



CALIFORNIA
WATER FIX
RELIABLE. CLEAN. WATER.



PROJECT IMPLEMENTATION CONSIDERATIONS FOR THE CALIFORNIA WATERFIX

Santa Clara Valley Water District
May 25, 2017



PROJECT LOCATION

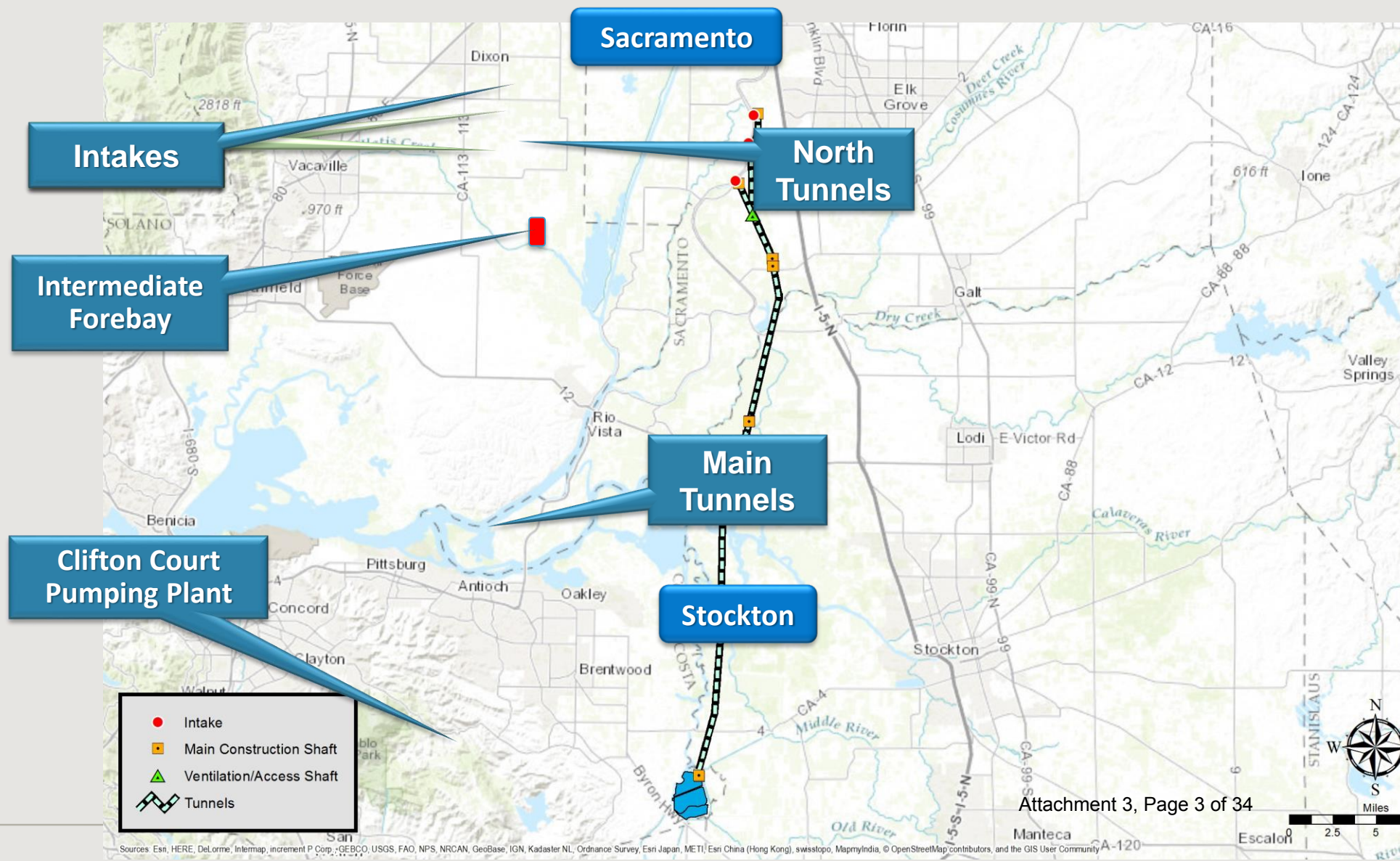


Bay Delta Region



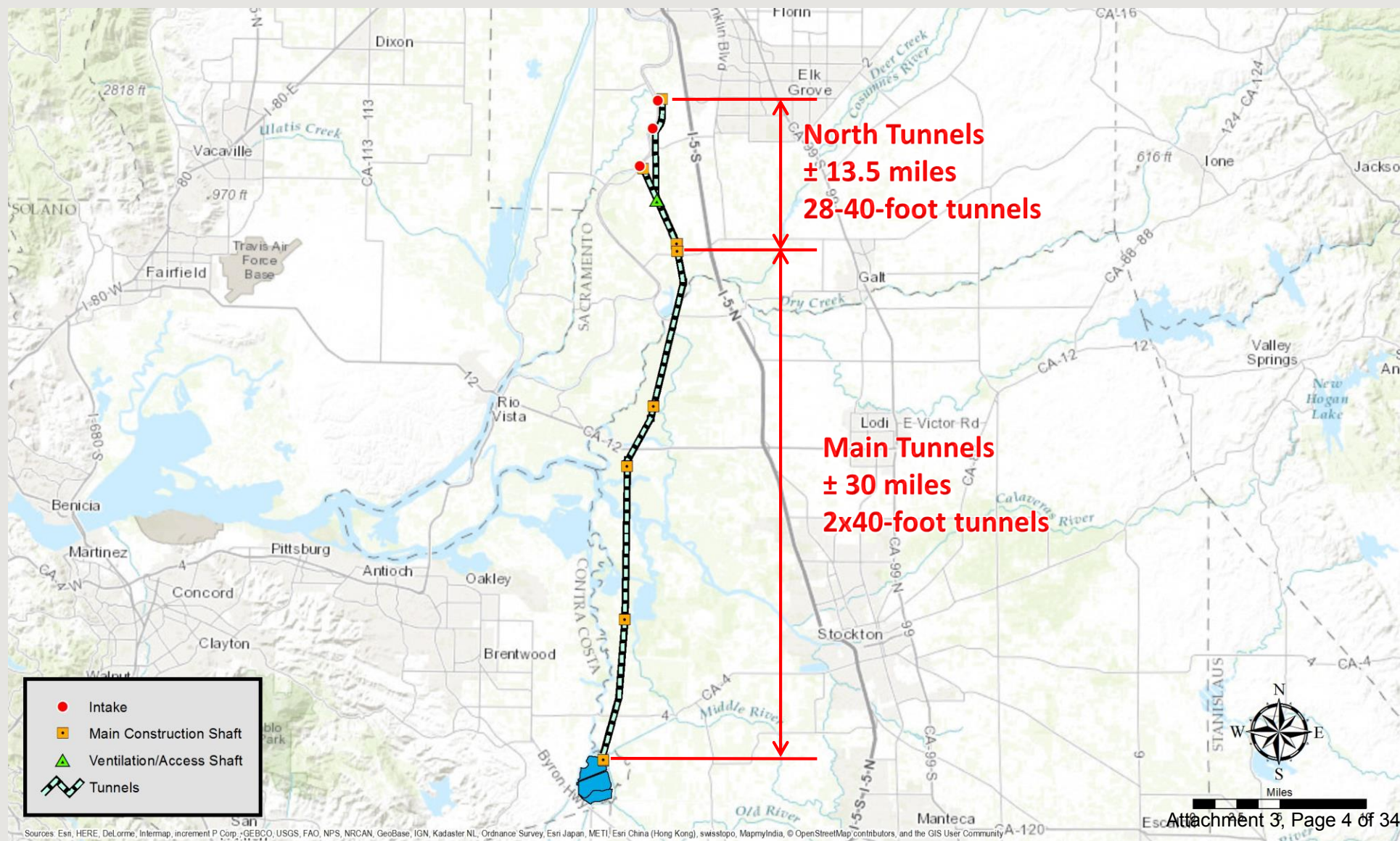


CALIFORNIA WATER FIX- OVERALL PROGRAM





