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IN-STREAM ISOLATION METHODS: Techniques, Tips and Lessons Learned

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The Living City Foundation

Toronto and Region Conservation for The Living City

TRCA AT A GLANCE

- One of 36 CAs in Ontario
- Provincially legislated under the CA Act of 1946
- Watershed boundaries (crosses multiple municipalities)
- Largest landowner in the GTA

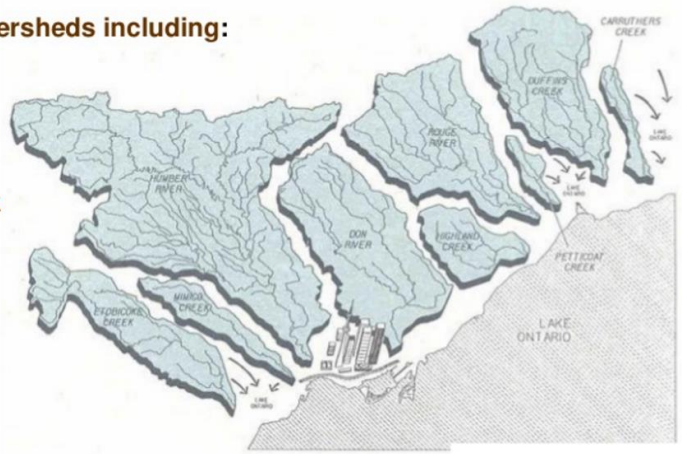
The TRCA's area of jurisdiction includes:

- **3,467 sq. km: 2,506 on land and 961 water-based.**

This area is comprised of nine watersheds including:

- Etobicoke Creek
- Mimico Creek
- Humber River
- Don River
- Highland Creek
- Rouge River
- Petticoat Creek
- Duffins Creek
- Carruthers Creek

The TRCA's jurisdiction also extends into Lake Ontario to a point defined by the Territorial Divisions Act, R.S.O. 1980



The population in 2004 within TRCA's jurisdiction is approximately 4,300,000 (37% of Ontario's population).

TRCA AT A GLANCE

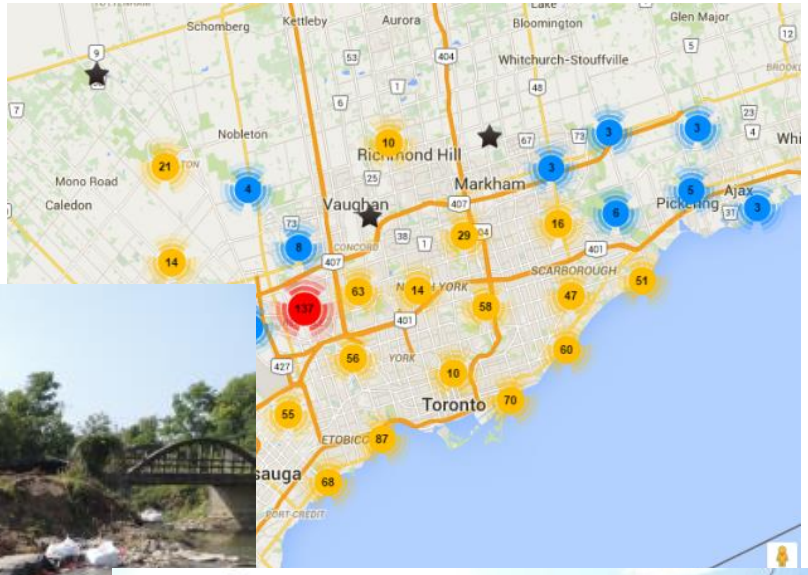
Conservation Authorities Act (1946)

- created in 1946 in response to flooding and erosion concerns

- basis for TRCA's mandate to prevent, eliminate or reduce the risk to life and property from flooding and erosion

  - ➢ Ont. Reg.166/06 (permits)
  - ➢ Programs like **Erosion Management and Habitat Restoration**

EROSION HAZARD MANAGEMENT @ TRCA



IN-STREAM ESC CONTROL PRACTICES

Necessary when:

- The work itself is located in the water:
  - to control stream erosion
  - to install new infrastructure (bridges with piers)
  - to realign a section of watercourse
  - to protect buried infrastructure (pipelines, sewers)

WHAT IS IN-STREAM ISOLATION?

