Kamloops
March 12, 2002

Pilot 2

Design and Installation of Embedded Culverts

Part 3: Construction

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6 Main Topics

1. Planning & preparation
2. Construction layout control
3. Diversion works
4. Culvert installation
5. Construction practices
6. As-built

1. Planning & Preparation

- Approvals & design in place?
- Timing of construction
  - In-stream window
  - dry period

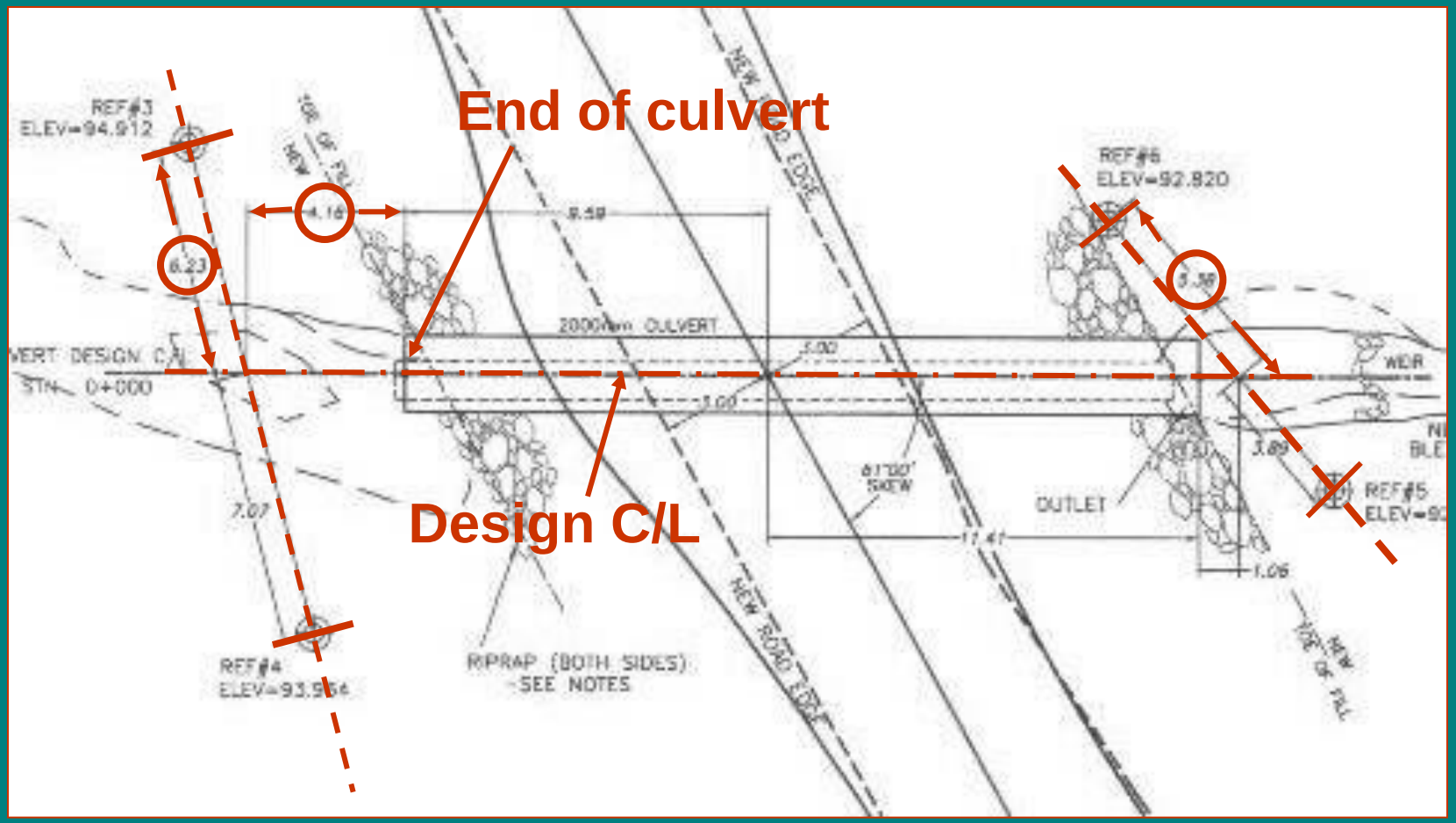
Deliver all materials and mobilize equipment in advance of when required

