Proposed Delta Conveyance System

Presented at December 11, 2019
DCA Stakeholder Engagement Committee Meeting

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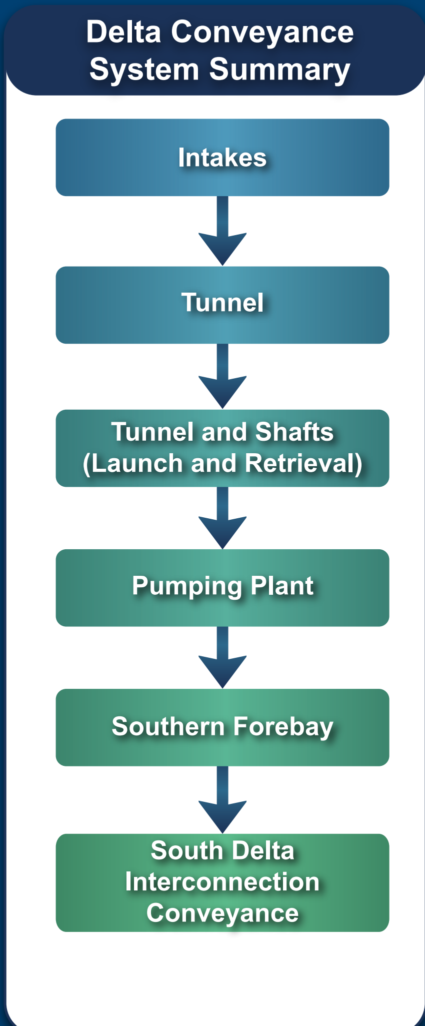
DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY
STAKEHOLDER ENGAGEMENT COMMITTEE (SEC)

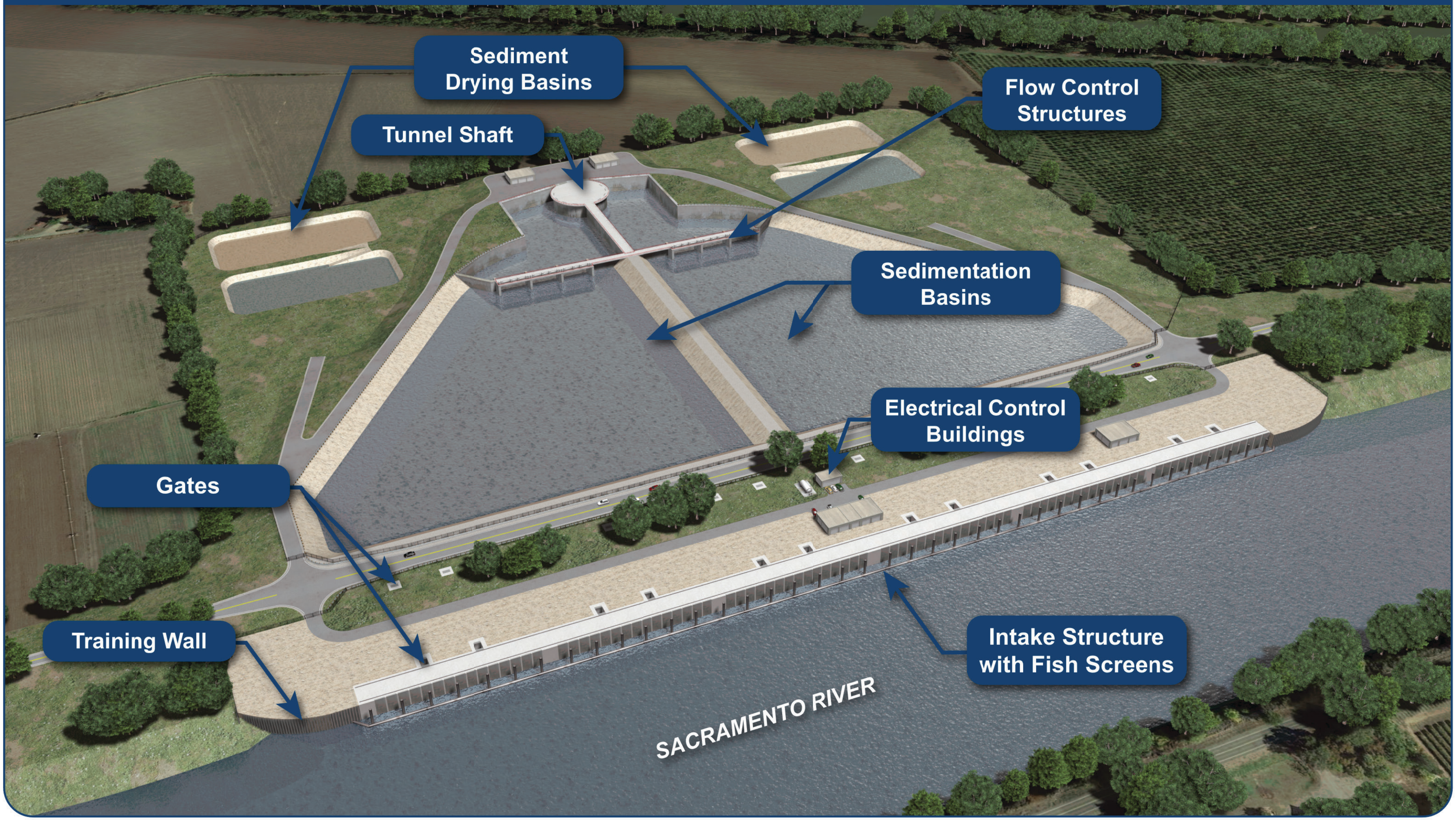
Introduction to Proposed Facilities Overview



Currently, the SWP Delta water conveyance facilities include Clifton Court Forebay and the Banks Pumping Plant in the south Delta that enable the Department to divert water and lift it into the California Aqueduct. The proposed project would construct and operate new conveyance facilities in the Delta that would add to the existing SWP infrastructure.

Water would be diverted from the Sacramento River at the intakes and then flow through a tunnel to the intermediate forebay. From there it would move through the main tunnel to the Southern Forebay Pumping Plant which brings the water into the Southern Forebay. Water is stored here until it is released into the California Aqueduct by the South Delta Interconnection Conveyance.

Intake



Sediment Drying Basins
Tunnel Shaft
Flow Control Structures
Sedimentation Basins
Electrical Control Buildings
Gates
Training Wall
Intake Structure with Fish Screens
SACRAMENTO RIVER

About Intakes

Purpose

An intake is a structure that is used to divert water from a waterbody (river or lake) and into a conveyance system. Where the water supply to be diverted contains significant sediment and other solid material, sedimentation basins and drying beds are often located downstream of the intake(s) to remove this material and prevent it from settling in the conveyance system.

Primary intake functions include:

- **Water Diversion**—Direct water into a conveyance system from a river source, depending on river flow and depth conditions
- **Fish Protection**—Prevent juvenile and adult fish species from being diverted with river water or impinged on a fish screen surface

General Description

Potential intake facilities would include two salient features:

1. Intake structure(s) including in-river fish screens
2. Sedimentation management facilities (typically large water basins), flow control and flood prevention facilities

A concrete intake structure would divert water from a river and be fitted with fish screens at the interface between the structure and the river. The size of the intake is based on the screen area needed to prevent various aquatic species from being sucked toward the intake structure. The screens require a cleaning system to keep debris and aquatic growth from attaching to the screens and clogging the screen openings.

From the intake structure, water flows into a settling basin where sand, grit and other settleable material can drop to the bottom of the basin and be removed and pumped to drying beds. The dried material can either be diverted back into the flows stream or reused in another location as appropriate.

Gates located just behind the fish screens are used to control the flow through the intakes. Likewise, a second set of gates are located at the outlet of the sedimentation basin to control the flow into the conveyance system.

