



Hydraulics | Hydrology | Geomorphology | Design

Rose Creek Watershed Analysis and Assessment

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Environmentally sustainable solutions for the water resources industry

Topics Covered

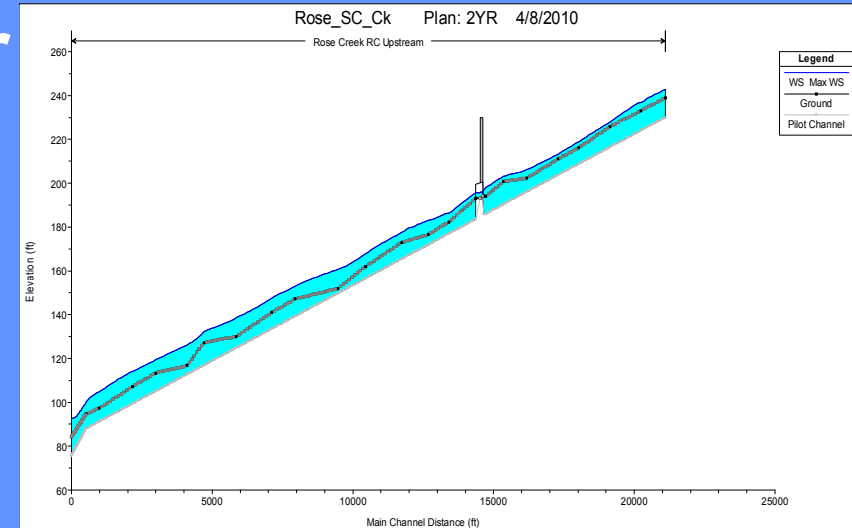
- Review Scope of Work
- Existing Data Collection Effort (cross-sections, sediment, water level, flow)
- Hydrologic Model and Results
- Hydraulic Model Development
- Hydraulic Model Results
- Future Efforts



The purpose of developing the hydrologic and hydraulic models is to use these tools to identify, prioritize and help develop designs for potential restoration sites in the Rose Creek and San Clemente Creek canyons. The models and the associated data that has been collected will also be useful for other projects in the watersheds.

Review of SOW

- Develop Modeling Tools for Watershed Analysis
- Model Existing Conditions
- Model Future Conditions Hydrology
- Formulate Restoration Alternatives
- Analyze Restoration Alternatives



The pictures on the right give an example the type of information that can be derived this analysis. The top graphic shows an example of a profile view of the peak water levels along the channel one would see during a given storm event. The photo below shows the area inundated by the same storm event overlaid onto an aerial image.

Goals and Objectives – Hydraulic Modeling

- Modeling to Improve Restoration Design
- Flood attenuation (water storage)
 - Off channel swales / depressional areas
- Sediment Trapping
- Groundwater Recharge
- Reduction of Erosion
- Reduced Flood Risk in Lower Rose Creek
 - Due to upstream attenuation / storage

The above lists the objectives of potential restoration and how the modeling tools can be used to quantify the benefits

- Bathymetric and Topographic Surveying
- Characterize Bed and Bank Sediments
- Hydrologic Analysis
- Hydraulic Analysis
- Sediment Transport Analysis

