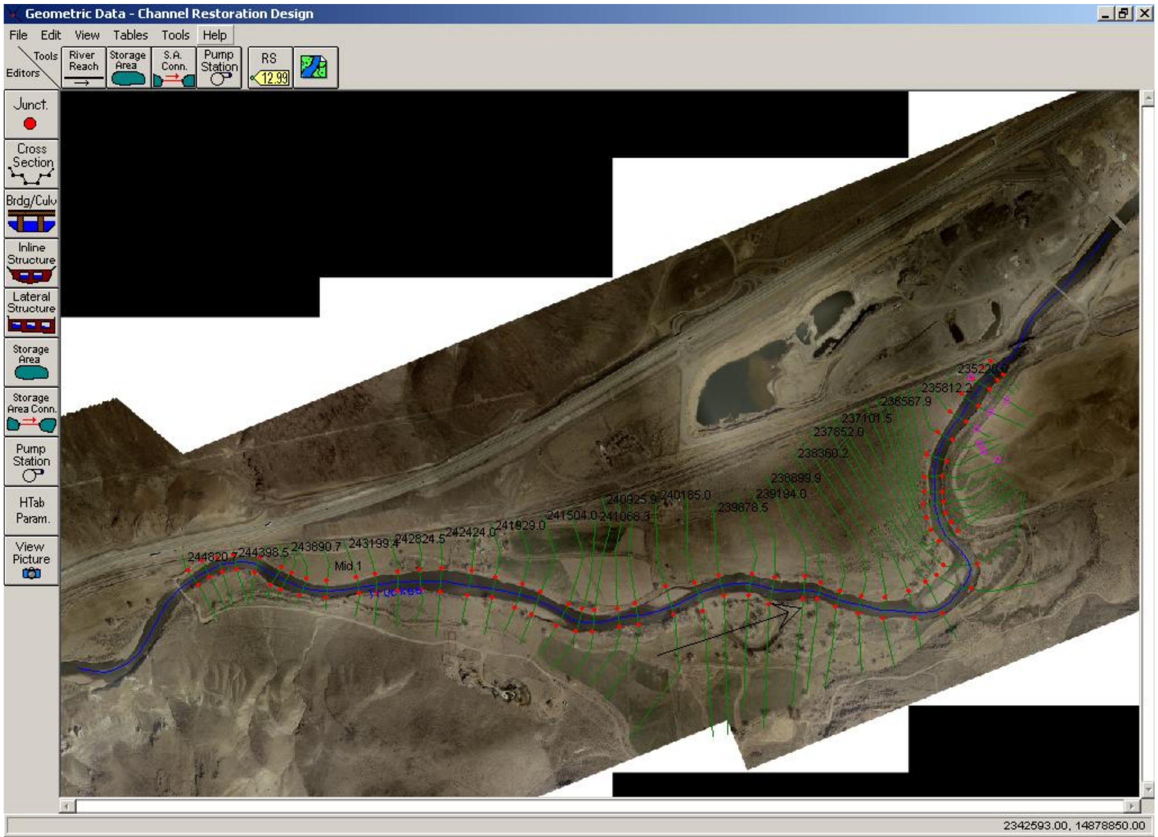
HEC-RAS Workshop: Application of Hydraulic Principles for Stream Restoration: Solution

<u>The models in this workshop have been modified and the alternative arbitrarily designed for the purposes of instruction. These models should not be used for actual investigations.**</u>**

