identify a suitable location for screen placement and to minimize biologically sensitive and production areas.

- If a hydrographic survey is not available, perform one to properly evaluate the local hydrodynamics of the source water to facilitate the effectiveness of reduction mechanisms afforded by the screens.
- Perform in situ pilot testing of the two screen slot sizes (2 mm and 6 mm) to evaluate entrainment, impingement, and debris effects on screen performance. This pilot testing is essential to evaluate both the biological and engineering feasibility of the 2.0-mm and 6.0-mm cylindrical wedge wire screens to determine their biological exclusion efficiency in comparison to an open port and their performance in controlling biofouling and debris clogging. The study phases would include (i) the development of the study plan, (ii) the engineering design of the wedge wire screen deployments and biological sampling facilities, (iii) the development of the biological sampling plan, and (iv) the analyses of collected data to determine the debris biofouling potential and the screen cleaning techniques/frequency for each of the two screen slot sizes, with the objective of determining which of the two is more suitable.
- Field test screen construction material and slot size.
- Perform geological and geotechnical investigations of the affected offshore areas.
- Evaluate the constructability and safety of the proposed system.
- Develop an operational inspection plan. The current plan is that the screens will require an inspection and possible external cleaning twice a year. This plan would be adjusted based on the testing program.

Following the complete due diligence survey, including its evaluations, physical field testing, and engineering and constructability investigations, the suitable slot size and material can be finalized and impacts on aquatic life can be evaluated.

4.2.7 Future Actions

Potential variations of the wedge wire screen concept could involve using different alignments, sizes, or both, for the connecting conduits. Also, further assessment of detailed engineering data and permitting requirements would be needed to establish the optimal arrangement of the wedge wire screens.

4.2.8 Permitting

The initial Phase 1 (Report 25762-000-30R-C01G-00009) permitting assessment focused on identifying the applicable (required) permits and approvals for construction and operation of the offshore modular wedge wire screening technology. A comprehensive list was developed of potentially applicable permits and approvals at the federal, California, county, and municipal levels (as applicable). The applicability of each permit/approval to the wedge wire screen system was evaluated. Those permits and approvals that were deemed applicable were subsequently scrutinized to characterize the expected duration and complexity of the regulatory review process. Ultimately, the offshore modular wedge wire screening technology was one option selected for the phase 2 assessment.

The subsequent permitting assessment focused on identifying the critical path (longest duration) initial preconstruction permitting processes and the associated project costs. The Preconstruction permits are those approvals that directly support site mobilization, physical site access, and initial earthwork/foundations for the subject cooling system technology option. The costs include the direct permit filing, impact mitigation, and permitting application development (services) costs.

4.2.8.1 Cost and Schedule Evaluation

The cost and schedule to secure the following major applicable permits were developed based on discussions with key relevant regulatory authorities and from associated website resources:

- California Environmental Quality Act – Final Notice of Determination
- Section 404/10 Permit, U.S. Army Corps of Engineers
- California Public Utilities Commission
- Coastal Development Permit, California Coastal Commission
- Coastal Development Lease, California State Lands Commission
- NPDES Industrial Discharge Permit, Central Coast Regional Water Quality Control Board and State Water Resources Control Board
- Letter of Authorization, National Marine Fisheries Service (NMFS)
- Dust Control Plan, San Luis Obispo Air Pollution Control District
- Local Approvals, San Luis Obispo County

Table WW-1 summarizes the key cost and schedule details and assumptions for the offshore modular wedge wire screening system. Legal costs associated managing appeal processes and related litigation have not been included. The bulk of the potential mitigation costs will be developed through negotiation process and are, consequently, not included in the cost estimate.