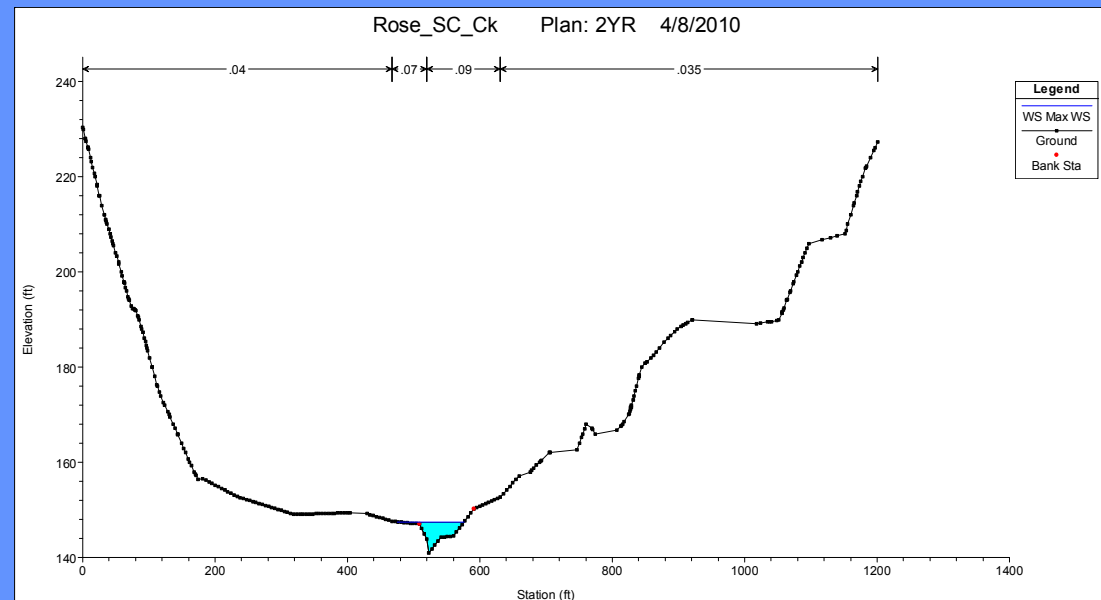


These are necessary steps in the examination potential restoration alternatives for Rose Creek Canyon. Hydrology – the study of water on the larger scale; starting from rainfall intensity to how that rain interacts with different soil types and land uses to produce a given volume of runoff for a particular storm event. Hydraulics – the study how water is conveyed after it has made its way to a stream or river. Velocity, flow depth, discharge, area of inundation and shear stress are the types of variables derived from a hydraulic model. Sediment Transport – the study of how the hydrology and hydraulics of a system conveys sediment. How water interacts with the sediment is very important when designing stream restoration projects.

Cross Section Surveys

- Transect Locations
 - 64 Survey Cross sections
 - 500 to 1000 foot spacing
 - Rose Creek and San Clement Creek (I-805 to Mission Bay)

- See Google Earth



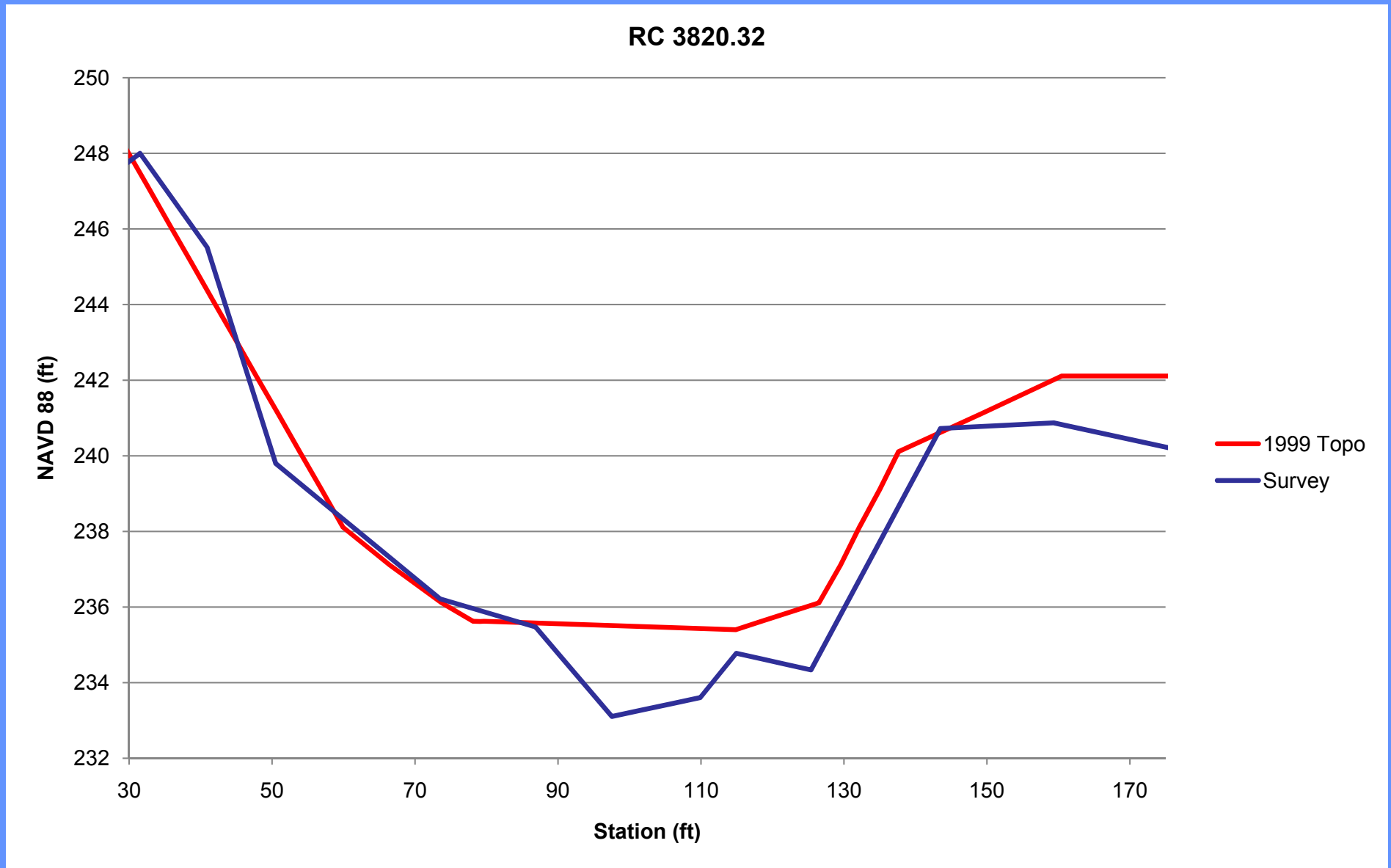
A surveyed transect is a measurement of topography along a straight line that is perpendicular to a stream channel. This is an important component of a hydraulic model termed “model geometry.”

