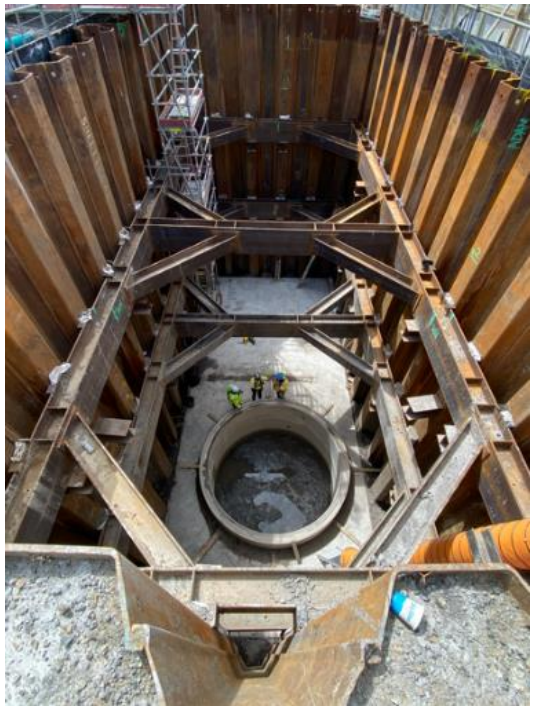

Archboyd Pump Station

Managing Acid Sulfate Soils and Groundwater Risks

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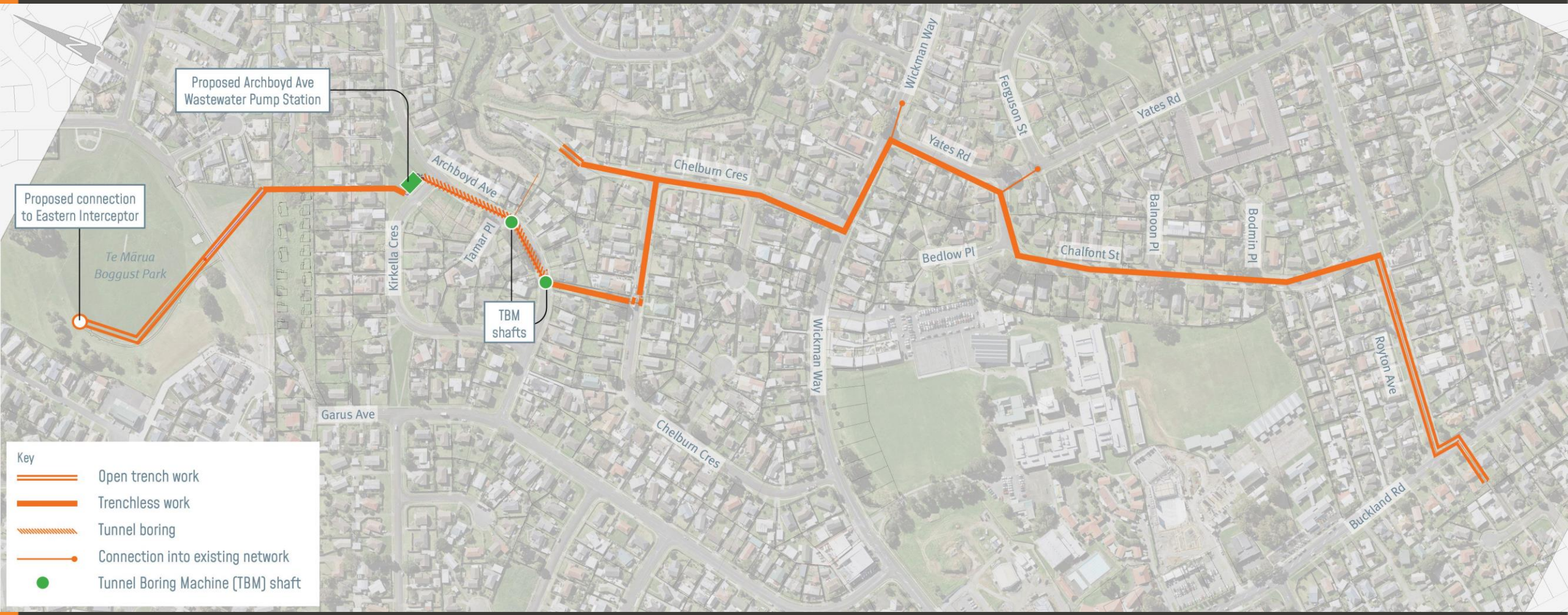

