CIBOLA COUNTY
JUNE 19, 1981

CITY OF GRANTS SPIRIT

VILLAGE OF MILAN CORPORATION SEAL NEW MEXICO

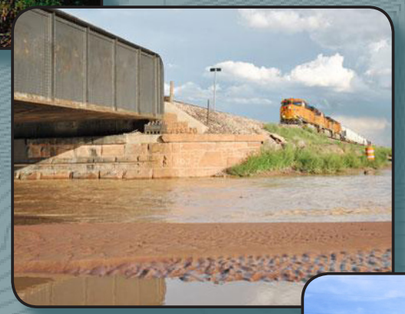
Rio San Jose
Flood Control District

NMDOT

US Army Corps
of Engineers

Project No. 10-600-033-00 September 2010 Revised April 2011











City of Grants and Village of Milan New Mexico

Drainage Master Plan Phase 1

Base Analysis and Problem Identification

WILSON & COMPANY
ENGINEERS & ARCHITECTS

1. Introduction 1
1.1 Authorization 1
1.2 Study Area Location 1
1.3 Background 1
1.4 Purpose and Goals 1
1.5 Project Team 1
1.6 Participating Agencies 2
1.7 Stakeholder Meetings 2

2. Hydrologic Analysis 2
2.1 Methodology 2
2.2 Hydrologic Characteristics 3
2.2.1 Watershed Delineation 3
2.2.2 Hydrologic Soil Groups 4
2.2.3 Climate and Precipitation 4
2.2.4 Time of Concentration 5
2.2.5 Land Use/Cover 6
2.2.6 Runoff Curve Numbers 8
2.2.7 Model Calibration 8
2.3 Hydrologic Modeling Results 11

3. Hydraulic Analysis 12
3.1 Scope 12
3.2 Methodology 12
3.3 Data Sources 12
3.3.1 Topographic Data 12
3.3.2 Manning's Roughness Values 12
3.3.3 Hydrologic Flows 12
3.3.4 Ineffective Flow Areas 13
3.3.5 Flow Regime 14
3.3.6 Culvert Input 14
3.4 Results of the Hydraulic Analysis 14

4. FEMA Floodplain 15

5. Drainage/Flooding Problems 15
5.1 Grants Canyon Arroyo 16
5.2 Rio San Jose 17
5.3 First and Second Streets 18
5.4 Civic Center Area 19
5.5 Milan Heights 19
5.6 North Street Arroyo 20
5.7 5th Street Railroad Crossing 20
5.8 Other Local Drainage Problems 20

6. Summary and Recommendations 21

Certification

I hereby certify that this report for the City of Grants and Village of Milan, New Mexico, Drainage Master Plan – Phase 1, was prepared under my direction.

_____
Vancel S. Fossinger
State of New Mexico PE No. 13064

Cover Photos: *Photos representing some of the drainage problems in Grants and Milan. Photo descriptions are as follows (left to right): Floodwater overflowing College Boulevard at the Grants Canyon Arroyo crossing, Photo by the Cibola Beacon showing sediment and flood flows at a Railroad Bridge over the Rio San Jose, Damaged culvert ends at the College Boulevard crossing over Grants Canyon Arroyo, Rio San Jose north of High Street is attractive to look at but lacks capacity to convey significant flood flows, Pools of water in High Street at Iron Avenue after a small rainstorm.*

Appendix Section 1 - General Exhibits

Figures	Description
1-1	Vicinity Map
1-2	FEMA Floodplain

Appendix Section 2 - Hydrology

Figures

2-1	Hydrologic Soil Groups
2-2	Future Land Use/Cover
2-3	Composite CN Values – Future Land Cover Condition
2-4	Existing Topography
2-5	HEC-HMS Routing Diagram
2-6	Drainage Basins
2-7	Analysis Points Overall Key Map
2-8	Analysis Points Insert Map 1
2-9	Analysis Points Insert Map 2
2-10	Analysis Points Insert Map 3
2-11	Analysis Points Insert Map 4
2-12	Analysis Points Insert Map 5
2-13	Analysis Points Insert Map 6