Survey



A total station and a survey grade GPS was used to survey cross sections within Rose and San Clemente Creek Canyons. Watch out for the poison oak!!

Survey Data Comparison



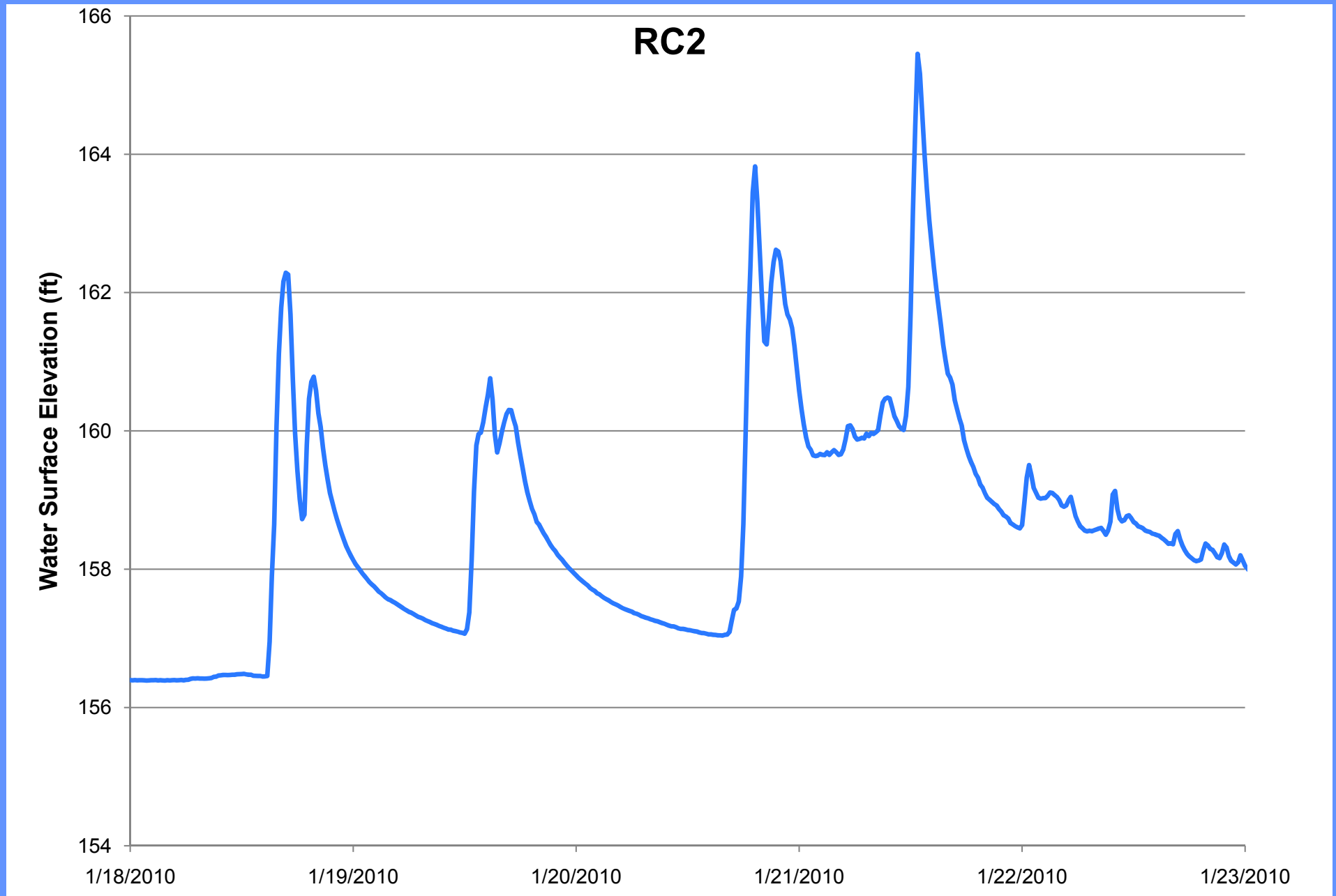
This graph shows a comparison of a cross section surveyed from the ground (blue) versus one surveyed from the air (red). Sometimes vegetation can contribute to errors in aerial surveys, which exemplifies the need for ground surveys.

