"Planning Honolulu's Wastewater System Following The March 2006 Waikiki Beachwalk Force Main Rupture

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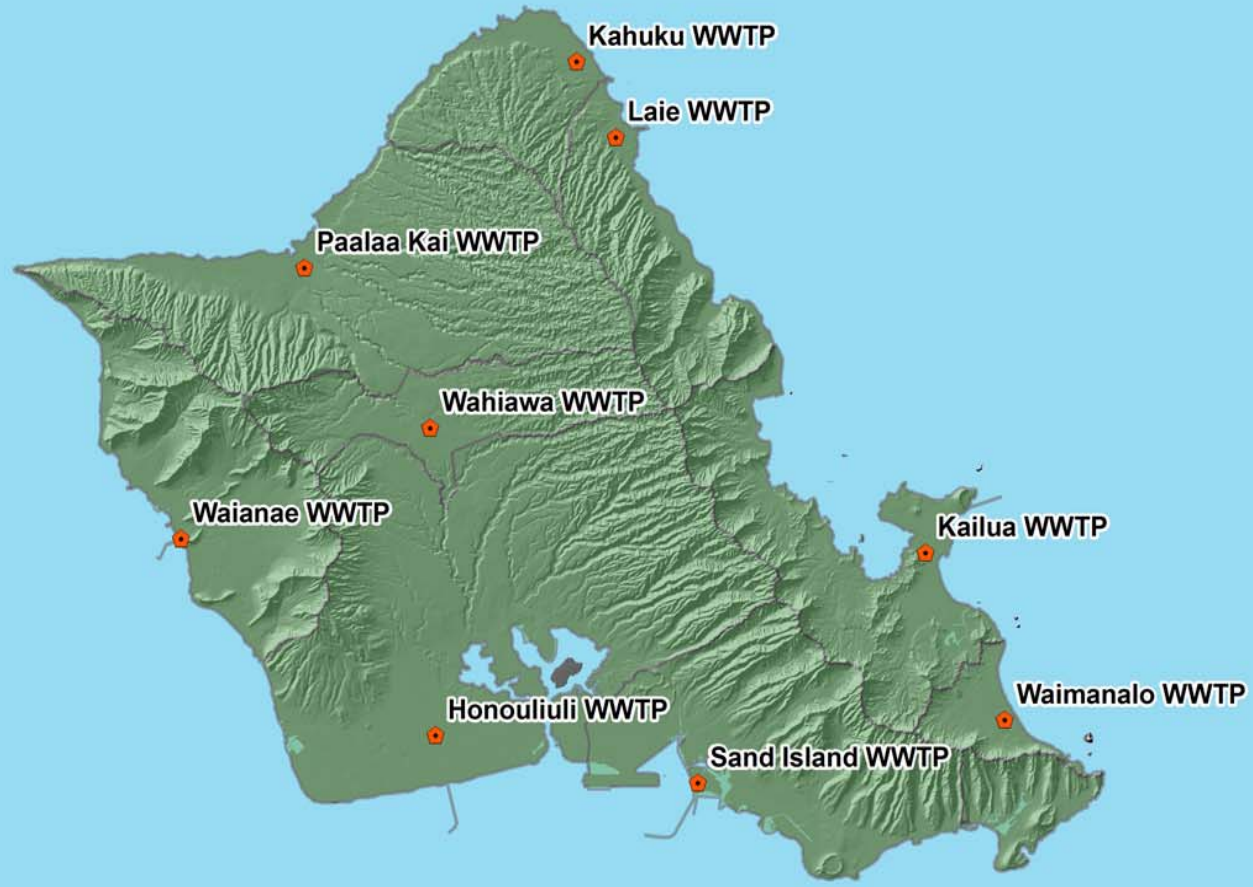
Protecting and Preserving Honolulu's Primary Tourist Destination - Waikiki

- Wastewater Infrastructure – Conveyance system in the Waikiki area needs to be reliable and robust (long-life).
- Wastewater spills should be minimized (if not eliminated) to the extent possible.
- Drogue Surveys during spill event was not conclusive.

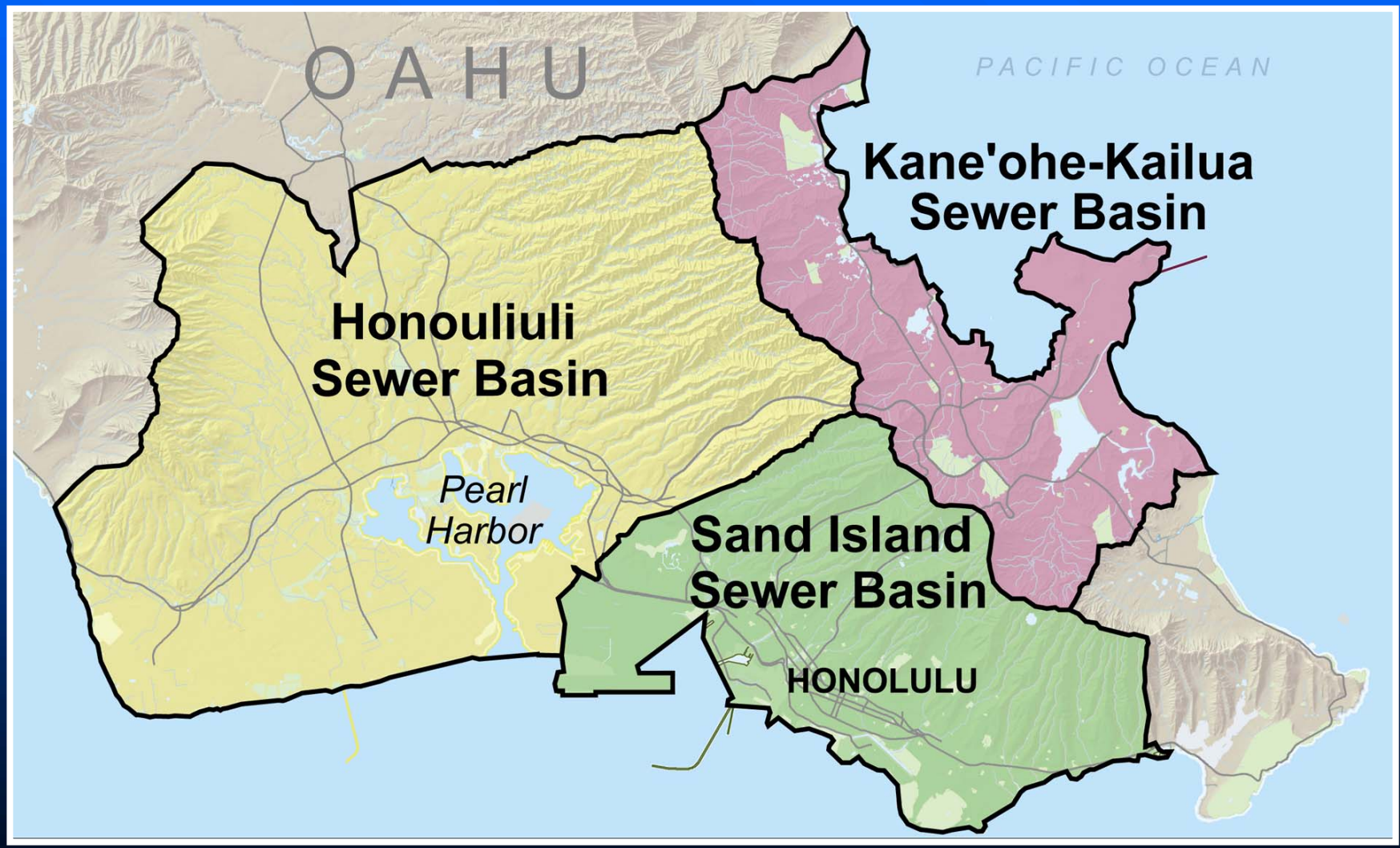
Vulnerability from Wastewater Pump Stations and Force Mains