- A sediment control practice in flowing water
- To isolate sediment in the work area from the rest of the watercourse

WHY IN-STREAM CONTROLS ARE REQUIRED

- Comply with legislative requirements
- Protect terrestrial and aquatic organisms from excess sediment
- Reduce turbidity and water quality concerns
- Protect of downstream infrastructure from sediment and debris accumulation

http://www.irv-software.at/kunden/sifim/images/region/ImpoundmentFig4.jpg

CURRENT RESOURCES FOR IN-STREAM CONTROL PRACTICES

- OPSS / OPSD
  - Turbidity Curtains (219.260/261)
  - Temporary bypass / Full Diversion (221.030)
- **Erosion and Sediment Control Guidelines for Urban Construction (GGHA, 2006)**
- Sustainable Technologies Evaluation Program (STEP)
- Supplier websites

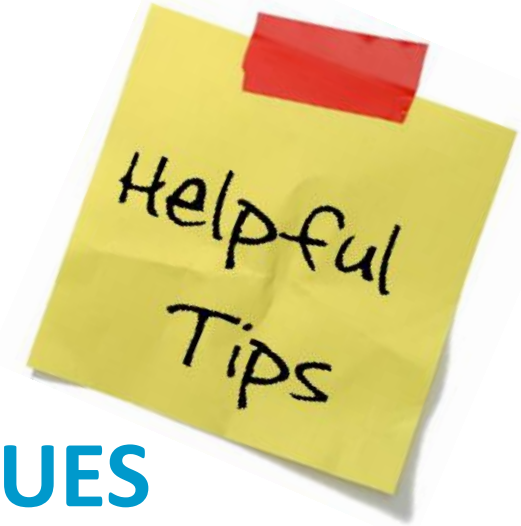
- **Application**
- **Design considerations**
- **Installation & maintenance**

WHAT THE TYPICAL DETAILS DON'T TELL YOU

There are many variables that affect performance & suitability

- Water levels
- Ice
- Debris
- Soil type
- Uneven bed surface
- Thalweg position

Choosing the wrong method can be time consuming and costly to repair and maintain



TIPS AND TECHNIQUES FOR COMMON IN-STREAM CONTROL PRACTICES

COMMON IN-STREAM CONTROL PRACTICES

- Polypropylene Bag ('Meter bag') Cofferdam
- Floating Silt / Turbidity Curtain
- Flume
- Water-filled dam
- By-pass pumping