Water Level Monitoring



Measuring water levels during storm events is important when calibrating hydraulic models. This ensures the results derived from the model are representative of what is actually occurring in nature.

Stage Data



Here is an example of water level data collected within Rose Creek during the January 2010 storms. Notice an increase in water level of nearly 8 feet from the beginning to the peak of the storm.

2/27/10 Storm: San Clemente



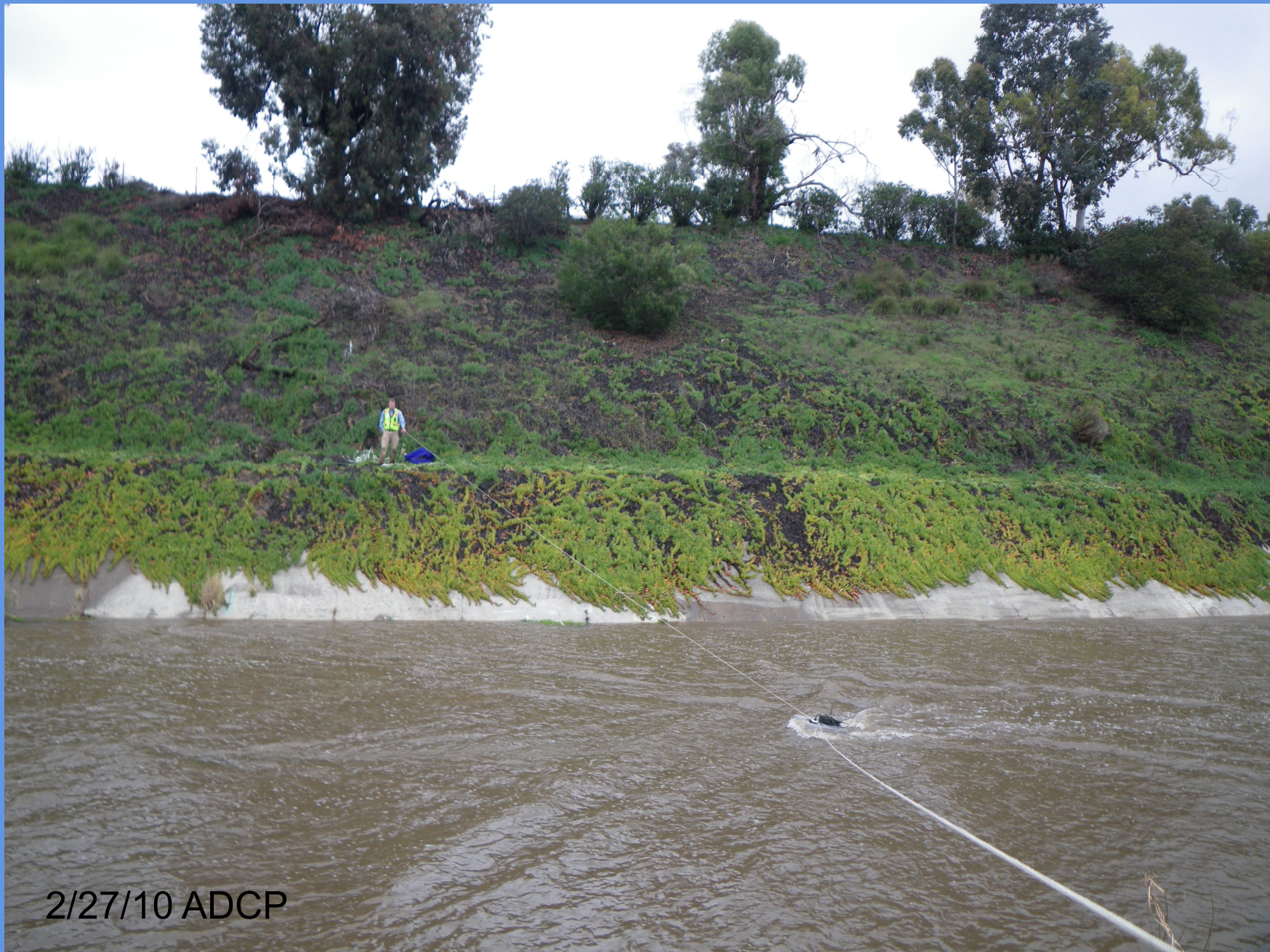
Discharge Measurement



2/27/10 ADCP

Measuring discharge (volume of flowing water) is another important way to calibrate a hydraulic model. This device (Acoustic Doppler Current Profiler – ADCP) uses acoustic technology to measure velocity (V) and flow area (A) which are used to calculate discharge (Q). $Q = V \times A$