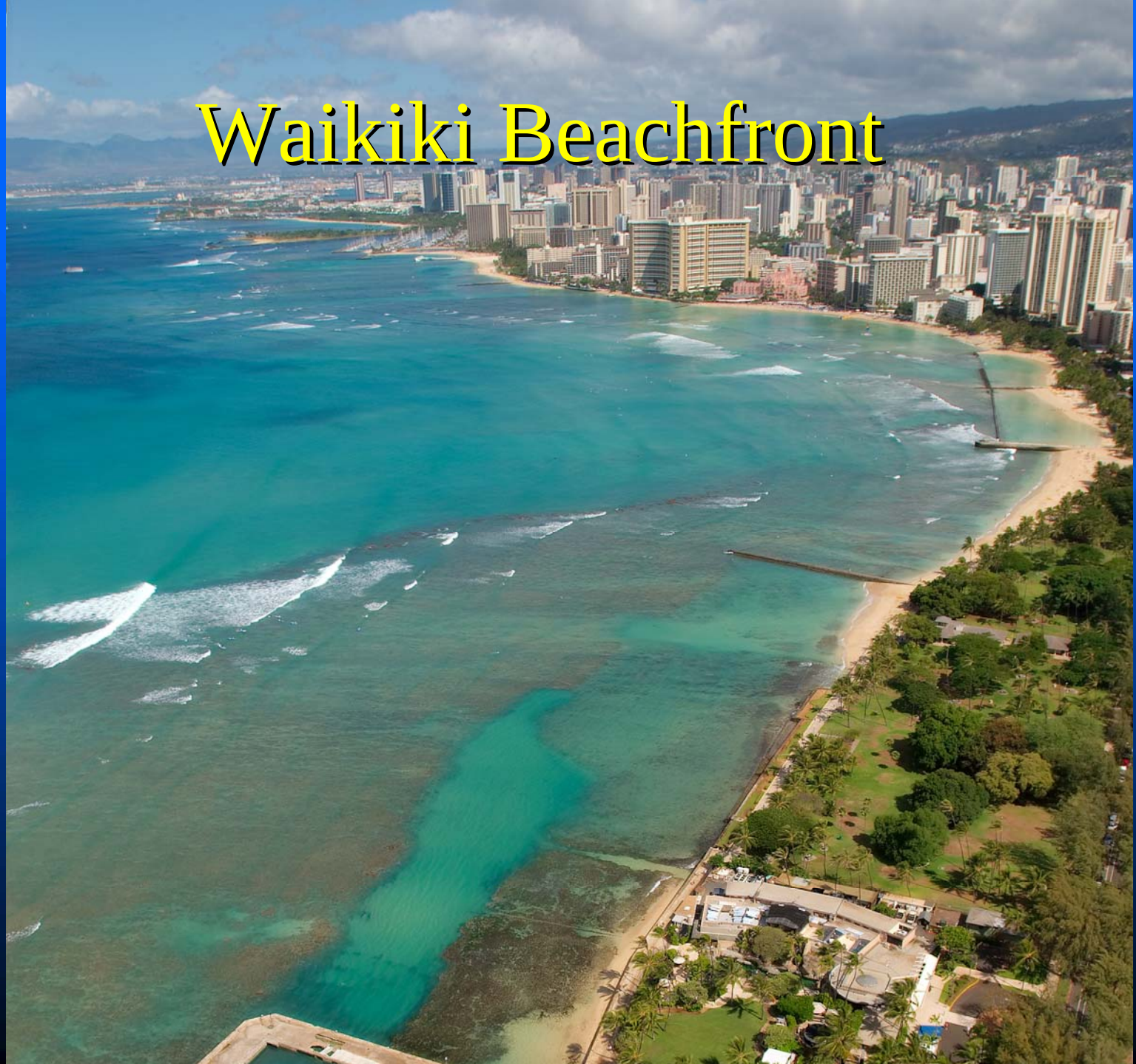
- Pump Stations Built with Redundant/Backup System
- Force Mains were not designed to have a backup system (no second pipe)
- Beachwalk FM break spilled approx. 12 mgd = 500,000 gallons per hour
- For Hawaii, these PS/FM are situated in the coastal beach/recreational areas

Oahu's Wastewater Basins



Oahu's Three Major Wastewater Basins




Waikiki Beachfront

Ala Wai Canal View

Waikiki's Beachwalk Pump Station and Force Main

- Constructed in 1964
- Average Wastewater Flow = 15 mgd
- Peak Wet Weather Flow = 38 mgd
- Force Main = 42-inch diameter, 6,600-feet in length, RCP

March 26, 2006 Spill Event

- Occurred during a period when Honolulu was experiencing continuous rainfall over 40 consecutive days
- Beachwalk PS/FM experienced many episodes of peak flow events (higher pressures/normal pressures)
- Pile driving on adjacent property creating additional geological vibrations

