Design and Installation of Embedded Culverts

Kamloops
March 12, 2002

Pilot 2

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

End of culvert

Design C/L
Horizontal Control

Location Stake
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 filtered through the forest floor before re-entering a stream
- Seepage should be controlled to maintain a dry worksite
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

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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 be 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”.