Table WW-1. DCPP Environmental Permit/Approval Cost Assessment:
Offshore Modular Wedge Wire Screening System

Permit/ Approval	Cost Discussion	Responsibility	Permit Review Period	Filing Costs	Remediation or Mitigation Costs	Permitting Service Costs
Section 404/10 Permit – U.S. Army Corps of Engineers (USACE)	No filing fees are associated with the Section 404 permit application, although there is a nominal fee ($10–$100) associated with preparing an Environmental Assessment (EA). Labor costs for preparing an individual permit application = 1,000 hours @ $150.	Owner	120 days from complete application (goal); 12 months (expected but aligned with CEQA)	$100	$0	$150,000
Section 401 Water Quality Certificate –Central Coast Regional Water Quality Control Board (CCRWQCB)	Fill & Excavation Discharges are evaluated as: $944 + $4,059 x disturbed area (acres) Dredging Discharges are $944 + $0.15 x cy Channel and Shoreline Discharges are $944 + $9.44 x discharge length (ft) (CCR Title 23§2200) Assumption: 2,000 ft of shoreline impacts. Labor costs: contained in Section 404/10.	Owner	Aligned with Section 404/10 Permits	$19,284	$0	$0

Permit/ Approval	Cost Discussion	Responsibility	Permit Review Period	Filing Costs	Remediation or Mitigation Costs	Permitting Service Costs
Section 7 Consultation with U.S. Fish and Wildlife Service (USFWS), Endangered Species Act of 1973	It is unlikely the project would have sufficient “federal nexus” (federal funding, federal lands) to trigger USFWS consultation. However, California Department of Fish and Wildlife would likely provide the consultation.	Owner	May be part of CEQA review	$0	$0	$0
Letter of Authorization – Marine Mammal Protection Act – National Marine Fisheries Service (NMFS)	Relocation of sea lion population resident in the cove may require approval from NMFS. Labor costs for preparing associated documentation and relocation = 200 hours @ $150/hr.	Owner	While review can take 8 to 18 months, approval will parallel the CEQA review process.	$30,000	$0	$0
California Public Utilities Commission (CPUC) Approval	While formal CPUC review and approval may prove necessary, the primary costs of this process are associated with the CEQA review process. The CPUC could be the lead CEQA agency or share this role with another regulatory organization (California Coastal Commission, San Luis Obispo County). These CEQA costs are addressed in the County Conditional Use Plan Approval Process.	Owner	About 12 months if required	$0	$0	$0
Coastal Development Permit – California Coastal Commission/Local Coastal Programs	The CCC indicates that the filing fee for non-residential development is $265,000 (CCC, 2008). There may be additional fees for reimbursement of reasonable expenses, including public notice costs. CEQA costs are covered in the County Condition Use Plan Approval Process. Labor costs for preparing/submitting related forms and documentation = 2,000 hours @ $150/hr	Owner	A 3–9 month process is advertised but would be aligned with the CEQA review process	$265,000	$0	$300,000
Coastal Development Lease – California State Lands Commission and potential California Environmental Quality Act (CEQA) Lead Agency	The Commission lease-related fees include (CSLC, 2011): Industrial Lease: $25,000 Dredge Lease Fee: $1,500 Filing Fee: $25 Labor costs for preparing/submitting related forms and documentation = 3,000 hours @ $150/hr	Owner	Depends on duration of CEQA/EIR review process; about 2 years	$26,525	$0	$450,000