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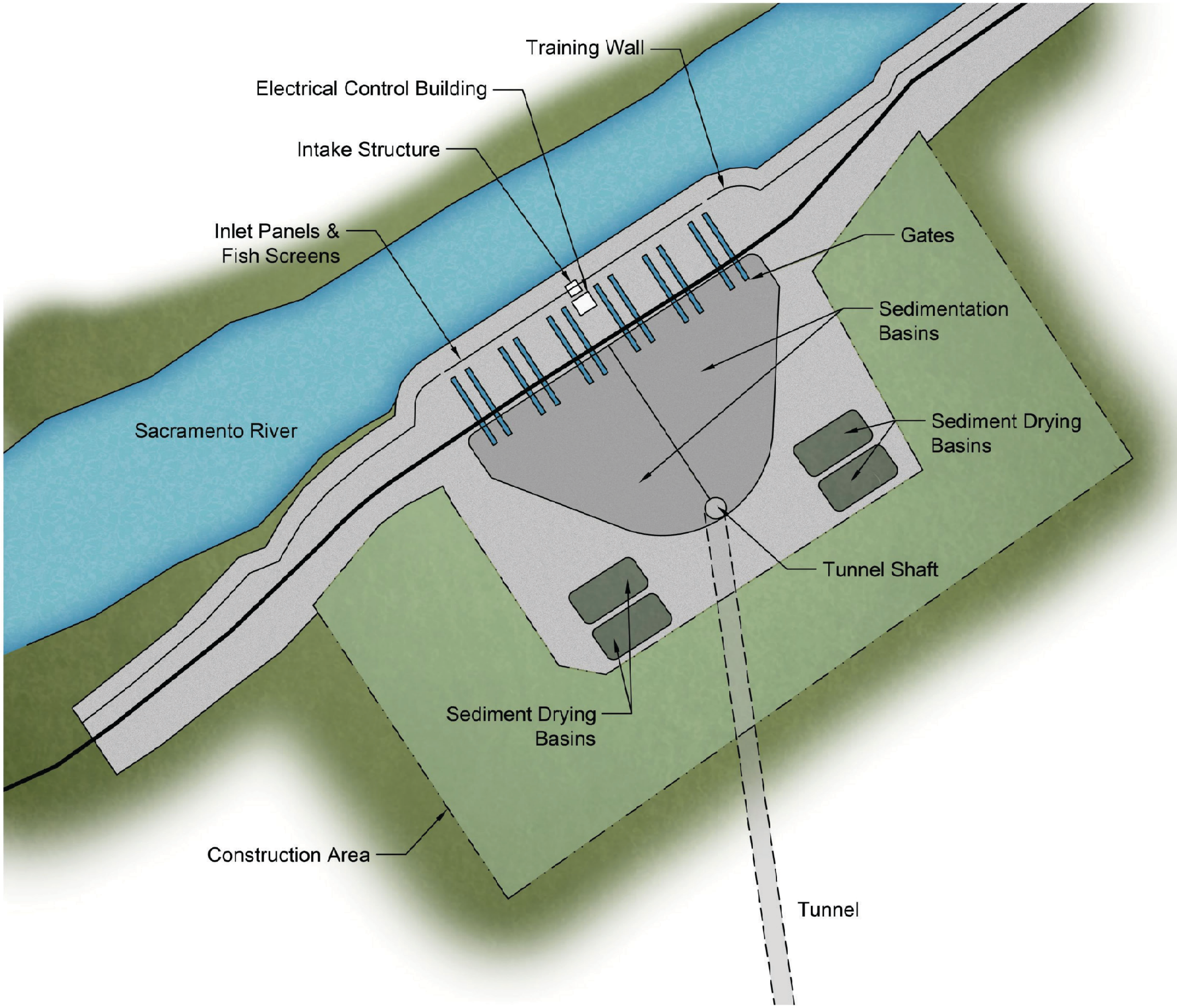
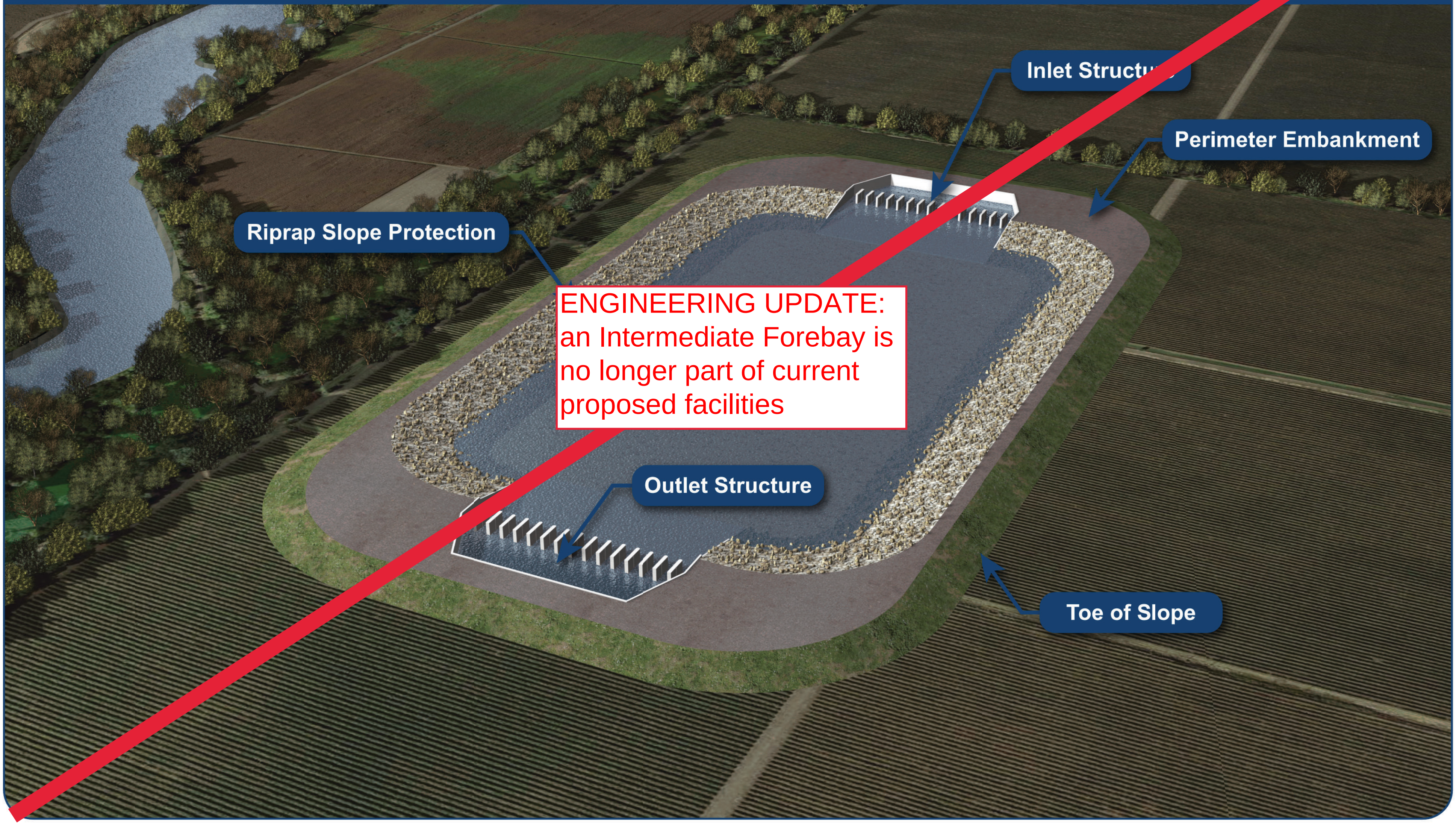


Construction Site Plan

Intake - Approximately 115-210 Acres

Intermediate Forebay



About Intermediate Forebays

Purpose

An intermediate forebay provides water storage in any potential water conveyance system to help keep the system in balance as the flow rate of incoming water changes at the intakes or flow of outgoing water changes at the pumping plant. If the flow into the system is slightly higher than the flow out, the water surface will slowly rise. Likewise, when the flow in is less than the rate of pumping out, the level will fall. Level sensors on the forebay will help inform pumps to speed up or slow down in order to stay in balance with intake flows.

General Description

The size of an intermediate forebay as part of any potential water conveyance system will be determined using an operational model of the system and examining the reaction times as flow changes are made both at intake(s) and pumping plants. Concrete shafts would be needed at both ... to allow water flows from a tunn... shafts could also serve as tunn... during tunnel construction.

ENGINEERING UPDATE: an Intermediate Forebay is no longer part of current proposed facilities

Forel... with side slopes made of of compacted earthen embankments. The embankments would need to be above flood levels to prevent flood levels at intakes from overtopping the forebay walls. The inlet and outlet of an intermediate forebay would feature bulkhead slide gates to provide flow isolation as needed for inspections, maintenance or repair work. Gate configurations can include double isolation feature with two sets of gates at both forebay inlet and outlet to provide redundancy for life-safety considerations.