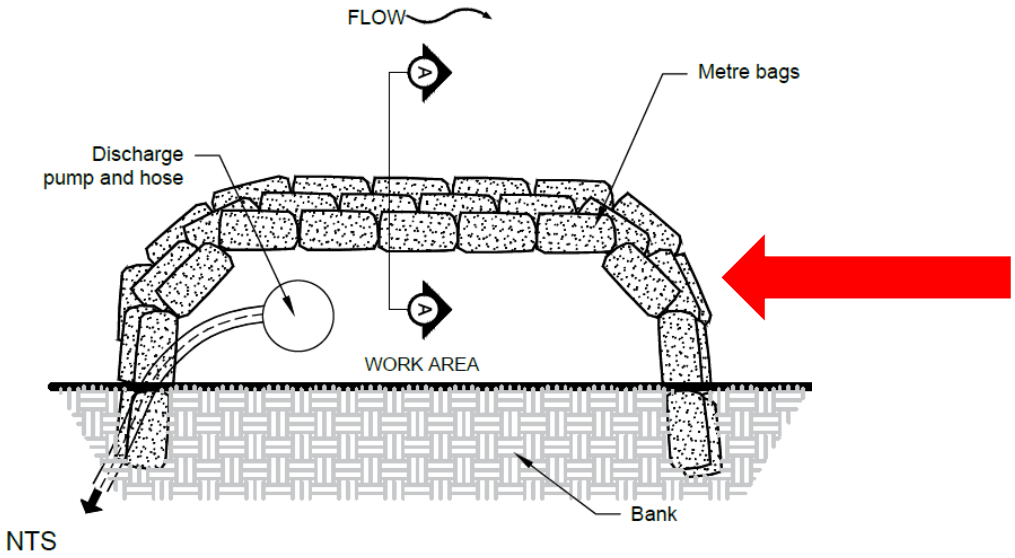
WOVEN POLYPROPYLENE BAG COFFERDAM

- Typically 36”x36”x36”
- 1 cubic metre capacity (commonly known as meter bags)
- Typically filled with pea gravel
- 4 point straps for lifting/placing

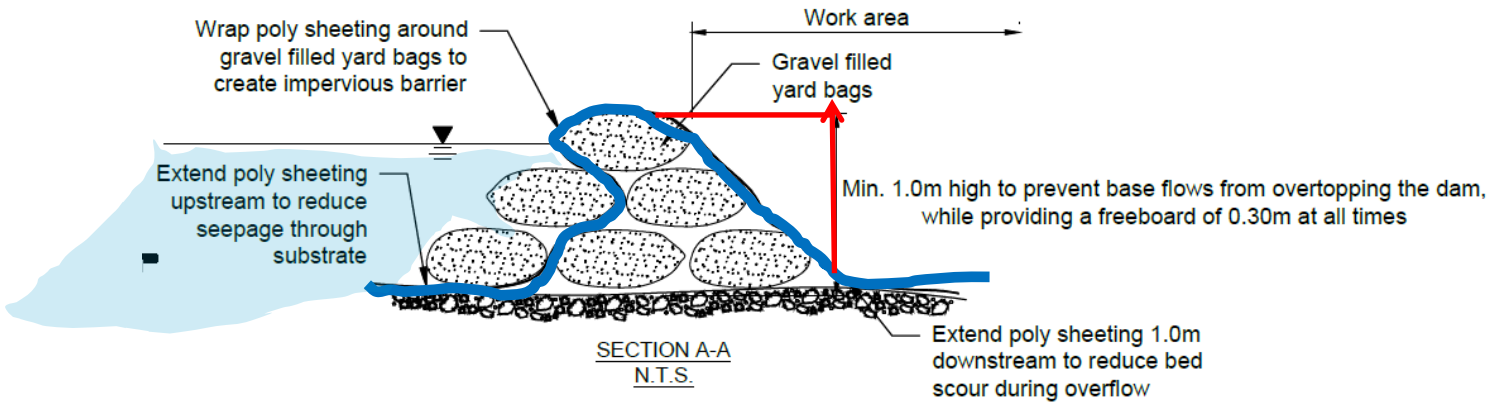
WOVEN POLYPROPYLENE BAG COFFERDAM

- Provides a structural barrier adjacent to or in the watercourse
- Constricts flow to the remainder of the channel
- Can be utilized with unwatering to provide a dry work area

WOVEN POLYPROPYLENE BAG COFFERDAM



- Used perpendicular to flow for bypassing; or
- Parallel to flow for temporary diversion



WOVEN POLYPROPYLENE BAG COFFERDAM

Pros

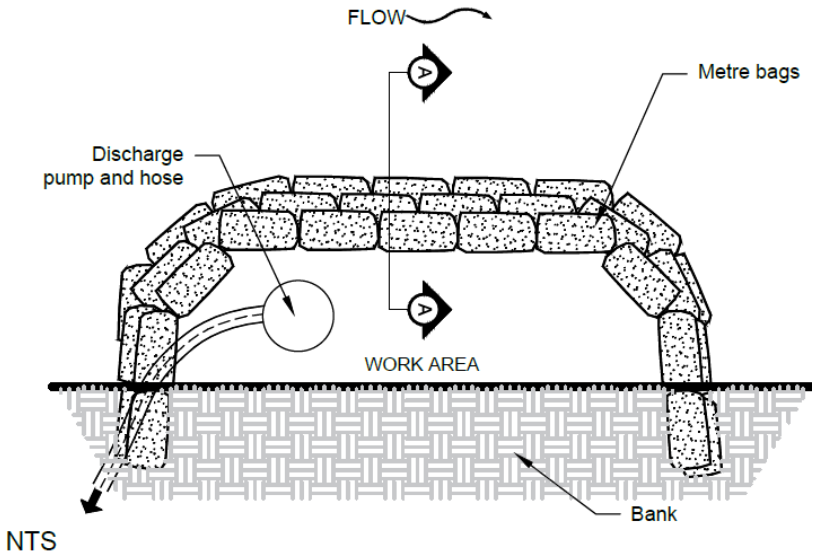
- Flexible configurations
- Reusable (typically can be moved 2-3 times*)
- Small-moderate footprint
- Good for winter construction projects
- Adjustable when floods are forecasted