1. Analysis of Existing Conditions

A. Open and View Project

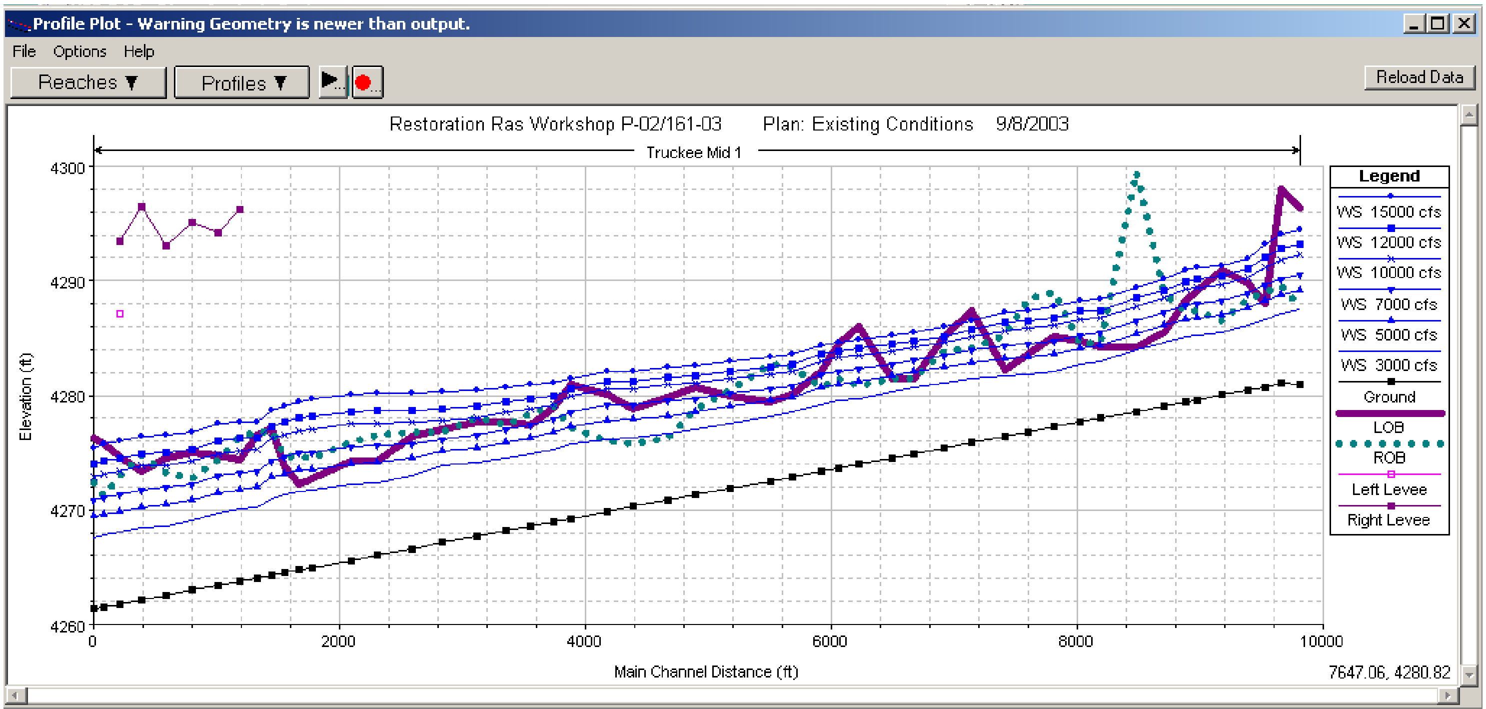
View Geometry Schematic

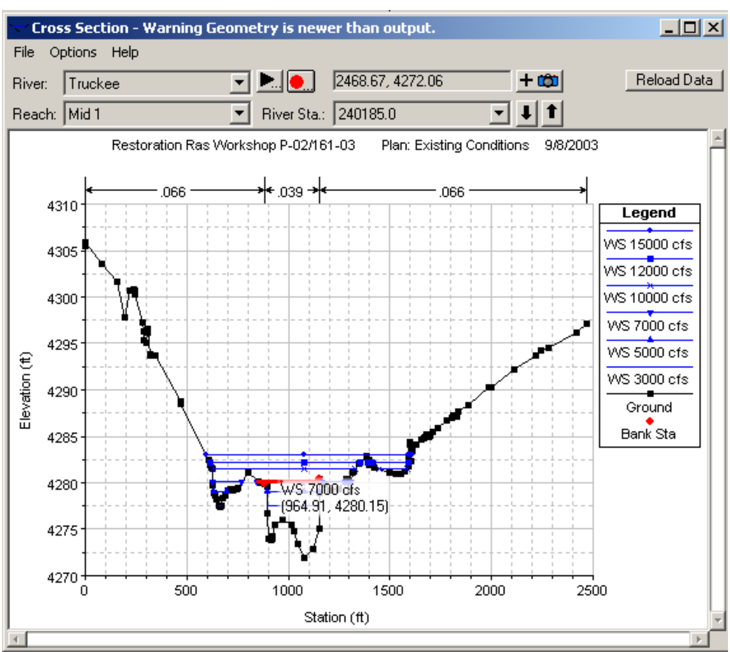


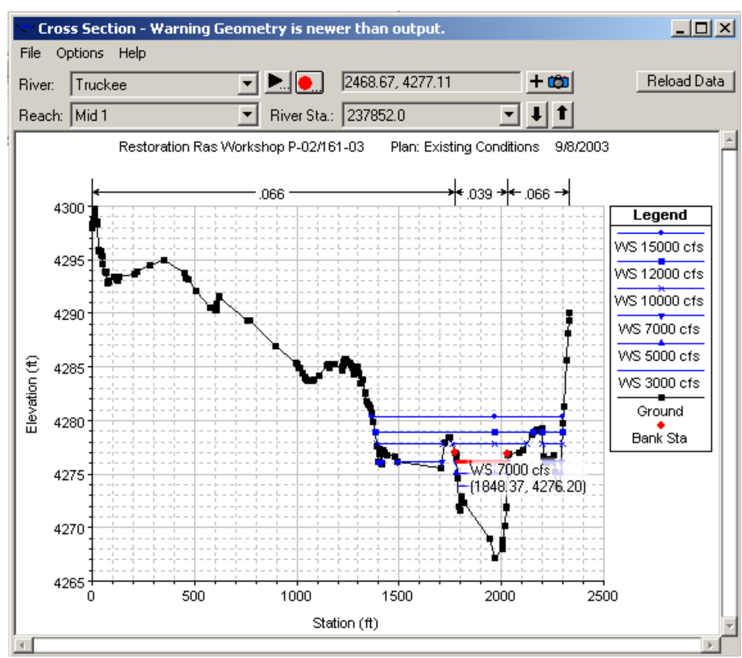
B. Run Simulation and Compare Flows

Compute. Review cross sections and profiles to estimate bank full flow.

Use the model runs to estimate a bank full flow: **<u>~7000 cfs</u>**


Profile Plot - Warning Geometry is newer than output.
File Options Help
Reaches
Profiles
Reload Data
Restoration Ras Workshop P-02/161-03 Plan: Existing Conditions 9/8/2003
Truckee Mid 1
Elevation (ft)
Main Channel Distance (ft)
7647.06, 4280.82
Legend
WS 15000 cfs
WS 12000 cfs
WS 10000 cfs
WS 7000 cfs
WS 5000 cfs
WS 3000 cfs
Ground
LOB
ROB
Left Levee
Right Levee


Cross Section - Warning Geometry is newer than output.
File Options Help
River: Truckee
Reach: Mid 1
River Sta.: 240185.0
2468.67, 4272.06
Reload Data
Restoration Ras Workshop P-02/161-03 Plan: Existing Conditions 9/8/2003
.066
.039
.066
WS 7000 cfs
(964.91, 4280.15)
Elevation (ft)
Station (ft)
Legend
WS 15000 cfs
WS 12000 cfs
WS 10000 cfs
WS 7000 cfs
WS 5000 cfs
WS 3000 cfs
Ground
Bank Sta


Cross Section - Warning Geometry is newer than output.
File Options Help
River: Truckee
Reach: Mid 1
River Sta.: 237852.0
2468.67, 4277.11
Reload Data
Restoration Ras Workshop P-02/161-03 Plan: Existing Conditions 9/8/2003
.066
.039
.066
WS 7000 cfs
(1848.37, 4276.20)
Elevation (ft)
Station (ft)
Legend
WS 15000 cfs
WS 12000 cfs
WS 10000 cfs
WS 7000 cfs
WS 5000 cfs
WS 3000 cfs
Ground
Bank Sta