Permit/ Approval	Cost Discussion	Responsibility	Permit Review Period	Filing Costs	Remediation or Mitigation Costs	Permitting Service Costs
Dust Control Plan or Construction Activity Management Plan (CAMP) – San Luis Obispo Air Pollution Control District (SLO-APCD)	While SLO-APCD does not list any specific fee for the Dust Control Plan, other California Air Resources Board (CARB) entities are known to charge $300 to reimburse review costs. If the construction ozone precursor emissions (ROG + NOx) exceed the SLO-APCD quarterly significance threshold of 6.3 tons, the SLO County CEQA Handbook (SLO-APCD, 2012) defined mitigation rate is $16,000 per ton of ozone precursor plus 15% administrative fee. The current assumption is that precursor emissions are below this threshold. Labor costs for preparing/submitting the plan = 80 hours @ $150/hr	Contractor	1-month plan development process	$0	$0	$12,000
NPDES Industrial Discharge Permit – Central Coast Regional Water Quality Control Board (CCRWQCB) and State Water Resources Control Board (SWRCB)	The operating project is incurring annual fees based on its current discharge rate, which is not expected to change appreciably with the addition of this new intake system. Consequently, any associated fee structure is not expected to change. Labor costs for revising NPDES permit to reflect new intake structure = 500 hours @ $150/hr	Owner	About 6 months	$0	$0	$75,000
Conditional Use Plan Amendment – San Luis Obispo County Department of Planning and Building and Potential California Environmental Quality Act (CEQA) Lead Agency	As the CEQA lead agency or co-lead, the county would assess fees for development of the Initial Study, environmental coordination fees, and EIR processing fees (SLO-DPB, 2012). Initial Study Cost: $14,603 Other fees include: CalFire Review: $603 Health Department Review: $600 Geological Review: $2,671 (min) Resource Conservation District Review: $375 (min) Labor costs for EIR consultant + 50% premium = 4,000 hours @ $150/hr x 1.5.	Contractor	Depends on duration of CEQA review process; about 2 years	$20,000	$0	$900,000

Permit/ Approval	Cost Discussion	Responsibility	Permit Review Period	Filing Costs	Remediation or Mitigation Costs	Permitting Service Costs
Notification of Waste Activity – Resource Conservation and Recovery Act Hazardous Waste Identification Number (Small Quantity Generator) – Construction Phase – Department of Toxic Substance Control, USEPA, San Luis Obispo County Environment Health Services – California Unified Program Agency	Securing the Construction Phase Hazardous Waste ID (if necessary) does not demand a filing fee. Labor costs for preparing/submitting related forms = 4 hours @ $150/hr	Contractor	1–2 weeks if required	$0	$0	$600
Building Permits – San Luis Obispo County Department of Planning and Building and Public Works: Grading Site Plan Reviews/Checks Mechanical, Plumbing, and Electrical Tanks Fire Inspections	County of San Luis Obispo Department of Planning and Building has a complex fee schedule (SLO-DPB, 2012). Recent SLO County experience on a significant solar PV project indicates that overall building permit and inspection fees could total $750,000. Labor costs for preparing/submitting related engineering packages = 2,000 hours @ $150/hr	Contractor	4–6 weeks for initial permits following completion of CEQA review and conditional use permit	$750,000	$0	$300,000
California Department of Transportation (Caltrans) – Oversize/Overweight Vehicles	Caltrans Transportation Annual or Repetitive Permit (oversize/ overweight loads): $90 (Caltrans – FAQ, 2013) Labor costs for preparing/submitting related forms = 4 hours @ $150/hr	Contractor	About 1 month	$90	$0	$600
Caltrans Heavy Haul Report (transport and delivery of heavy and oversized loads)	No direct costs. Labor costs for preparing/submitting related forms = 16 hours @ $150/hr	Contractor	About 1 month	$0	$0	$2,400
Fire Safety Plan Approval, Certificate of Occupancy, Flammable Storage – San Luis Obispo County Fire Department	Revisions to the existing Fire Safety Plan are not expected to result in additional filing or direct regulatory fees. The initial filing fee of $408 would probably not apply. Labor costs for revising Fire Safety Plan = 20 hours @ $150/hr	Contractor	1 month for plan approval	$0	$0	$3,000
TOTAL				$1,110,999.00	$0.00	$2,193,600.00

4.2.8.2 Summary

The list of potentially applicable federal, state, and local permits for the offshore modular wedge wire screening system reflects the potentially significant impacts to the onshore and near-shore marine environment. The efforts to conduct a successful CEQA review would be the primary critical path permitting process. The CEQA lead agency may be a shared responsibility among a number of key regulatory departments (e.g., San Luis Obispo County, CSLC). The requisite USACE Section 404 permit, CCC Coastal Development Permit, CSLC Lease, and NPDES permit modification would have potentially lengthy review processes but would all be essentially bounded by the critical path CEQA/EIR review process.