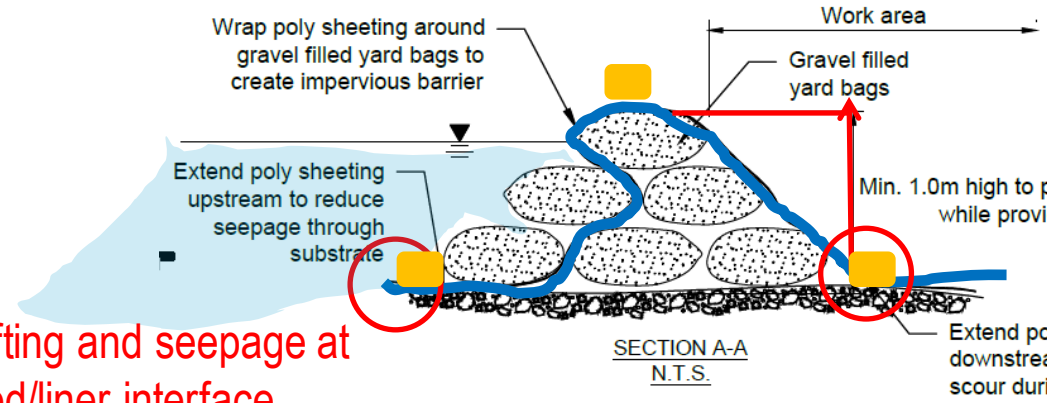
WOVEN POLYPROPYLENE BAG COFFERDAM

Cons

- Typically needs a liner for an effective seal → installation in depths > 1 bag high is challenging
- Reusability requires operator TLC
- Can have a big footprint in deep watercourses
- Eventual landfill disposal

WOVEN POLYPROPYLENE BAG COFFERDAM





Think about duration and time of year

Lifting and seepage at bed/liner interface

WOVEN POLYPROPYLENE BAG COFFERDAM

General Tips

- **Use a sling** to lift the bags
  - Directly with teeth when no staff are in the water
  - With a clevice hook if staff are in the water (for safety)
- **Don't fill the bags to capacity**
  - ~80% optimal
  - Advise your estimator!
  - Use clean pea gravel – never sand or any deleterious materials in the event of a break

WOVEN POLYPROPYLENE BAG COFFERDAM

More General Tips

- When installing perpendicular to flow (e.g. for bypassing) pump first to lower water levels and make liner installation easier
- Consider a bentonite liner and/or bentonite bags at toe of liner for gabion-lined channels and other watercourses with highly permeable beds
- Remove from d/s to u/s

WATER-FILLED DAMS

- Water filled tubes to provide a structural barrier between the work area and the receiving watercourse
- Can be installed perpendicular or parallel to flowing water

WATER-FILLED DAMS

Pros

- Very portable
- Uses on-site water to fill
- Adjustable lengths
- Work ‘in the wet’ but isolated
- Or in the dry in conjunction with pumping

WATER-FILLED DAMS

Cons

- Big footprint when inflated; problematic for small streams (parallel to flow)
- Rolling (extreme conditions)
  - Hard to re-position if it rolls
  - Not as adaptable for storm events
  - Bacterial growth
- Thermal impacts (short-term)

