



# **Streambed Aggregate**

**Construction/Design Conference**



# 2006 Materials Engineer Meeting

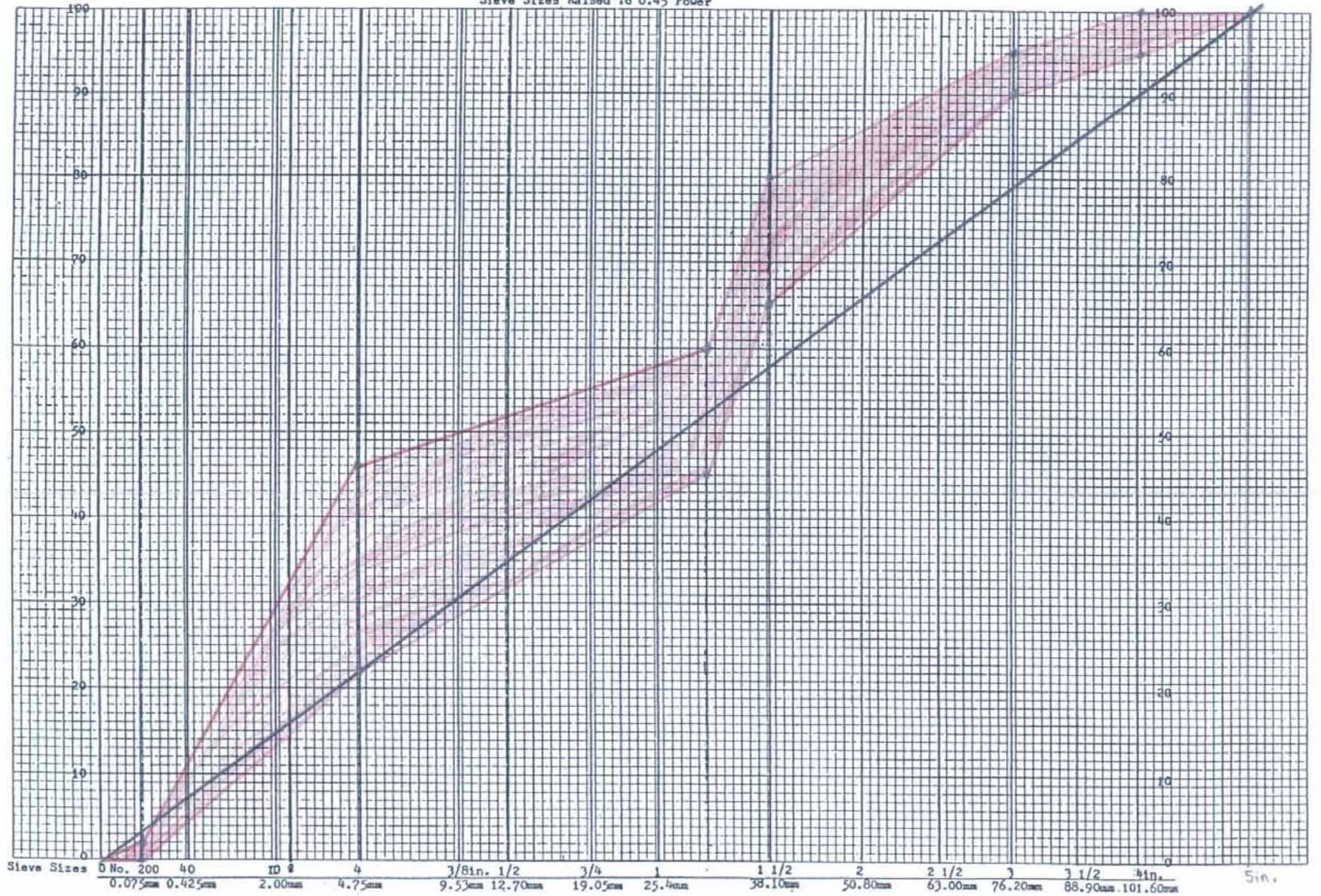
- Aggregate size identified by sieve designations
- Specified sieves differ from WSDOT standards
- Reported failure using WDFW recommendations



# Historical Research

- Reviewed current GSP and Region special provisions for streambed aggregates
- Plotted 0.45 power gradation analysis curve on aggregate structures
- Contacted HQ Hydraulics and WDFW to address statewide problems
- Team Consisted of Materials, Hydraulics, Bridge Preservation, and WDFW

GRADATION CHART  
Sieve Sizes Raised To 0.45 Power



# SWR Bowman Creek Project

- Analyzed gradation on a 0.45 power curve
- Added sand to minimize voids
  - Fines blended in the field
- Addressed larger materials separately
- Project successful

# Review of WSDOT Standards

- Analyzed 9-03.9(1) Ballast specification
- Developed modified ballast specification for streambed sediment
- Consulted with HQ Hydraulics and WDFW to determine compliance
- Changes to 9-03.9(1)
  - Requires naturally occurring aggregate
  - Removed SE requirement
  - Percent passing No. 200 changed to 5.0 - 9.0%

### 9-03.9(1) Ballast

Ballast shall consist of crushed, partially crushed, or naturally occurring granular material from approved sources manufactured in accordance with the provisions of Section 3-01. **Ballast used for streambed sediment shall consist of only naturally occurring granular material.** The material from which ballast is to be manufactured shall meet the following test requirements:

Los Angeles Wear, 500 Rev	40% max.
Degradation Factor	15 min.