Initial Task – Re-Evaluation of Honolulu's Wastewater Program

- Existing Wastewater CIP Program Evaluation
  - Evaluate and determine the changes that need to be implemented to allow the City to more effectively manage its wastewater program
- Develop a Long Term Plan to incorporate International "State-of-Practice" into existing Wastewater Program

International "State-of-Practice"

- **Deep, gravity-sewer tunnels for equalization and conveyance of wastewater**
  - Eliminates need for Pump Stations and Force Mains
  - Technology recently proven in similar geology
- **Compact "stacked" and covered wastewater treatment plant facilities**
  - Now technically and economically proven, and operator friendly
- Overall Philosophy: **Placing wastewater infrastructure "out of sight and out of mind"**

Economic Reasons to Consider Deep, Gravity-Sewer Tunnels

- **Tunnel service life is 150 years**
  - Replace/rebuild pump stations and force mains at 30-year intervals
  - Operation and Maintenance (O&M) costs are less
- **Provides equalization and conveyance of wastewater**
  - Elimination of above-ground equalization (EQ) basins, which have negative impacts to the neighboring communities and operational costs
  - Elimination of select relief line, force main replacement, and pump station expansion projects
  - Smaller, equalized flows = smaller, less costly wastewater treatment plant facilities
  - Smaller, equalized flows = can defer wastewater treatment plant expansions

Other Benefits to Consider Deep, Gravity-Sewer Tunnels

- Elimination of select pump stations and associated O&M costs
- Fewer sanitary sewer overflows
- Better treatment at wastewater treatment facilities
  - » Wastewater is “fresher” = less odor and corrosion
  - » Wastewater is “fresher” = less dissolution of organic matter = more effective primary treatment!

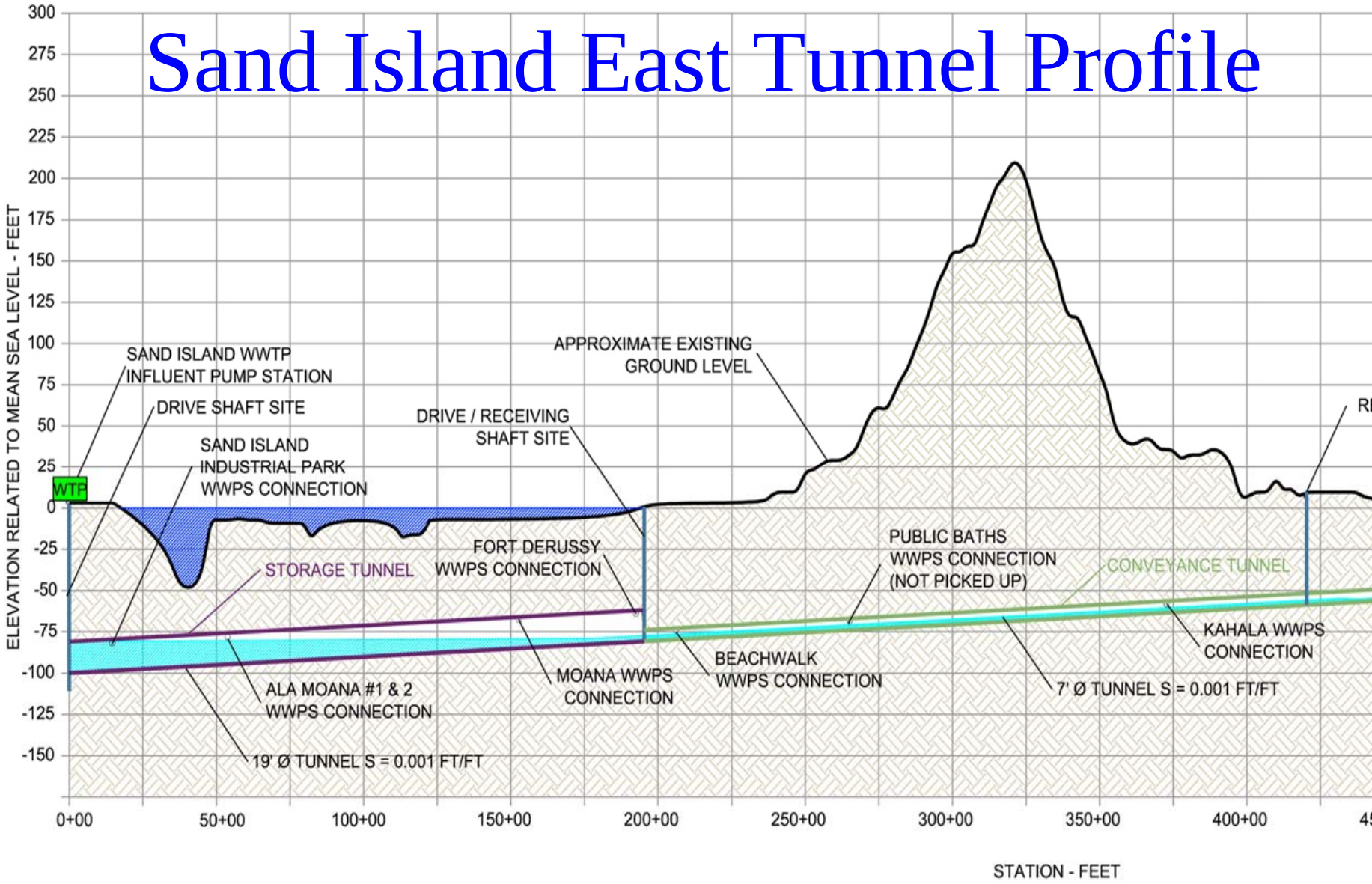
Other Reasons to Consider Deep, Gravity-Sewer Tunnels

- **Less Disruptive To The Local Community**
  - Less odor and noise in areas adjacent to select pump stations due to their elimination
  - Significantly less traffic disruption to local residents and businesses through the elimination of pump station, force main, and relief sewer project construction
  - Less impact on local residents due to construction method of deep tunnels
- **Environmental and Cultural**
  - Tunnel construction is below archeological assets and hazardous materials