TUNNEL PORTIONS OF PROGRAM





MAIN TUNNELS

- 100 year life
- Twin bore main tunnels
- 150 ft below grade
- Concrete segmental liner
- Pressurized face Tunnel Boring Machine construction
- 45 ft excavated diameter
- 40 ft finished internal diameter

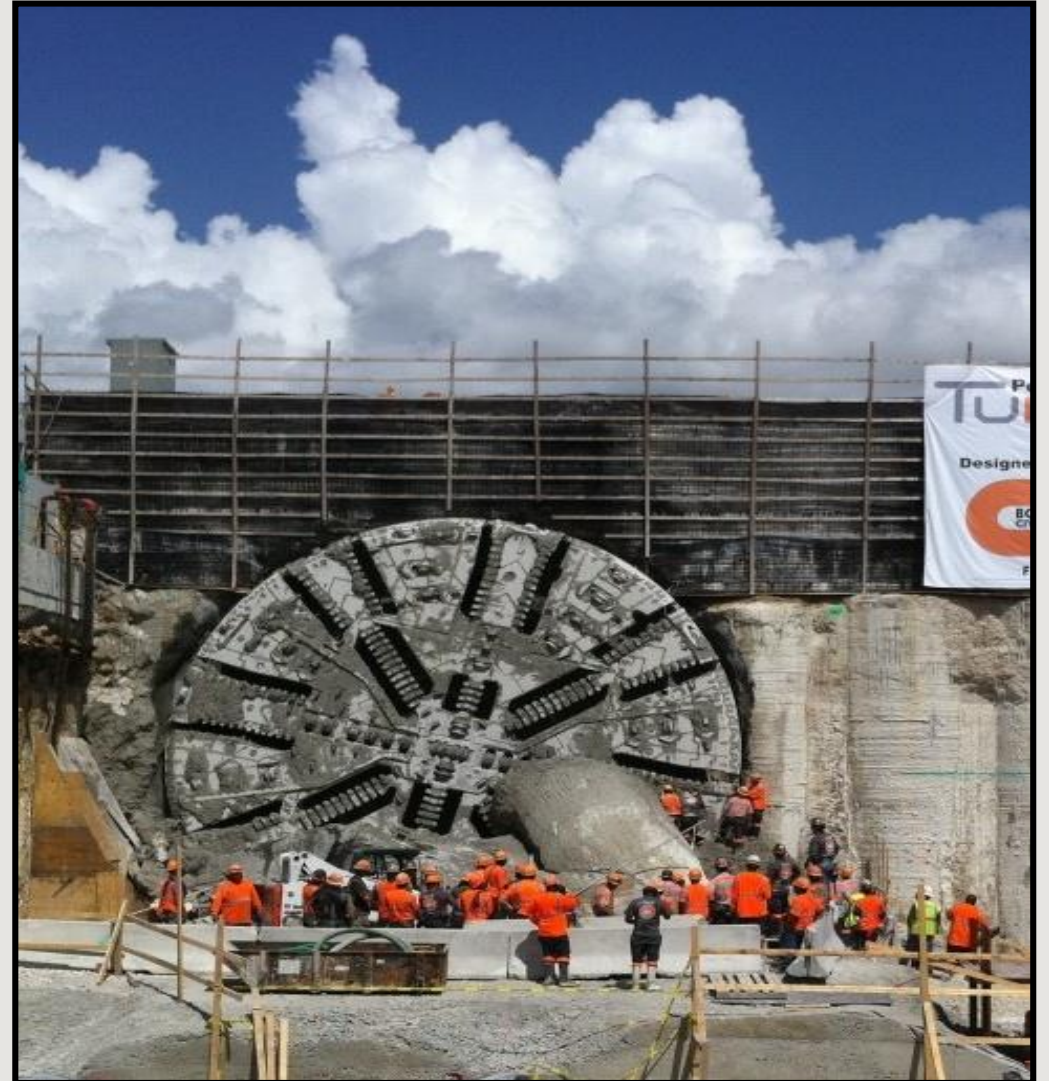
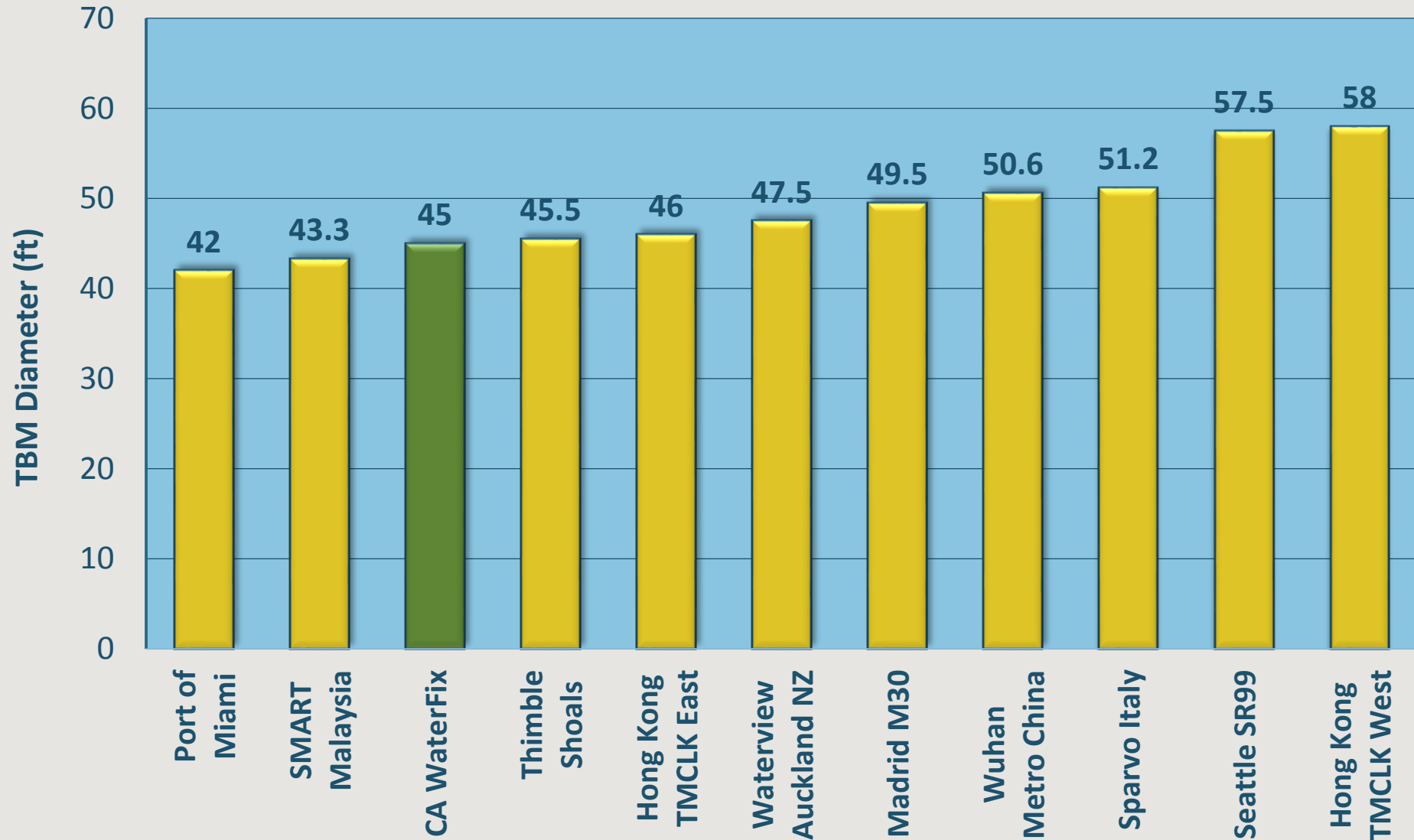