Discharge Measurement



2/27/10 ADCP

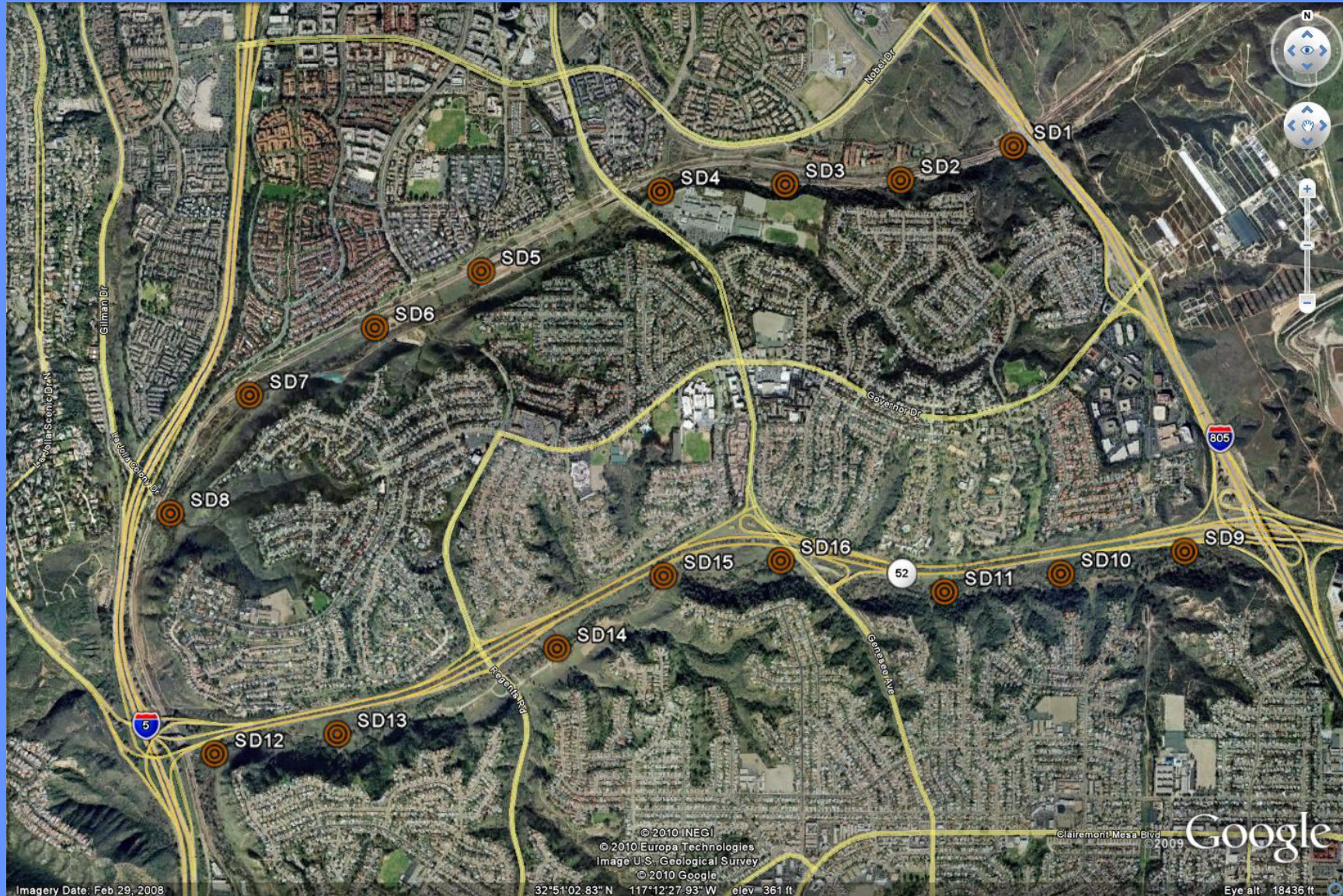
Using the ADCP to measure discharge in the Rose Creek flood control channel downstream of the confluence with San Clemente.

Discharge Estimates

Date	Time	Location	Estimated Discharge (cfs)
2/17/10	13:35	Flood Control Channel Downstream of Confluence	620
2/17/10	14:47	Flood Control Channel Upstream of Confluence (Hwy 52)	62