Tunnel Eliminates 17 Sand Island Basin PS/FM

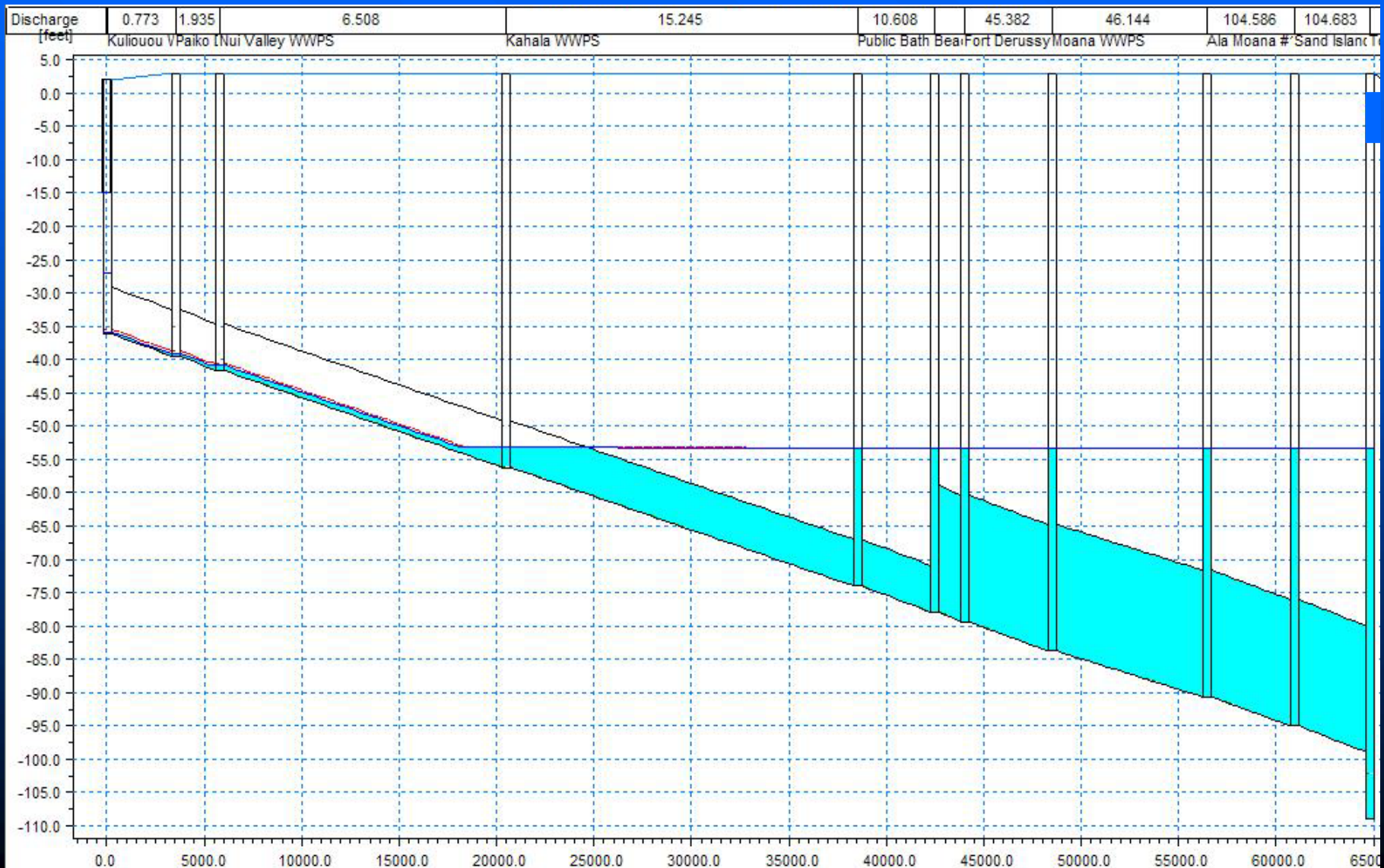
Sand Island Tunnel Option

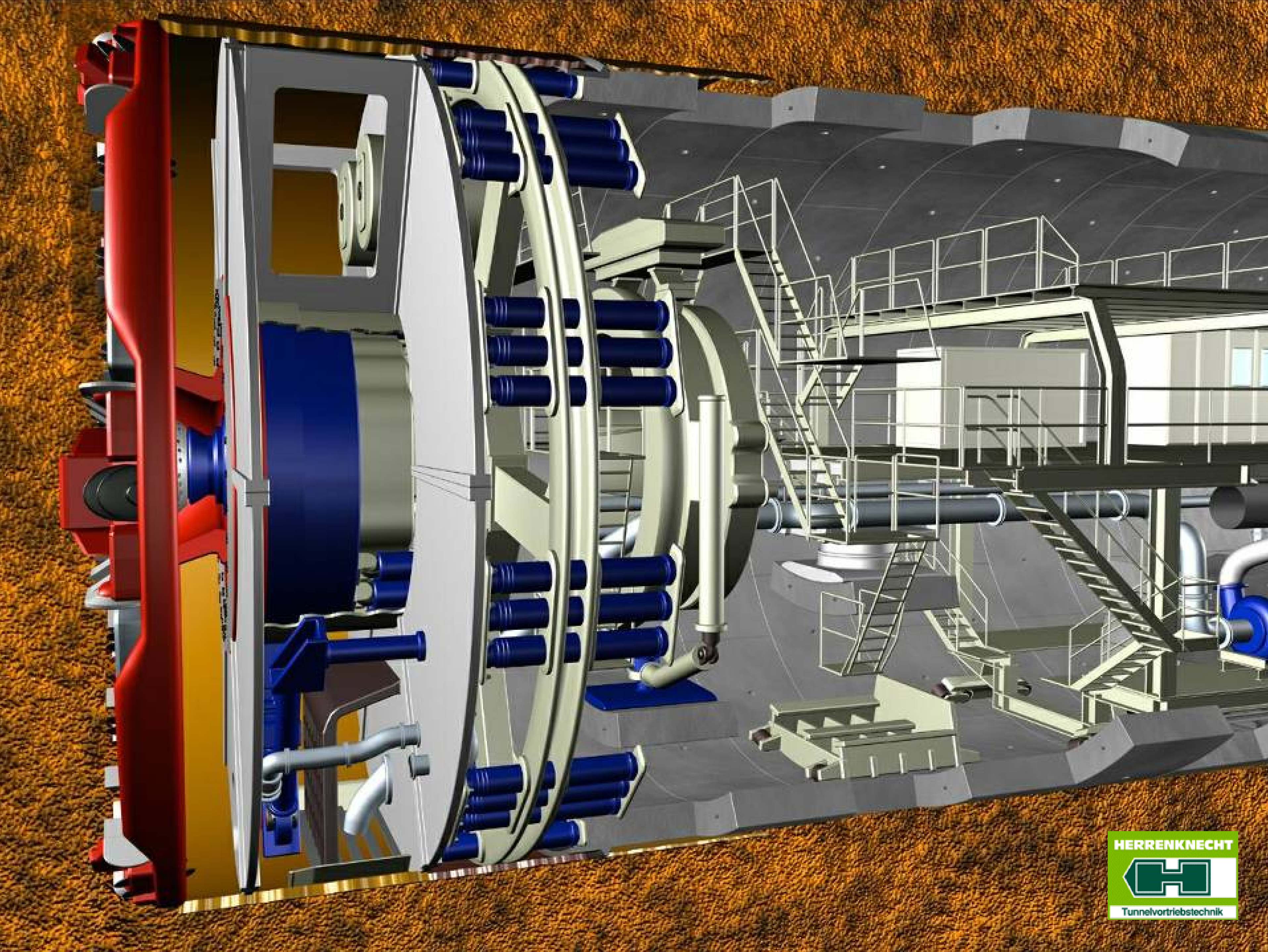
Sand Island East Tunnel Profile



East Tunnel Profile - Storage and Conveyance

Sand Island East Tunnel After 10-Year, 6-Hour Storm




