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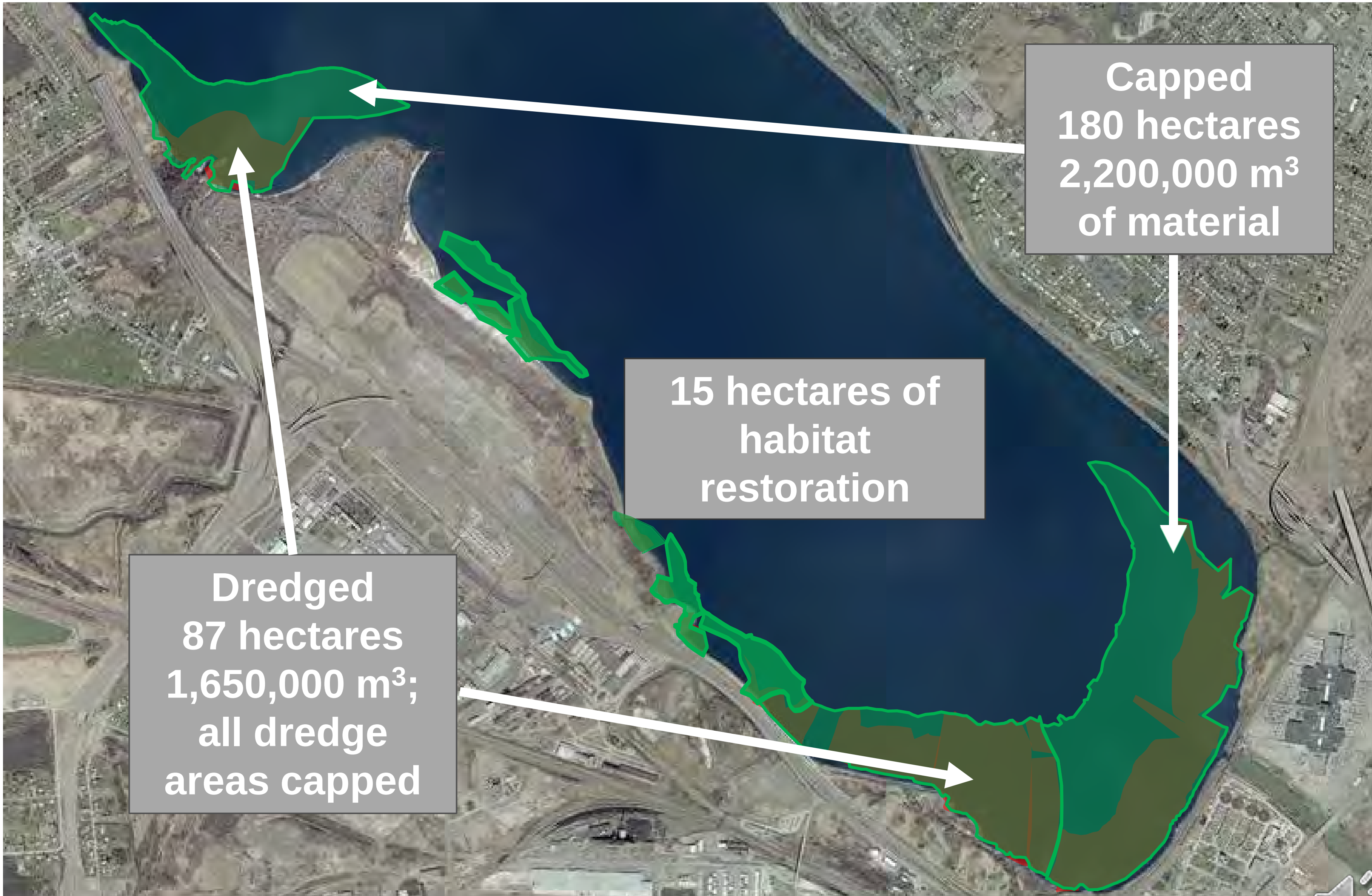
MANAGING A SEDIMENT CONSOLIDATION AREA WITH GEOTEXTILE TUBES

WODCON XXI – June 16, 2016

Onondaga Lake

- 7.2-kilometers long, 1.6-kilometers wide
- Average water depth of 11 meters
- Underlain by a thick layer of soft, unconsolidated sediments ranging from 24 meters to over 91 meters thick