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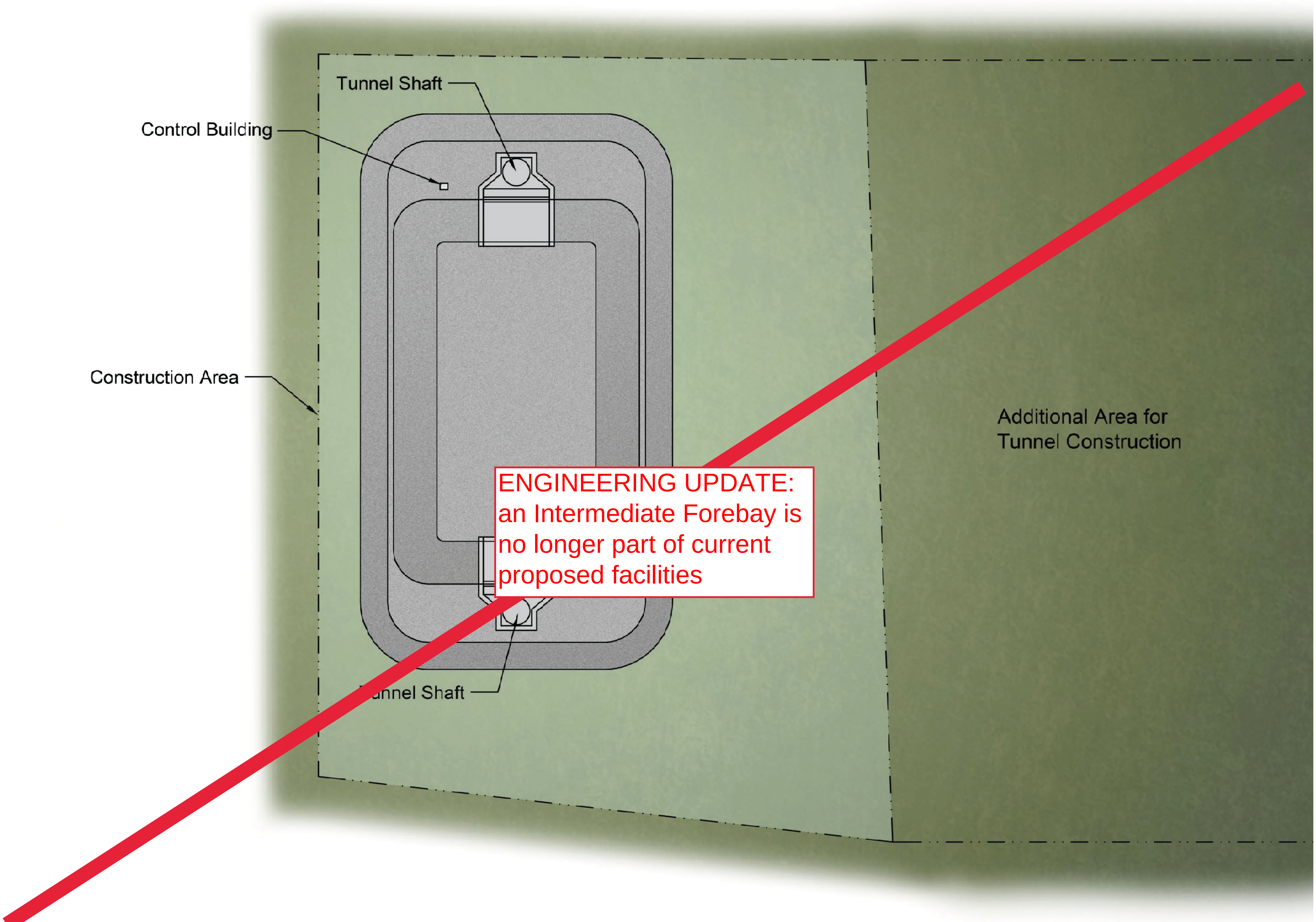
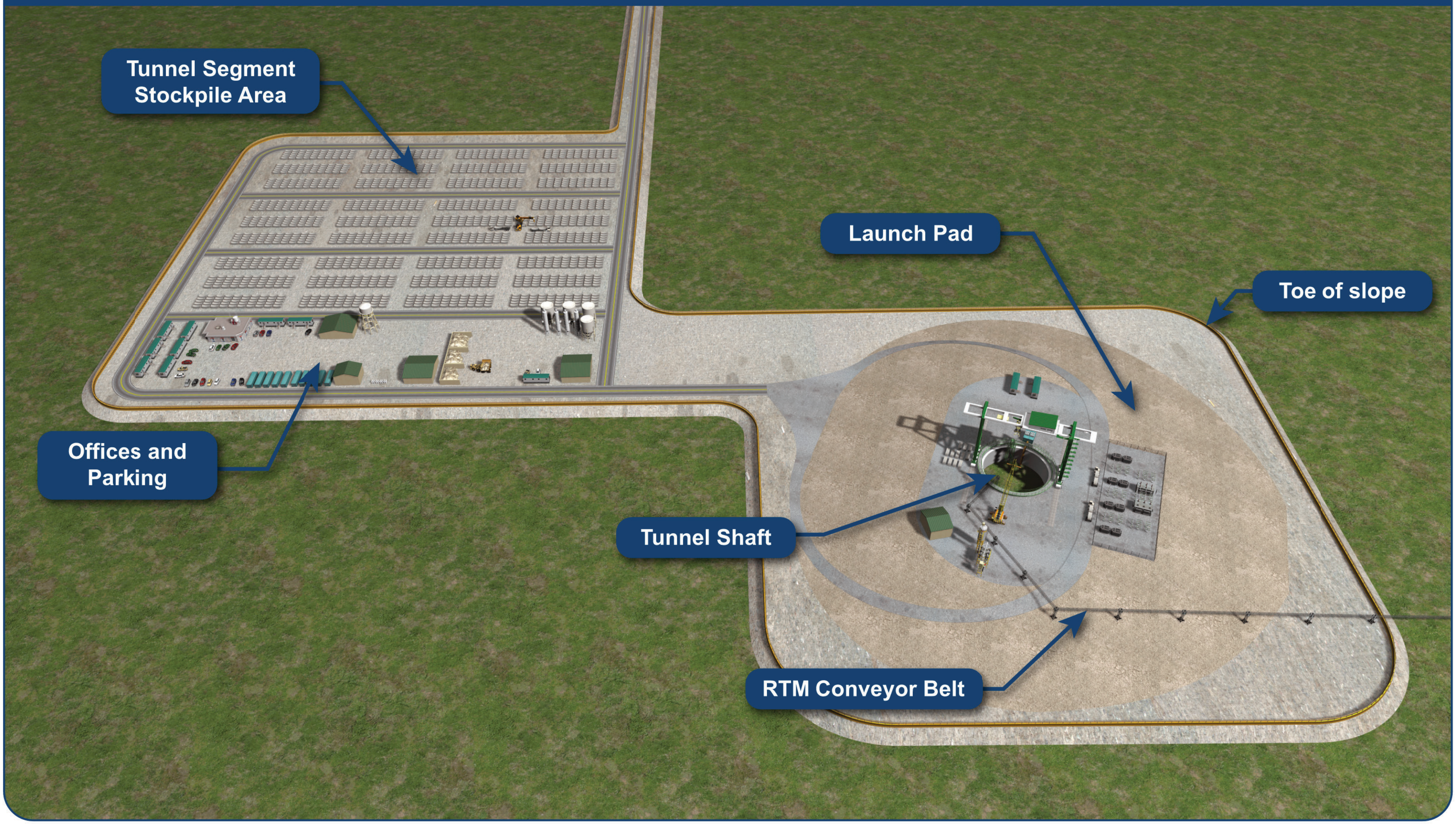


Construction Site Plan

Intermediate Forebay - Approximately 250 Acres

Launch Shaft



About Tunnel Launch Shafts

Purpose

A tunnel launch shaft is required to lower a tunnel boring machine (TBM) to the desired below-ground elevation for drilling. It also serves as a point of access to a tunnel for moving workers and materials into the tunnel as well as removing excavated soils out of the tunnel (reuseable tunnel material (RTM)). It also is used for ventilation, pushing fresh air into the tunnel and exhausting out stale air.

General Description

Launch shafts are generally cylindrical in shape and constructed of reinforced concrete walls and a reinforced concrete base. The top height of a launch shaft should be well above flood level to ensure that workers are never subject to external flood conditions while working inside the tunnel. The number of launch shafts needed will depend on the recommended tunnel run lengths.

Once the launch shaft is complete and the shaft has been fitted out with the proper equipment, a TBM lowered into the shaft and set at the appropriate elevation and direction for drilling. During tunnel excavation, large construction cranes would be used to lower tunnel lining segments and other materials down into a shaft where they are transported on rail to the advancing machine. RTM produced by tunnel excavation would be transported on conveyors moving in the opposite direction of the tunnel machine and removed from the tunnel via the launch shaft. Land is required near launch shafts for storage of concrete segment tunnel liners, as well as stockpiling of RTM removed during tunnel operations.

