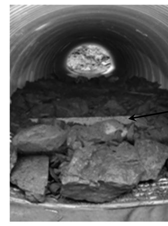
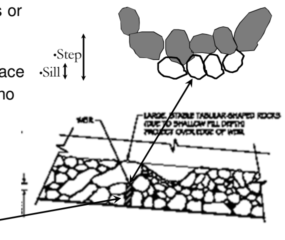
10. Final Design and Contract Preparation

Final Design and Contract Preparation Simulation Bed Details, Sediment and Pollution Controls – Section 10

Structure Appurtenances Bed Retention Sills (High Gradient Only! >6%)

- Bed retention sills are not baffles or weirs
- Anchors toe of steps
- Aids in keeping water at the surface
- Can help retrofit culverts where no other option is available





- Recommended maximum height equal to half of depth of bed or ½ of largest diameter pieces
- A bottomless arch or bridge would be a better choice.

•Pebble Count & Fuller Thompson used to develop stream sim bed mix

•Larger particles sized directly from reference channel

•Small grains derived by Fuller-Thompson curve based on D_{50}

•Fuller-Thompson

$$P = \left[\frac{d}{D_{100}}\right]^n$$

•P = percent finer

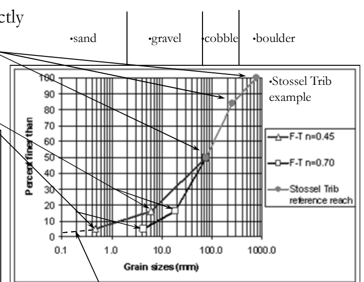
•d = diameter of particle

•n = Fuller-Thompson density; varies 0.45 to 0.70

•Simplify to:

•$D16 = 0.32^{1/n} \times D50$

•$D5 = 0.10^{1/n} \times D50$



•Verify 5% fines are included

•Now we need to turn this into a gradation specification

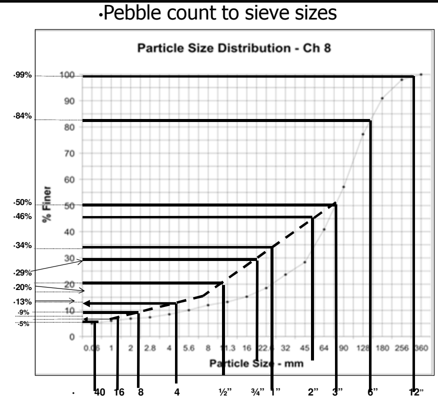
Bed material example design and spec W Fk Stossel Cr

	Reference	Design
D95	30"	30"
D84	10"	10"
D50	3"	3"
D30		1.45
D10		0.3"
D5	Sand	0.11"
Fines		5-10%
Colluvium, debris	Spanning 6-12" debris at 50' spacing	24" rock scattered at 15' oc throughout
Banklines	Bankline root structure protrudes 3' at 25' spacing	36" bankline rock at 25' spacing or continuous each bank

Developing a Gradation Table from Particle Distribution Curve

- Plot final particle distribution curve based on Mobility analysis (% increases if necessary)
- Add sieve sizes to the X axis and intersect the curve
- Draw a line that interests the Y axis (% finer and determine the percent
- Select 5 sieve sizes that describes the distribution and bracket the % finer of each sieve size by a 5% tolerance. Typically those closest to D100, D84, D50, D30, D10.

•Pebble count to sieve sizes



Gradation for Contract

Table 705-7– Project Gradation for Streambed Simulation Rock, Values are "percent finer" than sieve size

Standard Sieve (inches)		Full-Thomson adjustment For sub surface permeability	Filler Material For filling voids during construction
12"		90-100	
6"		79-89	
3"		45-55	
¾"		25-35	100%*
#40		5-10	Min 50%

Fill in % Finer Values allowing +/- 5% from the distribution curve:

*** d-16 from Pebble Count or 1 inch, whichever is smaller. But keep in mind your full gradation range. Smaller sizes require finer filler material. Coarser gradation require larger size range of fines**