Photo Courtesy: Port of Miami Tunnel

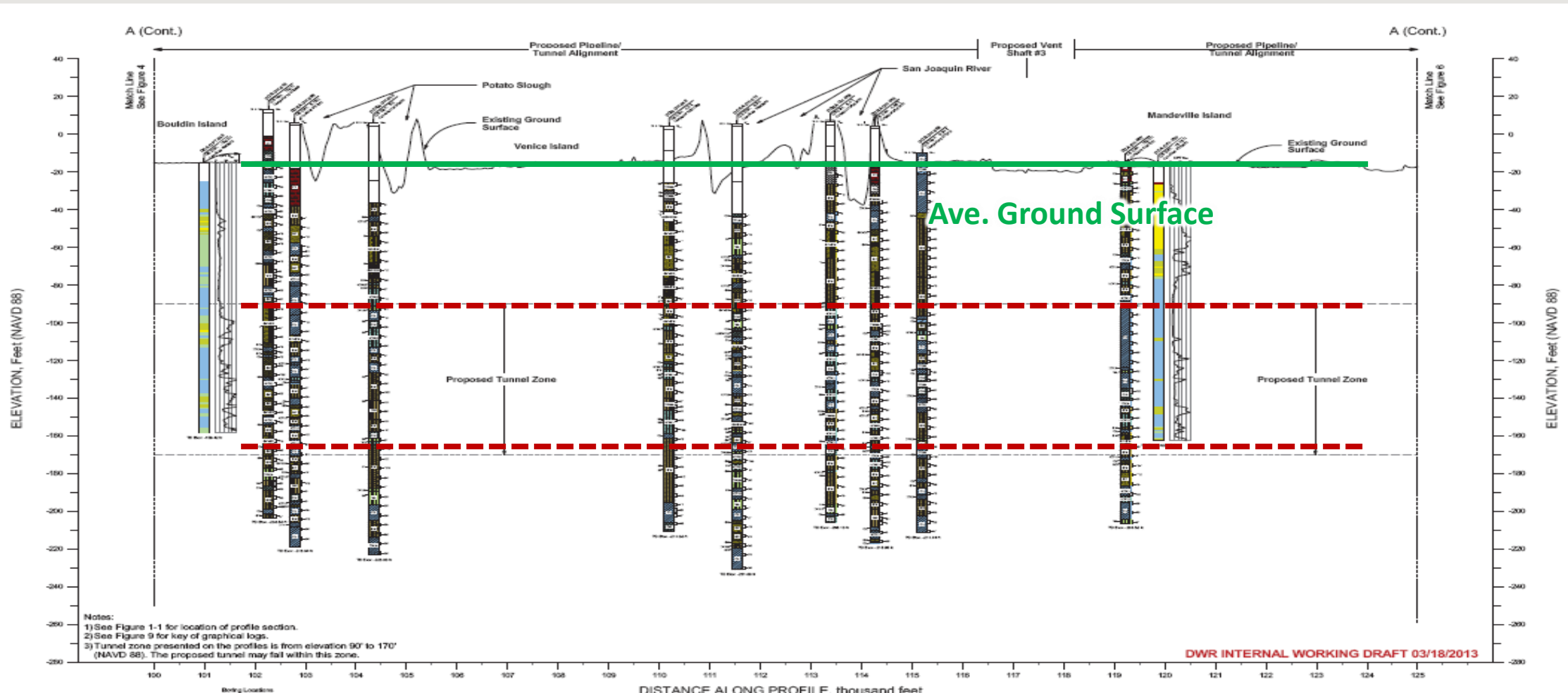


LARGE DIAMETER TUNNEL BORING MACHINE PROJECTS





GEOTECHNICAL PROFILE AT TUNNEL DEPTH



Note: Over 200 borings/CPTs completed



TYPICAL TUNNEL SEGMENTS





REUSABLE TUNNEL MATERIAL



- Preliminary level of testing (DWR Report)
 - Sterile material
 - Suitable for engineering fill
- Stockpiles at 6-14 ft
- Existing restoration uses
 - SFPUC Bay Tunnel Bair Island
 - London Crossrail Wallasea Island