Bed Material Characterization

Sample Locations

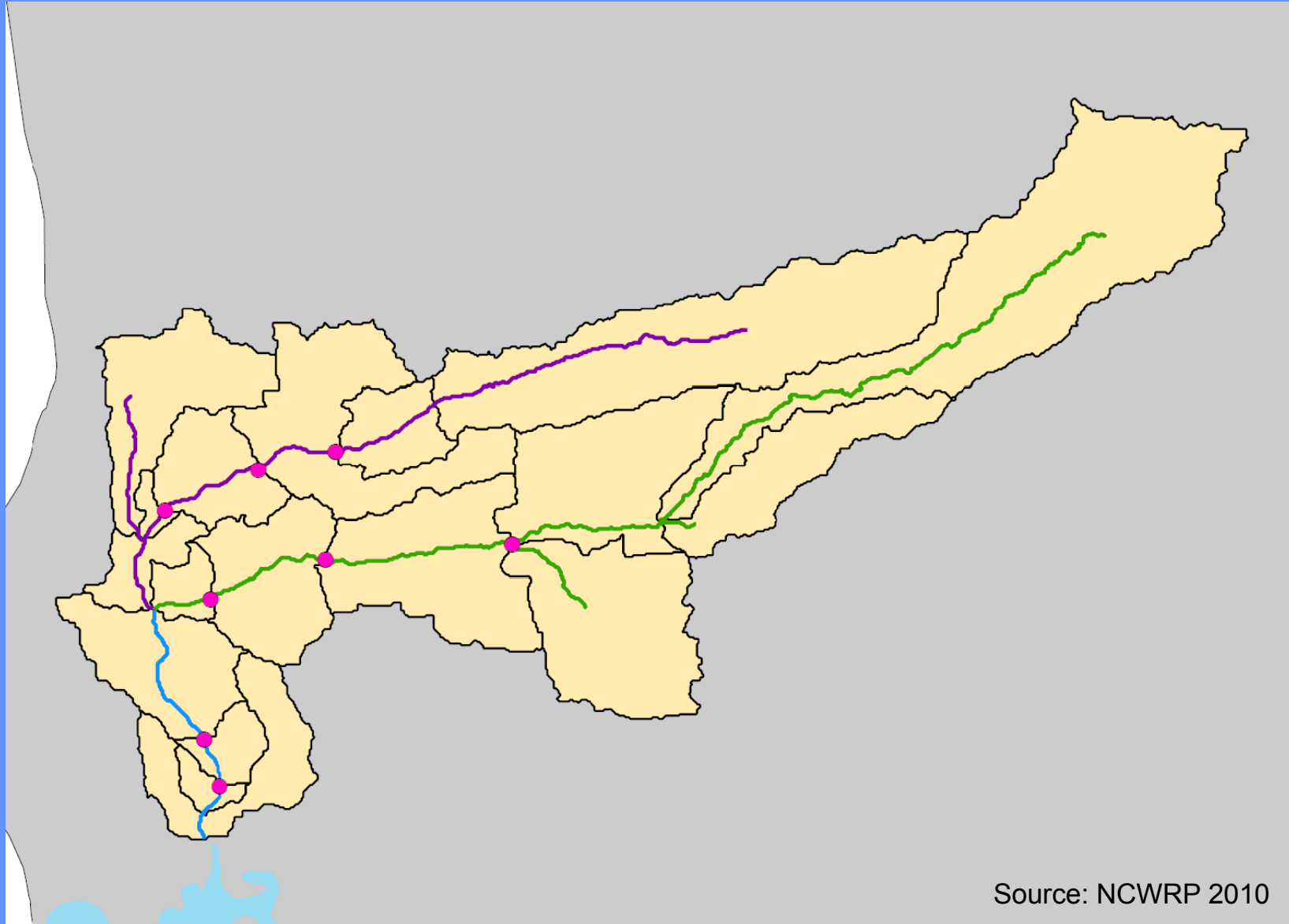


Characterizing the bed and bank sediments will aid in the understanding the sediment dynamics within Rose Creek.

- Rose Creek Watershed *Hydrologic* Model
 - Developed by Everest International Consultants
- HSPF continuous simulation
 - 30 year period continuous rainfall (Airport)
 - 18 sub-watersheds within model
- Bulletin 17B Flood Frequency Analysis
 - Use model output to determine n-year peak flows
 - Identify corresponding storm events from HSPF results

We performed a statistical analysis termed “flood frequency” on the results from a previously developed hydrologic model to determine of the magnitude of the 2, 5, 10, and 25-year storm events (those events that statically will occur every 2, 5, 10 and 25 years). These storm events are another important component (along with model geometry) used in the development of a hydraulic model.

Watershed Hydrologic Model



This map shows the different sub-watersheds within Rose Creek Watershed. Each of these areas will contribute a unique amount of water to the stream during a particular storm event. The volume of water each area contributes depends on the rainfall, soil type, land use (urban or rangeland) and its size / shape.