- Excavators
- Substrate importation equipment
- Construction survey and layout
- Manpower
- Substrate material
- Riprap
- Water pumps
- Filter fabrics

2. Construction Control Layout

- **Lay out the worksite, establishing field references for construction**

Horizontal Control



Horizontal Control

3. Diversion Works

- All work should be conducted "in the dry"

Isolate the work area from running water to work in the dry

- Bypass channel

Install diversion well in advance of excavation works

- Site will determine available options

- Gravity systems

- Pump(s)

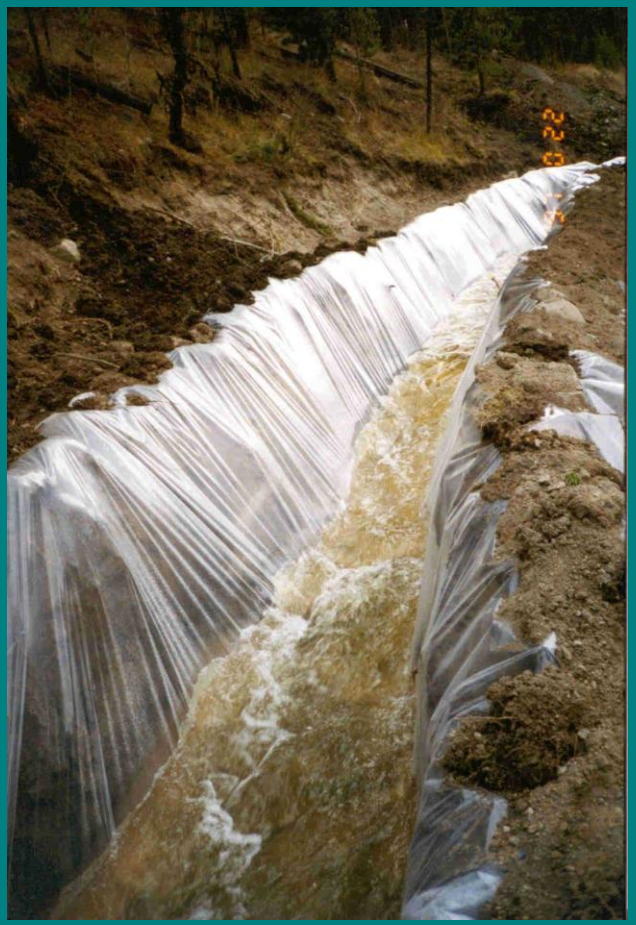
Install a Coffer Dam at the Upstream End

Alternatives for Gravity Bypasses

- Alternatives for gravity bypasses
- Plastic Pipes
- Water Sock

Open ditch

- If a lined ditch is used ensure material is rugged and capacity of ditch is adequate to carry all anticipated flow conditions



Salvage Fish from the Isolated work area

- Fish should be salvaged from isolated work zone (permit required from fishery agency)

Fish barriers

- **Install barriers to ensure fish cannot migrate into work zone**

4. Culvert Installation

- Grade control
- Bed preparation
- Backfilling & compaction
- Construction seepage control
- Substrate installation

Grade Control

- Determine design elevation and slope (as determined from profile) using construction level
- Check elevations frequently as excavation progresses

Bed preparation

- **Culvert foundation should be sound native soil or well compacted granular material**