Remedy Overview



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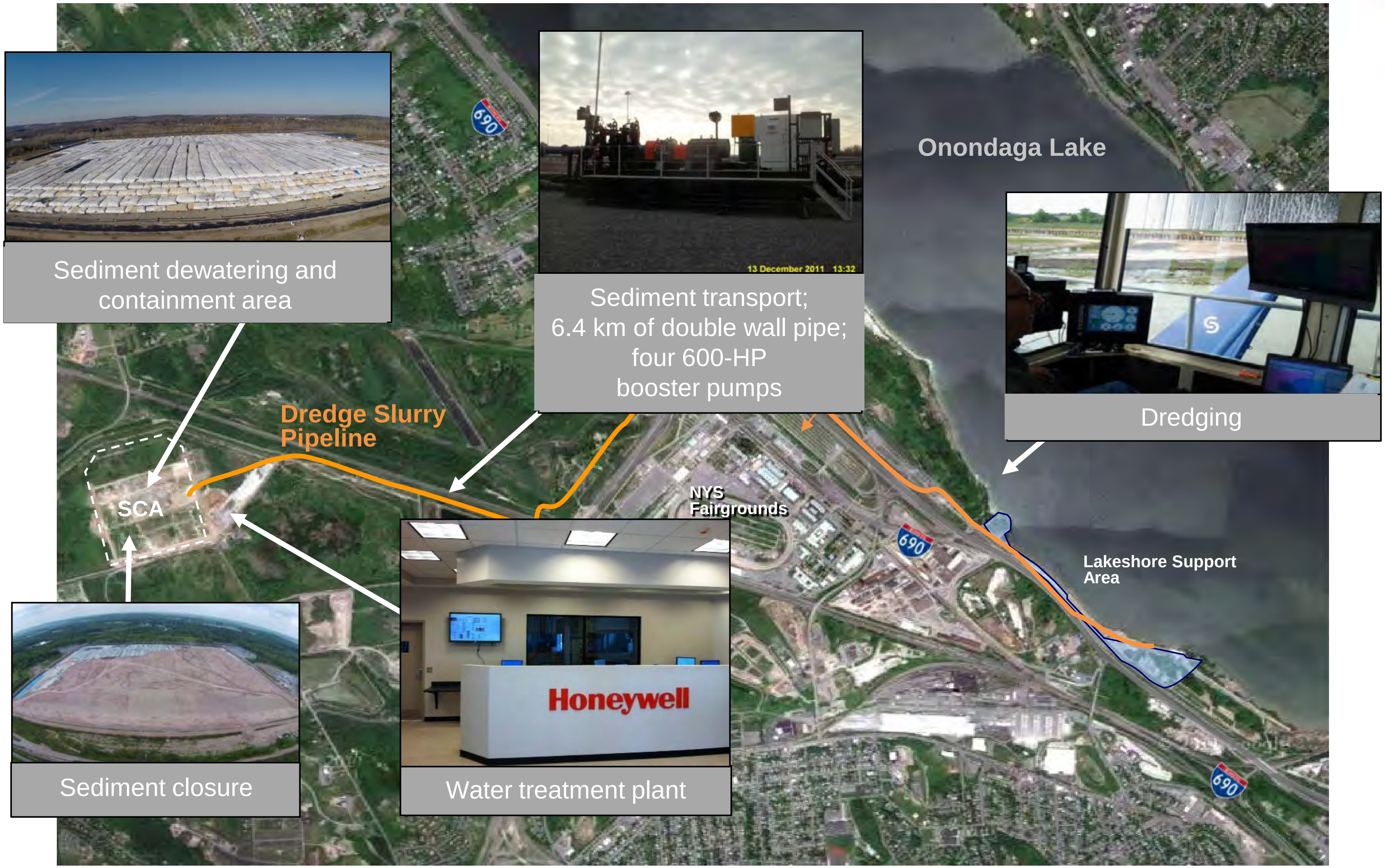
Dredging Overview