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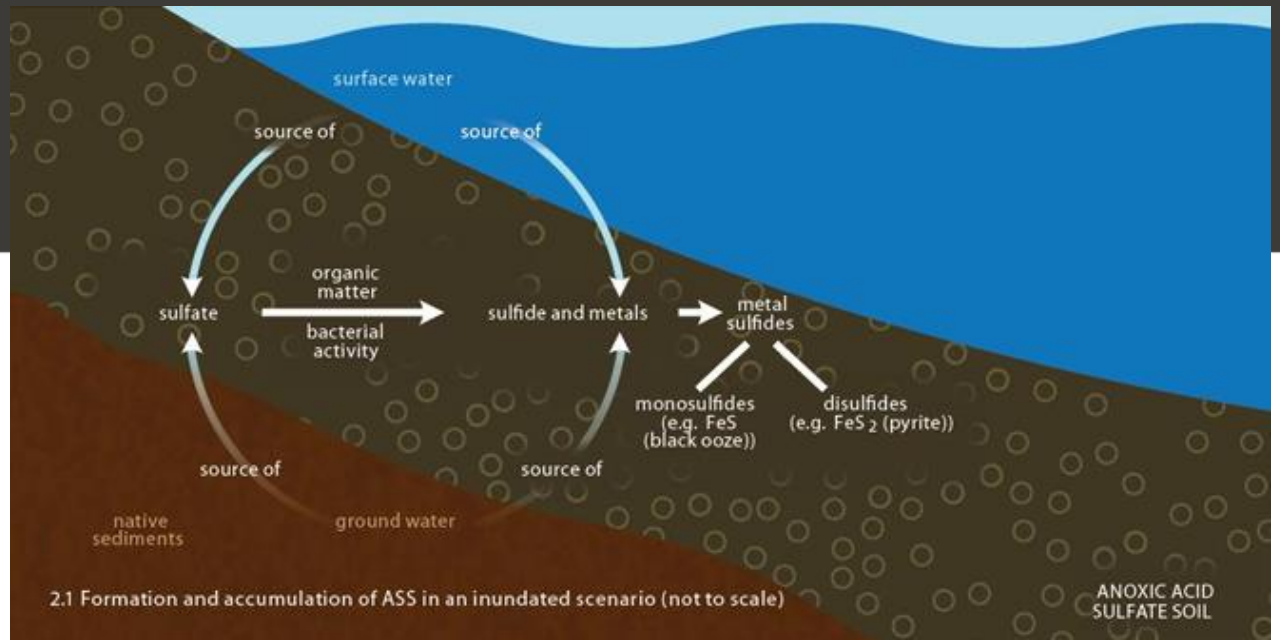
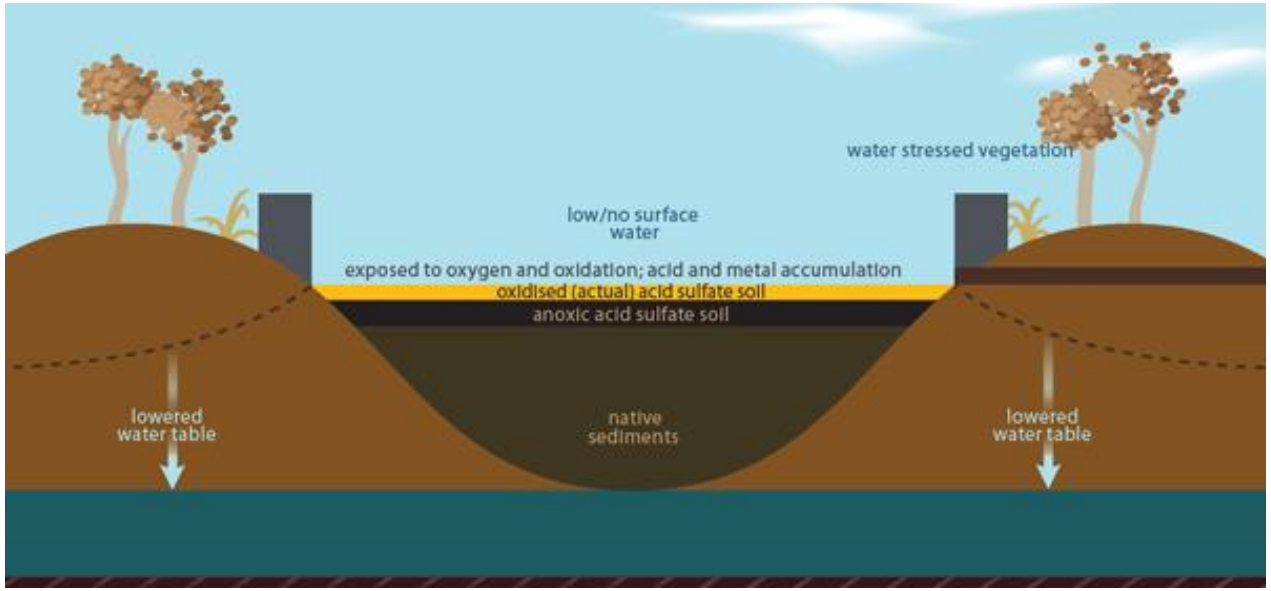
What is Acid Sulfate Soil?