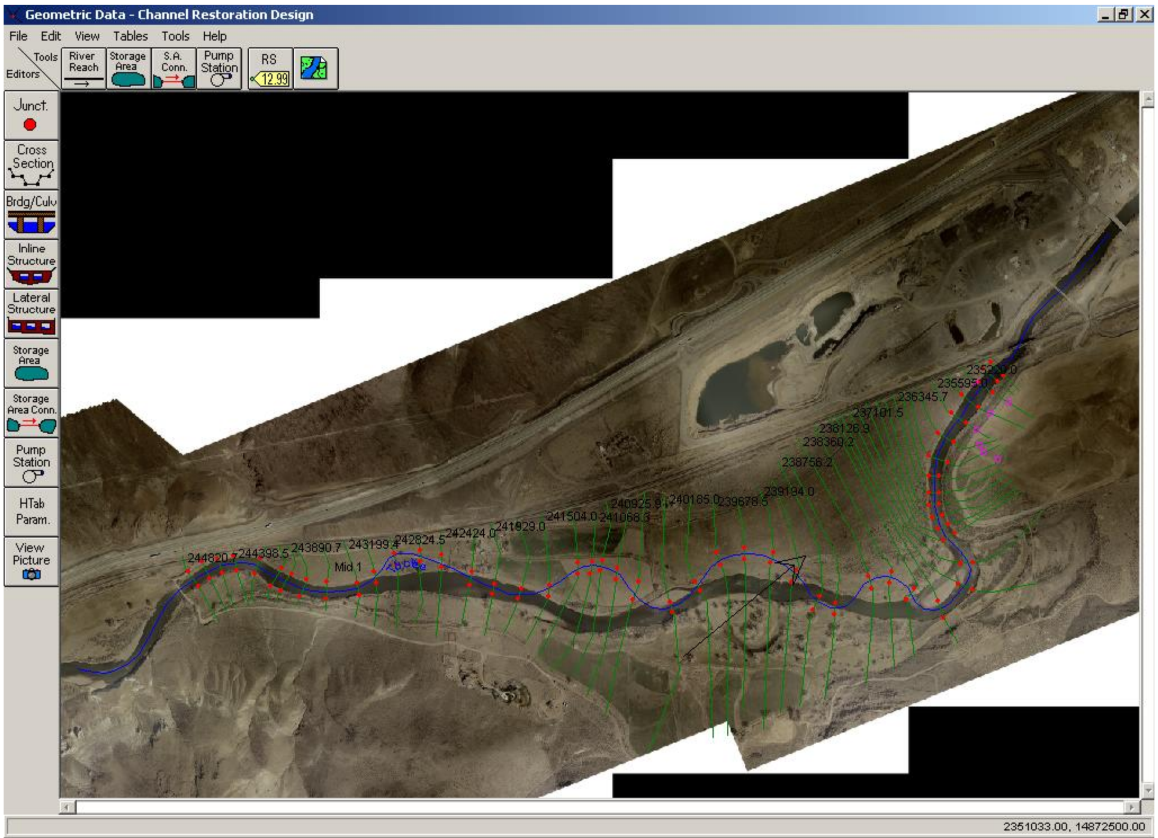
Based on this relationship what is the flow with a 50% exceedance probability (e.g. 2-year flow)?
~1500 cfs

What is the exceedance probability associated with the "bank full" flow determined above? **19%**

What is a possible explanation for the discrepancy between the 2-year flow and the "bank full" discharge?
The stream has a degraded, incised channel. Therefore, standard "bank full" flow will not reach the banks since the channel bottom has been degraded.

C. Evaluate Restoration Alternative: Overbank Flows

View the restored plan and view the profiles.