PROGRAM FACTS

- 700,000 tunnel segments
- 23 million cubic yards of excavated tunnel material
- 10-12 Tunnel Boring Machines operating simultaneously
- 195 Mega Watts of power required for Tunnel Boring Machines
- Existing levees protect project sites
- Limited highway access in Delta

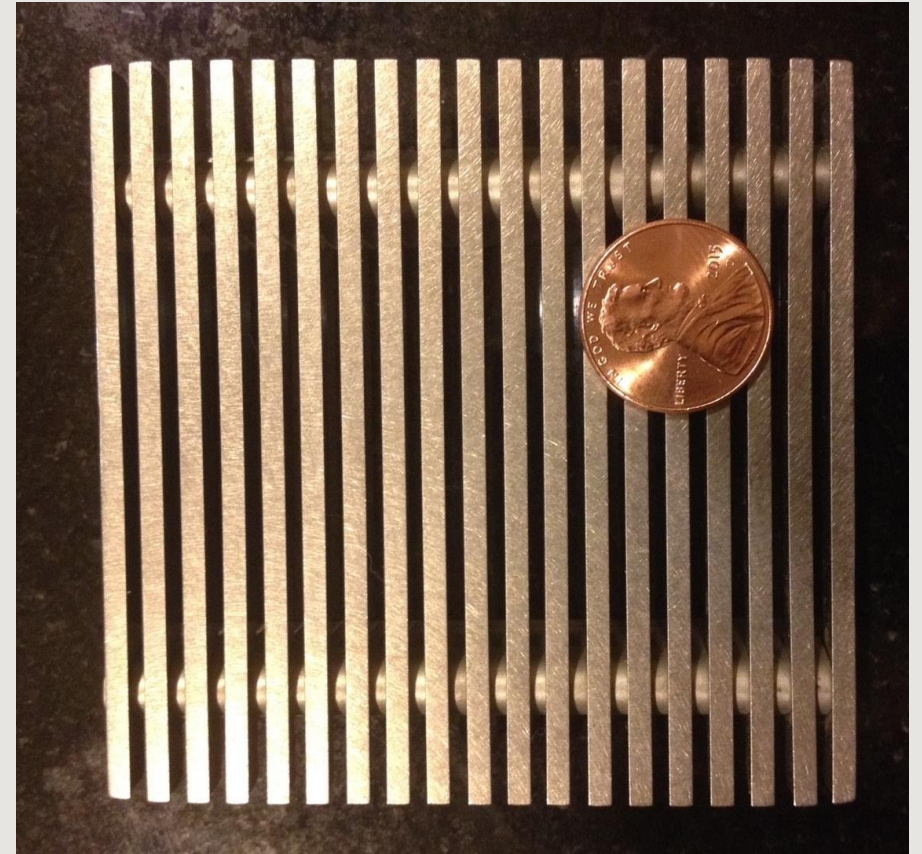
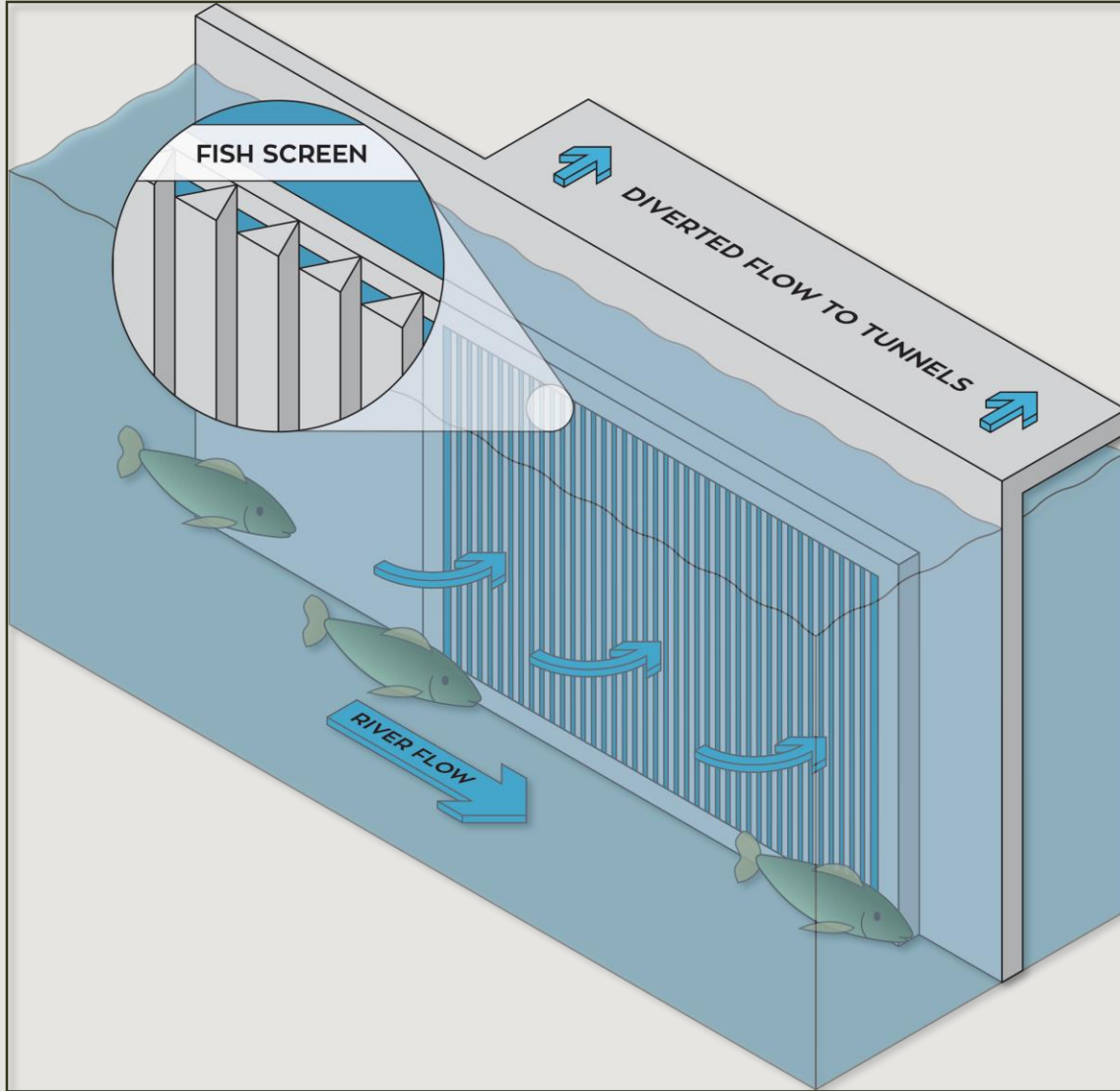