HERRENKNECHT
Tunnelvortriebstechnik

Portland Tunnel Boring Machines

International "State-of-Practice"

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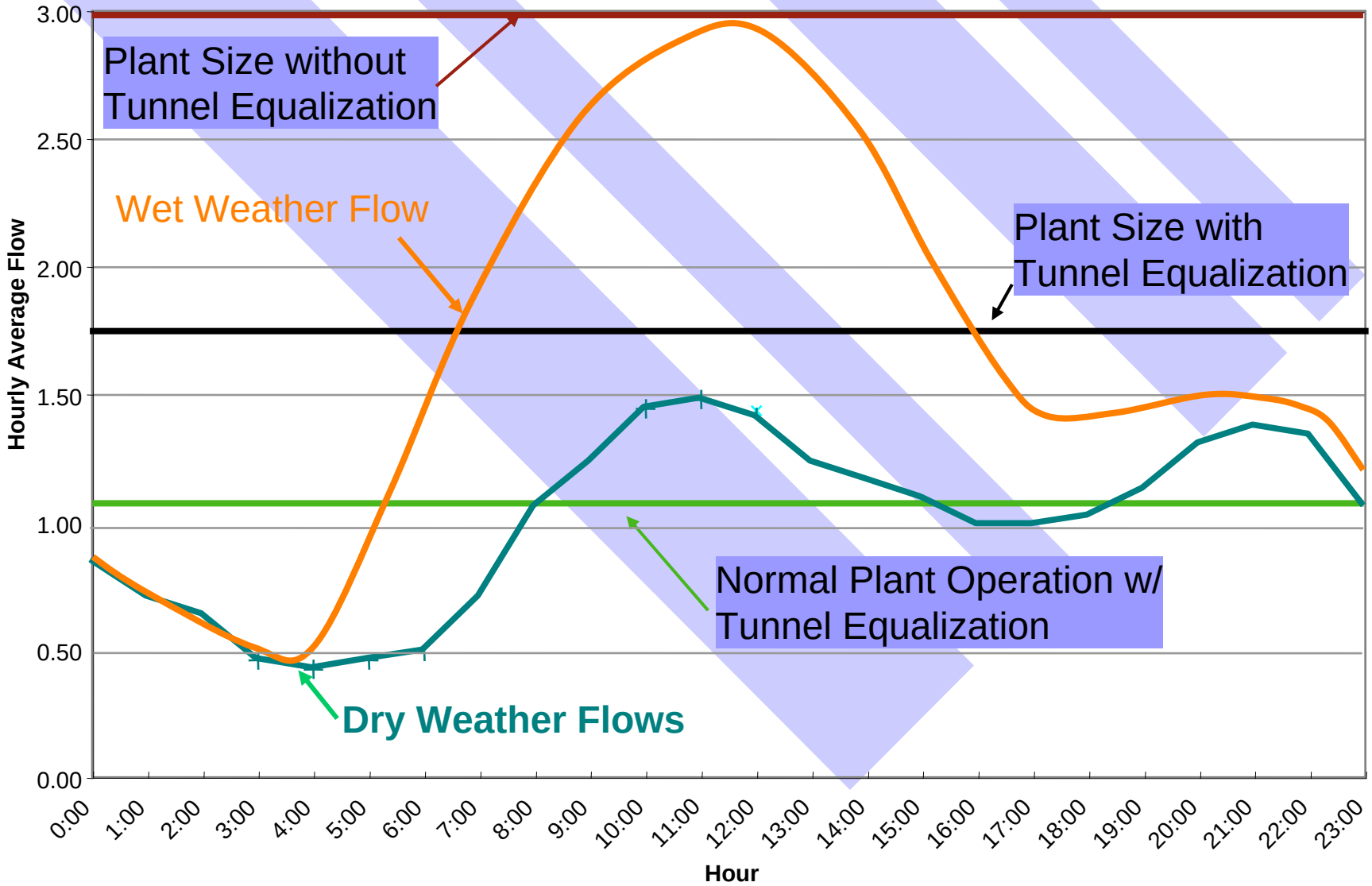
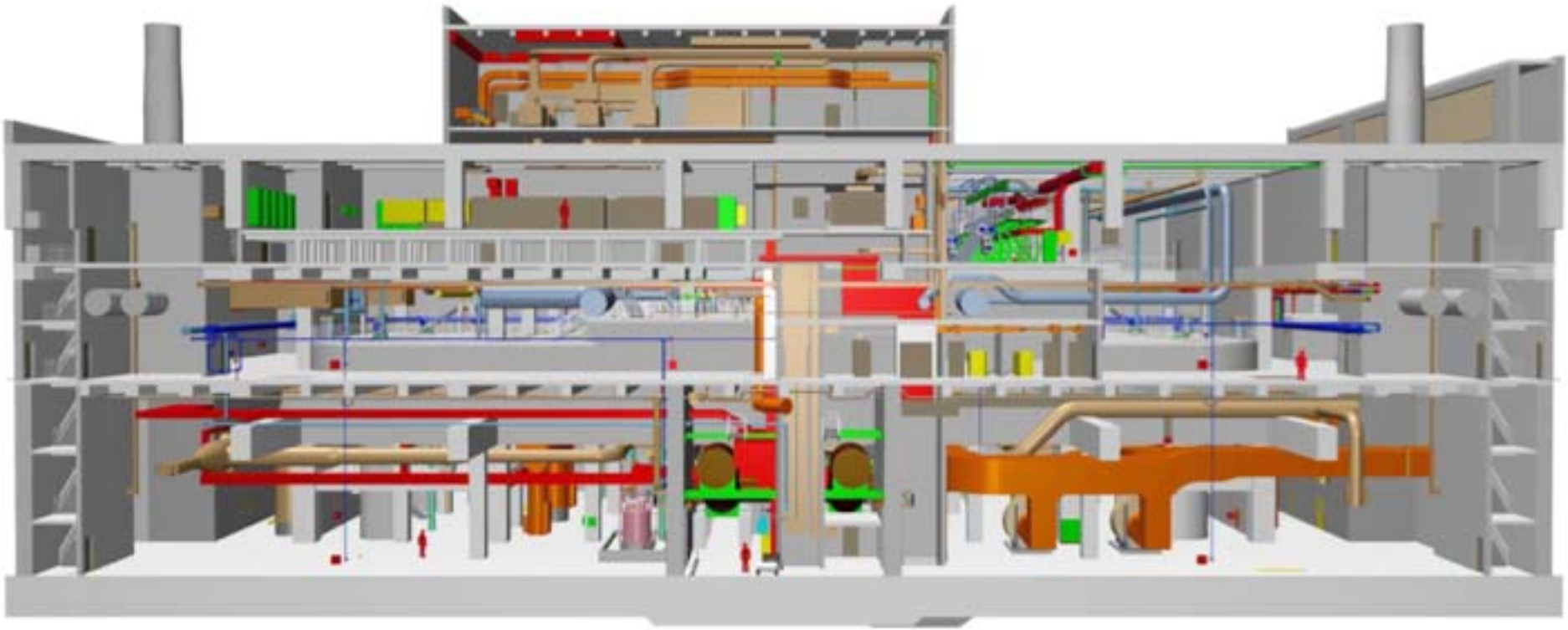
Conveyance Impacts On Treatment Plant Size