- Naturally occurring contaminated soil/natural hazard.
- Typically in low lying coastal areas; estuaries, mangroves and tidal swamps.
- When these soils are exposed to oxygen, the sulphides may oxidise resulting in the production of sulfuric acid.





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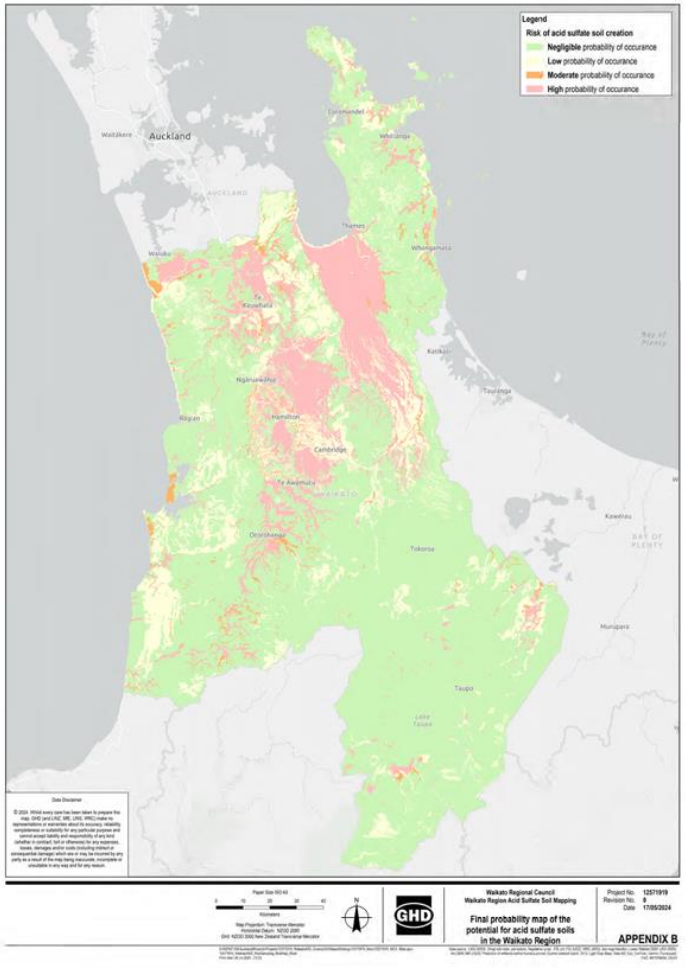
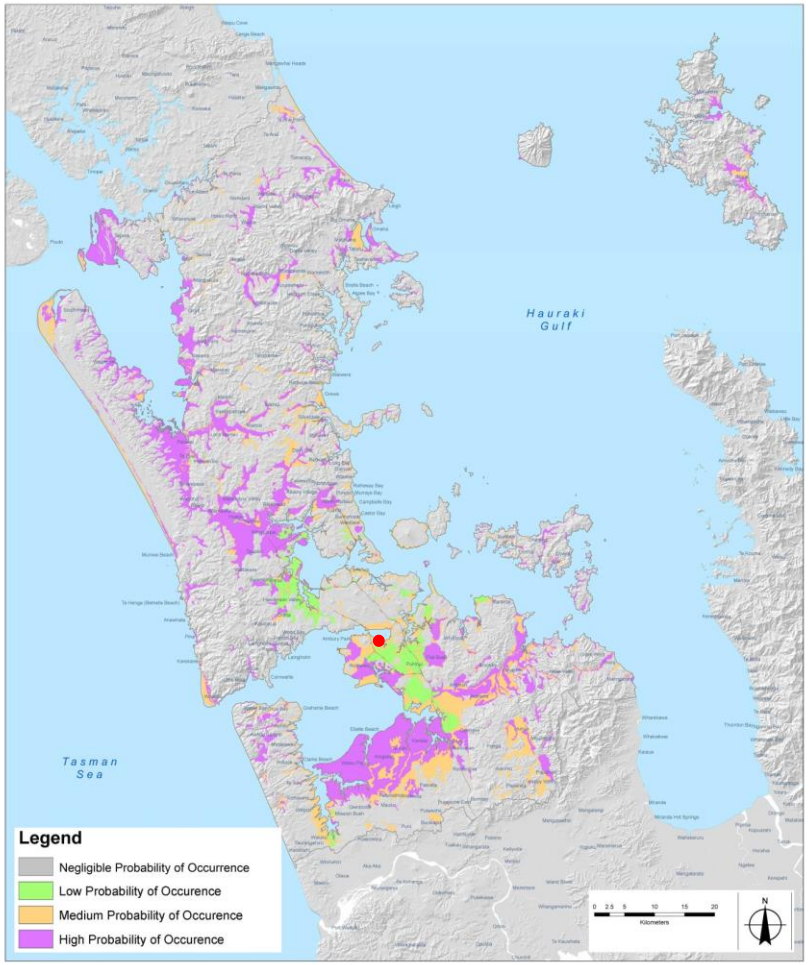
Where is it found?