Backfilling & Compaction

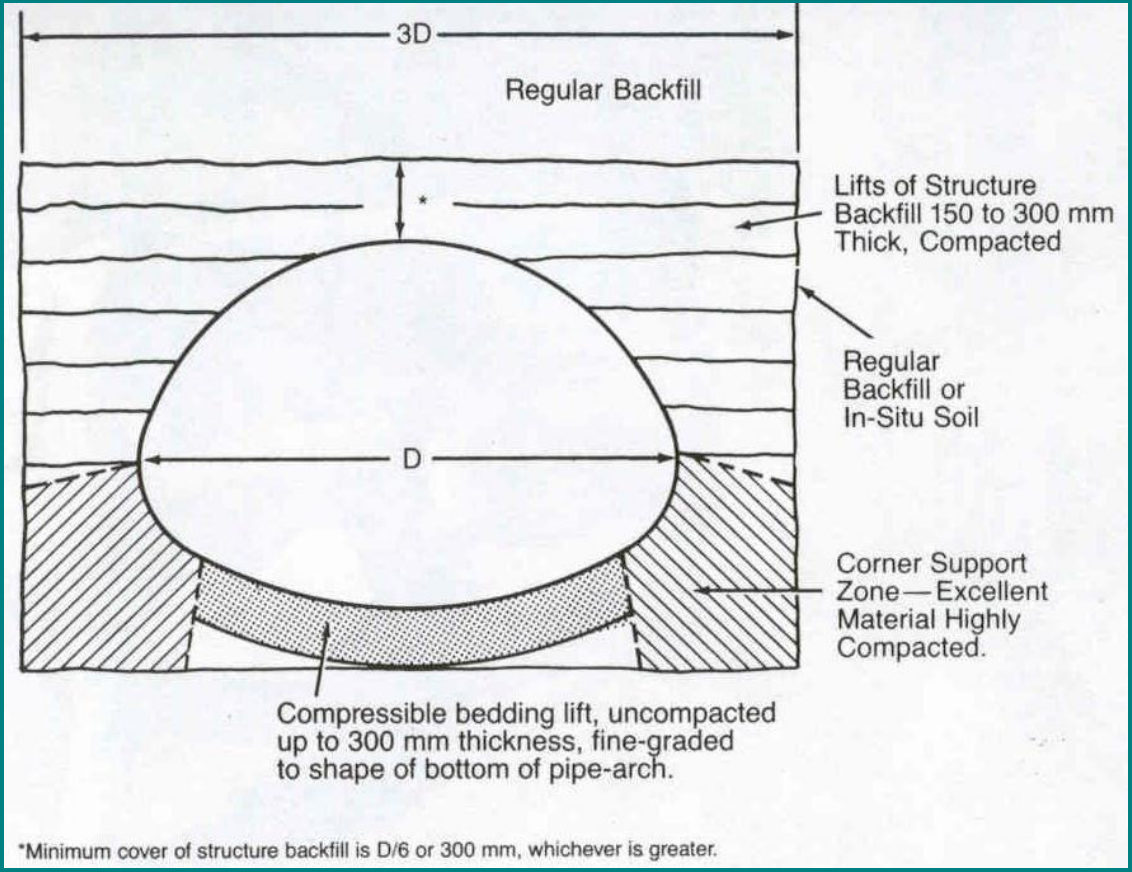
- Culvert foundation, trench walls and backfill material must be kept free of logs, stumps, limbs or rock that could damage or weaken the pipe
- Avoid entraining snow and ice

Backfilling & Compaction

- Culverts are soil steel structures

- Require soil compaction using mechanical vibratory equipment

Typical Backfill Envelope for Pipe-Arch



- **Haunch tamping**
- **Compact to springline**

Erosion Protection

- Riprap should be installed at culvert inlet and outlet as per the design
- Establish vegetation

Construction Seepage Control

Seepage is inevitable into excavation

Construction Seepage Control

•Seepage should be controlled to maintain a dry worksite

- Seepage should be filtered through the forest floor before re-entering a stream

Sump @ outlet

Substrate Installation

- **Creativity required for substrate placement**

Substrate Installation

- **Installation crew**

Substrate Installation

- Wheel barrow
- Time consuming, labour intensive, limited working room

Substrate Installation

- Use of a small excavator

- Limited working room, time consuming

Substrate Installation

- Portable conveyor belt system

Substrate Installation

- **Level line painted to guide substrate placement**

Substrate Installation

- Range of sizes required

- Remember “rule of thumb” to duplicate natural stream substrate sizes

Substrate Installation

- **Substrate material must be well mixed and contain enough fines to fill voids to keep water on the surface**