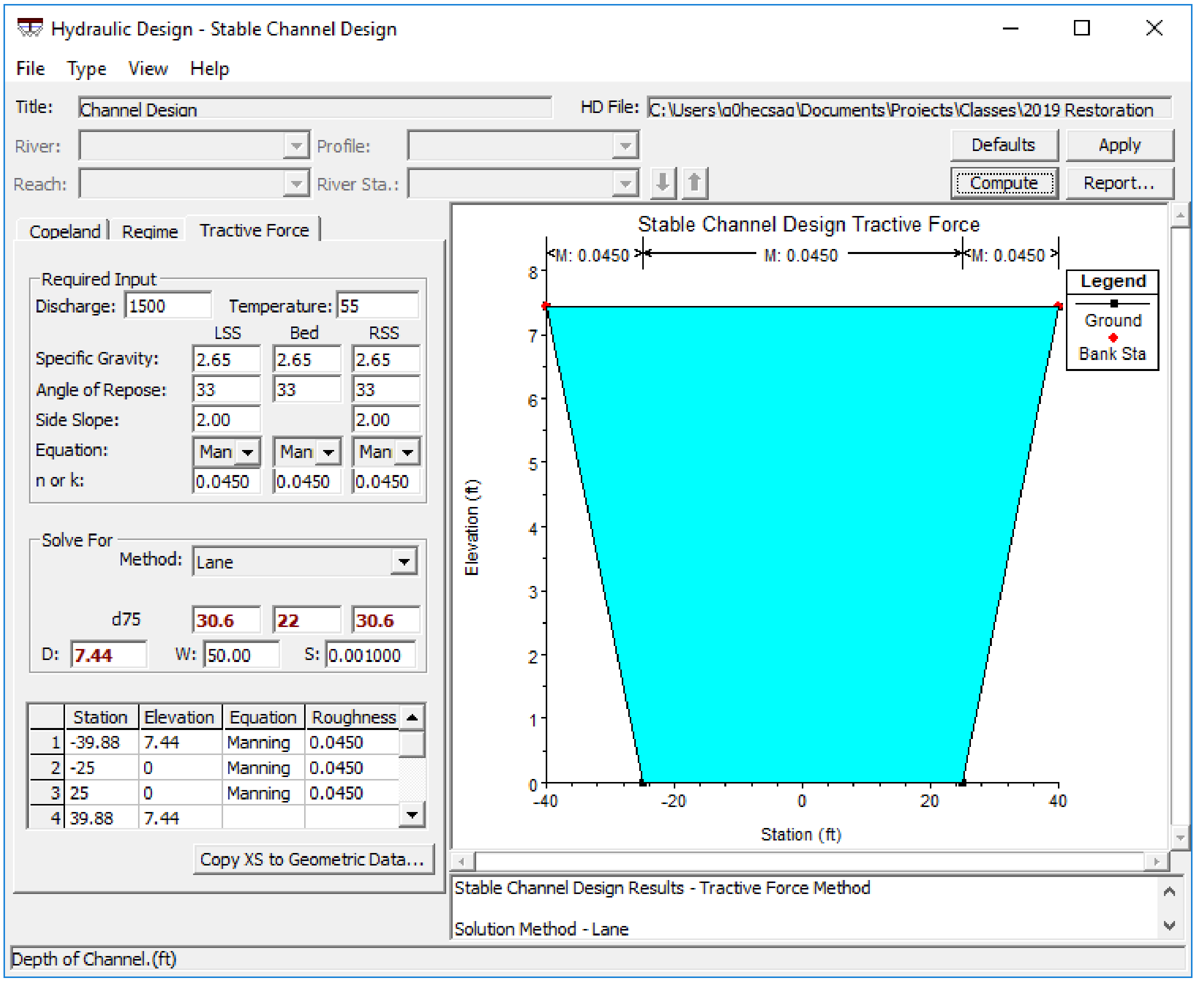


What flow floods the overbanks appreciably along most of the restored reach? **2000-3000 cfs**

If the intention of the restoration is to flood the overbanks approximately every other year how effective is this design?
2000 cfs has an exceedance probability of ~45%, 3000 cfs ~35%. The upper end of this range will average flooding about every three years. If this is not acceptable a slightly higher drop structure may be considered, or a slightly smaller channel size.

D. Evaluate Restoration Alternative: Channel Stability

Use the cross section and profile displays to fill in the fields for flow depth (**D**) **or** channel *bottom* width (**W**), and slope in the restored reach (**S**).



What are the minimum stable D75's for this channel: **<u>For a channel of D=7.44ft and W=50 ft</u>**

Left Bank	Channel Bed	Right Bank
30.6 **<u>mm</u>**	**<u>22 mm</u>**	**30.6 <u>mm</u>**