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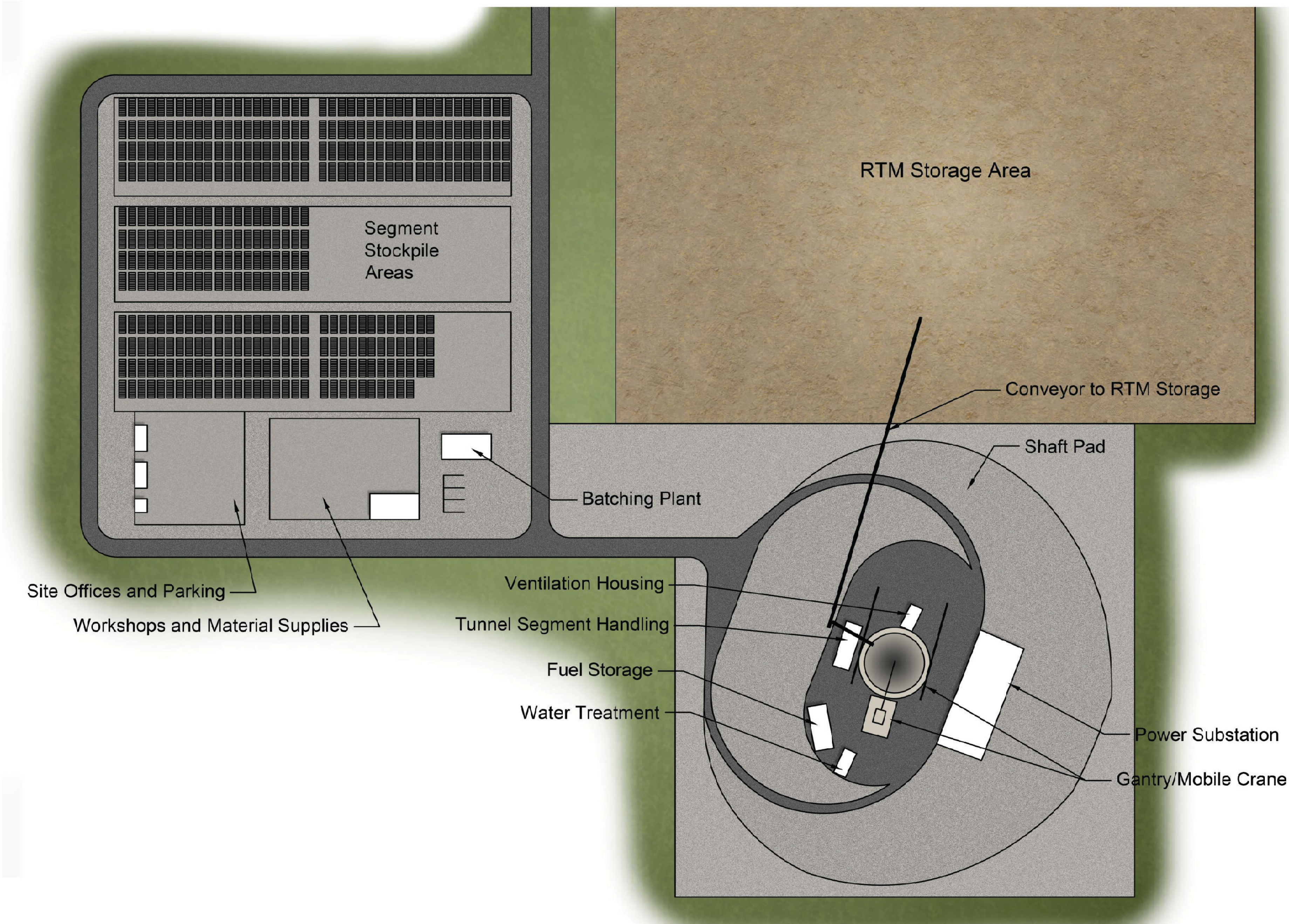
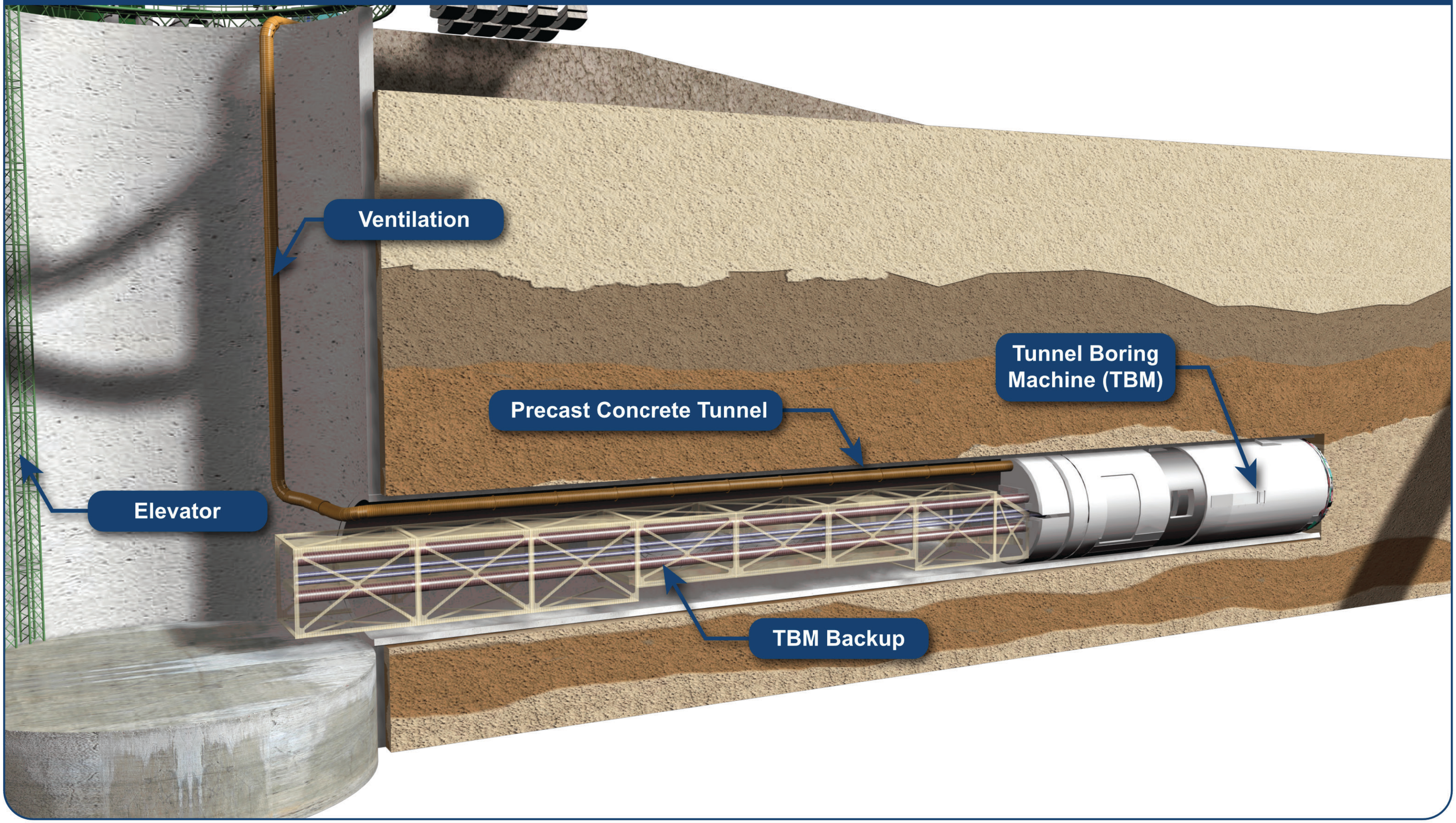


Construction Site Plan

Launch Shaft - Approximately up to 450 Acres

Tunnel


Ventilation
Tunnel Boring Machine (TBM)
Precast Concrete Tunnel
Elevator
TBM Backup

About Tunnels

Purpose

In any large water conveyance system, water is typically diverted by using canals, pipelines or tunnels. Historically, a canal was considered for the Delta Conveyance project but was replaced with a proposed tunnel to reduce the area of disturbed land. For the flow range under consideration for any potential Delta conveyance system, a tunnel is a more practical and standard engineering practice as compared to a pipeline. The primary purpose of a tunnel is to convey water from its point of inlet to its point of use. For a potential Delta conveyance system, a tunnel would divert flows from Intake structure(s) to connection facilities to existing state and potentially federal pumping plants.

General Description

Tunnels constructed through soft geology are typically drilled with Tunnel Boring Machines (TBMs). A launch shaft is typically constructed to allow transport of the TBM down to the desired below ground elevation for tunnel drilling. A TBM has a rotating cutting head protruding out a thick metal shield. The shield is a steel cylinder that serves as a temporary support structure to hold the borrowed ground in place until a permanent liner can be installed. For this type of geology, pre-cast, interlocking concrete liner segments would likely be used to form the permanent interior lining of the tunnel hole. The TBM includes a transport systems to convey excavated material (reuseable tunnel material or RTM) from the drilling head to the back of the machine where it can be conveyed out of the tunnel. An automated rotating erector system trails the TBM and is used to place the concrete liner segments into place. The tunnel lining would consist of a one-pass lining system using precast concrete liner segments that serve as both initial and permanent support structure for the tunnel. Rubber gaskets would be used along the joints of the segments to control water infiltration and leakage.

A TBM can bore only so far before the risk of mechanical failure becomes significant. The appropriate length of a tunnel run is dependent on the diameter, pressure, and soil conditions. Based on current understanding of range of size, tunnel depth, and geologic conditions, tunnel runs from 8 miles to as high as 15 miles could be considered, with each run requiring a launch shaft for operations.

In most tunnel runs, a retrieval shaft is constructed to lift the machine out of the ground. In some cases, TBM machines have been abandoned underground to eliminate the need for an additional shaft construction.

Tunnel diameter is driven largely by the capacity of the flow as well as other considerations such as headloss and surge response during a power outage. Typically, conveyance systems are designed to handle flow velocities between 3 to 8 feet per second (fps). At low flows, there is potential for undesirable sediment deposition, while at high velocities, surge pressure and headloss could increase, requiring more pumping energy to lift the water.

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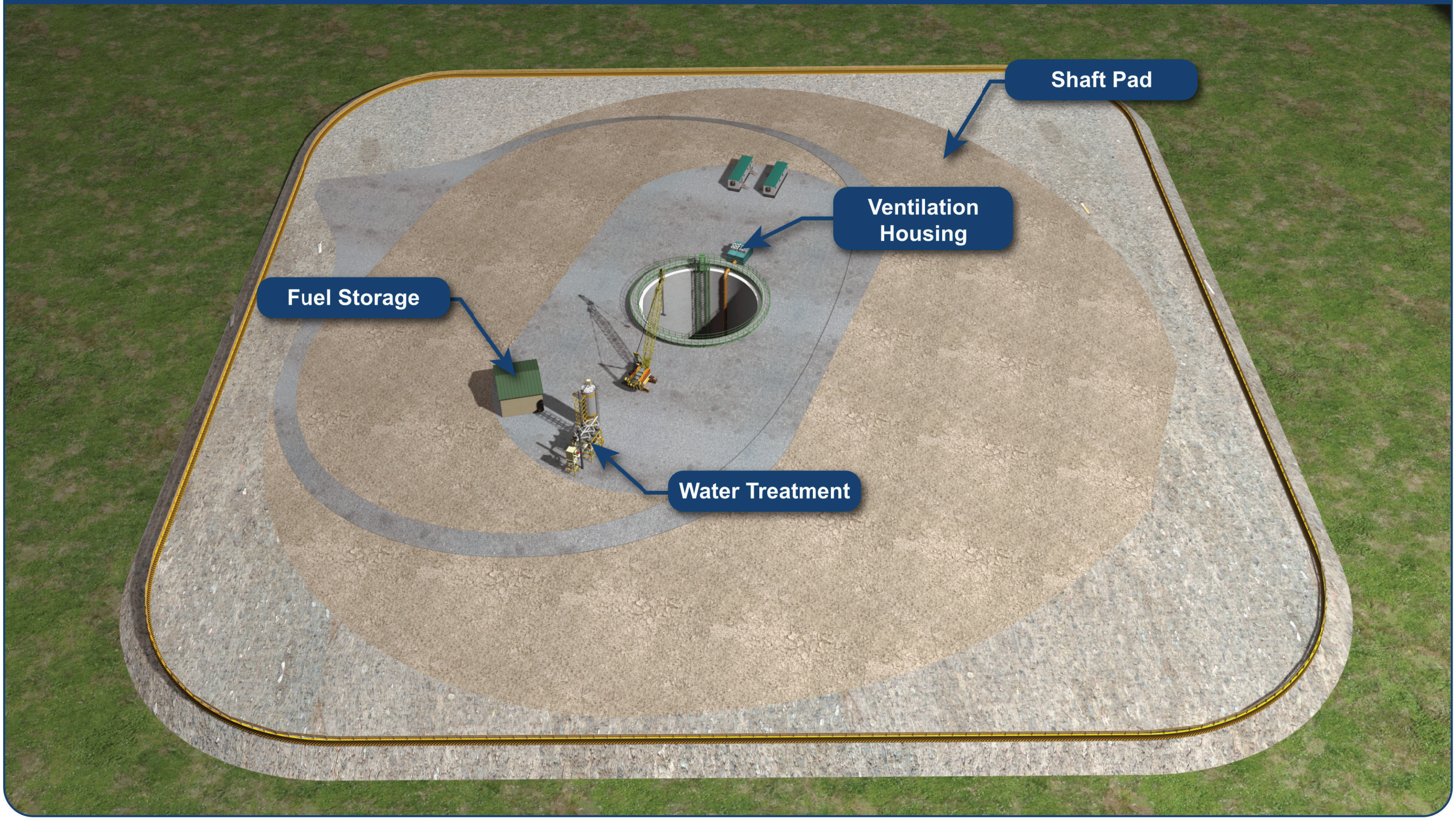
Retrieval Shaft



