Integration of Climate Resilience and Public Access into Port Brownfields Redevelopment

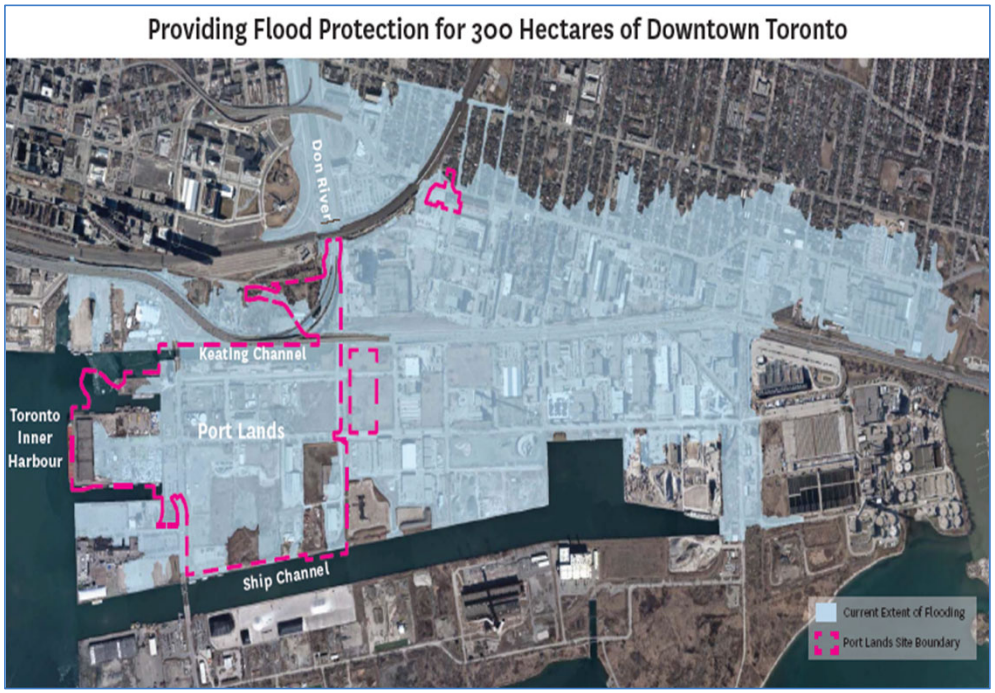
Geosyntec consultants

SACRAMENTO, CALIFORNIA


Waterfront Toronto

Hurricane Hazel Flooding

- In 1954, Hurricane Hazel caused massive flooding and property loss in Toronto.
- Development within the Don River's floodplain has been stifled due to flood control requirements for new construction