WATER-FILLED DAM

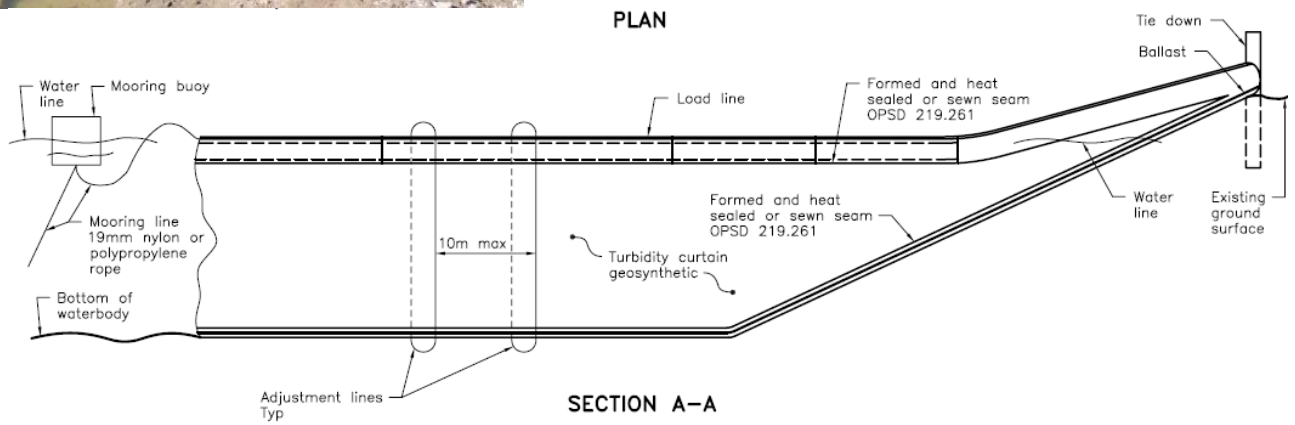
http://conceptservices.com.au/concept-partner-with-layfield-to-distribute-aqua-dam-in-australia/

General Tips

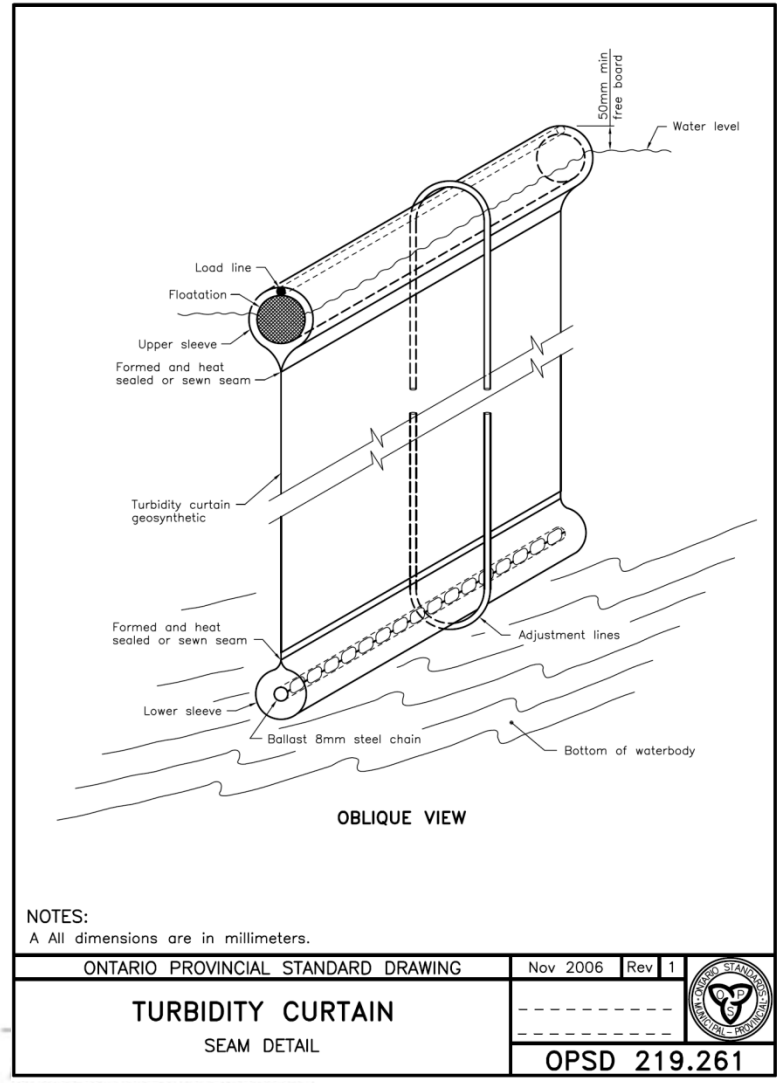
- Best for lower flow streams and lakes
- **Reinforce with meter bags** if using in higher flow systems
- **Release** captured water **slowly** or onto a splash pad
  - can cause erosion if released in an uncontrolled manner
- Consider discharging water into filter bag or in settling basin
  - temperature & bacteria