Hydrology – Flood Frequency



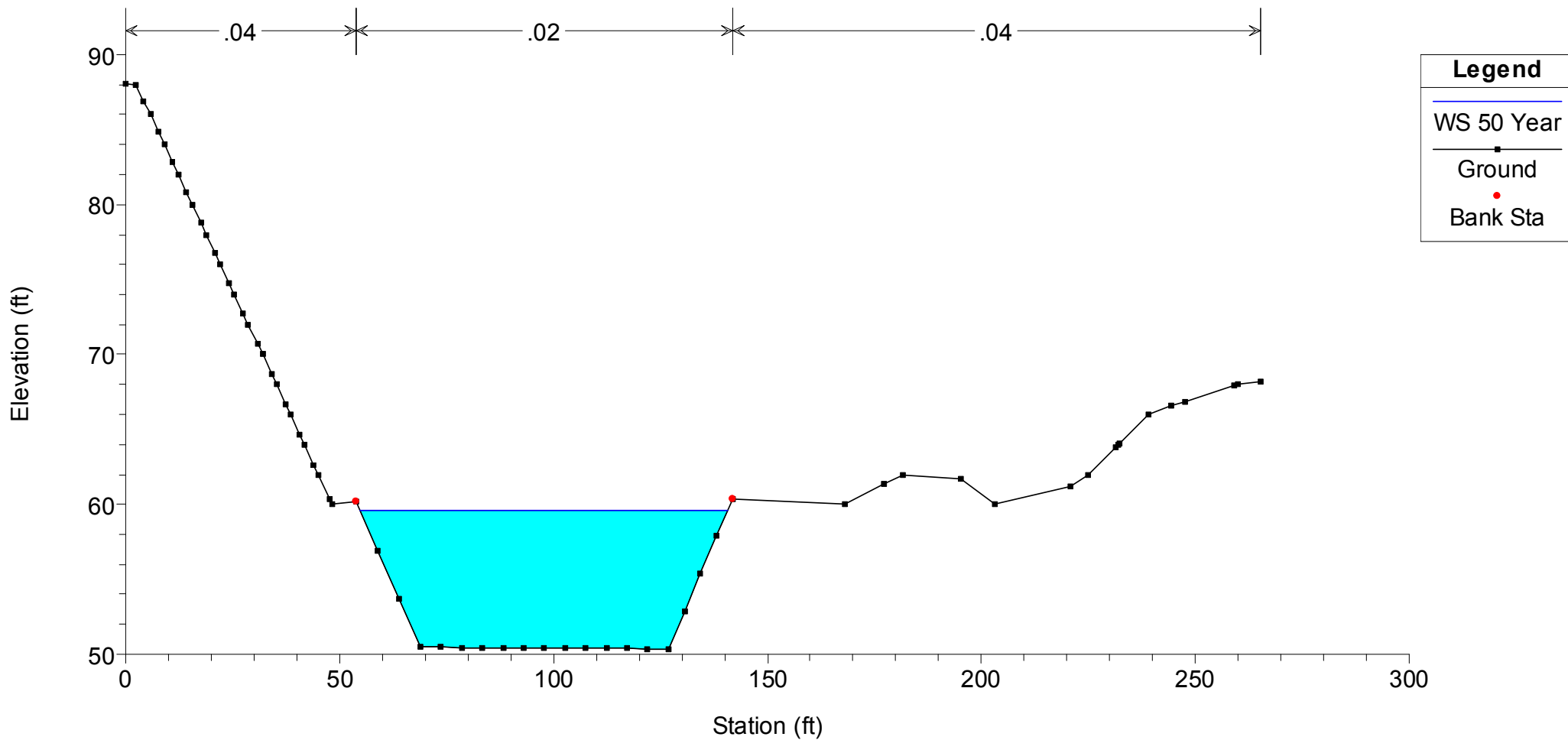
Storm Event	Peak Flows (cfs) (FEMA, 1972)	Peak Flows (cfs) (HSPF Model, 2010)
2-year storm		2406
5-year storm		3264
10-year storm	2700	3790
25-year storm		4501
50-year storm	8100	NA
100-year storm	12000	NA

The right hand column shows the peak discharges that resulted from our analysis. These were compared to those calculated by FEMA in the early 1970's. Changes in watershed land use and differences in the methodologies used likely contributed to the observed differences. The values in bold were used for our analysis.

- HEC-RAS 1D *Hydraulic* Model
- Model Geometry
 - 64 surveyed cross sections (I-805 to Mission Bay)
- Model Boundary Conditions
 - 100 and 50 Year Flow Events
 - 2, 5, 10 & 25 Year Flow Events (HSFP)
- Hydraulic Roughness (Manning's)
 - Estimated in the field per vegetation type along each surveyed cross section
 - Used to quantify flow efficiency

Hydraulic Roughness

Rose_SC_Ck Plan: FEMA_50_100_yr 4/11/2010



Differences in vegetation density along Rose Creek affect how efficiently water is conveyed through the channel. Estimates of this hydraulic “roughness” is estimated along each of the surveyed cross sections (notice .04 and .02 along top of graphic) . This is also an important component in the development of a hydraulic model.