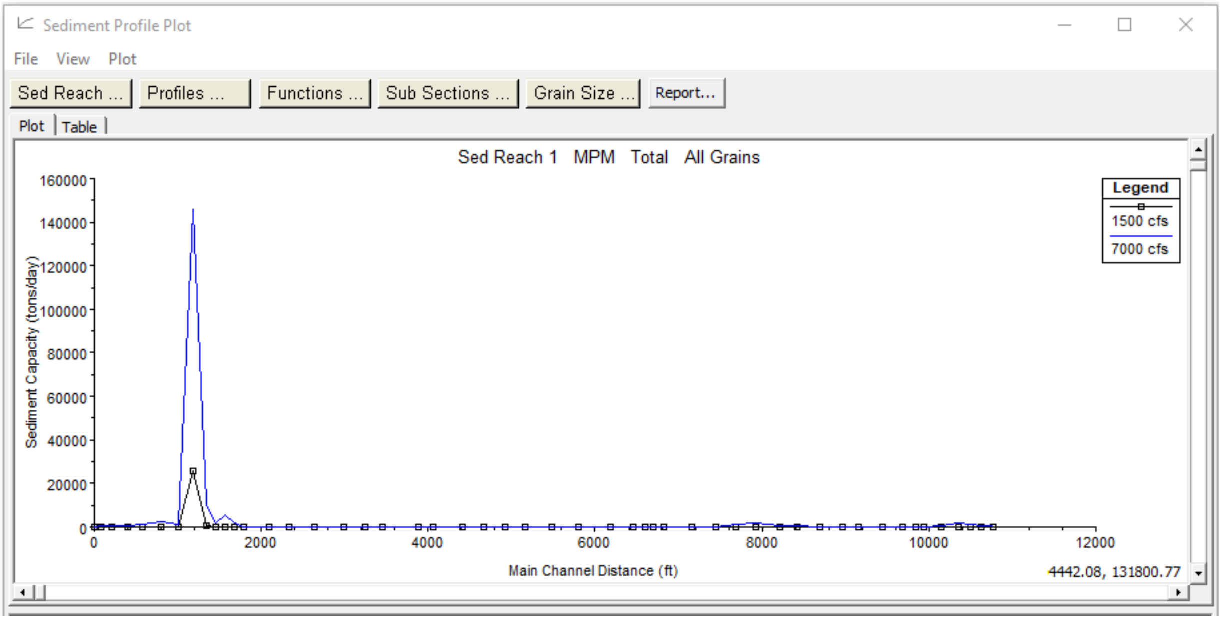
A grain size distribution for this channel is attached to the workshop. What is the D75 of this channel? **<u>90 mm</u>**

Is the channel likely to degrade? **<u>No</u>**
Why or why not? **<u>The bed load is significantly more coarse than the minimum stable grain size</u>**

What other geomorphic issues that should be considered? **<u>Since the erodible grain size is so much smaller than that in the bed, aggradation may be a concern for the constructed channel</u>**

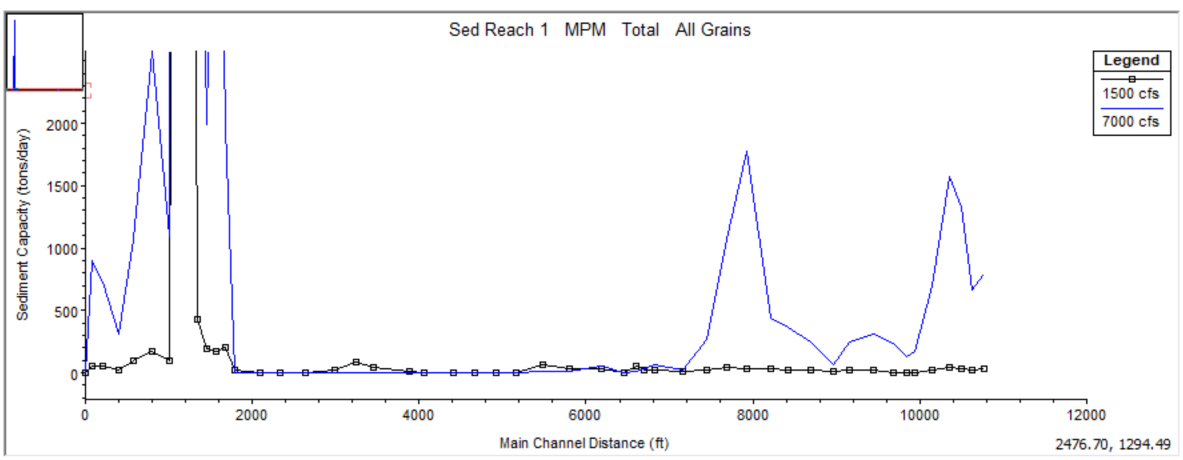
E. Evaluate Restoration Alternative: Sediment Transport Potential

Plot and view the sediment capacity of the reach.