RIVER INTAKES



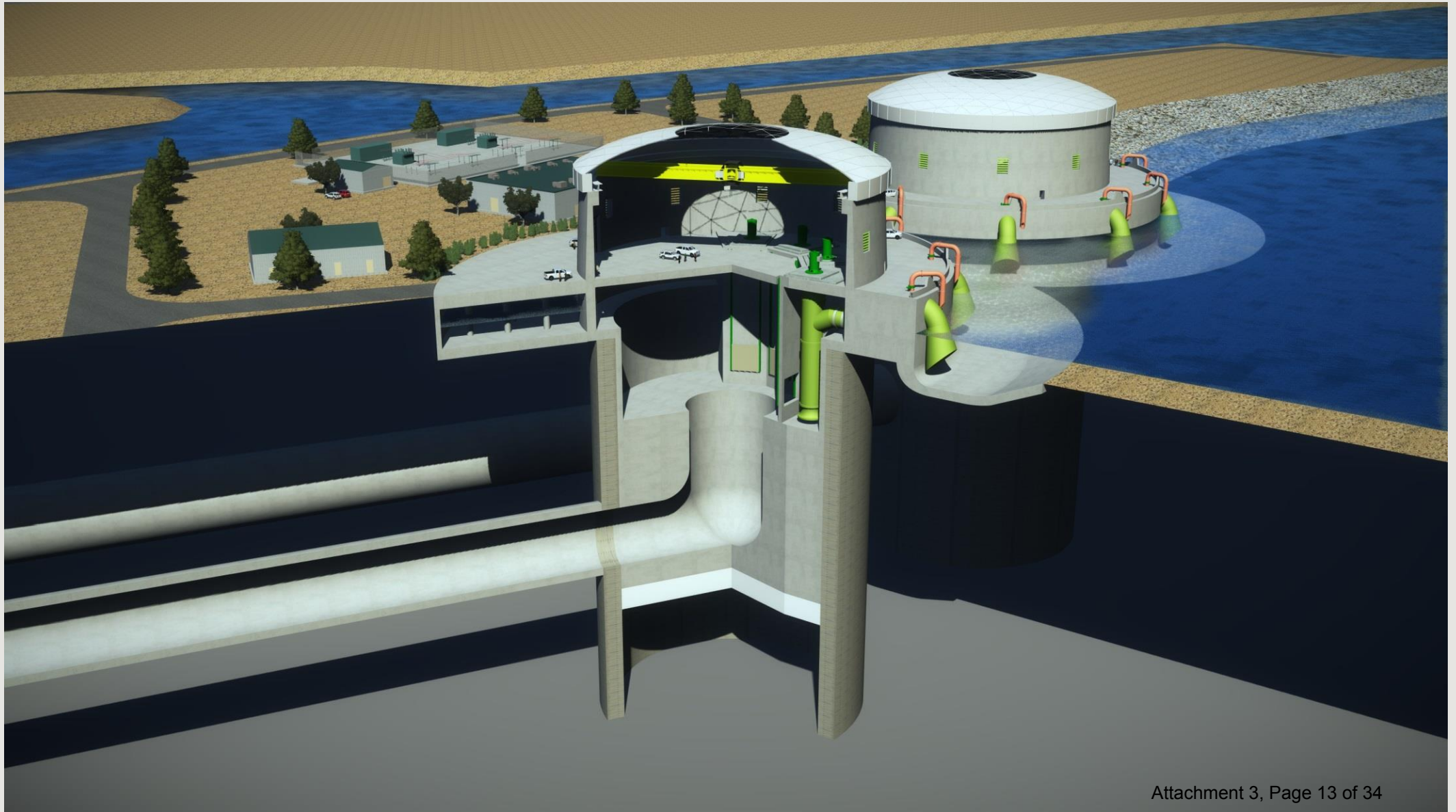


PROTECTING FISH





CLIFTON COURT PUMP PLANTS





PROGRAM ESTIMATES

	Amount (\$ billions)
Total	\$ 14.94
PM/CM/Engineering	\$ 1.91
Tunnels/shafts construction	\$ 6.82
Remaining construction	\$ 2.68
Land acquisition	\$ 0.15
Contingency (approx. 36% for tunnels/shafts and remaining construction)	\$ 3.38