- In NZ, predominantly found in low lying coastal areas of Northland, Auckland and Waikato.
- Globally they are predominantly found in coastal areas of south east Asia, Africa and Australia.





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What is the issue with Acid Sulfate Soils?

- Decrease pH for groundwater - increased acidity
- Potential influx of heavy metals into groundwater
- Corrosion of concrete and metal infrastructure.

What did we know?

01. PSI - Moderate to Low Risk

02. DSI - Potential to generate acid sulphate soils and leachate

03. Resource consent requirements for Acid Sulphate Soil Management Plan

Additional Testing

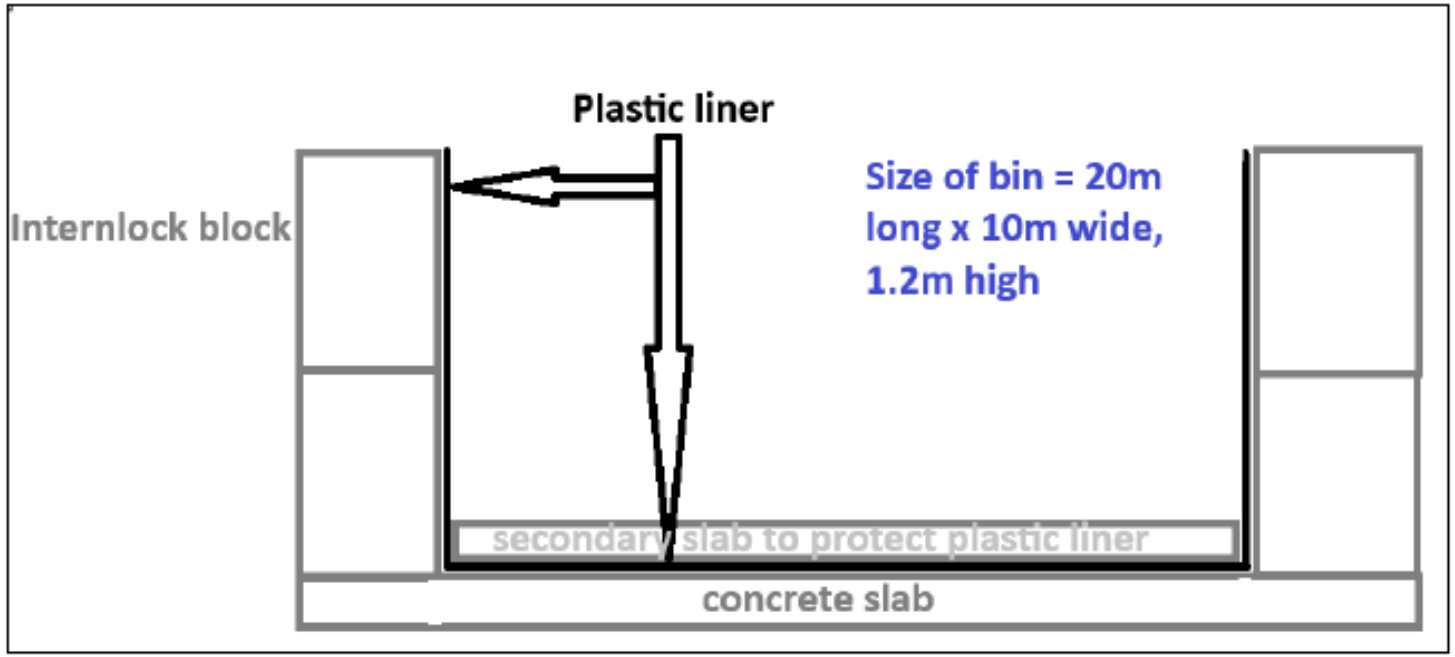
- Chromium reducible sulfur to estimate the net acidity.
- Net acidity exceeding the adopted guideline value of 0.03%S indicated presence of acid sulfate soils.

Sample location	Depth (m bgl)	Geology at sample depth	Net Acidity (%S)
MH01	2.6	Sandy SILT	0.27
MH01	5.5-6.0	Silty CLAY	<0.02
MH01	8.5-9.0	Clayey SAND	0.46
MH01	10.5-11.0	SAND	0.51
ST01	2.5	Sandy SILT	0.89
ST01	5.5-6.0	CLAY	<0.02
ST01	8.5-9.0	SAND	0.50