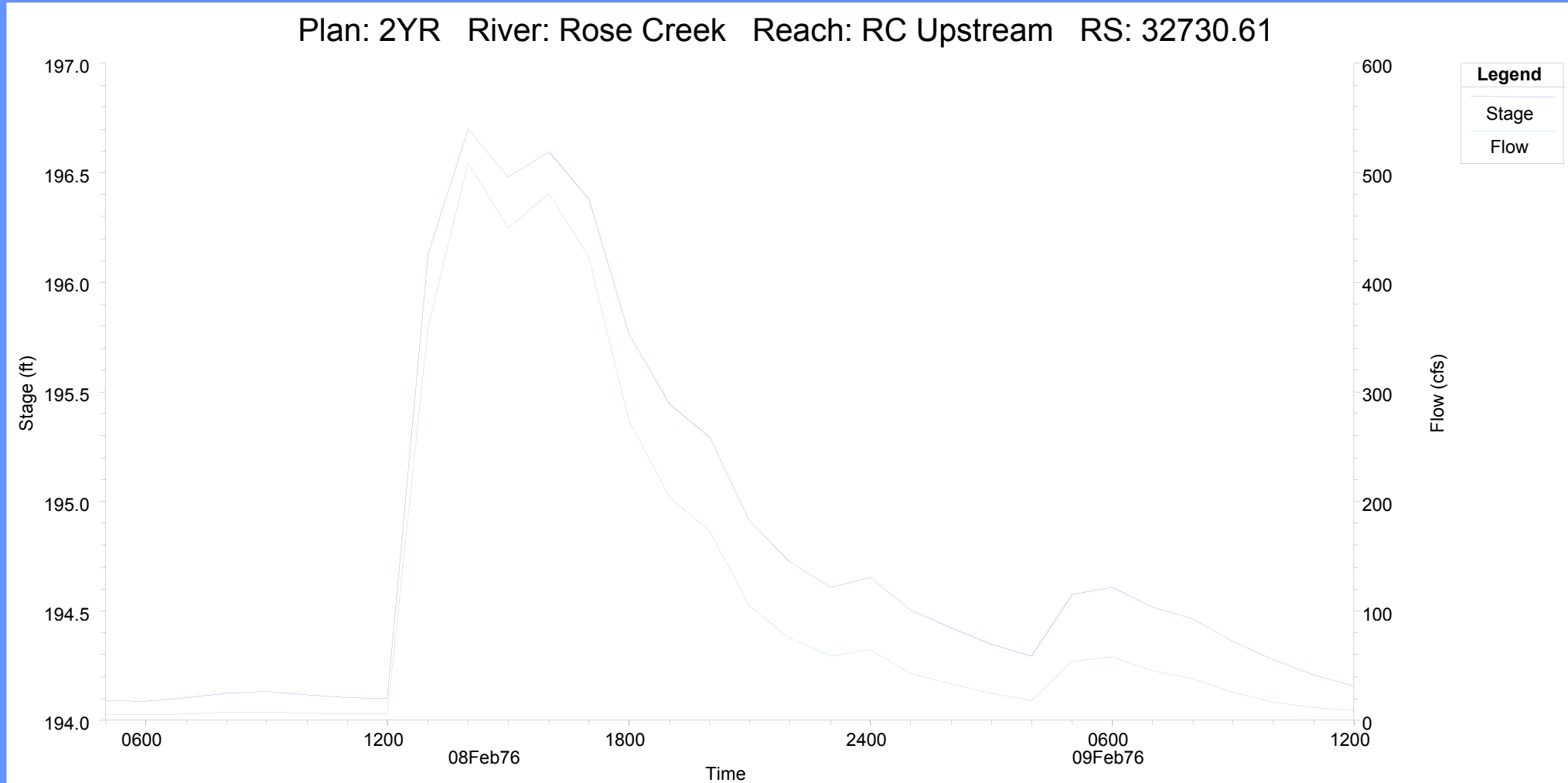
Inundation Mapping



Using the modeled water surface elevation and the surrounding topography, we can map the extent of inundation for a given flow event. This is especially useful when determining what plant pallets are suitable for a given restoration project.

Hydraulic Model Results

- Duration of inundation – Implications for future restoration efforts



This is an example of the type of data that is output from a hydraulic model. With a comparison the surrounding topography, it tells us the extent and duration the flow will inundate adjacent floodplains for a given storm event. This is very important when designing a stream restoration project for ecological function and flood reduction (attenuation / storage).

Future Efforts

- Improvements to the *hydrologic* estimates
- Refinements to the *hydraulic* model
- Formulate restoration alternatives
- Model restoration alternatives

Thank You!



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