Courtesy of MVVA, 2019

Past Site Use

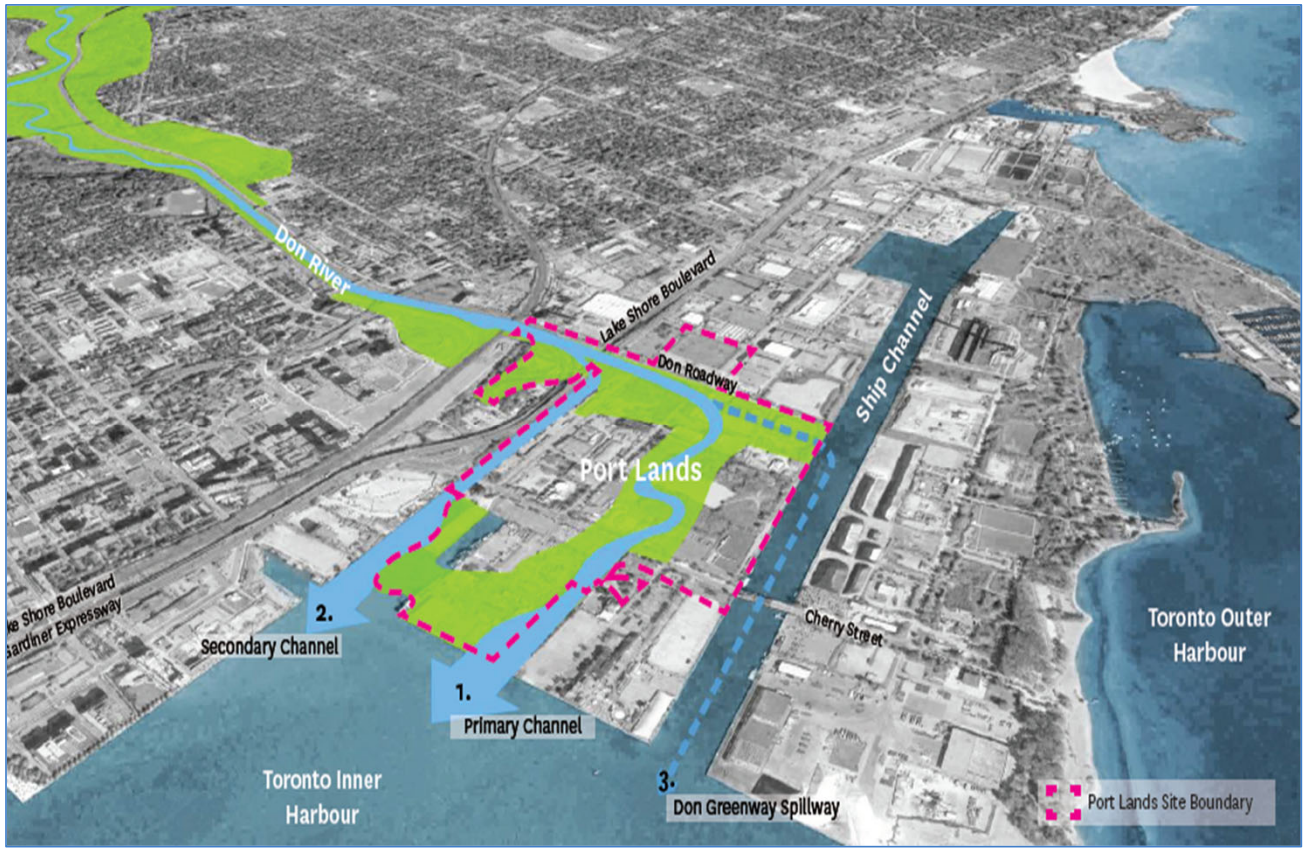
Historic wetlands were converted to heavy industrial land, which was contaminated with constituents associated with crude oil/petroleum hydrocarbon refining and storage, metals fabrication, natural gas processing, and explosive manufacturing.

Port Lands, 1970s

City of Toronto Archives

Waterfront Toronto

Project Overview



Courtesy of MVVA, 2019

- Constructing a new river valley and re-naturalizing the mouth of the Don River to Lake Ontario for flood control and protection

- Beneficial Soil Reuse
- Environmental Barriers
- Redevelopment of over 289 hectares of brownfield land
  - Wetlands and parks
  - Recreational areas
  - New infrastructure
  - Fu

Design Objectives

River Valley

- **Hydraulic Control During Construction**
  - Minimize amount of dewatering and water treatment required
  - Facilitate construction of river finishes under dry conditions
- **Risk Management Measures (RMM)**
  - Long-term protection of surface water, visitors, workers, and ecosystems from future contaminant transport (dissolved and free phase)

Parks

- **Minimize surcharge/settlement timeframes**
  - Accommodate major changes in final grades
  - Establish stable base for construction of park features
- **Assess seismic concerns**
  - Liquefaction

DESIGN:

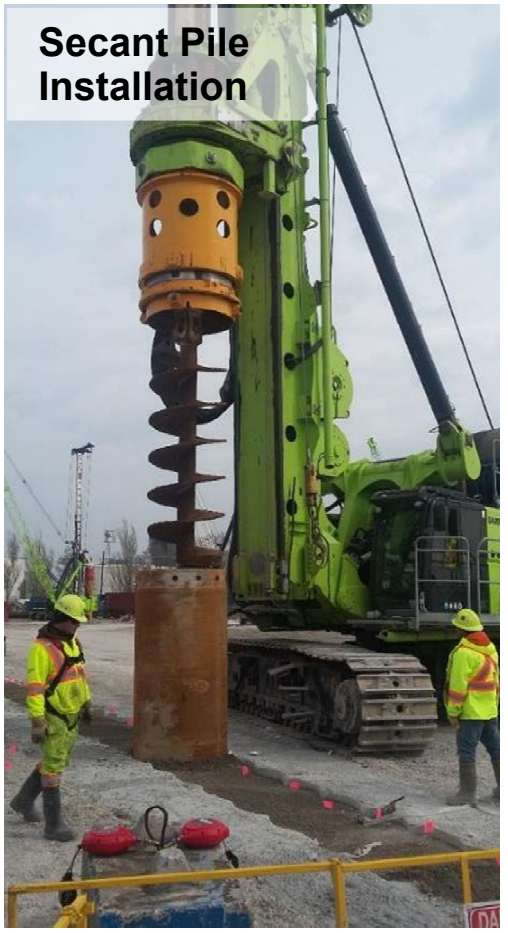
Vertical Cutoff Wall and Horizontal Barriers

Surcharge Plans and Surcharge Monitoring Plans

Vertical Walls

- Completion of 1933 secant piles, ~270 m diaphragm wall, and adjoining slurry walls around the entire river valley perimeter allowed for stable excavation and soil reuse, controlled dewatering and reduced water processing, and finishes construction in dry conditions.

Secant Pile Vertical Cutoff Walls

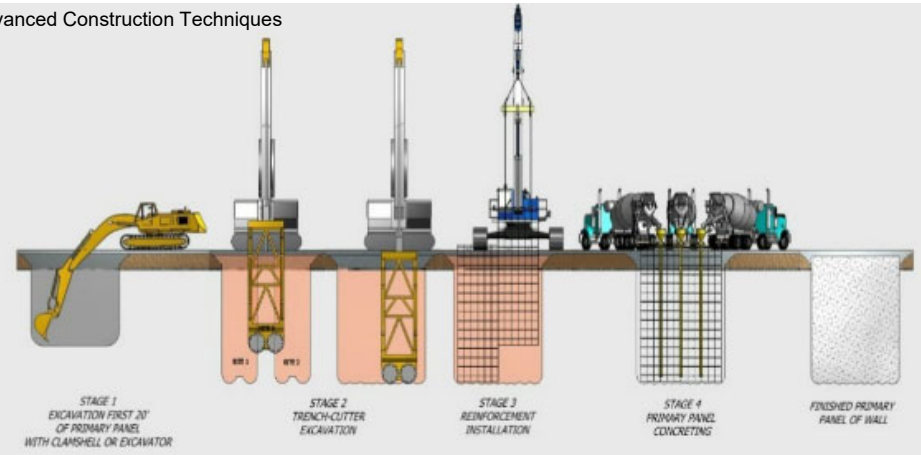


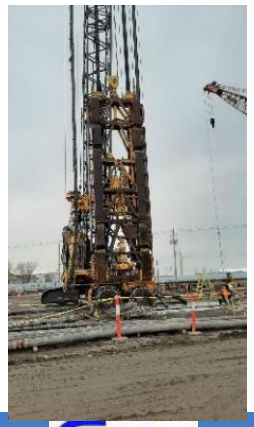
Slurry Wall Vertical Cutoff Walls

Long-stick excavator reaches bedrock and meets key refusal criteria while cement-bentonite slurry is used to support trench

