

Gravel 101

How we decide how much coarse sediment to place in the river and when to place it.

2000

The Trinity River Flow Evaluation Final Report and the Record of Decision:

The flow study suggested an immediate infusion of gravel totaling 16,000 yards was needed immediately below the dam and in the cableway reach. In addition, ranges of augmentation quantities to be added to the river over the long term were specified for each water year type.

Table 1		Low End	High End	Mid-point
	Probability	CY	CY	CY
ExWet	0.12	31,000	67,000	49,000
Wet	0.28	10,000	18,000	14,000
Normal	0.2	1,800	2,200	2,000
Dry	0.28	150	250	200
ExDry	0.12	0	0	0
Weighted Average				
	CY	6,922	13,590	10,256
	Tons	10,383	20,385	15,384

Table 1 lists:

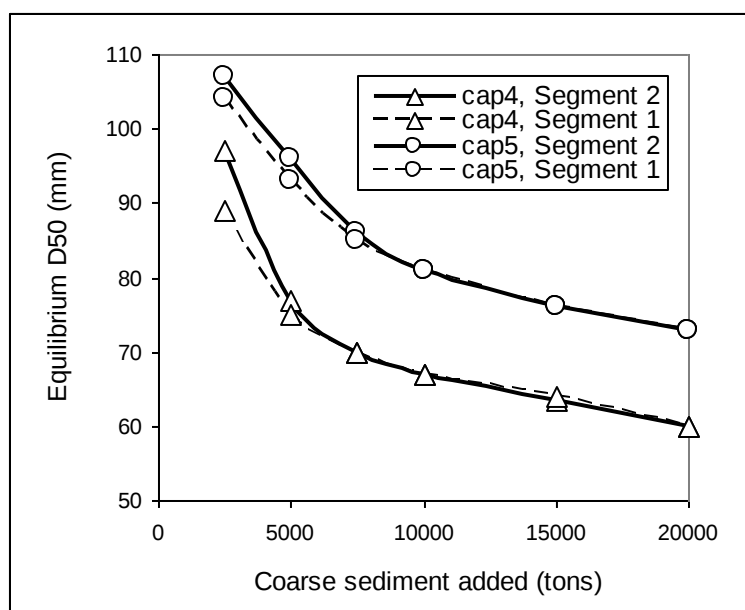
- The low and high ends of the flow study ranges, and the mid-point of those ranges.
- Weighted long term average augmentation rates are based on the probability of occurrence for each water year type.
- Long-term average figures are given in both cubic yards (CY) and in English tons.

2008

The report Gaeuman, D. 2008. *Recommended quantities and gradations for long-term coarse sediment augmentation downstream from Lewiston Dam*. TRRP Technical Monograph TM-TRRP-2008-2.

used the iSurf sediment transport model to predict how gravel additions of various size gradations and quantities would affect the surface grain size of the stream bed. It was assumed that a reduction in surface grain size would:

- Promote bed mobility and fluvial dynamics because finer bed material is more easily entrained by flows.
- Increase spawning habitat availability.



The analysis suggests that the benefit realized by additional augmentation quantities is relatively small for annual average augmentation quantities greater than 8,000 to 10,000 tons per year. A maximum long-term augmentation rate of about 10,000 tons (6,670 cubic yards) per year was determined by the range of weighted long term averages (Table 1) of flows recommended in the flow study. This rate was:

- Less than half of the high end recommended in the flow study.
- Similar to the low end of the range of weighted long term averages recommended in the flow study.
- About 65% of the middle of the ranges recommended in the flow study.

This recommendation took a different approach to gravel augmentation than the flow study, in that an average rate was recommended rather than water-year specific rates. This is because addition of very large quantities of gravel in wet or extremely wet years is logistically difficult.

2011

A journal article described numerical modeling and independent researchers corroborated the results of the 2008 analysis:

Viparelli, E., D. Gaeuman, P.R. Wilcock, and G. Parker, 2011. A model to predict the evolution of a gravel bed river under an imposed cyclic hydrograph and its application to the Trinity River. *Water Resour. Res.* 47, W02533, doi:10.1029/2010WR009164.

A 2010 sediment budget report suggests that long-term deficit has been reduced to near zero, except for immediately below the dam. A surplus of gravel relative to pre-dam conditions may exist in the Douglas City area downstream from Indian Creek.

Gaeuman, D. 2011. *2010 Bed-material sediment budget update, Trinity River, Lewiston Dam to Douglas City, California*. TRRP Technical Report TR-TRRP-2011-2.

Performance Measures

Recent (2005-2011) coarse sediment augmentation rates have been in excess of the recommended annual rate of 10,000 tons or 6670 yards per year that includes both construction of rehabilitation sites and gravel injection. Since 2005, the program has been adding coarse sediment at an average rate of 7,830 yards (11,750 tons) per year that includes augmentation at construction sites and gravel injection.

Placement of Gravel by Year

Fiscal Year	Gravel Augmentation Location	Gravel (CY)	Total per Year (CY)
2003	Cableway	2,000	2,000
2006	Hatchery	1,600	1,600
2007	Hatchery	4,300	4,300
2008	High Flow Injections	2,300	12,300
	Lewiston-Dark Gulch	10,000	
2009	High Flow Injections	2,300	8,000
	Sawmill	5,700	
2010	High Flow Injections	3,100	13,500
	Lowden Ranch Area and Reading Creek	10,400	
2011	High Flow Injections	5,300	5,300
Total =			47,000

2012

Criteria for when gravel will or will not be added at particular locations were proposed:

1. For high-flow injections at pool locations (e.g., Sawmill and the Diversion Pool), previously injected gravel has cleared from the pool so that pool dimensions and the habitat value of the pool are restored to near their initial conditions.
2. For low-flow placement at riffle locations (e.g., Hatchery), the constructed riffles have degraded and can be rebuilt.
3. For all augmentation locations, the added gravel has not begun to fill downstream adult holding pools or steelhead runs.
4. For all augmentation locations, the added gravel has not caused an increase in the local flood stage associated with the maximum fishery flow.

These criteria are assessed on the basis of annual bathymetric surveys that quantify changes in bed elevations, and on gravel transport measurements collected at 4 locations along the river. The bathymetric data shows if and when the stream bed at the augmentation location has returned to its initial elevation, and quantifies the extent and locations of downstream deposition.

Links to relevant document at www.trrp.net

The Trinity River Flow Evaluation Final Report

<http://odp.trrp.net/Data/Documents/Details.aspx?document=226>

Trinity River Record of Decision

<http://odp.trrp.net/Data/Documents/Details.aspx?document=227>

Gaeuman, D. 2008. *Recommended quantities and gradations for long-term coarse sediment augmentation downstream from Lewiston Dam*. TRRP Technical Monograph TM-TRRP-2008-2.

<http://odp.trrp.net/Data/Documents/Details.aspx?document=346>