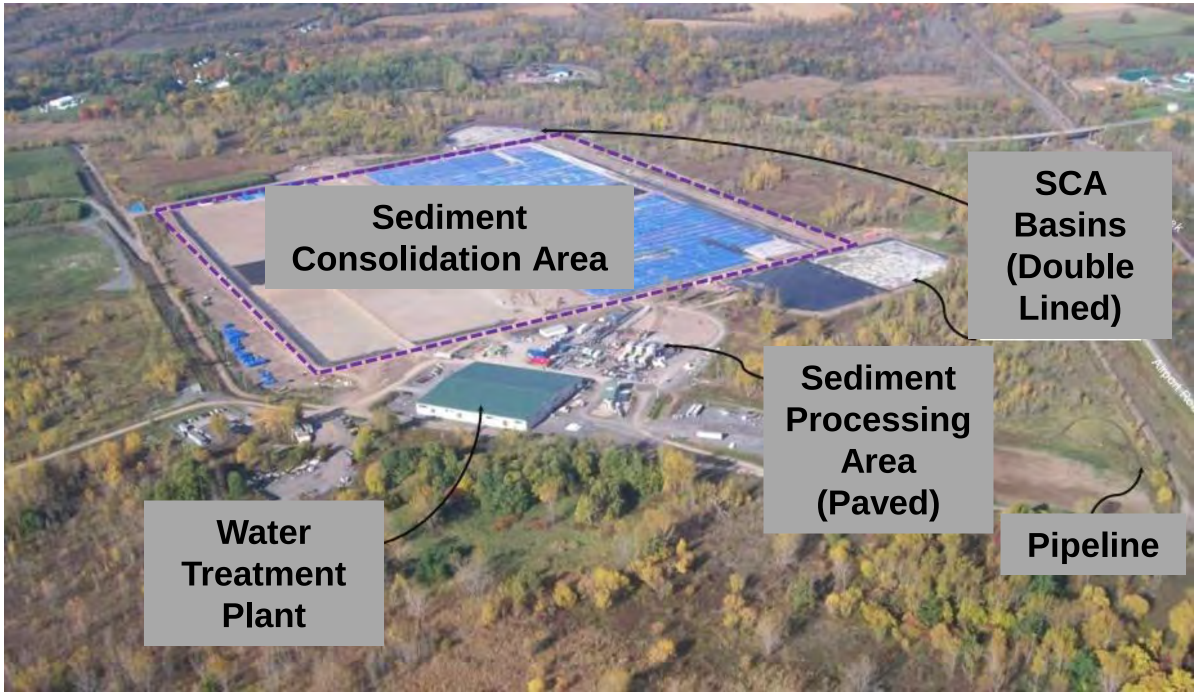


Sediment Transport

- Dredge operations commenced in 2012 and completed in 2014
- Sediments were hydraulically dredged and transported over 6.4 kilometers by way of a series of electric booster pumps to the sediment management area
- Material consistency ranged from oily fine sediments to hard material

Sediment Management

- Sediment management consisted of three main operations:
  - Sediment Processing Area – initial processing of the dredge slurry
  - Sediment Consolidation Area – sediment dewatered in geotextile tubes
  - Water Treatment Plant – treatment prior to discharge back to the lake