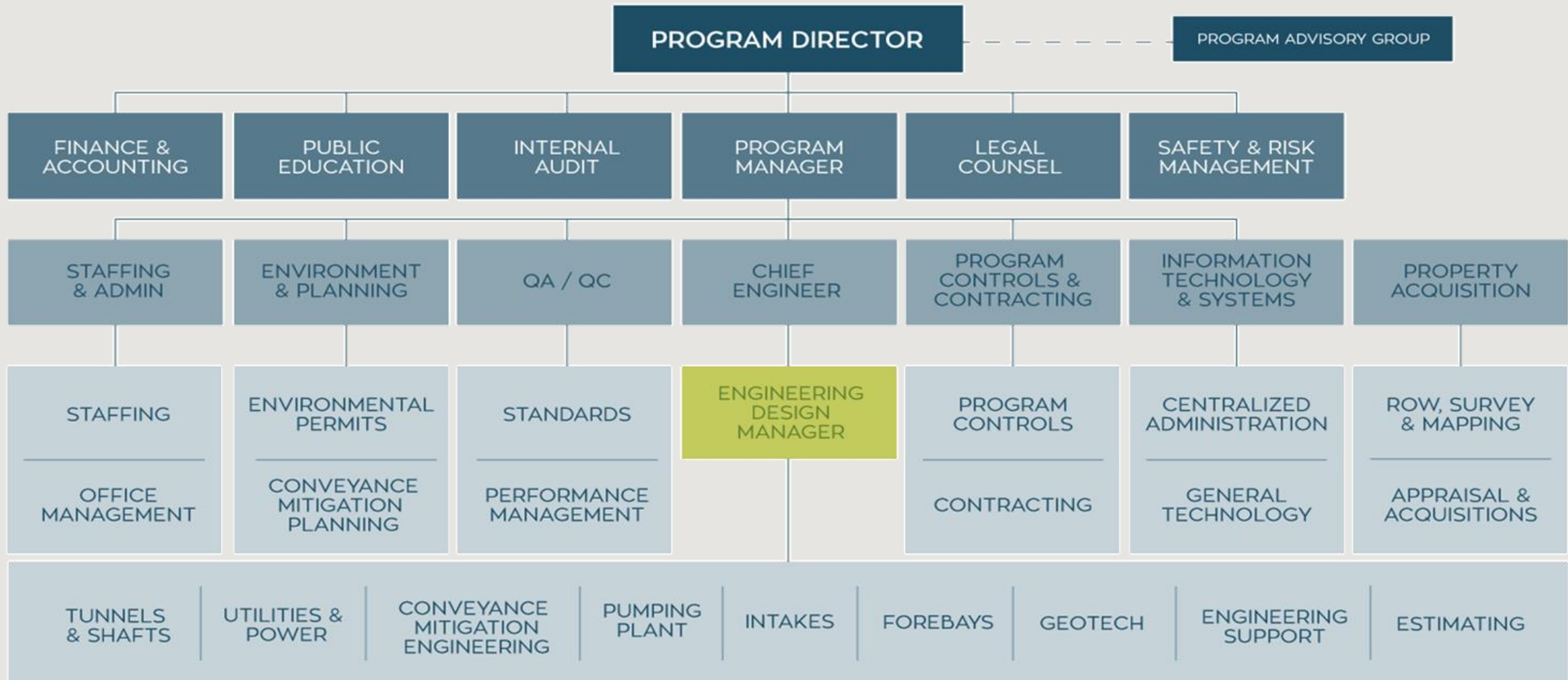
Program Estimate developed in September 2015

Program Estimate in 2014 Dollars



DESIGN AND CONSTRUCT ENTERPRISE

ORGANIZATIONAL STRUCTURE





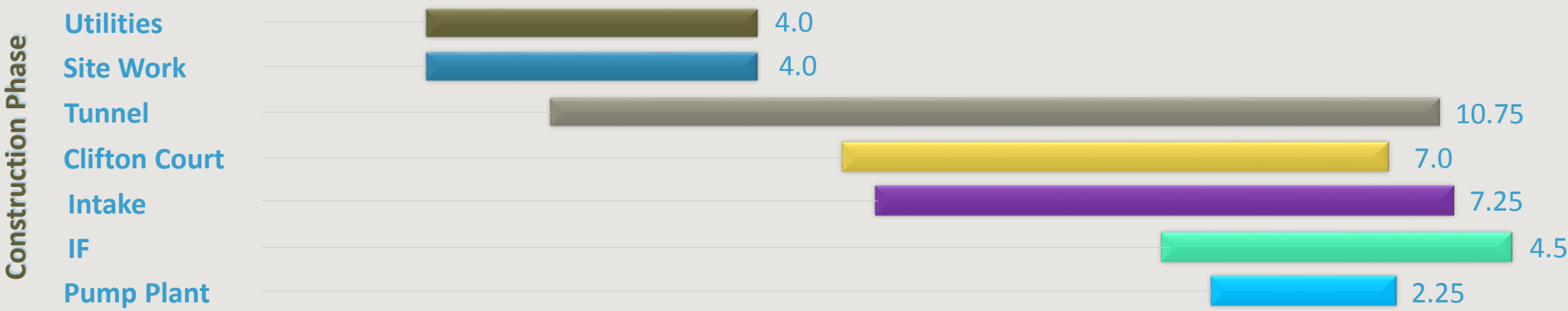
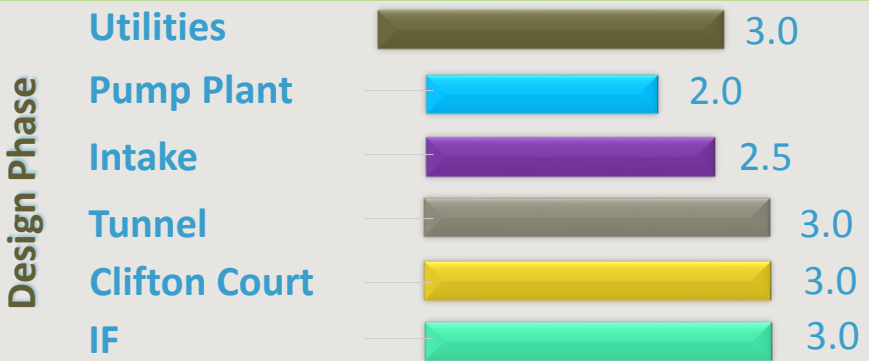
DCE PROGRAM SCHEDULE

Lead staffing 0.75

RFQ process 1.0

Land Acquisition 4.0

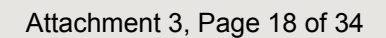
Note:
Numbers indicate task duration in years





REVIEW OF OTHER MEGA-TUNNEL PROJECTS

- The Eurasia Tunnel - Turkey
- Lee Tunnel - London
- Port of Miami Tunnel - Florida
- East Side Access - New York
- Blue Plains Tunnel Project - District of Columbia
- Bay Tunnel - San Francisco
- Willamette River Combined Sewer Outfall Program - Portland
- Gotthard Base Tunnel - Swiss Alps
- SR-99 Alaskan Way Replacement - Seattle