Tables

2-1	Drainage Basin Summary – Comparison of Existing and Future Values
2-2	Analysis Point Summary – Comparison of Existing and Future Values
2-3	Drainage Basin Summary – Existing Condition
2-4	Analysis Point Summary - Existing Condition
2-5	Drainage Basin Summary - Future Condition
2-6	Analysis Point Summary - Future Condition
2-7	HEC-HMS Model Results, Future Basin Summary, 10-yr, 24-hr, 100%
2-8	HEC-HMS Model Results, Future Junction Summary,10-yr, 24-hr, 100%
2-9	HEC-HMS Model Results, Future Reach Summary, 10-yr, 24-hr, 100%
2-10	HEC-HMS Model Results, Future Basin Summary, 10-yr, 24-hr, 84%
2-11	HEC-HMS Model Results, Future Junction Summary,10-yr, 24-hr, 84%
2-12	HEC-HMS Model Results, Future Reach Summary, 10-yr, 24-hr, 84%
2-13	HEC-HMS Model Results, Future Basin Summary, 100-yr, 24-hr, 100%
2-14	HEC-HMS Model Results, Future Junction Summary,100-yr, 24-hr, 100%
2-15	HEC-HMS Model Results, Future Reach Summary, 100-yr, 24-hr, 100%
2-16	HEC-HMS Model Results, Future Basin Summary, 100-yr, 24-hr, 84%
2-17	HEC-HMS Model Results, Future Junction Summary,100-yr, 24-hr, 84%
2-18	HEC-HMS Model Results, Future Reach Summary, 100-yr, 24-hr, 84%
2-19	Existing Condition Composite Curve Number (CN) Calculations
2-20	Future Condition Composite Curve Number (CN) Calculations
2-21	Lag Time Calculations
2-22	Channel Flow Segment Assumptions for Lag Time Calculations
2-23	HEC-HMS Routing Reach Characteristics
2-24	Rainfall Depths and Distributions 100%
2-25	Rainfall Depths and Distributions 84%
2-26	Rainfall Depths and Distributions 77%
2-27	Zuni Canyon Flow Contribution to Rio San Jose through Grants

Appendix Section 3 - Hydraulics

Hydraulic Analysis Index

Figures	Description	Page Range
3-1	Drainage Structures Inventory Key map	3
3-2	Drainage Structures Inventory Map 1	4
3-3	Drainage Structures Inventory Map 2	5
3-4	Drainage Structures Inventory Map 3	6
3-5	Drainage Structures Inventory Map 4	7
3-6	Drainage Structures Inventory Map 5	8
3-7	Drainage Structures Inventory Map 6	9
3-8	Drainage Structures Inventory Map 7	10
3-9	HEC-RAS Sections Map, Rio San Jose, Sta 435+00 to 383+00	11
3-10	HEC-RAS Sections Map, Rio San Jose, Sta 383+00 to 319+00	12
3-11	HEC-RAS Sections Map, Rio San Jose, Sta 319+00 to 253+00	13
3-12	HEC-RAS Sections Map, Rio San Jose, Sta 253+00 to 177+00	14
3-13	HEC-RAS Sections Map, Rio San Jose, Sta 177+00 to 131+00	15
3-14	HEC-RAS Sections Map, Rio San Jose, Sta 131+00 to 74+54	16
3-15	HEC-RAS Sections Map, Rio San Jose, Sta 74+54 to 10+00	17
	HEC-RAS Profile Summary Table, Rio San Jose	18-31
	HEC-RAS Bridge Summary Table, Rio San Jose	32
	HEC-RAS Culvert Summary Table, Rio San Jose	33
	HEC-RAS Profile Plots, Rio San Jose	34-40
	HEC-RAS Cross Section Plots, Rio San Jose	41-74
3-16	HEC-RAS Sections Map, Grants Canyon, Sta 0+00 to 42+00	75
3-17	HEC-RAS Sections Map, Grants Canyon, Sta 42+00 to 110+00	76
	HEC-RAS Profile Summary Table, Grants Canyon	77-79
	HEC-RAS Culvert Summary Table, Grants Canyon	80
	HEC-RAS Profile Plot, Grants Canyon	81
	HEC-RAS Cross Section Plots, Grants Canyon	82-88

Tables

3-1	Drainage Structure Inventory	1-2

Appendix Section 4 - Drainage Problems

- Interview/meeting Summaries
- Photographs
- Newspaper Articles Summaries
- Drainage Report Summaries

Appendix Section 5 - Calibration Data

Hydrology

- NOAA Flood Event Records
- NEXRAD Imagery for Calibration Storm Event
- Rainfall Spatial Distribution for HEC-HMS Calibration Model
- Rainfall Hyetograph for Calibration Storm Event
- Flow Rates and Water Surface Elevations Corresponding to Curve Number Calibration Values
- HEC-HMS Model Results for Calibration Storm
- Interview Summaries
- Newspaper Articles
- Regression Equations

Hydraulics

- Calibration Flood Exhibit with HEC-RAS Cross Section Locations and Approximate Boundary of Calibration Flood
- HEC-RAS Profile and Culvert Summary Tables
- HEC-RAS Profile Plot
- HEC-RAS Cross Sections
- USGS Peak Flow Data for Rio San Jose at Grants and Grants Canyon at Grants Stream Gage Locations
- Photographs of the Roosevelt Avenue Culverts

1. Introduction

1.1 Authorization

Cibola County authorized Wilson & Company, Inc., Engineers & Architects (Wilson & Company) to prepare a Drainage Master Plan for the City of Grants and the Village of Milan, New Mexico under a contract dated April 23, 2010.

1.2 Study Area Location

The primary area of focus for this study includes the City of Grants and the Village of Milan, New Mexico (the Study Area). Grants and Milan are located along Interstate 40 approximately 75 miles west of Albuquerque New Mexico.

The watershed analyzed in the course of this study encompasses approximately 40.5 square miles. A significant portion of this watershed originates in Grants Canyon located northeast of the City of Grants.

Figure 1-1 contained in Appendix Section 1 is a vicinity map that shows the primary areas of focus for the study as well as the overall boundary of the studied watershed.