About Tunnel Retrieval Shafts

Purpose

A tunnel drive typically starts from a tunnel launch shaft and ends at a tunnel retrieval shaft. In most tunnel operations, once a tunnel boring machine (TBM) finishes its drive, it is removed from the tunnel at a tunnel retrieval shaft. In some cases where site specific circumstances support, TBMs can be abandoned in place thus avoiding the need for a retrieval shaft.

General Description

A tunnel retrieval shaft is similar in design to a tunnel launch shaft in that both are typically cylindrical structures constructed with reinforced concrete walls and bottom slabs. Retrieval shafts are typically smaller in diameter than launch shafts as their sole purpose is to allow retrieval of the TBM, which can be disassembled prior to lifting out of the ground. Like the launch shaft, this shaft would also extend above the flood level to prevent accidental flooding of the shaft or tunnel during construction.

A TBM would complete its drive by boring through the shaft wall and enter the base of the shaft, where it would then be disassembled for ultimate removal. A single retrieval shaft could serve two tunnel runs coming from opposite directions.

The construction area required for retrieval shafts is relatively small as very little extracted RTM and no concrete liners need to be stored on site.

Tunnel retrieval shafts would be located based on the suitability of sites, the tunnel construction strategy relating to the length and direction of drives, and if abandoning the TBM in place might provide a better solution.

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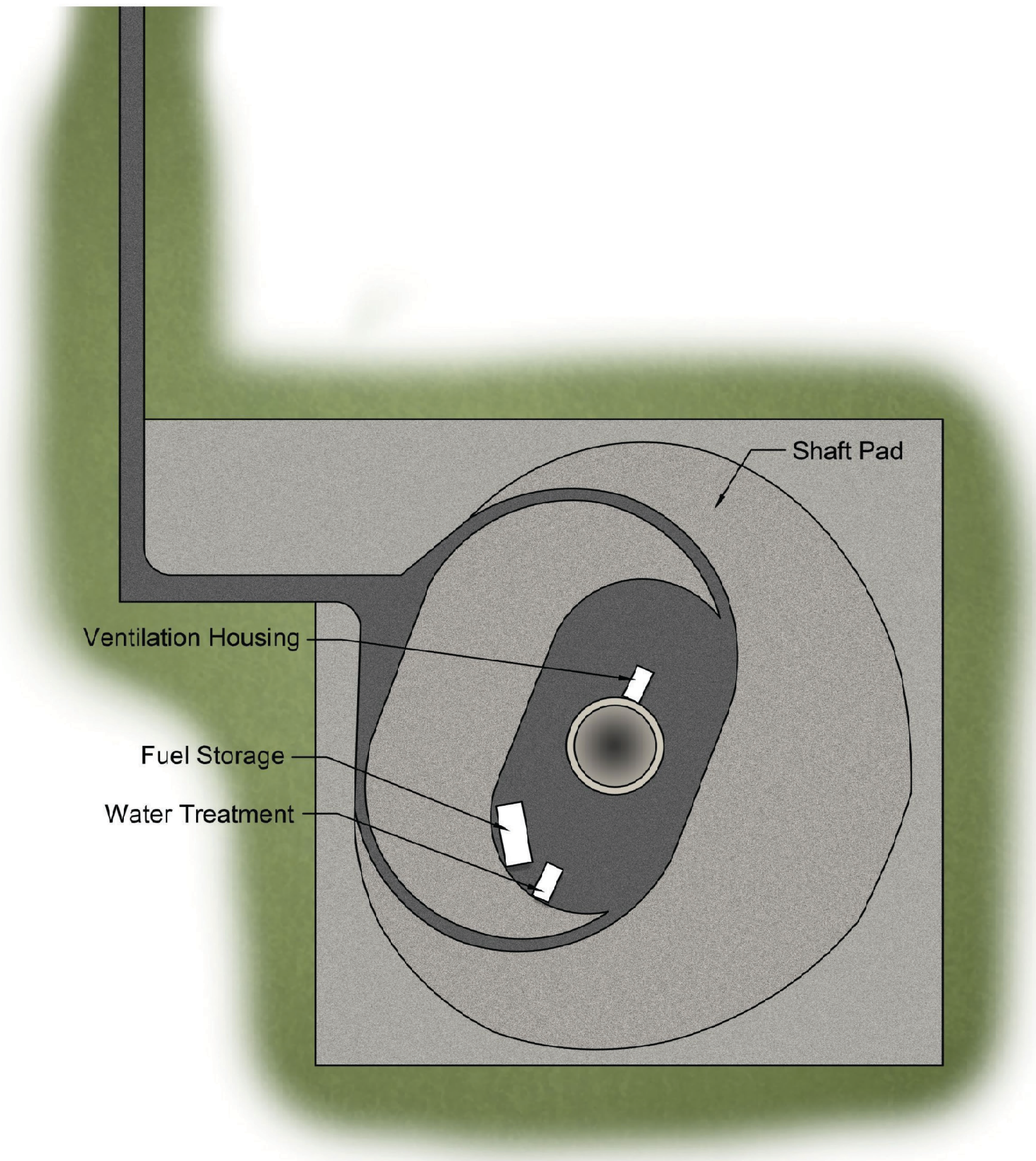
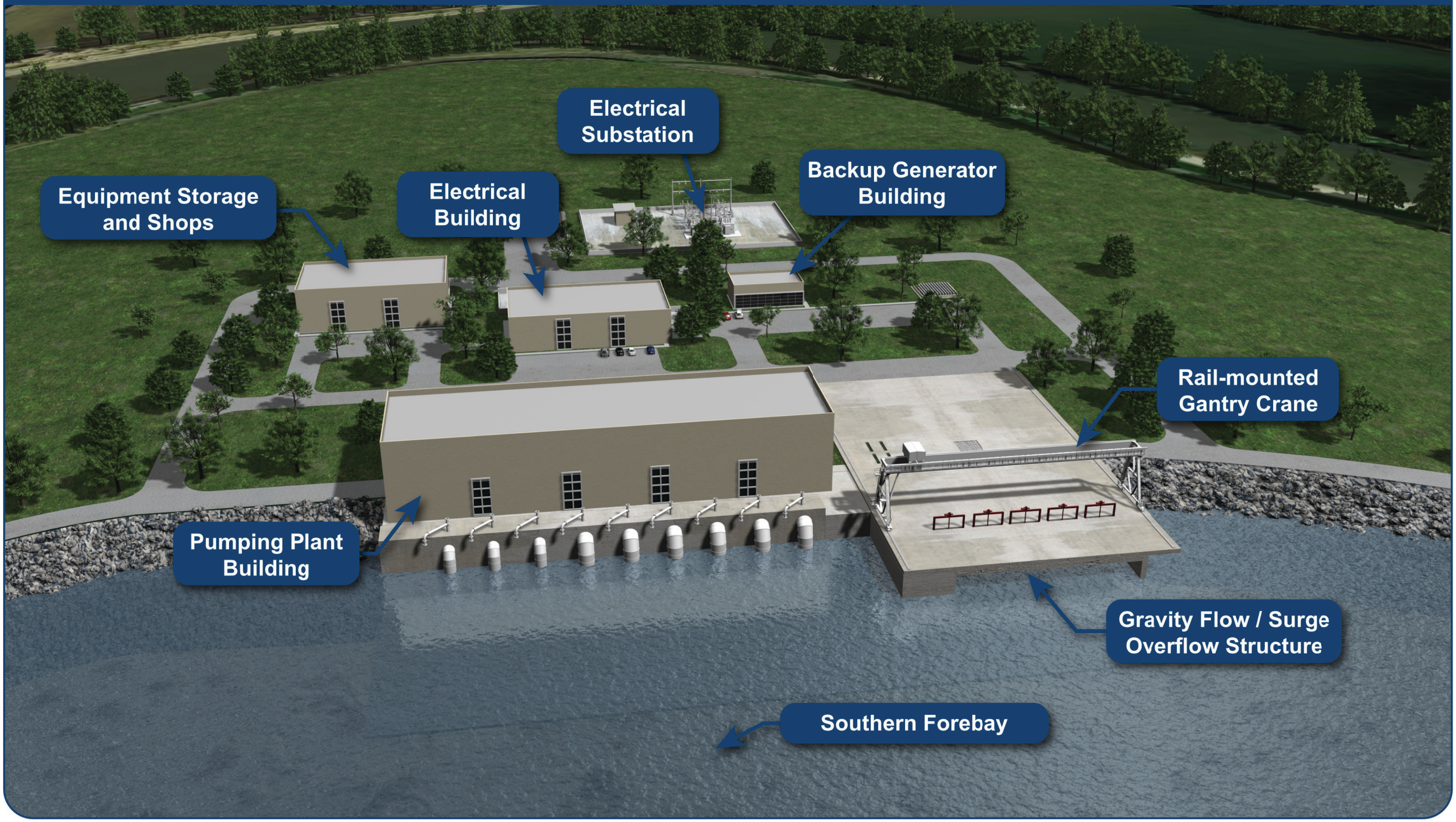


Construction Site Plan

Retrieval Shaft - Approximately 4 Acres

Pumping Plant



About Pumping Plants

Purpose

A pumping plant is typically required to lift water from a lower elevation to a higher elevation. A pumping plant is needed to lift the water from any potential conveyance system tunnel up to the appropriate elevation to connect into the existing Banks Inlet Channel and Pumping Plant (Banks). If there were federal participation in any potential Delta conveyance system project from the Bureau of Reclamation, water would also need to connect to the Jones Inlet Channel and Jones Pumping Plant (Jones). Pumping plants are sized to match the capacity of a conveyance system. Within any potential Delta conveyance system, the pumping plants would discharge water into a large southern forebay to help balance the pumping flow rate with the export flow rates at Banks.