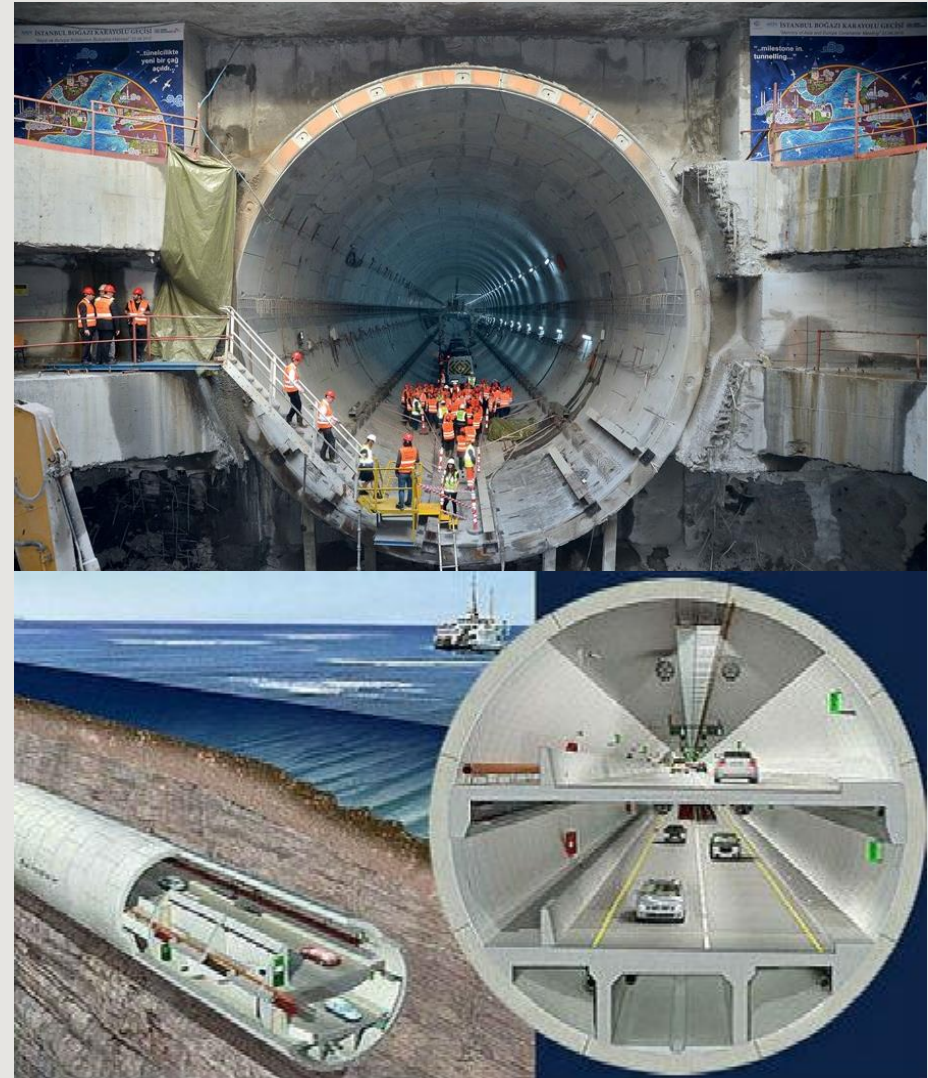




THE EURASIA TUNNEL – TURKEY

Project Information

- Transportation Tunnel
40 ft Internal Diameter (ID) x 2.1 miles
- 320 ft deep
- Completed Dec 2016
 - 3 months ahead of schedule
- Challenges
 - Complex geology, seismic deformations, and high groundwater pressure





PORT OF MIAMI TUNNEL - FLORIDA





PORT OF MIAMI TUNNEL

Project Information

- (2) 39 ft ID x 4,200 ft Long Transportation Tunnels
- 120 ft deep
- Completion May 2014
 - On schedule
 - Within budget
- Challenges
 - Porous coral and limestone required grouting, restricted access above tunnel due to shipping channel





BLUE PLAINS TUNNEL PROJECT DISTRICT OF COLUMBIA





BLUE PLAINS TUNNEL PROJECT

Project Information

- 23 ft ID x 24,200 ft CSO Tunnel
- 160 ft deep
- Completed Dec 2015
 - 3 months ahead of schedule
 - Under budget
- Challenges
 - Large deep shafts, existing infrastructure above tunnel





BAY TUNNEL – SAN FRANCISCO





BAY TUNNEL – SAN FRANCISCO

Project Information

- 15 ft ID x 5 mile water tunnel
- 110 ft deep
- Completed Oct, 2014
 - On schedule
 - Within budget
- Challenges
 - Long tunnel drive, no intermediate shafts, limited surface access, and high ground water pressure (3.5 bar)