Substrate Installation

Monitor depth of fill frequently

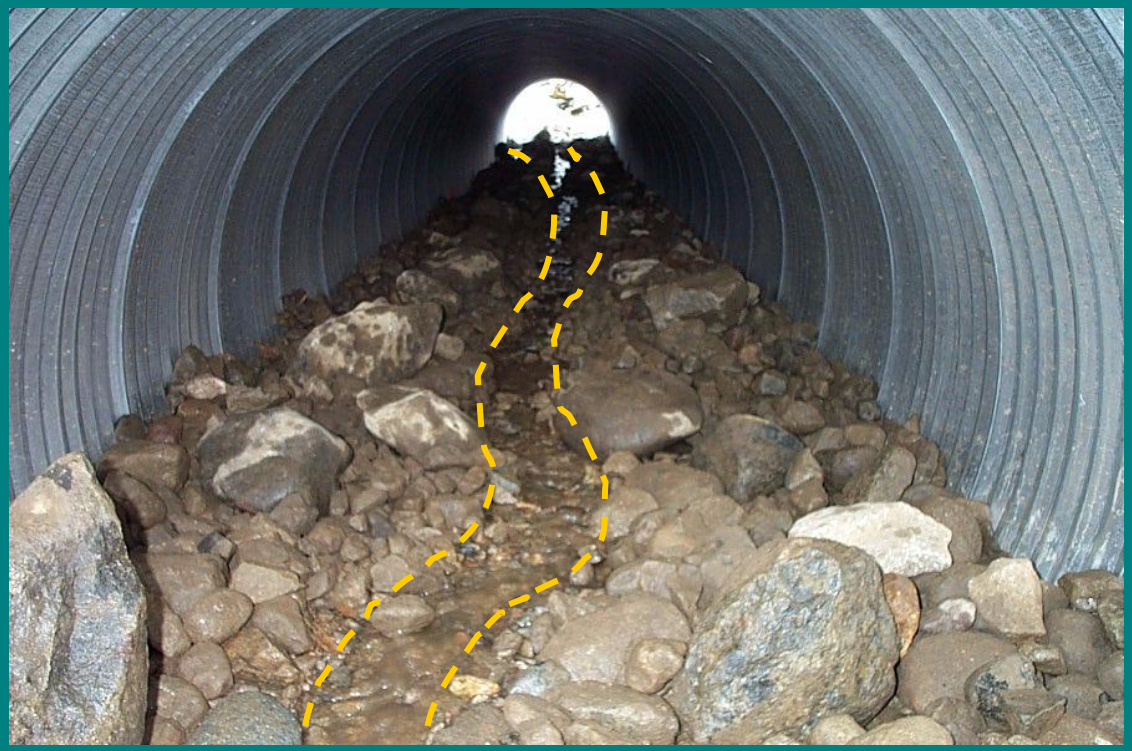
Substrate Installation

- Large rock installed for hydraulic roughness
- Large rock should project from streambed