The CEQA review process duration varies. The shortest path appears to be a nominal 210-day (7-month) period that would include the minimum 30-day period of review to determine that the initial CEQA application is complete. This process culminates in a Negative Declaration and does not involve developing a comprehensive EIR. The wire wedge screening system review process would likely demand preparation of an EIR, which would serve to significantly extend this review process. The process—inclusive of the initial 30-day completeness review, a 1-year EIR review, and a so-called 90-day “reasonable extension” triggered by compelling circumstances recognized by both the applicant and lead agency—would then extend out to 16 months. (CEQA Flowchart)

The CEQA review process would be extended even further by conservatively adding an additional 8 months to cover “unreasonable delays” ostensibly associated with the applicant’s difficulty in supplying requested information. Collectively, this longer and probably more applicable 2-year CEQA review process would likely follow a 1-year period of permit application development. The other permitting processes are assumed to proceed in parallel to the critical path CEQA review process.

The total permit filing and permitting service costs associated with this 3-year permitting process would be approximately $3.2 million. As noted earlier, this 3-year period does not reflect the impact of permit appeals, litigation, or potentially negotiated CEQA-related mitigation fees.

4.2.9 Sources

1. California Coastal Commission Permit Application Instructions, Appendix E Filing Fee Schedule (3/17/2008).

2. California Code of Regulations Title 23§2200 Annual Fee Schedules – Subpart a(3) Dredge and Fill Materials.

3. California State Lands Commission, Land Management Division Application Guidelines (10/12/2011).

4. California State Water Resources Control Board (SWRCB) Fee Schedule 2012-2013, 2012 http://www.swrcb.ca.gov/resources/fees/docs/fy12_13_fee_schedule_npdes_permit.pdf.

5. CEQA Flowchart for Local Agencies: California Code – Section 21151.5, http://www.ceres.ca.gov/planning/ceqa/flowchart.html.

6. San Luis Obispo County Air Pollution Control District (SLO-APCD) CEQA Air Quality Handbook – A Guide For Assessing the Air Quality Impacts for Projects Subject to CEQA Review, April 2012.

7. San Luis Obispo County Department of Planning and Building (SLO-DPB) – Fee Schedule 2012-2013, 2012.

4.3 Closed-Cycle Cooling Technology

4.3.1 Passive Draft Dry Air Cooling

[Later]

4.3.2 Mechanical Draft Dry Air Cooling

[Later]

4.3.3 Wet Natural Draft Cooling

[Later]

4.3.4 Wet Mechanical Draft Cooling

[Later]

4.3.5 Hybrid Wet/Dry Cooling

[Later]

5. Construction Approach

[Later]

6. Schedule Development

[Later]

7. Estimate Development

[Later]

8. References

1. Bechtel Power Corporation, "Independent Third-Party Interim Technical Assessment for the Alternative Cooling Technologies or Modifications to the Existing Once-Through Cooling System for Diablo Canyon Power Plant," Report No. 25762-000-30R-C01G-00009, Rev. 0, prepared for Pacific Gas and Electric Company and the State Water Resources Control Board Nuclear Review Committee, September 14, 2012.

2. Pacific Gas and Electric Company, "Report on the Analysis of the Shoreline Fault Zone, Central Coastal California," report to the U.S. Nuclear Regulatory Commission for Diablo Canyon, January 2001.

3. 25761-110-M6K-WT-00001 P&ID Traveling Screen Wash and Fish Return System

4. 25761-110-P1K-WL-00070 Circulating Water System – Fine Mesh Screen House – General Arrangement

5. 25762-110-M0X-YA-00006 Preliminary Mechanical Equipment List – Fine Mesh Screening

6. 25762-110-M6K-WL-00006 Process Flow Schematic Offshore Wedge Wire Screen

7. 25762-110-P1K-WL-00060 Circulating Water System Wedge Wire Screens General Arrangement

8. 25762-110-P1K-WL-00061 Circulating Water System Wedge Wire Screens Alternate General Arrangement