Key Piece Procedure

For Banks and Immobile bedforms (steps, cascade boulders, wood forced structures, etc)

- Based on stable size from stability analysis use the D95 average cubic dimension
- Then select appropriate FRS size class

19	XS2 &XS 3 (Segment C Reference Reach). Summary of 10 largest particles for the key pieces.						
20	particle number	long axis (mm)	inter-mediate axis (mm)	short axis (mm)	average cubic dimension (mm)	long axis/inter mediate axis ratio	particle shape; roundness
21	1	850	470	200	431	1.81	tabular- to disc-shaped; subangular
22	2	850	550	470	603	1.55	tabular; subangular
23	3	600	350	250	374	1.71	tabular-shaped; subangular
24	4	750	310	90	276	2.42	disc shaped; subangular
25	5	550	430	250	390	1.28	tabular; subangular
26	6	480	310	240	329	1.55	tabular- to blocky; subangular
27	7	630	400	200	369	1.58	tabular- to disc-shaped; subangular
28	8	600	510	250	425	1.18	tabular- to disc-shaped; subangular
29	9	680	430	130	336	1.58	tabular- to disc-shaped; subangular
30	10	640	330	130	302	1.94	tabular-to disc shaped; subangular
31	average				383	1.66	
32							
33	d95 percentile (mm)	850	532	371			
34	d84 percentile (mm)	806	492	250			
35	d50 percentile (mm)	635	415	220			
36	d16 percentile (mm)	572	319	130			
37							
38	average cubic dimension of d95 percentile			552			
39	average cubic dimension of d84 percentile			463			
40	average cubic dimension of d50 percentile			387			
41	average cubic dimension of d16 percentile			287			

Table 638-1 | sed. distribution | Final Design Bed Mix (crit q) | Key piece

Bank and stable pieces Pieces

Ribs and mobile bedforms

For Ribs and more mobile bedforms

- Use a range (multiple classes) use the D84 to D50 average cubic dimension. This should bracket your ave. cubic dimension from your 10 largest pieces. Select FRS class(es)

Quality Control &/or assurance

- Stream Simulation Rock Specifications can require testing, by pebble count methods (testing subcontractor)
  - Know how to review results, make corrections, allowing a tolerance within stability objectives
- ***Standard Method of* Determining Riprap Gradation by Wolman Pebble Count** FLH Designation: T 521-08 (modified)
  - Simply a pebble count done on a stockpile like might be done on a dry gravel bar

•*If you don't measure and check you don't know!*

Stream Simulation Bed Material

Reality check on what is available

- Know your local source of materials (Forest and Commercial)
- Make sure local operations have proper grid /sieve sizes to sort material
- Some material sizes are more expensive or may be unavailable locally so plan ahead
- May need to combine material from multiply sources.

648 Stream Simulation Material Placement "Should Include"

- Work from downstream to upstream (better compaction).
- Place in one or more layers with a layer depth less than 1 ½ times Dmax but not greater than 2ft.
- Do not cause segregation and remix bed materials before placement
- Place small lift of bed material to prevent damage to the invert of metal structures.
- Place or rearrange individual rocks for banks, steps, so they have maximum contact with the adjacent pieces and minimize void space.
- Compact bed and fill all voids with fines and flood with water to wash into void space to obtain a uniformly dense, compact, low permeability mass.
- Instream structures should be uneven and nonuniform.

648 Stream Simulation Material Placement continued

- Notify the CO in advance
- Compact using machines for large structures
- Hand labor with vibratory plate compaction for small structures
  - Advised on all projects – greatly increased consolidation and decrease permeability

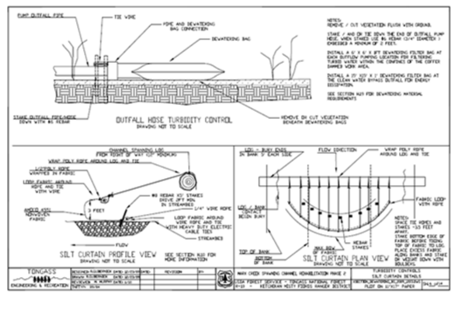
Typical Erosion, Sediment and Pollution Control Details

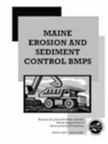
Combination of Standard & Special Specifications
Special Contract Requirements

Know what the project needs and choose to partially or fully design specific project details.