Substrate Installation

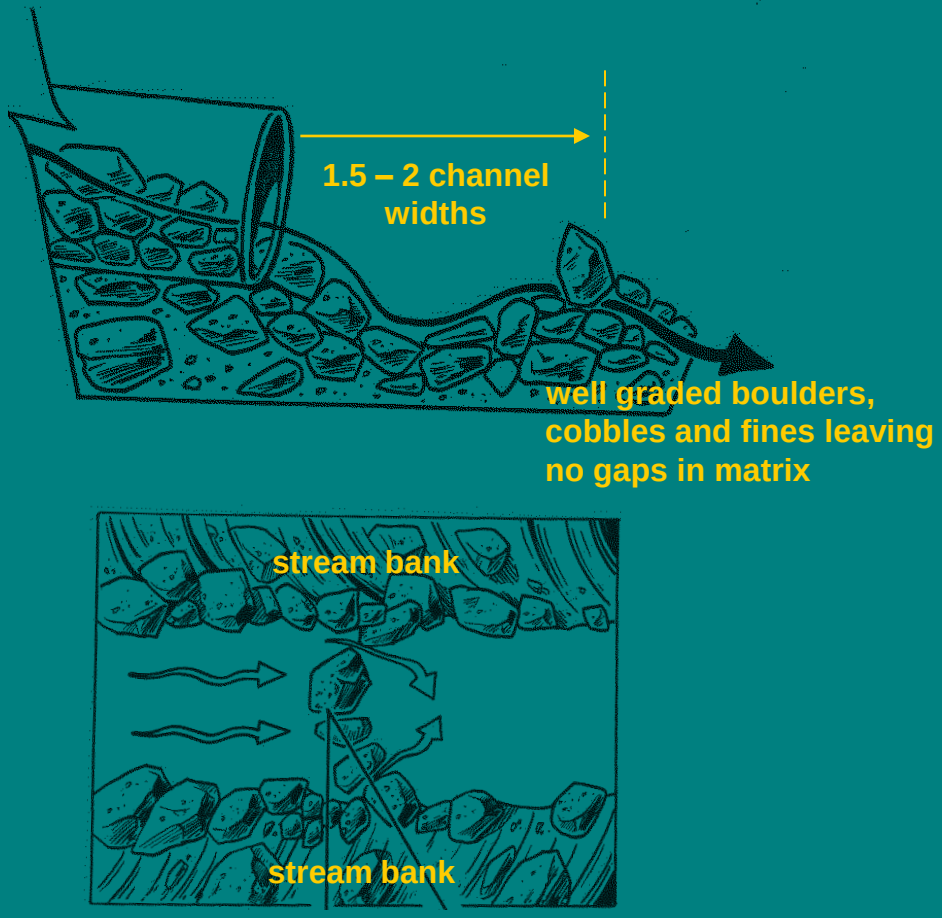
- Fines should be “washed-in” to ensure a good seal

Substrate Installation



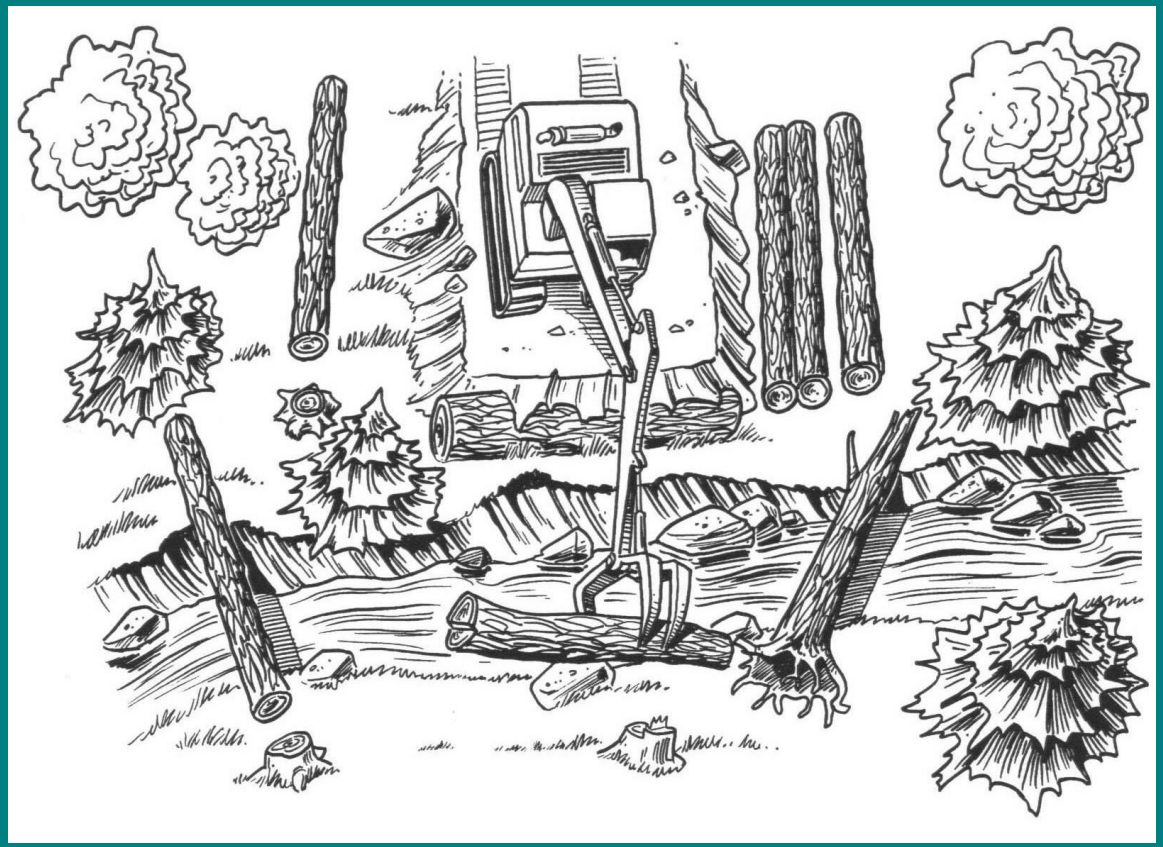
- **Fine tuning - thalweg (low flow channel) should be created within culvert substrate**