General Description

Large pumping plants generally require a campus of facilities to support all of the functions needed. Main features of a potential Delta conveyance pumping plant might include:

- **Tunnel Shaft –** A tunnel shaft can be used to connect the water from a tunnel and into the wetwell of the pump station. This shaft could also serve as a launch shaft or receiving shaft for construction of a tunnel run.
- **Wet Well –** A wet well is a large underground water basin where the suction bells of the pumps are located. It is sometimes referred to as a pump sump. Water from a tunnel would flow into the basin and pumps would suction water out of the basin.
- **Pump Station Building –** A pump building typically houses all the main pumping equipment and discharge conveyance pipes or channels and appurtenances (instruments, valves, flow meters, etc.). The pump station building would be located directly above the wet well.
- **Electrical Building –** A separate building is often used to house the electrical switchgear and drives needed to operate the pumps.
- **Electrical Substation –**Due to the significant size and power draw of the motors needed for a pump station, an electrical substation is needed to provide permanent power.
- **Mechanical Storage Building –** The mechanical and electrical equipment in a pump station would require periodic maintenance. A significant amount of spare parts to facilitate maintenance would be purchased and stored on site to reduce the time of maintenance and repair. This building would house maintenance parts and equipment, and include a workshop area to physically work on large pieces of equipment that cannot be serviced in place.
- **Emergency Generator Building –** This building would provide backup power for all life-safety systems during any main electrical supply power outages. The generator would not be used to continue operating the main pumps during an outage.

The shaft, wet well and main pump station building would all be constructed of concrete. Exterior façades of other buildings would be more flexible in use of different construction materials.

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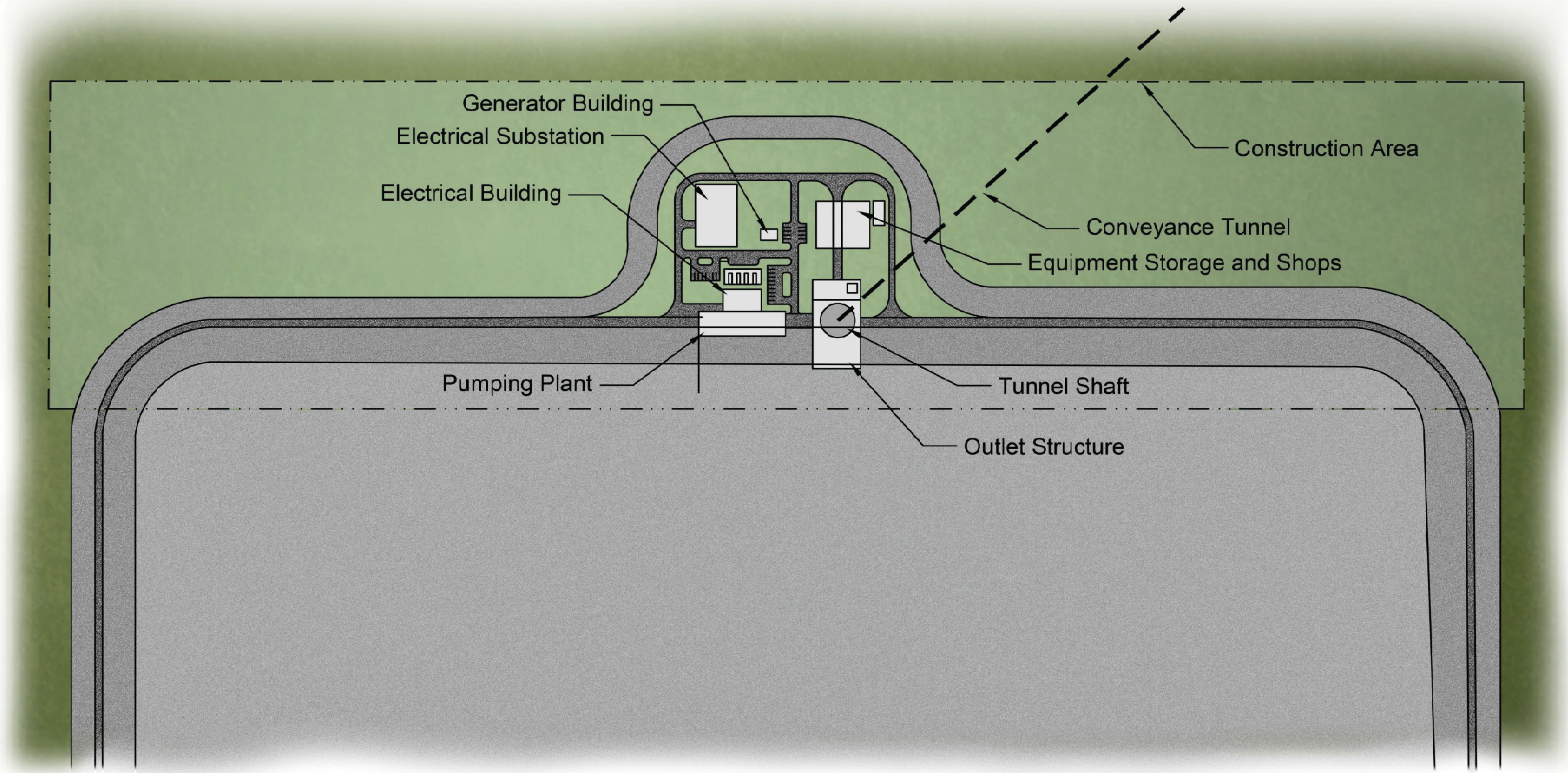
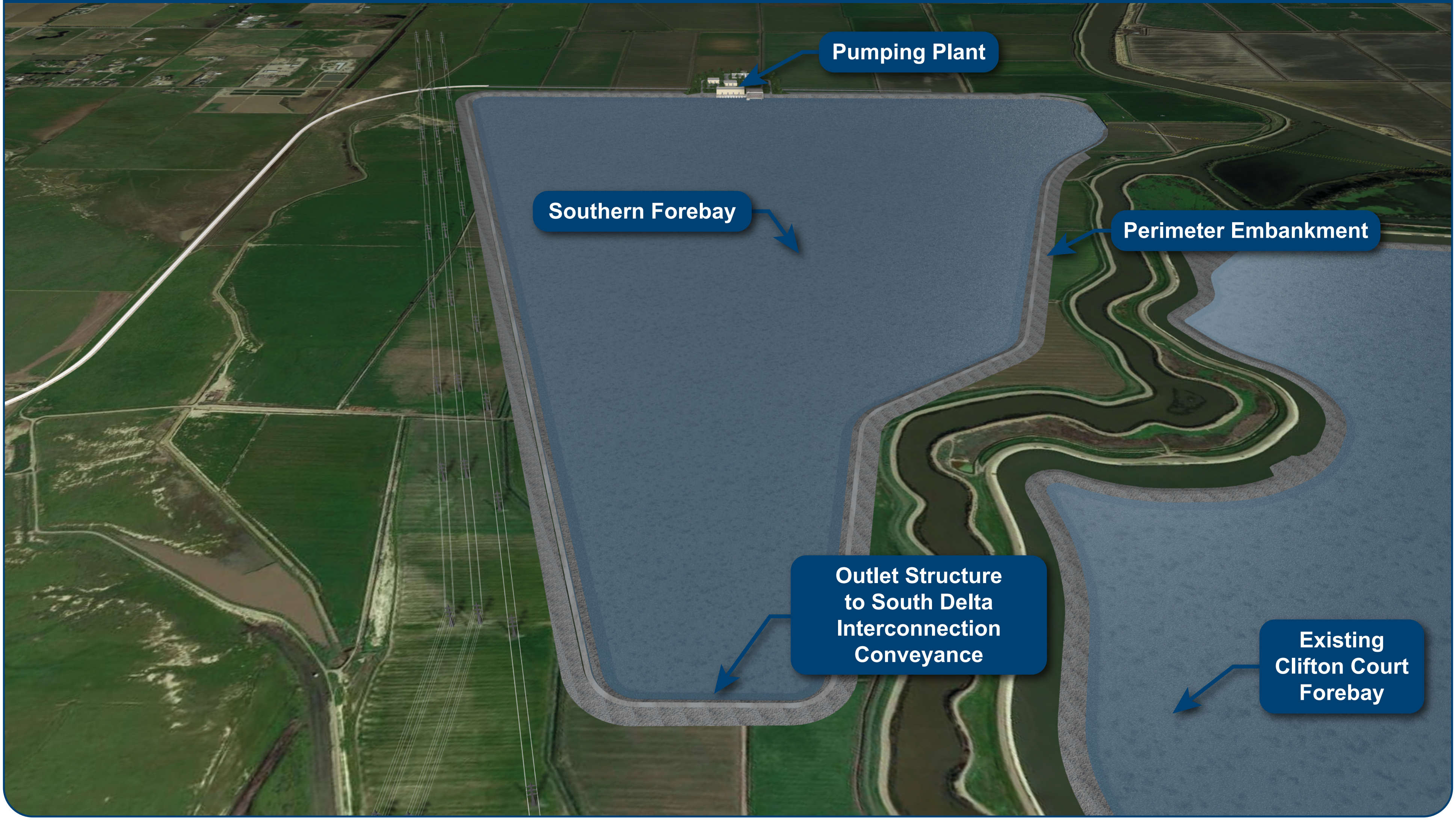