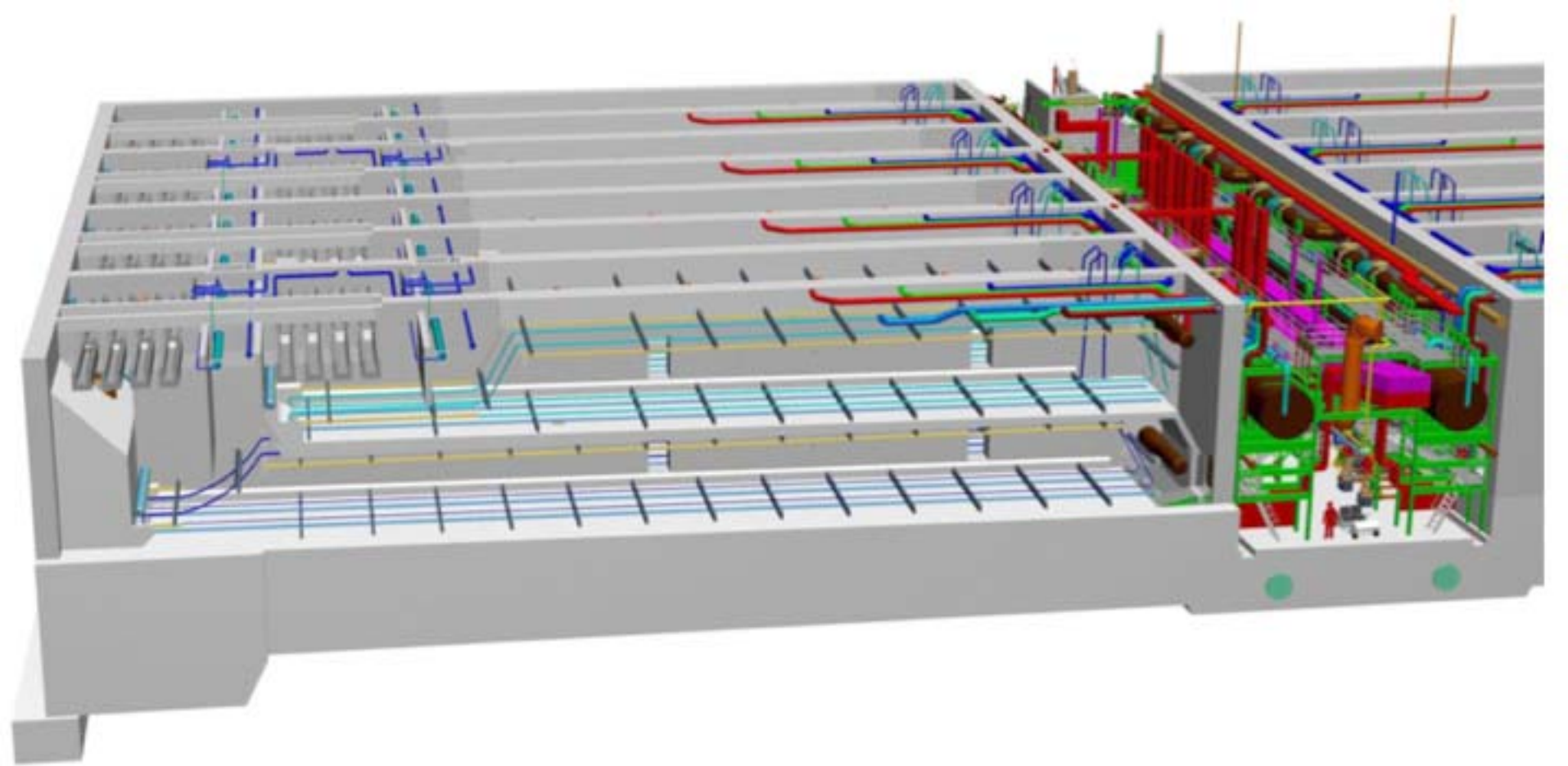
Compact “Stacked”, Covered WWTP Facilities