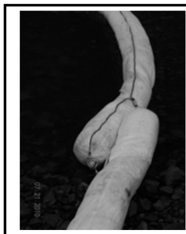
- Design critical details such as dewatering and erosion control methods using drawings and specifications: (If method designed fails we pay)
- Or critically review, modify, accept contractor plans. Require calculations for choosing diversion pipe, pumps, sump pumps, diversion ditches. (If methods fail contractor must fix the problem)

•Erosion Control Details



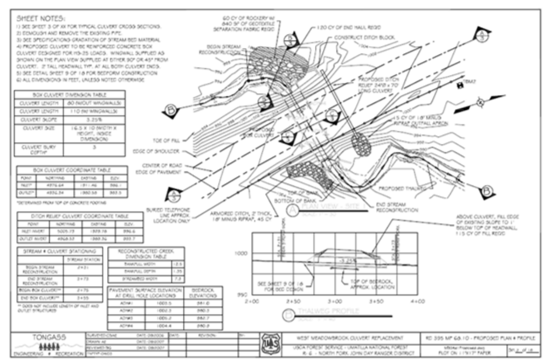


Oil Spill Prevention

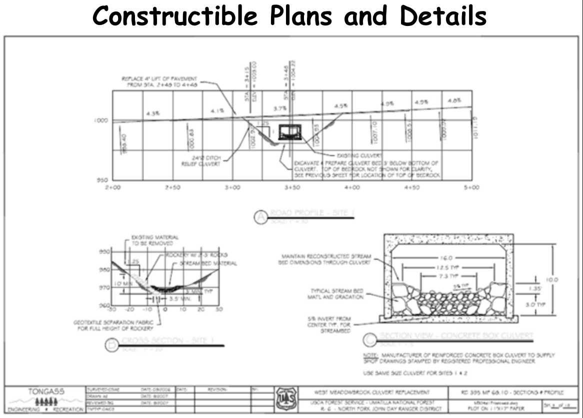


- ✓ Add the requirement of having spill prevention materials on hand adjacent to the work site.
- ✓ Sorbies & short length of oil absorbent boom to go across stream downstream of construction before work starts!

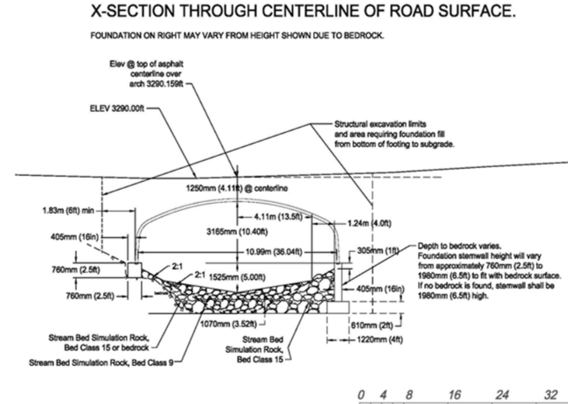
Constructible Plans and Details are Essential