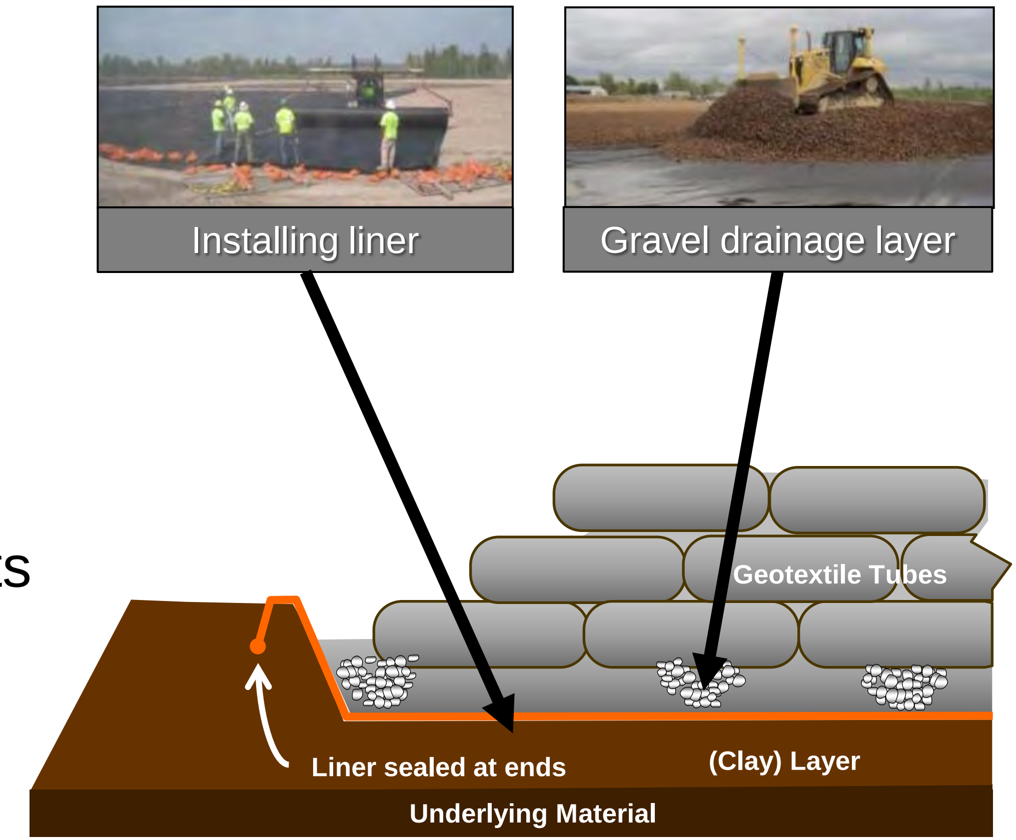


Sediment Processing Area

- Designed to optimize geotextile tube dewatering
- Dredge operations targeted a flow of 20,800 liters per minute (LPM) with 10% to 15% solids content (by volume)
- Slurry flow was injected with polymer based on flow and solids content of the slurry feed
- Primary polymer injection occurred in the slurry transport line prior to discharge to a set of three thickeners

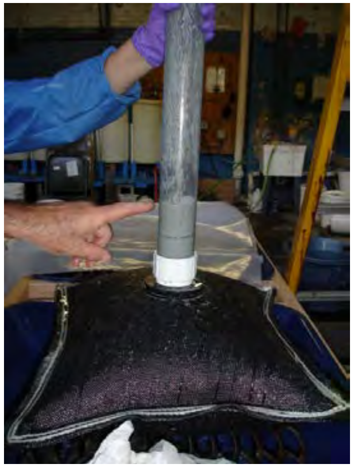
Sediment Consolidation Area

- 22-hectare
- Highly compressible underlying material
- Composite clay\HDPE liner system
- Leachate collection system
- Double-lined leachate management impoundments
- Sediment closure in place
- Extensive settlement monitoring system



Dewatering

- Site-specific evaluation of proper method
- Evaluation included:
  - Mechanical\landfill – belt press, filter press, and centrifuge
  - Open basin drying
  - Geotextile tubes
    - Bench testing – polymer and tubes



Dewatering – Geotextile Tubes

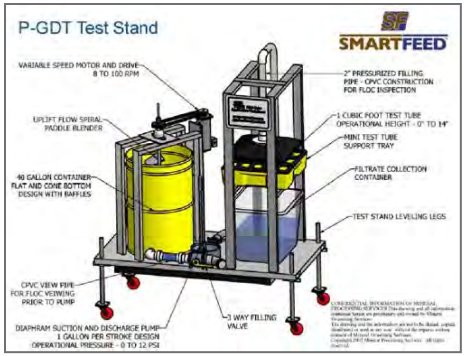
- Geotextile tubes
  - Fabricated from high-strength, permeable woven geotextile
  - Ranged from 24 to 27 meters in circumference
  - Up to 91 meters in length
  - Maximum capacity of up to 1,600 m^3
  - Approximately 1,000 tubes used, 76,200+ meters

Dewatering with Geotextile Tubes

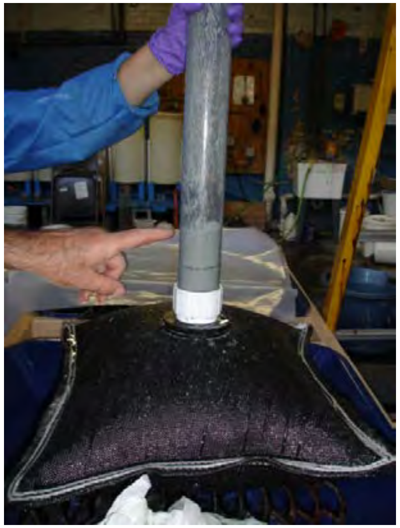
- Operational objectives:
  - Reasonable timeframe to allow for efficient tube stacking
  - Low suspended solids that allows for effective operation of the water treatment system
  - Operate in accordance with the Sediment Consolidation Area (SCA) design constraints
  - Minimize the impact on dredge production rates and project schedule

Dewatering

- Site-specific evaluation of proper method
  - 100+ polymers tested
  - Pressure-gravity dewatering testing (P-GDT) for geotextile tubes
  - Integration with procurement to minimize cost







Water Treatment Plant

- 24,600 LPM capacity
- Treatment
  - Metals precipitation
  - Sludge thickening and separation
  - Removal of suspended solids
  - Removal of organics
- Thickened sludge conveyed to the tubes for further dewatering of solids
- Treated effluent discharged to publicly-owned treatment works (POTW) for ammonia treatment prior to discharge back to lake
- Shutdown required during wet weather events (required dredge operations to stop)