- **“State-of-Practice” WWTPs offer advantages**
  - Compact “Stacked” = use of **common walls** = lower capital cost
  - Compact “Stacked” = smaller facility footprint which allows for room for potential expansion without the need for additional land acquisition
  - Covered = less fugitive emissions and better, more efficient odor control = lower O&M costs
  - Compact “Stacked” and Covered = new, fully automated facilities = easier to operate and maintain = lower O&M costs

Headworks Section



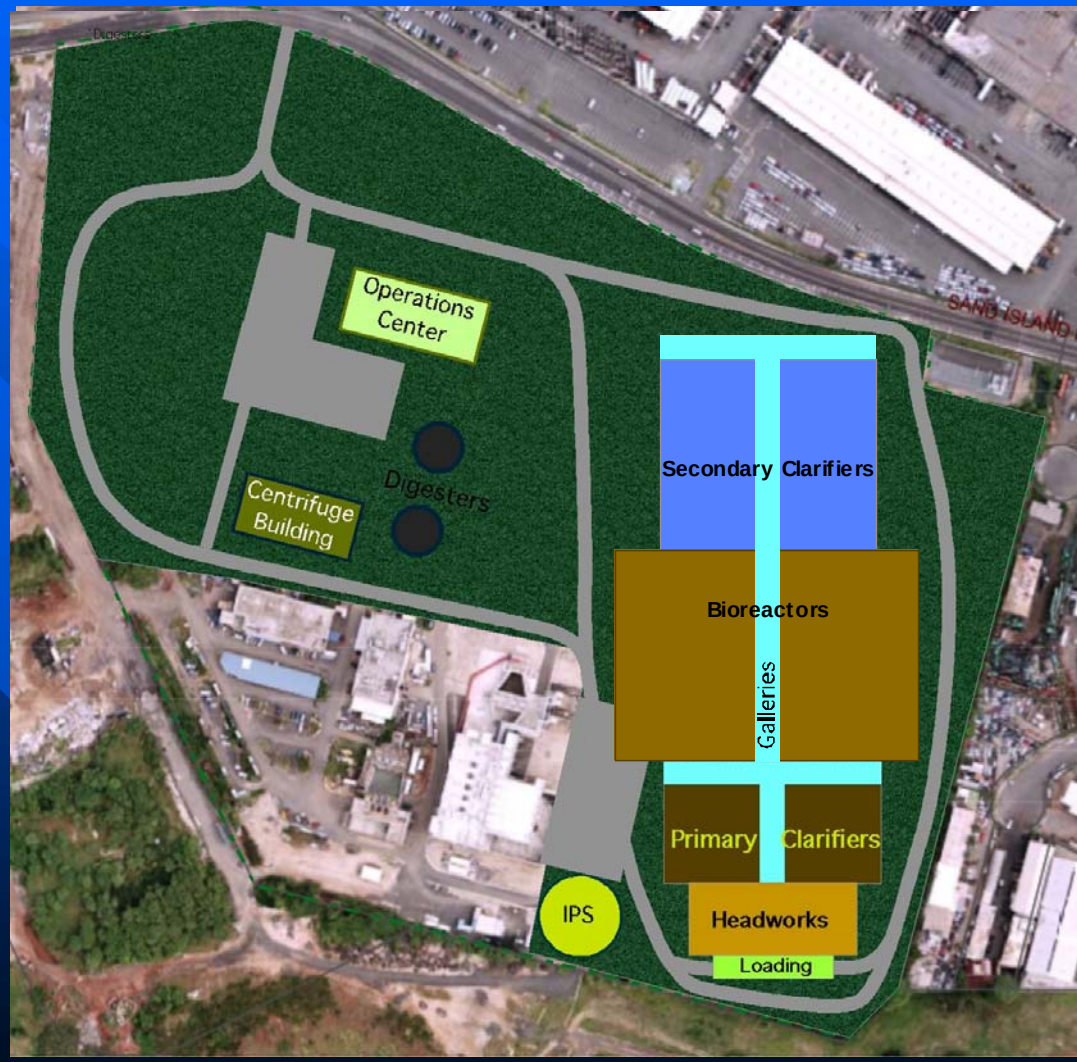
Primaries Sub-module



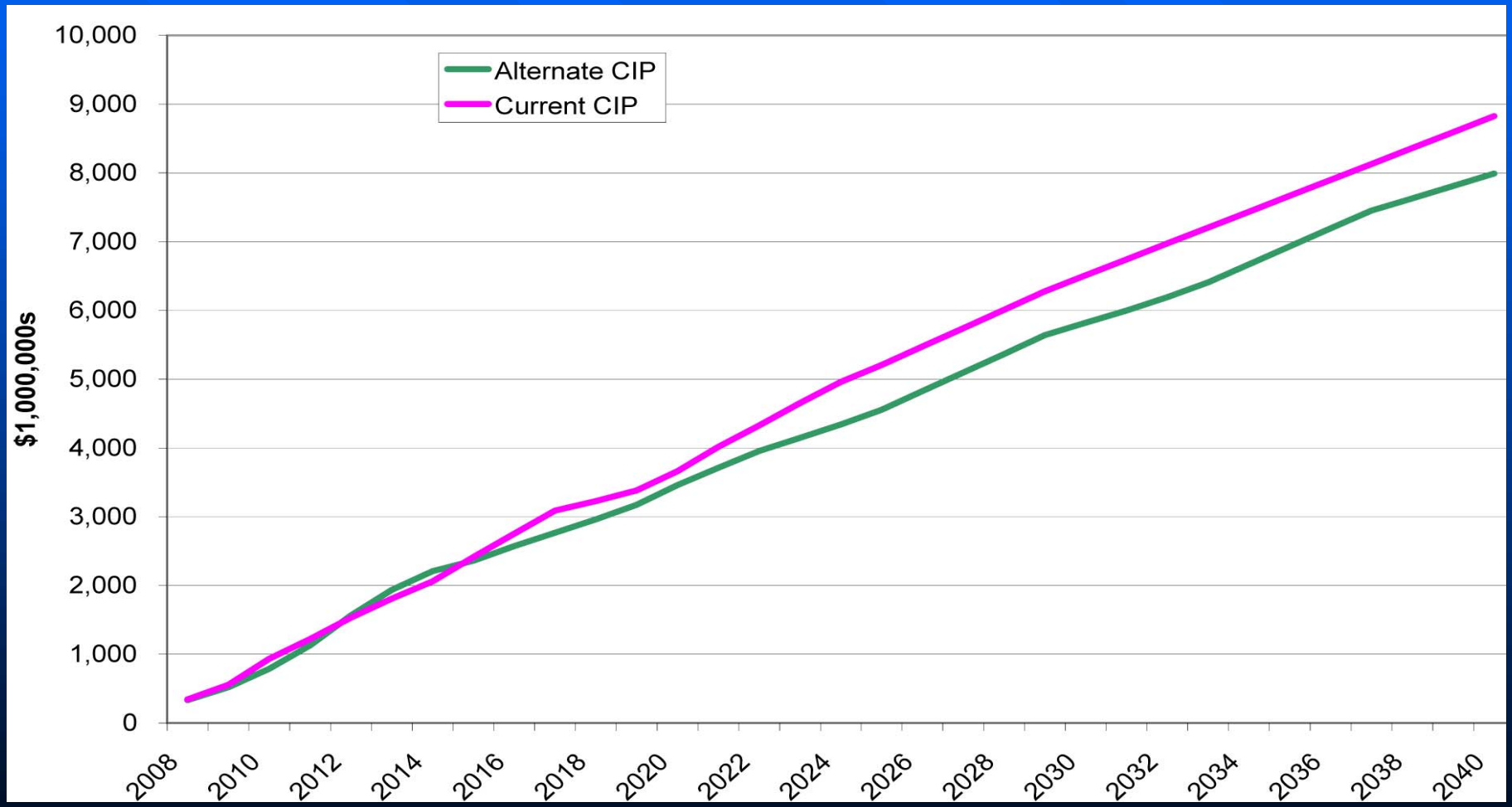
Primaries - Section

Sand Island WWTP

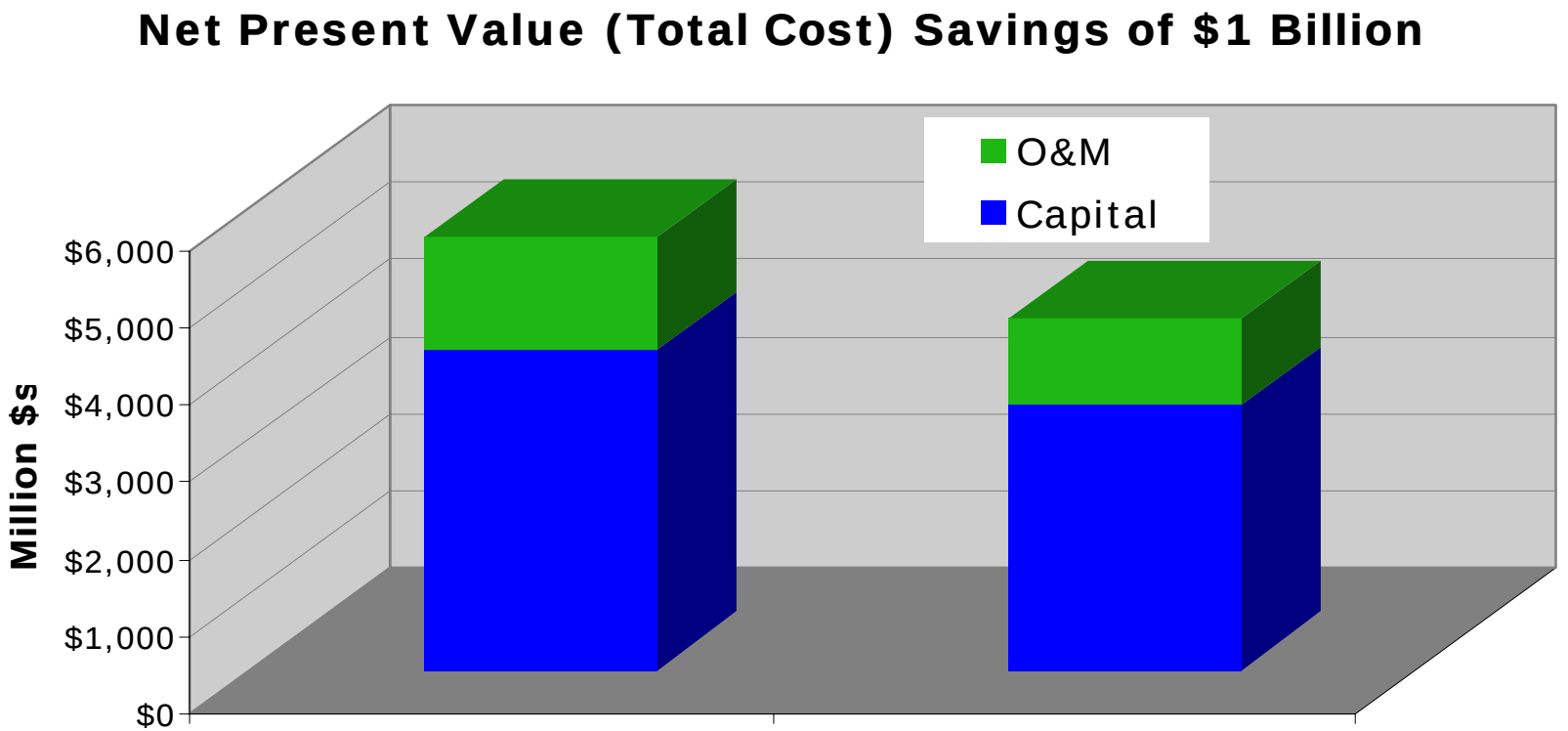
- A recent aerial photo
- Primary Treatment at “end of 150-year tunnel life”
- Secondary Treatment at “end of 150-year tunnel life”



Cumulative Capital + O&M Costs Through 2040 Significantly Favor Tunnels



The Net Present Value of All Costs Through 2040 Show The Heavy Advantage of Tunnels*



Summary - Protecting Our Fragile Coastline Through "State-of-Practice" Wastewater Technology

- Overall Philosophy: **Placing wastewater infrastructure "out of sight and out of mind"**
- **Primary Goal - to yield a solid, robust system that will last, trouble free, for another century +**
- **Our planning efforts saw that the "State-of-Practice" in the wastewater technology field was a combination of improvements to our conveyance and treatment systems**
- **Will provide a higher degree of protection for Waikiki's recreational coastline/beaches**

Summary - Protecting Our Fragile Coastline