Diaphragm Cutoff Walls

Courtesy Advanced Construction Techniques



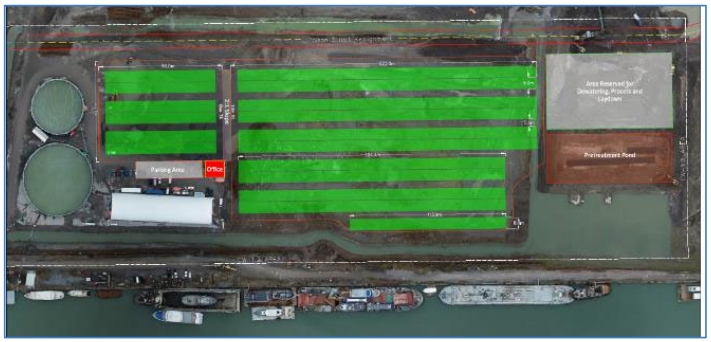


MANC

Geosyntec

Beneficial Soil Reuse

- Site specific reuse criteria developed (like-on-like principle)
- Cut (>1,000,000 m^3) and fill (>700,000 m^3) work allowing for soils and dredge material to be moved across entire site
- 20% of soils designated for disposal vs. 80% reused to raise grades and at cap.



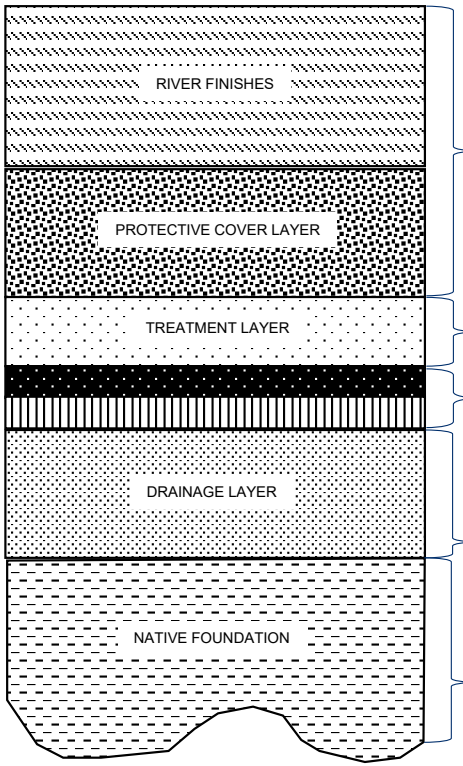
Horizontal Barrier Layers

- 60-mil HDPE (non-porous) for long-term longevity and chemical compatibility

GEOMEMBRANE

GEOSYNTHETIC CLAY LINER

- 1.5-cm bentonite liner as hydrologic and physical barrier, isolating underlying impacts from proposed river finishes



River Finishes Above RMM

Required Contingency (Simulated in Model)

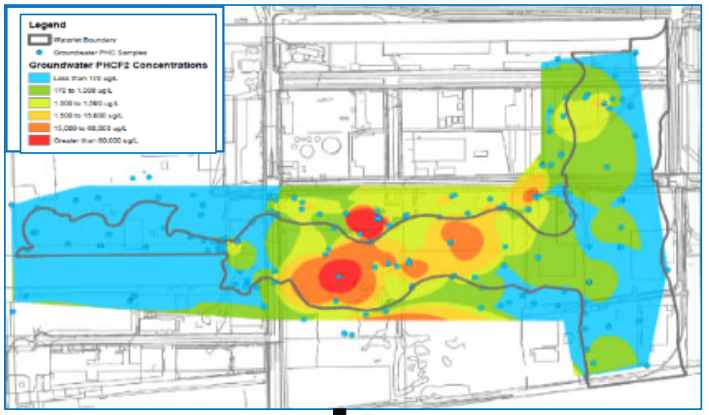
RMM Barrier

Seepage Collection of Water Contacting GCL and Premature Hydration during Barrier Placement (Maintains Dry Excavation)

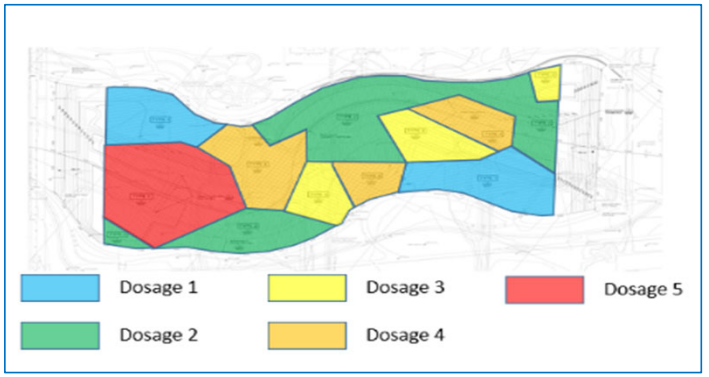
Bottom Boundary Condition (location specific impacts)