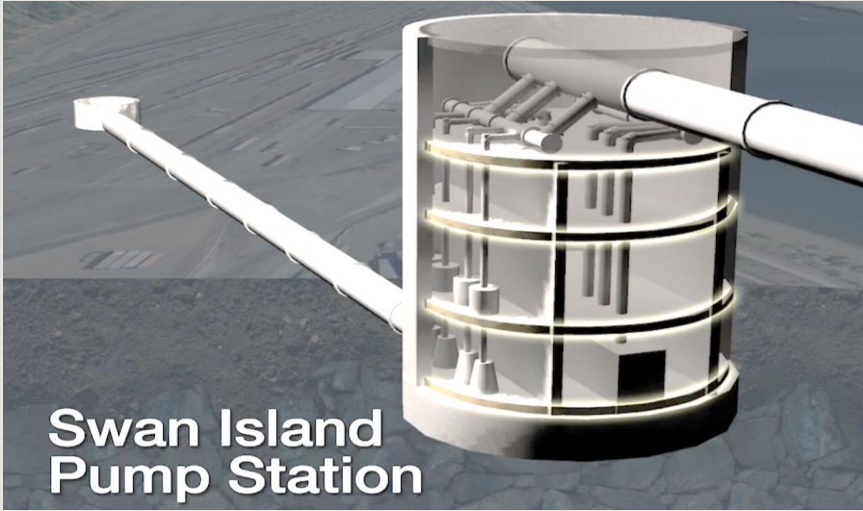
WILLAMETTE RIVER COMBINED SEWER OUTFALL PROGRAM – PORTLAND



Swan Island PS

Westside Tunnel

Eastside Tunnel

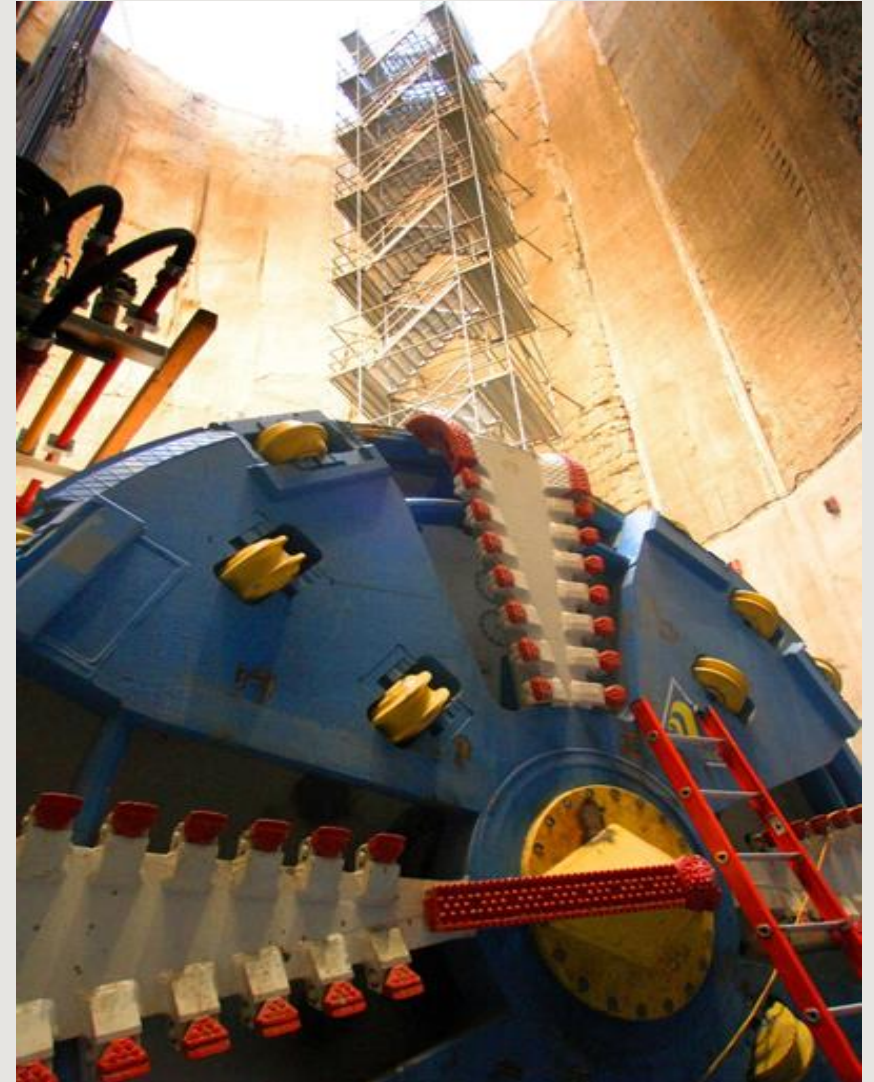




WILLAMETTE RIVER TUNNELS – PORTLAND

Project Information

- (1) 14 ft ID x 3.5 mile 120 ft deep and (1) 22 ft ID x 6 mile
- 150 ft deep CSO tunnels
- Cost Reimbursable Fixed Fee
- Construction Complete Feb 2012
8 months ahead of schedule
- Construction value US \$719 M, \$65M under budget
- Challenges
 - Schedule, existing infrastructure, groundwater, Tunnel Boring Machine breakout, soil modification, and subcontract changes





GOTTHARD BASE TUNNELS – SWISS ALPS





GOTTHARD BASE TUNNELS-SWISS ALPS

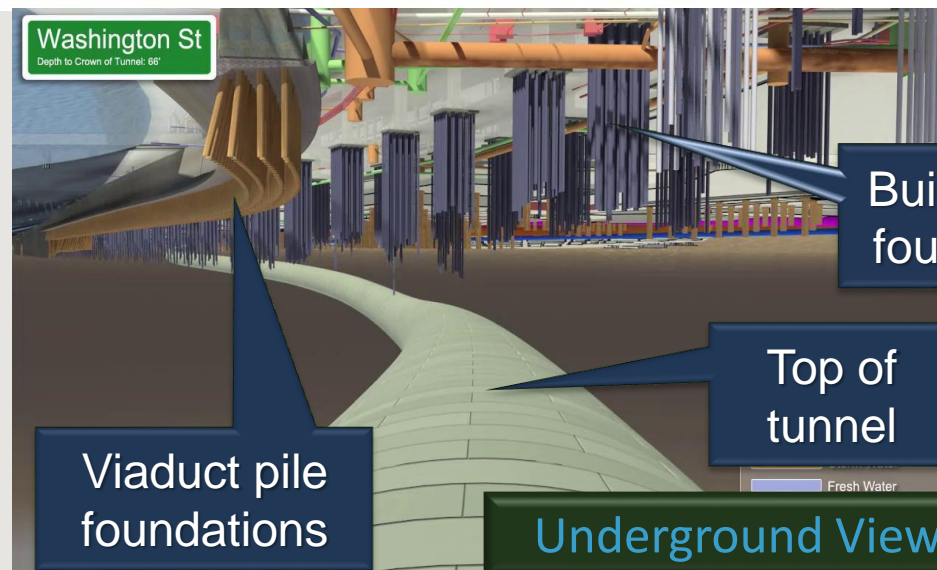
Project Information

- (2) 30 ft ID x 35 mile rail tunnel
- Up to 6,560 ft deep
- Completed June 2016 within schedule (17 years)
- Final construction cost \$12.5B over budget by \$0.8B
- Challenge: Safety, geology
- For the 2 main tunnels and the safety, ventilation and cross cuts, a total of 95 miles tunnel has been bored





SR-99 ALASKAN WAY REPLACEMENT-SEATTLE





SR-99 ALASKAN WAY TUNNEL-SEATTLE

Project Information

- 53 ft ID x 2 mile transportation tunnel
- Construction schedule
 - Approximately 2 year delay
- Challenges
 - Equipment malfunction, existing pile foundations and other infrastructure, difficult ground





SEATTLE TUNNEL SUCCESS



Inside Tunnel, prior to roadway construction

Tunnel breakthrough April 4, 2017





LESSONS LEARNED

- Proactive risk management strategy at all stages
- Assign risk to appropriate party
- Select project delivery method to maximize project benefits
- Get construction input early
- Invest in good geotechnical program and GBR
- Must have strong owner involvement
- Co-locate project team
- Resolve Right-of-Way and property acquisition early
- Resolve utility issues early
- Identify long lead items early
- Proactively manage logistical issues
- Develop effective program communication strategy



QUESTIONS