FLOATING SILT (TURBIDITY) CURTAIN

- OPSD219.260/61
- Geotextile vertically suspended in water to enclose work area
- Curtain acts as a sediment barrier to protect the rest of the watercourse from disturbance by construction activities
- **Parallel** to flow only



FLOATING SILT (TURBIDITY) CURTAIN



- Made of Woven geotextile ≤300 µm; or
- Geomembrane of low-permeability synthetic material
- Float, adjustment lines and ballast
- 50mm freeboard

FLOATING SILT (TURBIDITY) CURTAIN

Pros

- Height adapts to fluctuating water levels*
- Easy to install
- East to move and adjust as work progresses
- Small footprint
  - good for narrow streams
- For work ‘in the wet’

FLOATING SILT (TURBIDITY) CURTAIN

Cons

- Damaged easily by ice
- Vulnerable to failure on bends*
- Does not perform well in fast flowing streams
- Not for work that needs to be ‘in the dry’ (obviously)

**without additional measures in place*

FLOATING SILT / TURBIDITY CURTAIN

General Tips

- May need to **add pea gravel bags** for additional ballast
- If maintaining in colder temperatures, minimize movement and **break ice proactively**
- If located along a bend, use additional measures upstream to **deflect flow** (e.g. meter bags)
- Consider adding **T-bars and paige wire fencing** for structural support*

*Not appropriate for shale beds

FLUME

- CSP or HDPE pipe conveys flows through work area to allow work in the dry
- Can be used in conjunction with pumping to assist in conveying flow

FLUME

Pros

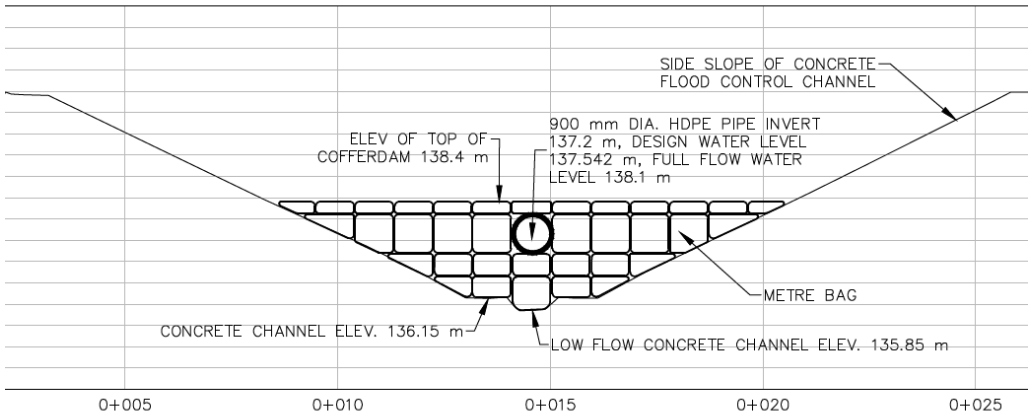
- Allows in-stream works to be constructed in the dry
- Good when construction activity spans entire watercourse
  - e.g., grade control work
- Typically more cost effective than full bypass pumping*