Reactive Treatment Layers (RTL)

Contaminant Distribution

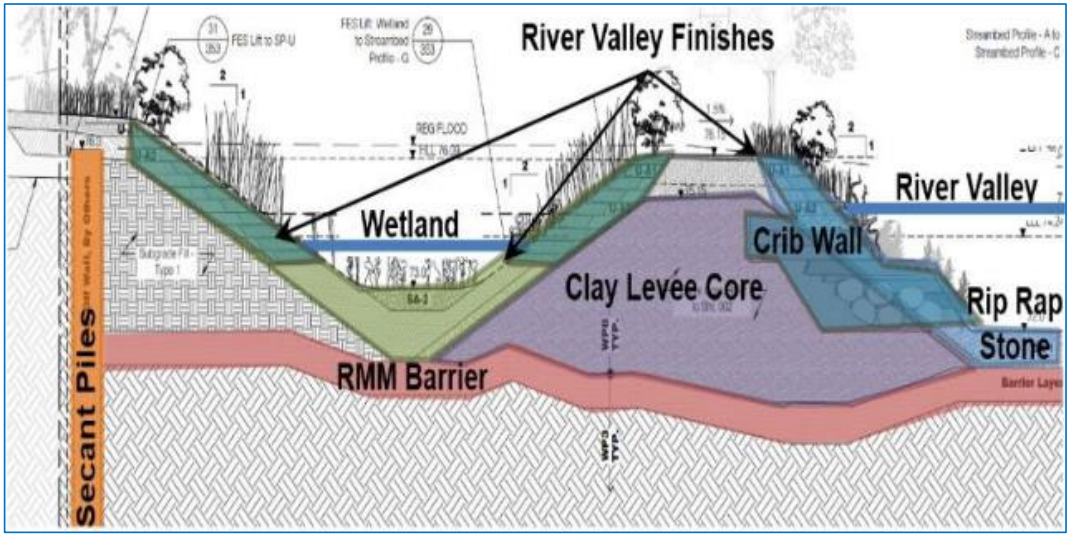


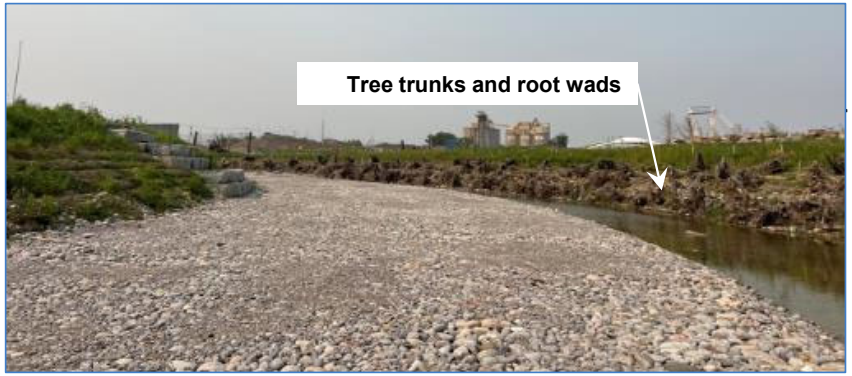
RTL Zones



River Valley Construction

- Impermeable lined clay levees to direct the flow of the river and provide separation from the four wetlands, allowing for dewatering and maintenance within the wetlands when necessary.
- Placement of rip-rap stone for streamed profile.
- Interlocking tree trunks and boulders, tied down, for crib wall inundation against levee core.





Wetlands & Bridges

- Community connection with the surface water and surrounding ecosystems
- New bridges, for transport and pedestrians, built above river valley path and within the wetlands

Courtesy of MVVA, 2019

Recreational Areas

- Extensive parkland network, including trails, play structures, and canoe coves
- Light-weight aggregate and geofoam blocks used as interlocking fill

Courtesy of MVVA, 2019