Adaptive Management

- The highly variable slurry characteristics, operational constraints, and magnitude of the dewatering operations presented a number of challenges, requiring an adaptive management approach to operations
- Key contributors common to the success of the operations included:
  - Close communication
  - Daily coordination meetings
  - Daily updating of plans
  - Close monitoring of spare parts inventory
  - Implementation of a robust and proactive safety program

Sediment Processing Area

- **Goal**
  - Reduce total suspended solids and polymer loading to water treatment plant
- **Findings**
  - Sediment particles were observed attached to floating air bubbles
  - The bubbles were suspected to originate from the pressure change of the water from lake bottom to the surface, where dissolved air and gases then vaporized, causing small bubbles to form and float the particles, making primary settling (thickeners) difficult
  - Increasing polymer dose would result in excess residual polymer fouling the WTP
- **Actions**
  - Defoamer spray bars and baffles installed to improve the effectiveness of defoamer and skim the foam from the overflow
  - Field-based test procedure using china (kaolin) clay was developed as an indicator of the residual charge density (residual polymer) in the thickener overflow and the geotextile weep water

Sediment Processing Area

- **Goal**
  - Provide increased pressure for geotextile tube feed system to reduce plugging of feed lines
- **Findings**
  - With the increased working height of the tubes as they were stacked (along with the expanded header system discussed under the next goal), pressure drops in the feed system resulted in an increased frequency of feeder pipe plugging
- **Actions**
  - A spare booster pump was added downstream of the thickeners to maintain critical velocity of the slurry and reduce the chance of plugging the pipes

Sediment Containment Area

- **Goal**
  - Maximize geotextile tube capacity and stability of the stacked tubes

- **Actions**
  - The geotextile tube header system was expanded to allow distribution of flow to each of the SCA quadrants, simultaneously and interchangeably
  - Operators were able to stop or start flow to groups of tubes within the SCA with simple valve turns
  - This increased safety and stability of the geotextile tube stacking operation and avoided dredge shutdowns

Sediment Containment Area

- **Goal**
  - Adjust dewatering operations to accommodate sediment consolidation area water management and settling issues
- **Actions**
  - The flexibility in the design of the geotextile tube header system, and the geotextile tube layout strategy of dividing the SCA into four quadrants, allowed SCA operators to “load” or “rest” different areas of the SCA to address uneven settling in the SCA
  - These design features allowed operators to shift geotextile tube dewatering to different areas of the SCA to address ponding concerns and reduce downtime even when responding to problems

Sediment Containment Area

- **Goal**
  - Reduce site odors related to dewatering operations
- **Actions**
  - Measures included the following:
    - Coating inactive tubes with a latex roofing material
    - Installing floating covers on the water storage basins
    - Refining procedures to minimize emissions associated with debris handling, including covering of debris piles
    - Installing a misting system to control odorants in the air
    - Enhancing the capture of vapors from the thickeners and WTP by installing additional stand-alone GAC filtration systems
    - Covering areas of flowing water from the geotextile tubes to the extent possible
    - Installing vegetative barriers at strategic locations along the site perimeter
    - Installing high-capacity orchard fans along the site perimeter
    - Using wind screens to enhance the performance of the misting systems by interrupting airflow across the sediment dewatering area

Example Adaptive Management Process

To mitigate odor, manually deployed tarp covers were added to Geotubes and held in place by sand bags

Change required handling of hundreds of sand bags and decreased footing on wet, slippery, uneven surfaces

Worked with Geotubes manufacturer to install pre-covered tarps before shipment, eliminating sand bags

Still slick surfaces, and required some sand bags due to wind

Painting inactive tubes to eliminate tarps and sandbags

Safer and better solution

Adaptive management is key to success

Water Treatment Plan

- **Goal**
  - Reduce municipal WTP wet weather downtime
- **Actions**
  - Modifications were made to divert treated effluent to one of two storage basins during wet weather shutdown events
  - The team worked closely with the regulatory agency to make this change, which provided up to an additional 12 hours of dredge operation time in the event of a municipal WTP wet weather shutdown
  - Piping modifications at the municipal WTP and SCA WTP modifications, including the installation of a temporary GAC system for final "polishing", were made to allow for short-term discharge to an existing permitted outfall during high storm events
  - Implementation of these changes in early 2014 allowed for continuous dredge operations during municipal WTP shutdown events for the balance of the season

Success

- Successful completion of the project 1 year ahead of schedule
- High operational uptime was maintained over the 3 years of dredging, ranging from 96% to 98%

Questions?

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