ST01	10.5	SAND	0.3
MH02	3.2	Silty CLAY	0.03
MH02	5.5	SILT	0.62
MH03	5.1	SILT	0.02
MH03	6.3-6.5	SILT	<0.02
RISING MAIN	3.0	Clayey SILT	<0.02
RISING MAIN	3.5	Clayey SILT	<0.02
MH04	3.8	Silty CLAY	0.54
MH04	5.0-5.5	SILT	0.45
MH07	2.5-3.0	Silty CLAY	0.04
MH07	6.0-6.5	Sandy SILT	0.69
MH10	2.2	Silty CLAY	0.13
MH10	3.5	Clayey SILT	1.33
MH10	5.5-6.0	Clayey SILT	0.72
MH12	1.8-2.0	Reworked Silty CLAY	0.07
MH12	3.5	SILT	0.17
MH13	2.6	SILT	0.05
MH13	5.5-6.0	Silty CLAY	0.06
MH15	2.0	SILT	0.13
MH15	4.0-4.5	SILT	0.16
MH17	2.0	Sandy SILT	0.18
MH17	3.5-4.0	PEAT	0.42

Notes: blue highlight indicates exceedance of the 0.03% sulfur net acidity value

How are we managing the soil?

- Soil disposal - Contaminated fill below groundwater levels and clean fill above.
- Stockpiling - concrete and plastic lined contaminant area.



How we thought we would manage the groundwater?

Our options for treating what we thought acid sulfate soil impacted groundwater would look like:

- pH treating lamella unit and discharge to SW.
- Dispose to trade waste.
- Dispose via sucker truck.

What is meant by acidified and what is meant contaminated?