Weir Construction



- Install as per design
- Ensure gaps between boulders to allow for fish passage

5. Construction Practices

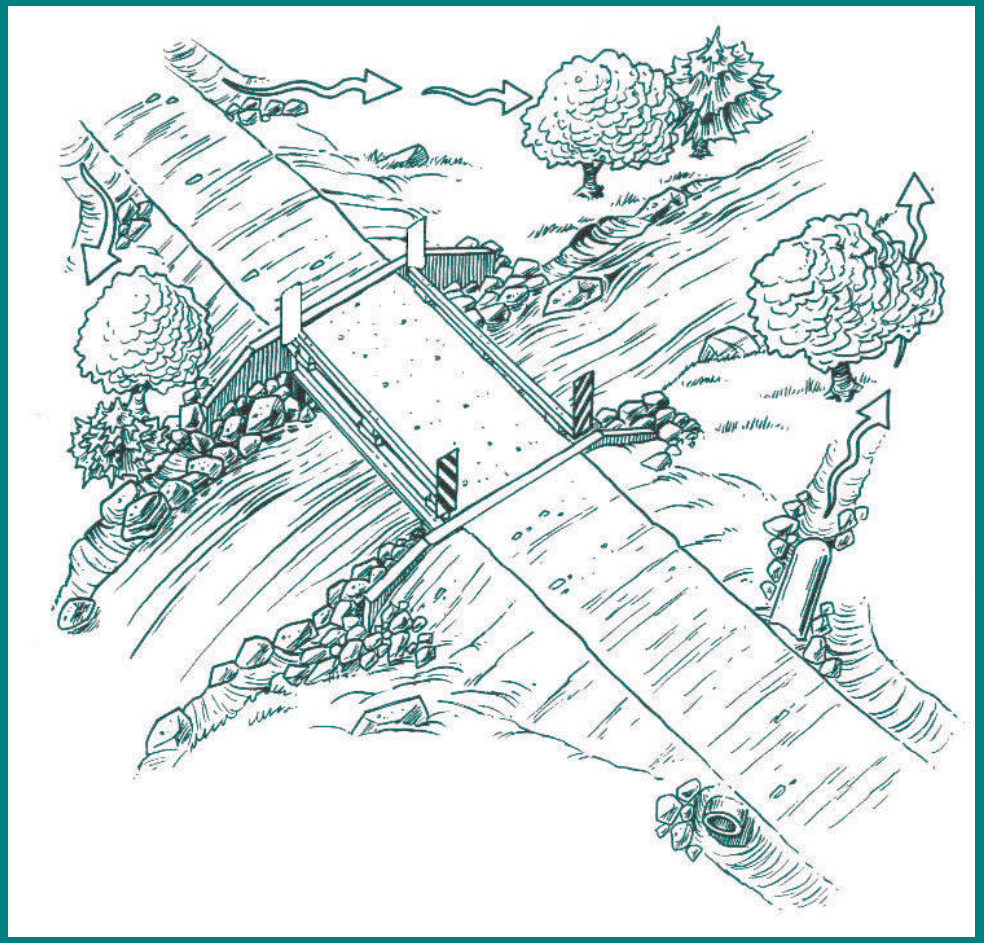


- **Use appropriate practices to minimize impacts to the stream and riparian zone**

