Easterly Tunnel Dewatering Pump Station

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OUTLINE

• Project Technical Overview
• Pump Design and Operation
• Architectural and Pump Station Support Facilities
• Below Grade Facilities
• Geotechnical
Project Technical Overview
Consent Decree Requires 98% Capture of CSO Volume by 2036
126 CSO Locations Throughout the Combined Sewer Area are Driving a Systematic Approach to Mitigate Overflows
Project Clean Lake – Easterly Service Area

Easterly Service Area Includes:

• Five Tunnels
• Dewatering Pump Station
• Ancillary Consolidation Sewers
• Regulator Improvements
The Nine Mile Site Will Be the Nexus of Seven Projects:

<table>
<thead>
<tr>
<th>Project</th>
<th>Cost</th>
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<tbody>
<tr>
<td>DWIRS</td>
<td>$64M</td>
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<tr>
<td>ECT</td>
<td>$200M</td>
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<tr>
<td>DST</td>
<td>$150M</td>
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<tr>
<td>ETDPS</td>
<td>$70M</td>
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<tr>
<td>E. 140&lt;sup&gt;th&lt;/sup&gt;</td>
<td>$41M</td>
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<tr>
<td>Substation</td>
<td>$5M</td>
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<tr>
<td>Euclid Creek PS</td>
<td>$11M</td>
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<tr>
<td><strong>Total</strong></td>
<td>$541M</td>
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Nine Mile Project Site is Accessed from East 140th Street
3D Rendering From Above

ECT Shaft 1

Electrical Substation
Northeast Corner
ETDPS Project Technical Overview

1. Cavern Style Pump Station
   • 160 MGD Firm Capacity
   • 230 +/- Feet Deep

2. Receives Flows from 3 Storage Tunnels:
   • Euclid Creek 61MG
   • Dugway 51MG
   • Shoreline 48 MG

3. Delivers Flows to Easterly Interceptor
   • Gravity Delivery to Easterly WWTP
   • Easterly Flow Management Important
Below-Ground Facilities
ETDPS Programmed to be CompleteShortly After ECT is Activated and Ready
to Accept Flows.

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</thead>
<tbody>
<tr>
<td>Euclid Creek Storage Tunnel</td>
<td>Apr 2011</td>
<td>4 years duration</td>
<td>Apr 2015</td>
<td></td>
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<tr>
<td>Tunnel Dewatering Pump Station</td>
<td>Jan 2012</td>
<td>3 years 6 months duration</td>
<td>Jun 2015</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Dugway Storage Tunnel</td>
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<td></td>
<td></td>
<td>Sep 2015</td>
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ETDPS must coordinate w/ ECT for final connections:
- Install Roller Gate
- Final Adit Connection
- Pump Testing and Commissioning
Pump System:
Pumped Flow & Hydraulic Design
Pump Design and Operation - Objectives

1. Meet Requirements of Consent Decree
2. Cost-Effective, Reliable System
3. Operability/Maintainability Considerations
   • Collection/Tunnel System
   • Pump Station
   • Easterly
Pump Design and Operation - Components

1. Main Dewatering Pumps
   - 4 @ 40 MGD
   - 1 @ 20 MGD

2. Final Dewatering Pumps
   - 2 @ 10 MGD

3. Valves
   - Suction (Isolation)
     A. Knife Gate Valves (5 Main Dewatering Pumps)
     B. Plug Valves (2 Final Dewatering Pumps)
   - Discharge (Isolation/Flow Control)
     A. Hydraulically Operated Cone Valves

4. Emergency Sump Pumps
   - 2 @ 1 MGD
Tunnels will fill to HWL EL. 575 about 3 times in an average year.

- **Throttled Operation**: 30 hours/yr @ 160 mgd
  - [0.2 BG volume]
  - 10% of operating volume

- **Un-throttled Operation**: 303 hours/yr @ 160 mgd
  - [2 BG volume]
  - 90% of operating volume

Top of Header Normally Submerged at End of Pumping Cycle.
Separate Discharge Headers Were Provided to Maintain Minimum Velocities and Minimize Solids Accumulation
Pump Room - Floors Added

- Mezzanine
- Upper Level
- Lower Level
Ventilation Designed to Avoid Hazardous Classification (i.e. Explosion Proof Devices)

- Occupied: 6 Air Changes
- Unoccupied: 6 Air Changes with 75% Recirculation
Pump Room - Entire Structure Added

- Cast-in-Place Concrete for Shafts
- Shotcrete in Pump Room Walls and Roof
Consideration was given to ensure adequate space for maintenance and repair.
Pump Room Looking East - Elevs. 389 & 400
Pump Room Looking West - Elevs. 389 & 400
West End of Pump Room - Elevs. 389 & 400
Phase 1

The Original Model showed two of four pumps could experience adverse flow conditions of pre-swirl and axial velocity deviation.

Phase 2

The model was revised by adding straightening vanes and adding reducing type bends.
CFD Modeling Confirmed Need For Flow Straightening Vanes

Vanes are Shaped to be “Self-cleaning”
Main Dewatering Pump Supports

Finite Element Analysis of Pump Supports were used for Vibration Analysis
Architectural and Pump Station Support Facilities
Architectural and Pump Station Support Facilities

Superstructure Contains:
- Materials Handling Features
- Electrical, Communications and Control Rooms
- Hydraulic Room
- Maintenance-Related Rooms
- Rest Rooms
Pump Building Plan - Architectural
Pump Building at Grade - Roof Removed
Material Handling

12’x12’ roof hatch provides access for wheel or track mounted crane to move large equipment to and from cavern.

5 Ton Jib Crane designed to lift mid sized items to at-grade floor level 609.0
Below Grade Facilities
Below-Ground Facilities

Heights Hilltop Interceptor 132” dia.

Pump Building

Chamber 1

Chamber 2

78” Gravity Sewer to Easterly Interceptor

102” Raw Water Tunnel

Pump Room

Easterly Interceptor 162” dia.

Easterly Junction Chamber
Access Shafts - Looking North
Cavern and Access Shaft Dimensions

Primary Shaft Support in Overburden
Steel Liner Plate and Steel Ribs on 4” COC Spacing.

Primary Shaft Support in Rock
Rock Dowels in 6’ x 6’ Pattern with 2” Thick Layer of Shotcrete (WWM or Fiber-Reinforced). 4” Thick Shotcrete for 20’ Zone above Cavern Roof.
Geotechnical
Access Shafts - Looking North

Soil
95 Ft

Rock
130 Ft
Current Principal Topics of Geotechnical Evaluation

• Permanent structural support
  – Rock bolt lengths, diameter, spacing
  – Shotcrete thickness, strength, reinforcing

• Long term stability of shale
  – Slaking

• Long term durability of permanent support
  – Corrosion of steel
  – Deterioration of shotcrete

• Permanent drain system
  – Drain spacing
  – Encrustation prevention
Rock Bolt/Dowel Pattern – Cavern Roof and Walls

- 5’ x 5’ Dowel Pattern on Walls
- 5’ x 4’ Bolt Pattern on Roof and Haunches w/ Add’l Bolts @ Shafts
- 297 Dowels
- 487 Bolts
- 306 Dowels

Two 2” Thick Layers of Reinforced Shotcrete on Walls with a Layer of Non-Reinforced Smoothing Shotcrete on Lowest 10’

Two 3” Thick Layers of Reinforced Shotcrete on Roof and Haunches
Rock Dowel Pattern – Cavern Floor

270 Dowels

5' x 5' Dowel Pattern on Floor
Raw Water Tunnel
Questions?