At what station is the transport suspiciously high? **<u>236200 ft</u>**
Why? **<u>This Corresponds to the high velocity zone of the drop structure. It will likely be armored.</u>**

Rescale the plot.



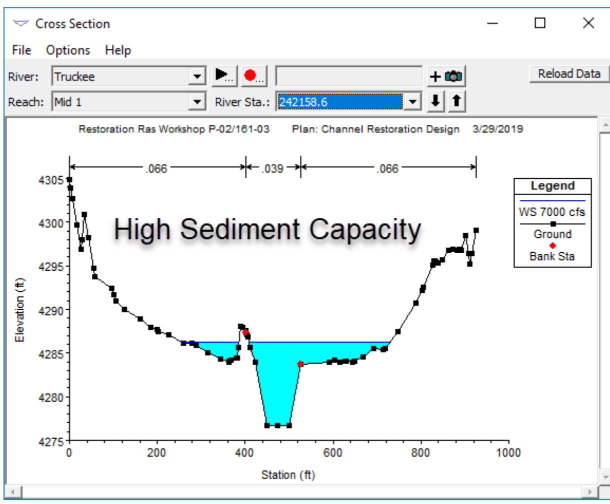
What is the range of transport capacities along the restored reach for the 2-yr flow? **<u>0-20 tons/day</u>**

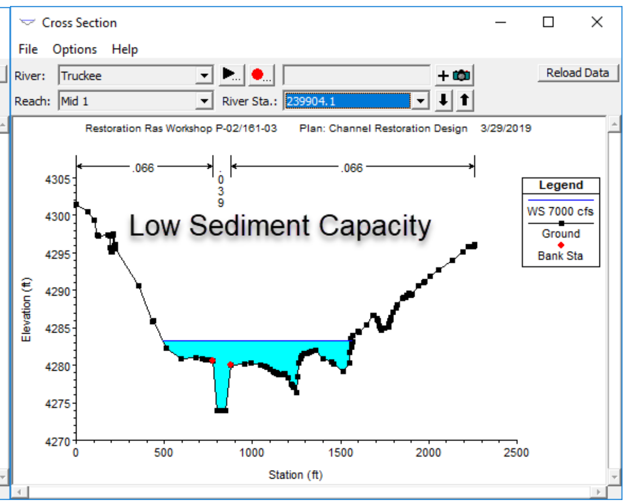
For the higher flow where is the most likely region(s) of scour? **Upstream of station 7000 ft, particularly around 8000 ft and in the region of the drop structure**

Deposition? **Between Stations 2000 ft and 7000 ft**

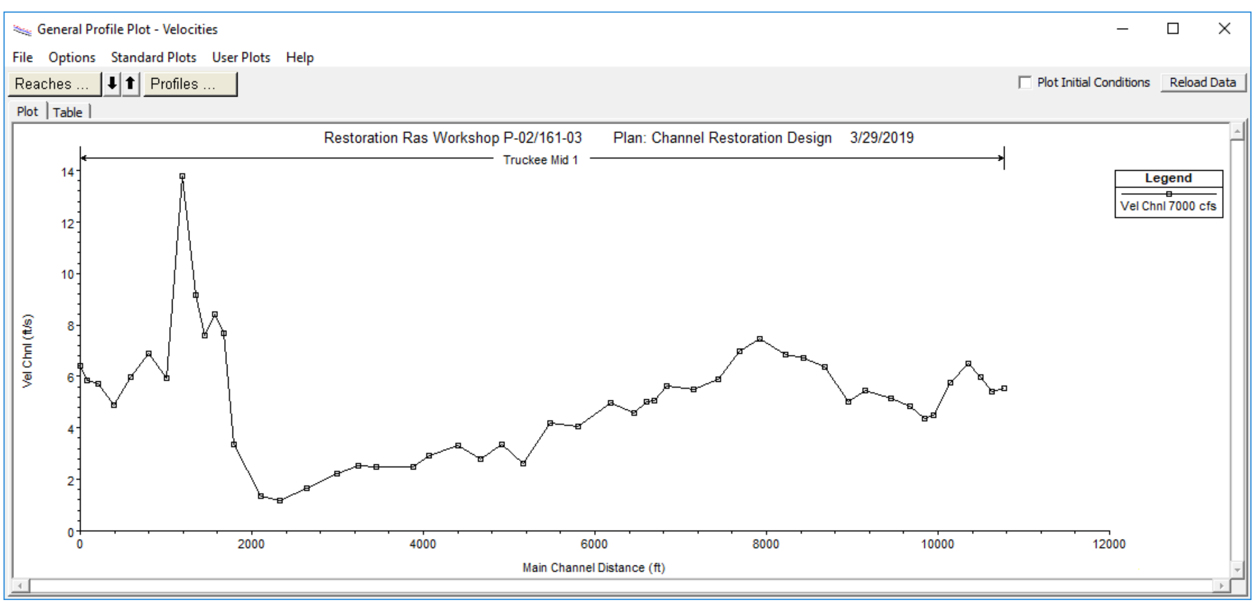
Look at some of the cross sections with high and low transport capacity for the 7000 cfs flow. What is causing the transport capacity to be higher in some than others?