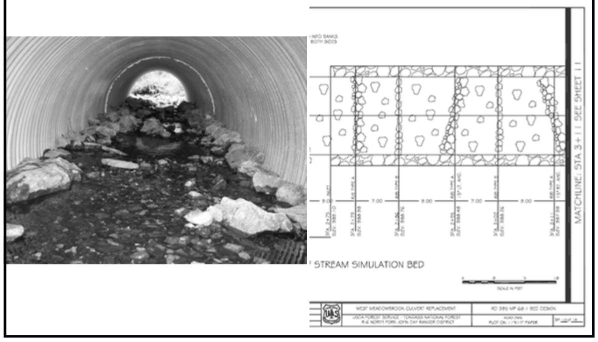
Constructible Plans and Details



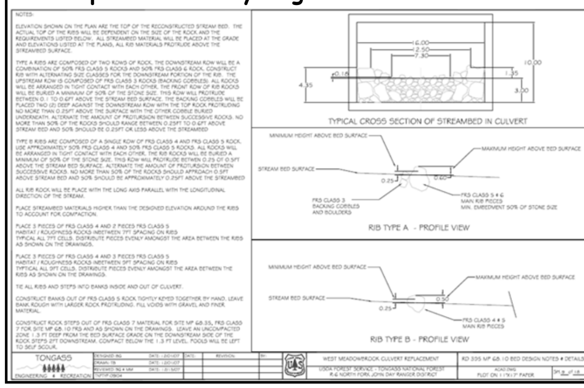
X-SECTION THROUGH CENTERLINE OF ROAD SURFACE.



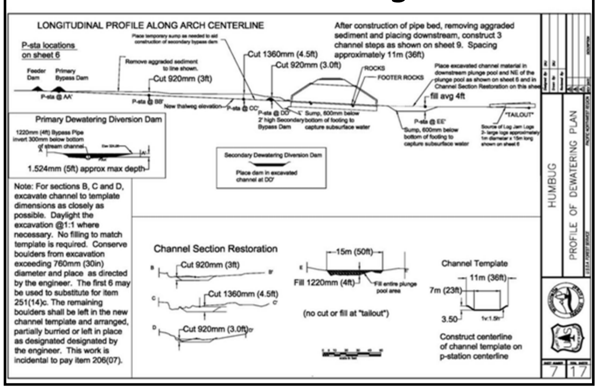
•Bed Design Details



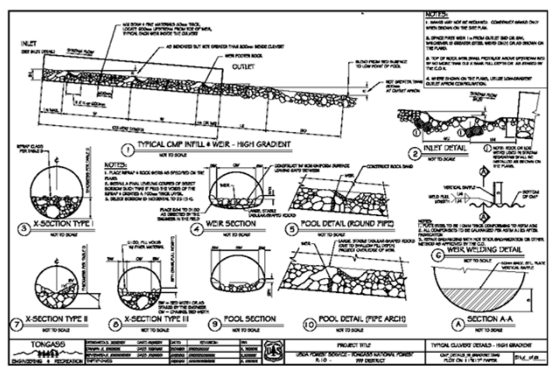
Bed Details: Include tolerances your end product is only is good as the details!

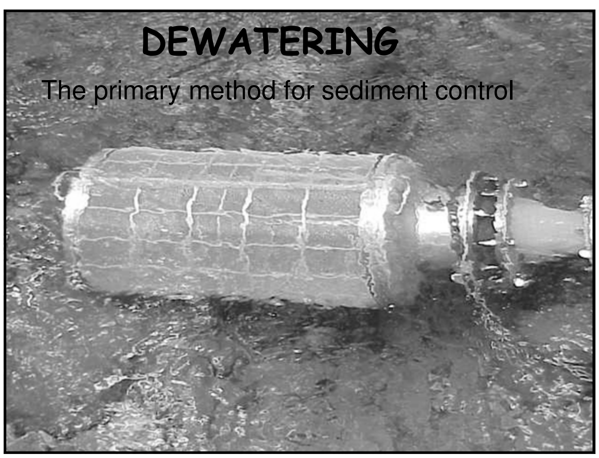


Channel Design



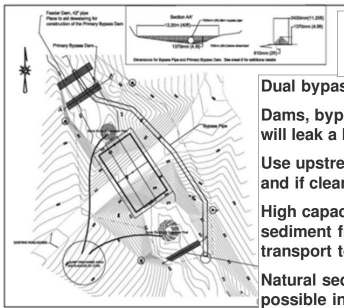
Small Embedded Pipe Details





Dewatering Design Elements

- Temporary sump – (turbid water)
  - capacity, pumps
- Diversion dam or pump (clear water)
  - flow capacity, pumping method for 24hr/7days/week, outfall energy dissipation
- Diversion pipe or channel – (clear water)
  - flow capacity, channel lining (rock or membrane)
- Removal of aquatic species
  - timing for FS biologist
- Sediment control and treament of turbid water
  - fines and treatment method , filter area / distance from stream,



GENERAL:

Dual bypass dams may trap more flow.