Construction Sediment Control

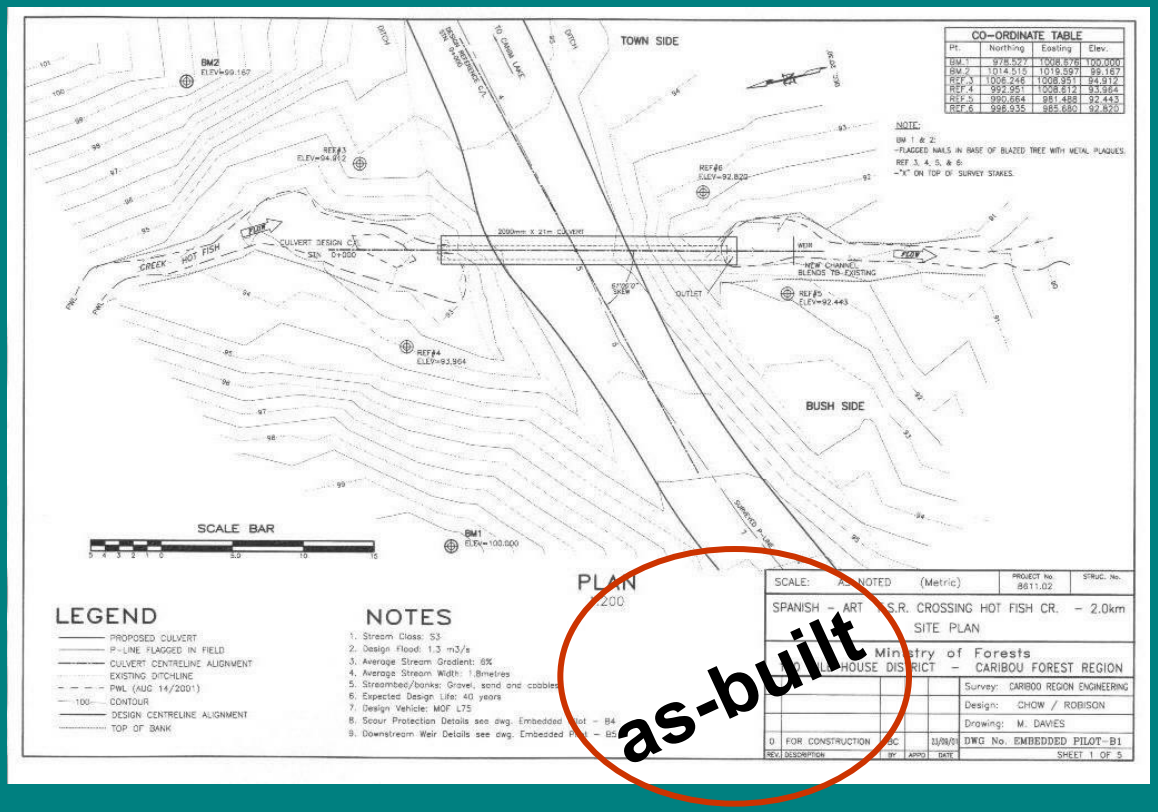
Sediment controls installed during construction

Manage drainage during construction



- **Permanent runoff/drainage controls installed during construction**

6. As-built documentation



- "As-built" drawing should be completed for installed culvert
- Document "as-built" according to design as well as record for monitoring

Summary

- All approvals and design should in place prior to commencement
- Layout construction according to design using precise instruments
- Install embedded culvert “in the dry” by diverting streamflow prior to construction
- Install embedment material according to design specs
- Have a sediment control plan in place
- Document installation with “as-builts”