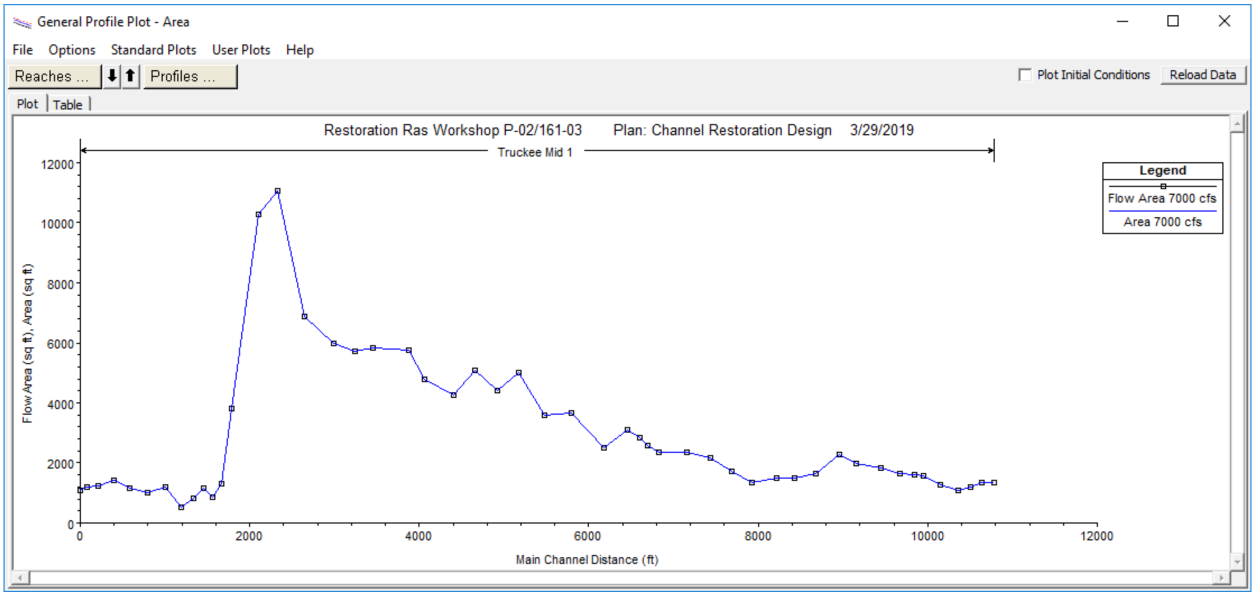
More of the flow is inside the channel for the cross sections upstream of station 7000 ft. This results in higher velocities (less wetted perimeter and lower n values) which yields higher sediment capacities





If you have extra time:
Plot the velocity and area profiles for the reach.





How do the velocity and area trends correspond to sediment capacity along the reach?
<u>Sediment capacity is generally higher in areas of higher velocity and lower area.</u>

Try other sediment transport functions for the sediment capacity calculation.
How sensitive are the calculations to the selected function? **<u>The calculations are very sensitive to the selected function, particularly because the gravely bed is outside of the grain size range for which most of the relationships were developed. Most of them predict significantly more capacity than MPM because they were not developed for gravel transport behavior.</u>**