Construction Site Plan

Pumping Plant - Approximately 25-50 Acres

Southern Forebay



About Southern Forebays

Purpose

For any potential Delta conveyance system, a large storage basin, a southern forebay, would be required in the South Delta area in proximity to the existing Clifton Court Forebay to serve the following purposes:

1. Balance the flows from a potentially new Delta conveyance system pumping plant and the flows needed for export into the existing State Water Project aqueduct system.
2. Water storage to allow continued operation during a planned or unplanned pumping outage or other disruption to a potentially new Delta conveyance system.
3. Water storage to allow more off-peak pumping at the existing Banks Pumping Plant by filling the reservoir when rates are higher and draining the reservoir when rates are lower.

General Description

For any potentially new Delta conveyance system, a southern forebay would be constructed immediately downstream of a new pumping plant to allow the pumped flows to be diverted directly into the forebay, thus minimizing any additional connector facilities needed. By extension, the location of a southern forebay, would drive the location of any new Delta conveyance pumping plant.

The basin would be sized to meet the storage requirements for operations balance, as well as shutdowns of either a new pumping plant or the existing Banks Pumping Plant. The southern forebay would be constructed of compacted earthen levees, built up sufficiently high to protect from flood levels, sea level rise, and wind throws. An outlet shaft would be needed to divert flows from a southern forebay and into new conveyance facilities to connect any potentially new Delta conveyance system with the existing Banks Pumping Plant and, potentially, the Jones Pumping Plant.

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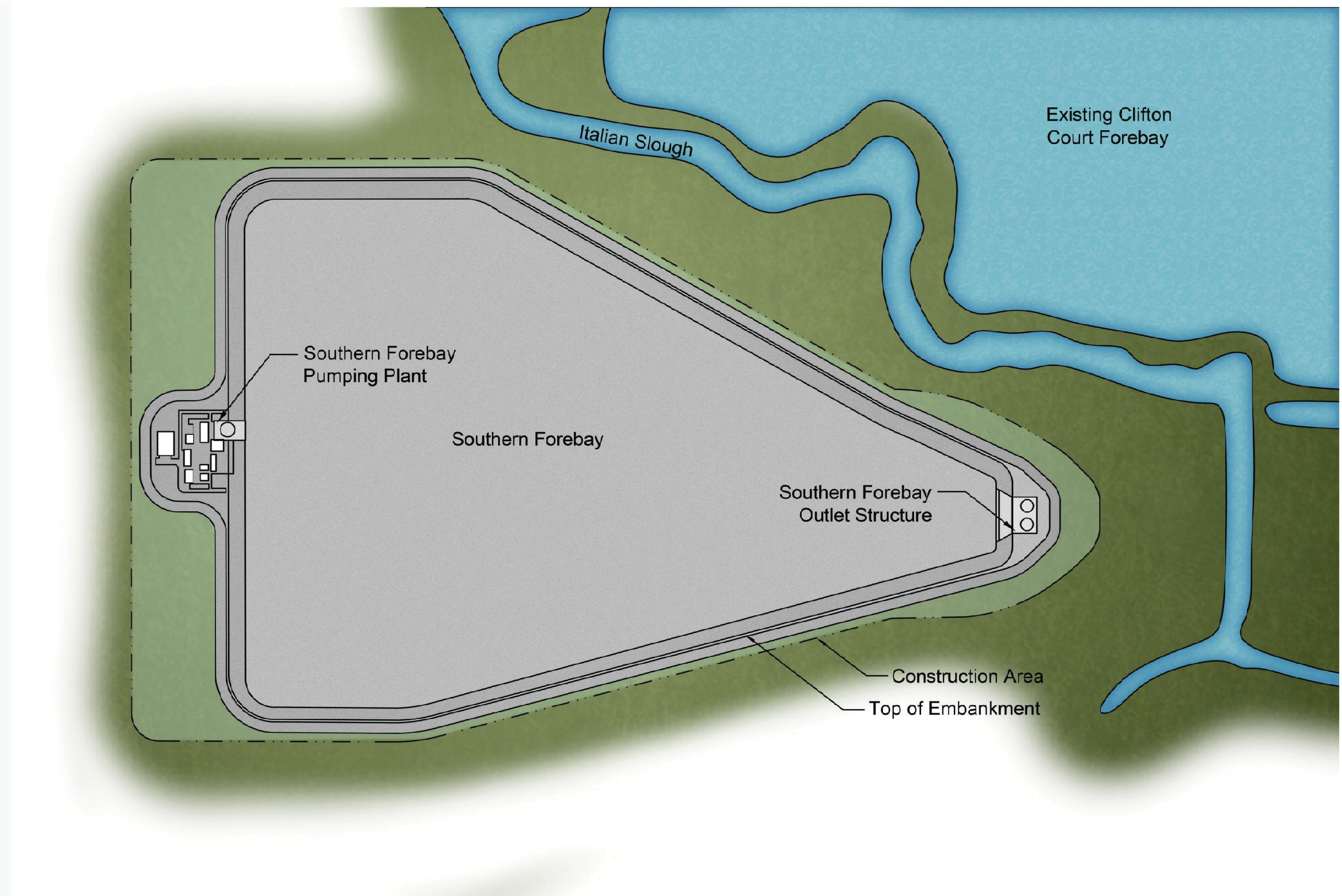
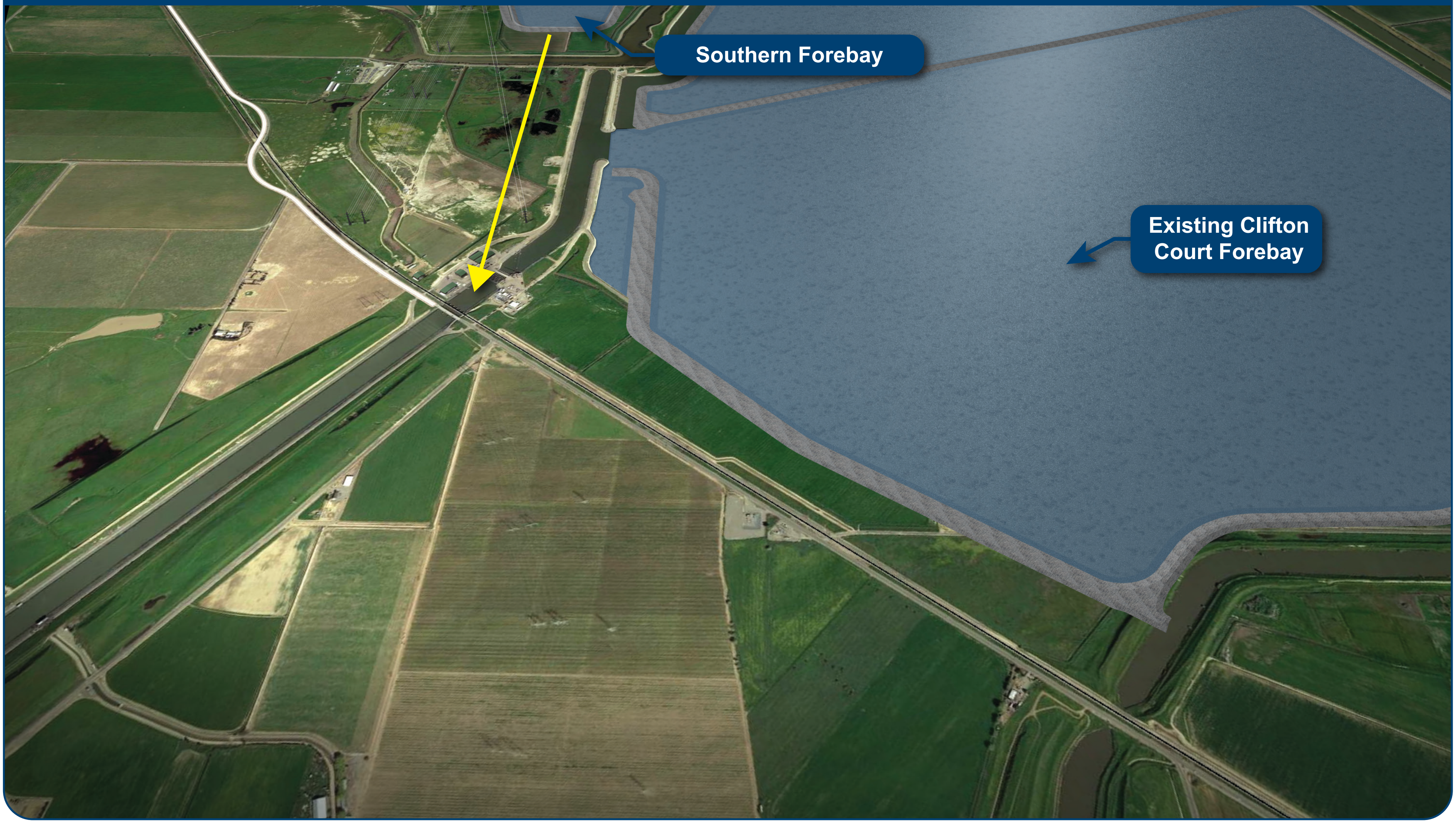


Construction Site Plan

Southern Forebay - Approximately 1100 Acres

South Delta Interconnection Conveyance



About South Delta Interconnection Conveyance to Existing PP

Purpose

Any potential new Delta conveyance system must ultimately integrate with the existing State Water Project System in the South Delta. This is likely to be achieved with interconnections in the form of tunnels or surface canals to move water from a new southern forebay and into the existing Banks Inlet Channel which feeds the Harvey Banks Pumping Plant (Banks). Delta export water stored in the existing Clifton Court Forebay also flows into the Banks Inlet Channel. If the Bureau of Reclamation were to join any potential Delta conveyance system, it would also be necessary to add connecting conveyance facilities to the Jones Inlet Channel which flows to the CW Bill Jones Pumping Plant (Jones).