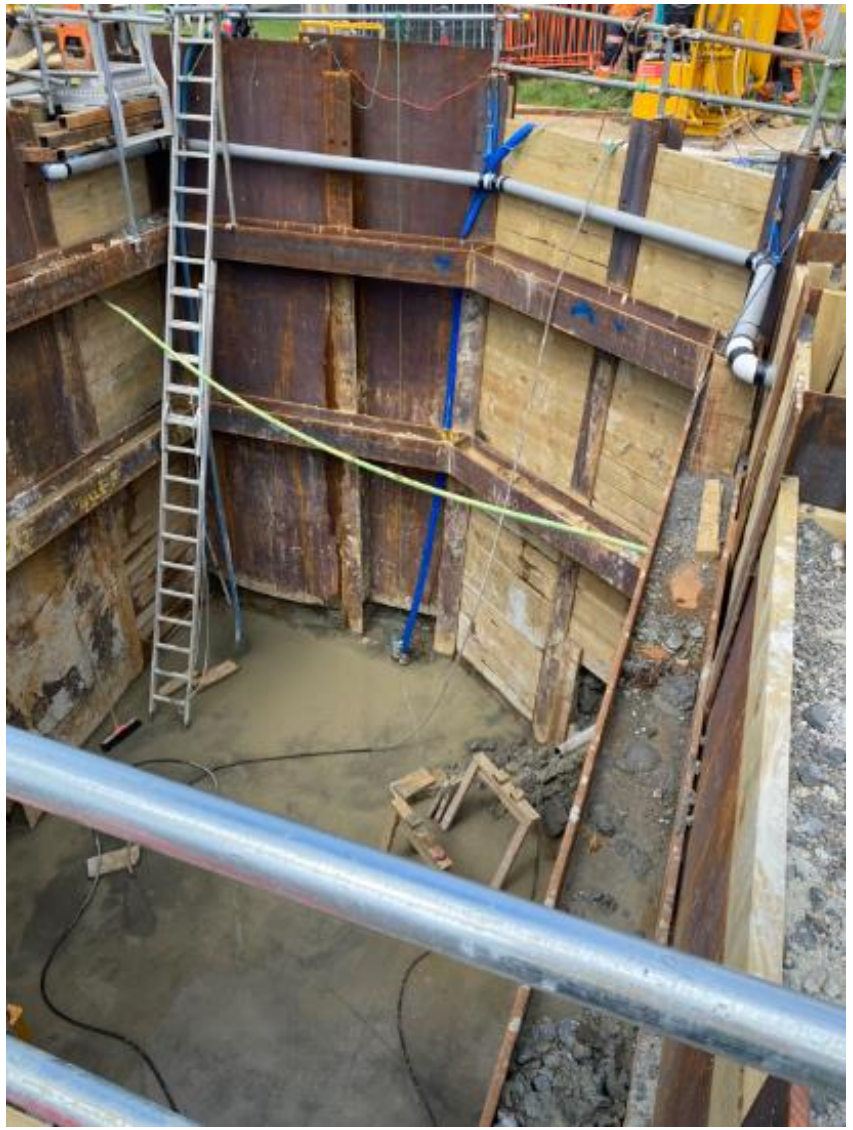
- Any groundwater collected must be disposed of appropriately. Off-site disposal could include entering into an agreement with Council to discharge collected groundwater to their existing drainage network or via a Trade Waste Agreement with Watercare.
- Where acidified or contaminated, groundwater collected in trenches may need to be treated or removed and disposed of.
- If required during heavy rain events, construct levees or barricade to divert stormwater from flowing into open excavations. Silt fences may be required to remove sediment from stormwater.

- **Condition 31:** The design of the pipeline must incorporate consideration for the potential generation of acid sulphate soils and acid soil leachate; and an acid sulphate soil management plan and dewatering plan for works across the pipeline alignment must be developed prior to the works commencing, and submitted to Council for review and certification at least 10 days prior to works commencing.

What is a dewatering plan?

How we actually are managing the groundwater?

- Completed a dewatering assessment
- Dewatering to stormwater can occur following lab analysis:
  - pH
  - Alkalinity
  - Major Ions
  - Nutrients and
  - Dissolved Metals (Al, As, Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Zn)
- ANZECC 80% protection of marine aquatic species.



Groundwater management alternatives we have considered

- Impact of PAC on compliance with ANZECC guidelines
- Utilising hay in a secondary treatment device.
- Storage of groundwater.

Key Learnings

- Engage early and ask questions up front.
- Ask for the simplified version and avoid assumptions.
- Best practice might not be practical or possible, flexibility may be required.

Ngā mihi | Thanks!

Fulton Hogan