FLUME

Cons

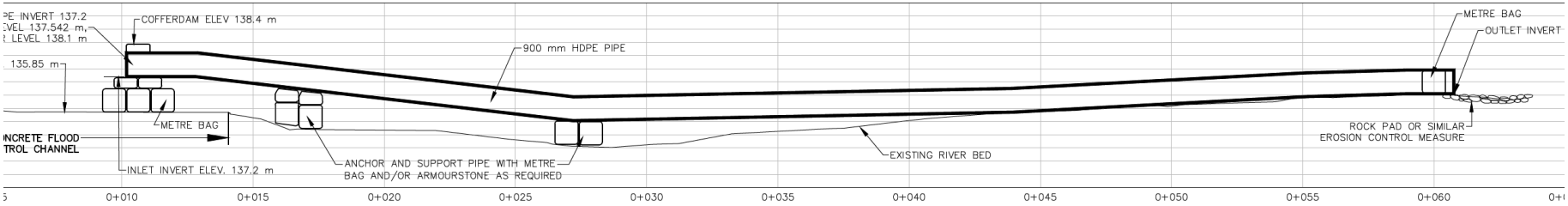
- May not be suitable for highly sensitive streams
  - Installation/removal disturbs bed
- Should be sized to convey the 2 year event
  - may be cost-prohibitive depending on flow rates
- Requires sufficient elevation change to work passively (may need pumping → additional $)

FLUME



General Tips

- May need to add supports to get required slope
- Splash pad at outlet for erosion protection
- Work should still be phased in the event of a major storm event



BY-PASS PUMPING

- Uptream and downstream limits of work area are blocked with a cofferdam
  - rock, meter bags, water-filled dam, pea gravel bags, jersey barriers, etc.
- Flows are bypassed with a pump and hose(s) or into a temporary channel to isolate the desired length of watercourse

BY-PASS PUMPING

Pros

- Allows in-stream works to be constructed in the dry
- Good when construction activity spans entire watercourse
  - e.g., grade control work

BY-PASS PUMPING

Cons

- Pumps can use ~1200 L/day in fuel
  - $7,000 - $10,000 / week (fuel only)
  - GHG emissions
- Submersible pumps clog easily in sandy streams
  - Daily maintenance
- Generator and pump system are at risk of vandalism when left running overnight
- Can be noisy
- Pump and hose requirements are frequently underestimated

BY-PASS PUMPING

General Tips

- Stabilize work area daily so pumps can be shut off overnight and allow water to flow through site
  - Easiest with meter bag cofferdams
- Supplier flow rates typically do not take fish and self-cleaning screens into account
  - Additional restriction to flow
- Trash pumps with self-cleaning screens are better for sandy bottoms
- Dig a small sump for the pump or place in pool section for best performance

BY-PASS PUMPING

General Tips

- **Clear leaf litter and debris proactively** before pumping to reduce clogging and cleaning
- For **sandy bottoms** where trash pumps are not desired; **elevate submersible pump on a skid** and strap upright
- **Consider an additional cage around** intake in streams with a lot of woody debris
- **Pay more for a self-cleaning fish screen** to save on maintenance

IN-STREAM CONTROLS – LESSONS LEARNED

REMEMBER FIRST PRINCIPLES

- **Avoid** in-stream works to the fullest extent possible – back to planning stage
- **Phase work** to minimize downstream risk in the event of failure
- **Adhere to timing windows** to reduce risk to aquatic life and habitat

STORM EVENTS ARE BECOMING MORE INTENSE

- Don't pray it *won't* rain – **plan for it to rain** and know what to do

IN-STREAM CONTROLS – LESSONS LEARNED

KNOW YOUR FLOW

- When you price your job and when you actually do the job may be very different
- **Velocity, depth and discharge** should be understood at different times of year
- Measures should be designed to withstand the **2 year event** where possible

SHORT TERM GAIN = LONG TERM PAIN (USUALLY)

- Don't choose the cheapest method to buy and install – choose the method that can perform under the site conditions
- Wrong selection = increased maintenance = $$$$


Questions?

Thank You

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