General Description

The size of any potential South Delta interconnection conveyance facilities would be dependent on the total design flow of the project and the maximum desired flow capacity feeding the Banks Pumping Plant. Facilities that may be used to connect a potential Delta conveyance system to the existing State Project Water System include:

- Tunnel(s) or concrete-lined canal(s) to divert water out of a new Southern forebay and into the Banks Inlet Channel.
- Tunnel shaft (if tunnels are used) to bring the flow up to the ground surface for connection to new or existing surface canals.
- Flow control structure to control the rate of diversion from the new system and into the existing State Water Project System.
- If there is federal participation in the project from the Bureau of Reclamation, similar conveyance and flow control structures would be needed to connect to the Jones Pumping Plant and the Jones Inlet Channel.

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About Concrete Batch Plants

Purpose

Typical concrete batch plants are facilities that would be used to produce concrete and related materials at or near a construction site to construct various elements of a project. An on-site batch plant replaces the need to purchase concrete from a remote concrete vendor thus substantially reducing the number of concrete deliveries to the site.

For any potential Delta conveyance system facilities, primary needs for concrete would be:

- **Intakes**—Concrete structures, such as walls and foundations of structures to control water flow or capture sediment, as well as other buildings
- **Forebays**—Concrete structures, such as inlet and outlet structures to control water flow
- **Tunnel Shafts—**Concrete walls of launch and retrieval shafts
- **Pumping Plant—** Concrete structures, such as walls and foundations of buildings and structures to control water flow
- **Connection Facilities to Existing Pumping Plants** – Concrete structures, such as canals and inlet and outlet structures to control water flow
- **Access Facilities** – Concrete for required new or modified structures, such as bridges, along access routes

General Description

A typical concrete batch plant site would consist of material storage areas; and a mixing plant that combines sand, aggregate, and cement with water and mixes them. All processing facilities and material storage sites would be established considering suitable grading, surface water, and local area effects, and would meet environmental and regulatory compliance. Concrete batch plant locations would be determined as part of future engineering and environmental analyses.

Concrete batch plants would require electricity, a water supply, and access to a transportation network for delivery of materials. Equipment at a site would include tractors and conveyors that could dump aggregate and sand into a batch plant and trucks or slurry pumps to haul mixed material to the point of use.

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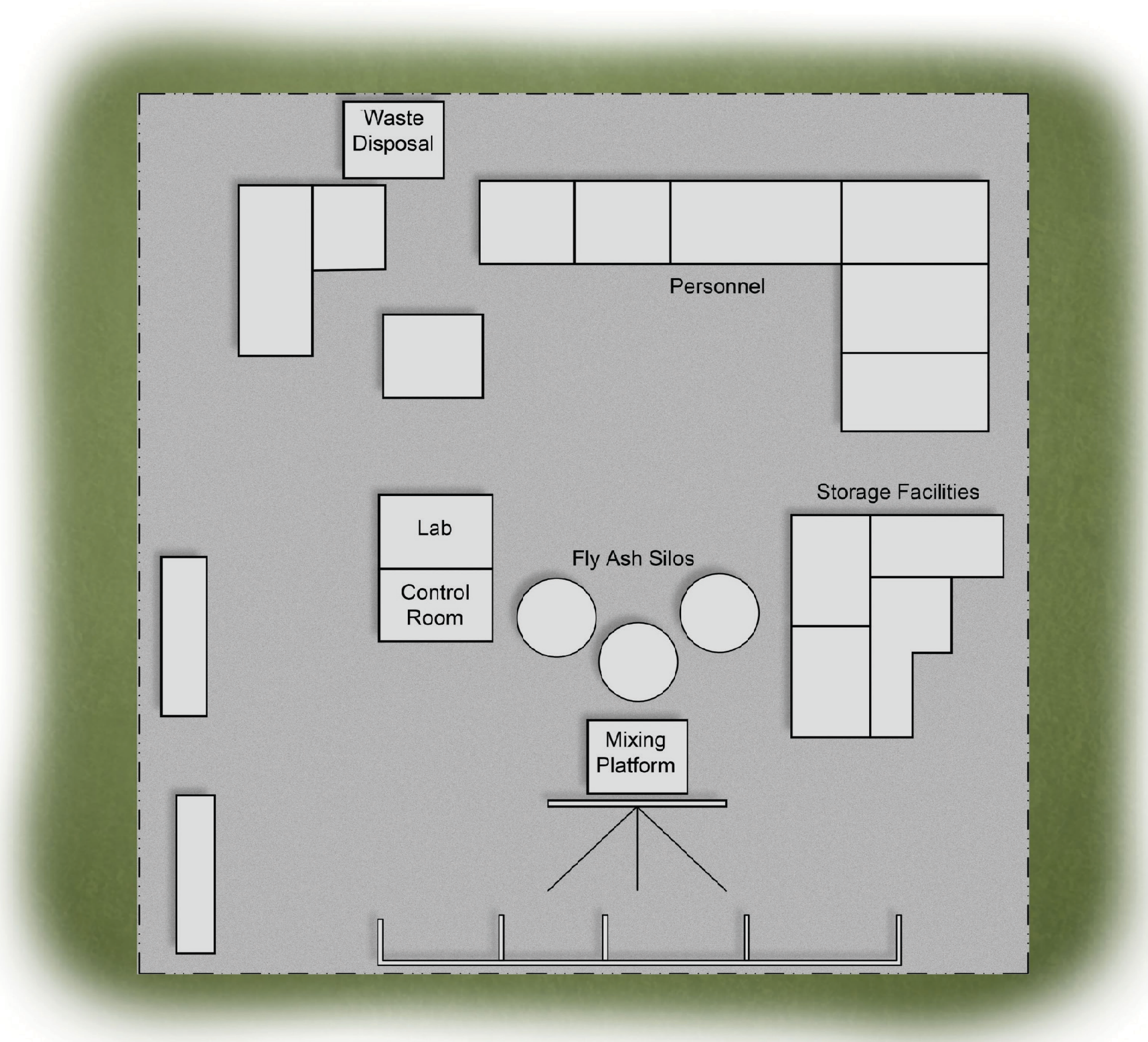

Construction Site Plan

Batch Plant - Approximately 2-6 Acres

About Reusable Tunnel Material

Purpose

Reusable Tunnel Material (RTM) (tunnel spoils or tunnel "muck" in the industry) consists of soils excavated from the boring of tunnels and the digging of shafts. The excavated material at the head of a tunnel boring machine (TBM) typically runs through the machine and is discharged into a conveyor system that moves the material back out of the tunnel and shaft following the opposite path of the tunnel machine. Thus the RTM would leave the tunnel at the launch shafts rather than the retrieval shafts where the TBM can be removed.

General Description

RTM characteristics would depend upon the soils where the tunnel is constructed. Based on data collected from historical geotechnical boring logs, and given anticipated depth of any proposed tunnels, it is anticipated that soils would include clays, silts, silty and clayey sands, and clean sands. Additionally, some organic materials, such as peat, could be encountered closer to the ground surface during shaft excavation. Some contaminated or hazardous material could also be encountered during excavation; future soil exploration programs would collect data and evaluate such a risk.

RTM and other excavated materials would be tested for the presence of hazardous material in accordance with federal and state regulatory criteria. If soils exceed these criteria, hazardous materials would be segregated from other construction spoils and properly handled and disposed of in accordance with applicable federal, state, and local regulations.

The method of excavation, as well as soil conditions, influence RTM consistency. Additives would be used to improve soil conditions for more effective TBM operation and to reduce wear on tunnel cutters from soil abrasion. Additives used for soil conditioning would be inert, biodegradable, and nontoxic to prevent contamination of surrounding ground, groundwater, and surface water, and would not cause RTM contamination.

Some space would be provided at a launch site to store RTM while it is tested, dried and sorted. The total amount of storage needed on site will be dependent upon the ultimate designated use for the material. Other uses for the material include build up of levee walls at the forebays of any potential Delta conveyance system, use in restoration projects elsewhere in the Delta, or use by other organizations such as local Reclamation Districts to support their land and levee maintenance programs, or to soil brokers who would purchase the material and sell to future buyers.

The RTM will contain water which must be decanted from the material prior to use. This decant water must be treated to remove sediment and other constituents necessary to both allow reuse or discharge of the decant water as well as to facilitate reuse of the material.

Any stockpiling of RTM will require careful consideration to limit runoff from precipitation and to provide treatment systems to treat any run-off from the stockpiles consistent with local, state and federal regulations for construction stormwater management.

The total working area required for temporary RTM storage would depend on several factors, including:

- How quickly the material is brought to the surface, stored, dried, tested, and moved to reuse locations
- How high the material is stacked, considering foundation conditions
- How long the RTM needs to dry relative to conditioning, reworking to promote drying, and weather conditions

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