Ballast shall meet the following requirements for grading and quality when placed in hauling vehicles for delivery to the roadway **project** or during manufacture and placement into a temporary stockpile. **The requirements for Sand Equivalent and Dust Ratio are not applicable for streambed sediment.** The exact point of acceptance will be determined by the Engineer.

Sieve Size	Percent Passing
2 1/2" square	100
2" square	65 - 100
1" square	50 - 85
U.S. No. 4	26 - 44
U.S. No. 40	16 max.
U.S. No. 200	9.0 max. <sup>Note 1</sup>
Dust Ratio:	2/3 max.
Sand Equivalent	35 min.

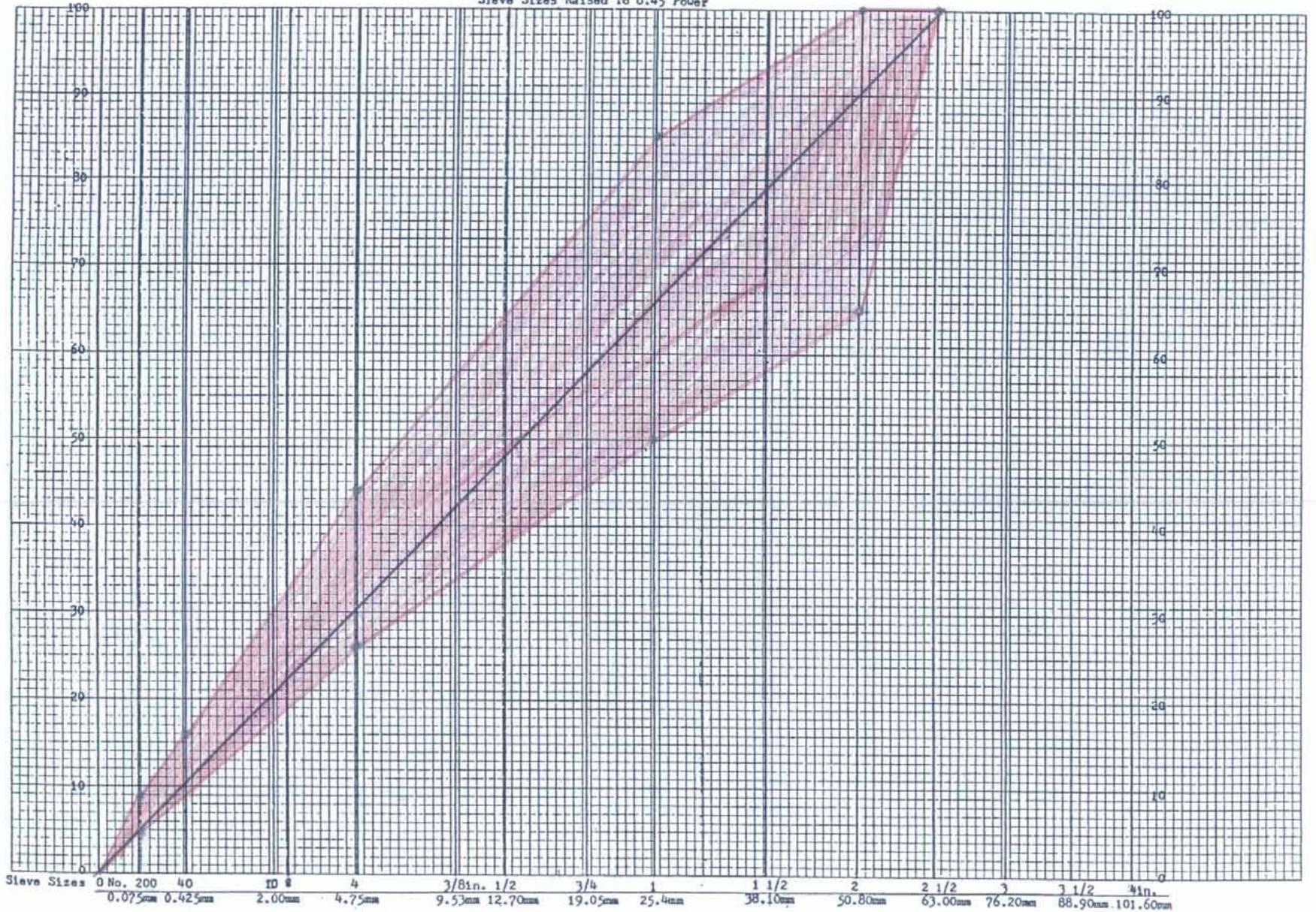
All percentages are by weight.