Dams, bypass pipes joints, and trenches will leak a little if constructed properly;

Use upstream sump to capture seepage and if clean, put back into stream.

High capacity sump below project, traps sediment from excavation area and transport to treatment area.

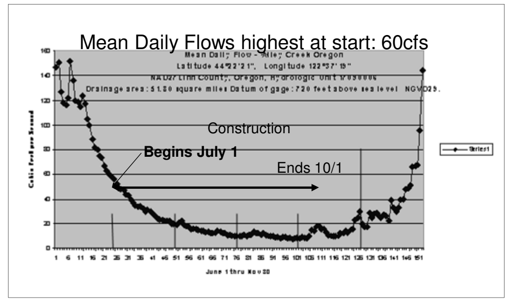
Natural sediment filtering is often possible in vegetation; may need to do more

May need a backwater prevention dam on backwatered, deep excavations.

A scour pool can frequently be used

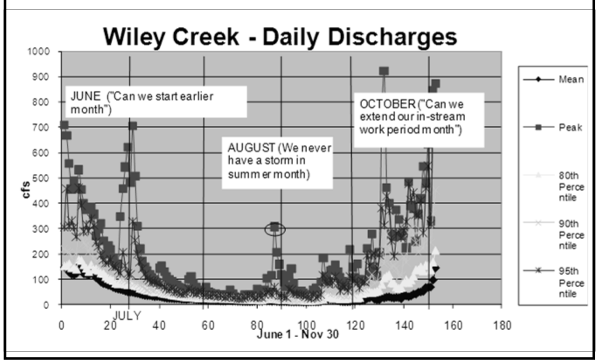
Develop your design dewatering flows

- Design and/or require Dewatering Plan from Contractor
- Specify dam height, pump size and pipe size, channel, etc



Know what kind of flows to anticipate during construction

Understand risk of the design flow and how to address dewatering if Contractor request early or late start or propose inadequate dewatering facility



What to Know and specify

- Design Dewatering flow
- It's not just pipe capacity. It's how full, debris, alignment, headwater supplied by diversion dam, actual gradient of bypass pipe, lowest point in dam, etc.
- <u>Design requires some form of hydraulic analysis</u>
- Specify pipe size (minimum of 24" diameter in small streams. 30 – 48 in larger channels
- Specify pump location and size(s), layout, dam height, channel dimensions, channel lining, filtering methods and locations, energy dissipaters, etc. consider contractors plan but don't compromise on hydraulic capacity for storms.
- If you don't know how to design dewatering facilities, get help when reviewing a contractors plan

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Include Dewatering Design for Inside the Coffer Dams. Keep the Excavation Dry

Mandatory Feature – Screen box to prevent fish, debris, and gravel from getting into the pump.

Material handling bags

Erosion Prevention and Trapping, Pollution Control

Long term stabilization

sediment trapping measures

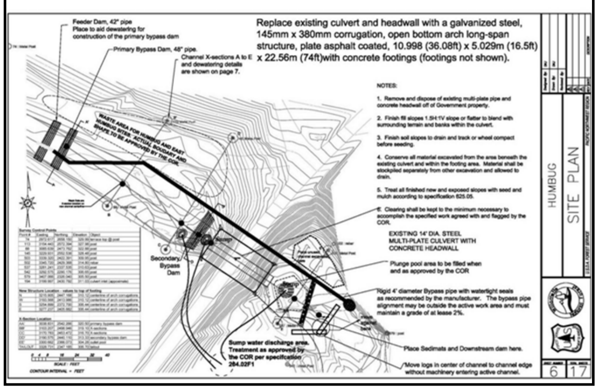
Sediment removal

Pollution containment

Erosion control during dewatering

- Pollution control under pumps and fuel stations
- Erosion of disturbed ground and slopes
- Dirt on road can create considerable turbidity during a storm
- Call for straw or Coir bales, silt fence and other erosion control materials in the contract.
- GOV Best Management Practices

Designed Dewatering Plan



Diversion Channel Design