The portion of ballast retained on U.S. No. 4 sieve shall not contain more than 0.2 percent wood waste.

**Note 1: The requirement for the percent passing the U.S. No. 200 for streambed sediment is 5.0 to 9.0.**

# MODIFIED BALLAST 9-03.9(1)2006

GRADATION CHART  
Sieve Sizes Raised To 0.45 Power



# Wildcat Creek SR101

- Modified ballast specification initial use
- Local habitat biologist approved material and implementation
- Materials performing as intended after heavy winter rainfall
- Continue on-site monitoring during low flow conditions this summer



← Before Construction  
August 2006

Construction Phase  
August 2006 →



January 2007



# Today

- Specifications drafted for the following applications:
  - 9-03.11 Streambed Aggregates
    - 9-03.11(1) Streambed Sediment
    - 9-03.11(2) Streambed Cobbles
    - 9-03.11(3) Streambed Boulders
    - 9-03.11(4) Habitat Boulders
- Currently recommending specifications for projects
- Encouraging continued on-site monitoring

# Streambed Rock Specifications

## 9-03.11 Streambed Aggregates

Streambed Aggregates shall be naturally occurring water rounded aggregates. Aggregates from quarries, ledge rock, and talus slopes are not acceptable for these applications. Streambed aggregates shall meet the following test requirements for quality:

<b>Aggregate Property</b>	<b>Test Method</b>	<b>Requirement</b>
Degradation Factor	WSDOT T 113	15 min.
Los Angeles Wear, 500 Rev.	AASHTO T 96	50% max.
Bulk Specific Gravity	AASHTO T 85	2.55 min.

## 9-03.11(1) Streambed Sediment

Streambed sediment shall meet the following requirements for grading when placed in hauling vehicles for delivery to the project or during manufacture and placement into temporary stockpile. The exact point of acceptance will be determined by the Engineer.

<b>Sieve Size</b>	<b>Percent Passing</b>
2 1/2" square	100
2" square	65 – 100
1" square	50 – 85
U.S. No. 4	26 – 44
U.S. No. 40	16 max.
U.S. No. 200	5.0 – 9.0

All percentages are by mass.

The portion of sediment retained on U.S. No. 4 sieve shall not contain more than 0.2 percent wood waste.

### 9-03.11(2) Streambed Cobbles

Streambed cobbles shall be clean, naturally occurring water rounded gravel material. Streambed cobbles shall have uniform distribution of cobble sizes and meet one of the following requirements for grading, see contract provision for sizes specified:

Approximate Size <small>Note 1</small>	Percent Passing				
	4" Cobbles	6" Cobbles	8" Cobbles	10" Cobbles	12" Cobbles
12"					100
10"				100	
8"			100		70 max.
6"		100		70 max.	
5"			70 max.		40 max.
4"	100	70 max.		40 max.	
3"			40 max.		
2"		40 max.			
1 ½"	40 max.				
¾"	10 max.	10 max.	10 max.	10 max.	10 max.

The grading of the cobbles shall be determine by the Engineer by visual inspection of the load before it is dumped into place, or, if so ordered by the Engineer, by dumping individual loads on a flat surface and sorting and measuring the individual rocks contained in the load.

### 9-03.11(3) Habitat Boulders

Habitat enhancement boulders and turning rocks shall be hard, sound and durable material, free from seams, cracks, and other defects tending to destroy its resistance to weather. Habitat boulder sizes are approximately as follows, see contract provision for sizes specified:

<b>Rock Size</b>	<b>Approximate Size</b> <sup>Note 1</sup>
One Man	12" - 18"
Two Man	18" - 28"
Three Man	28" - 36"
Four Man	36" - 48"
Five Man	48" - 54"
Six Man	54" - 60"

Note 1: Habitat enhancement boulders and turning rocks can be measure by taking the average dimension of the three axes of the rock; length, width, and thickness by use of the following calculation:

$$\frac{\text{Length} + \text{Width} + \text{Thickness}}{3} = \text{Approximate Size}$$

# Hydraulics Application Concerns

- Design
  - Maintain at least a 12” of sediment below cobble mix
  - Cobble mix lift should be about 3 times the largest aggregate size
  - Natural streambed takes precedence
- When contract specifies use of habitat boulders/turning rocks, contact Hydraulics Engineer for placement

# Questions or Comments