1.3 Background

Portions of the City of Grants and Village of Milan have been subject to reoccurring flooding over the years. Runoff is generated in large offsite contributing watersheds as well as portions of Black Mesa within the Study Area. In significant storms, this runoff overwhelms the existing drainage facilities in the relatively flat areas that encompass much of the City of Grants and the Village of Milan, resulting in shallow flooding that damages public and private property. Significant pooling of water in streets within the study area is not uncommon, even in small, frequent rainfall events.

Photos presented on the cover of this report represent some of the drainage problems in the Study Area. These problems include existing drainage facilities with inadequate capacity and density and existing drainage facilities that are damaged or corroded.

Several drainage reports have been prepared over the years for the Study Area. Some of these reports have quantified runoff, identified problems and proposed solutions to flooding problems Unfortunately, only a few of the projects have been funded and constructed. Thus, nearly all of the problems still exist, and in some cases, the opportunity to implement some of the proposed solutions has been lost due to development of real estate required for the projects. In addition, new development in the community has increased runoff and more development is expected over time.

The need for an updated drainage master plan was recognized by local community leaders in the process of working to solve localized drainage problems. Funding for the master plan was assembled through a collaborative effort between local, county, and federal agencies. The primary goal of the drainage master plan is to identify significant and beneficial drainage improvement projects and provide the technical documentation needed to support funding requests for the identified projects.

1.4 Purpose and Goals

This project is being executed in two phases. The primary goals of Phase 1 are as follows:

- Quantify Runoff (Hydrology) at points of interest in the watershed for the 10 and 100-year runoff events to provide a basis for analyzing existing facilities and planning adequate improvements.
- Evaluate Major Existing Drainage Facilities (Hydraulics) within the primary areas of focus to determine where improvements may be needed.
- Identify Significant Flooding Issues within the areas of focus through research of existing documents, interviews with local agency personnel, and hydrologic and hydraulic analysis.

The primary goals of Phase 2 of this project will include the following:

- Develop Drainage Improvement Alternatives to mitigate major flooding problems in the Study Area
- Evaluate Drainage Improvement Alternatives in regards to effectiveness, construction and long term costs, and constructability.
- Select Drainage Improvement Alternatives to be carried forward

1.5 Project Team

Wilson & Company is preparing this Drainage Master Plan under contract to Cibola County.

1.6 Participating Agencies

Cibola County is the lead agency for the project and is also managing project funding. Funding for the project was a cooperative effort between Cibola County, City of Grants, Rio San Jose Flood Control District, US Army Corps of Engineers (USACE), and the State of New Mexico through a Community Development Block Grant.

Other agencies that have participated by providing information and/or documents, review, and/or participated in project meetings include the Village of Milan and the New Mexico Department of Transportation (NMDOT).

1.7 Stakeholder Meetings

Two meetings open to the general public and agency stakeholders were held in the Cibola County office building in Grants New Mexico during the execution of Phase 1 of this project. The first of these meetings was a project kickoff meeting held on June 3, 2010. The project scope and general information about the known drainage problems were presented and participants were invited to provide comments and information about specific problems. A second meeting was held on October 19, 2010 to discuss the first draft of the Phase 1 report. The preliminary findings were presented and participants were invited to provide comments.

While new information provided by participants at these meetings was very limited, the meetings did provide information on project progress to agencies and the public, and resulted in contacts being made with individuals that provided more specific information through separate interviews and field trips. Copies of summaries of these interviews are contained in Appendix Sections 4 and 5 of this report.

A third and final stakeholder meeting will be held at the completion of the Phase 2 draft report.

2. Hydrologic Analysis

2.1 Methodology

Hydrologic modeling for the study area was developed using the USACE Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS) Version 3.4. A HEC-HMS model was developed for the study area and includes elements for basins, routing reaches, junctions, and baseflow. Figure 2-5 in Appendix Section 2 is the routing diagram for the HEC-HMS model.

Modified NOAA-SCS rainfall distributions, in accordance with the NMDOT Drainage Manual, were manually entered into the model's precipitation gage manager for the 10 and 100-year frequency events. Areal reductions of rainfall depths were applied in model executions used to predict peak flow rates at points with sizeable contributing watersheds. This is discussed in greater detail in the climate and precipitation section of this report.

HEC-HMS generated hydrographs for each basin by utilizing the SCS Unit Hydrograph methodology for runoff transformation and the SCS Runoff Curve Number method to determine infiltration losses. Hydrographs were routed through all of the assigned downstream elements in the model to major outfall points. A network of routing reaches was defined to convey flows to appropriate junctions within the model using the Muskingum-Cunge routing method. Table 2-23 in Appendix Section 2 provides a summary of the geometric information for each of the routing reaches within the model.

Analysis of existing drainage facilities in the watershed indicated that nearly all of them are inadequate to convey the peak rates associated with the 100-year design storm. Thus, there is potential that some runoff will be diverted from the main flow path in some areas during large storm events. Given the limited scope of this analysis, the watershed was modeled ignoring these potential existing diversions. Instead, the watershed was modeled with runoff from large storm events being conveyed along the same flow paths that runoff from small events would follow. In most areas, overtopping of existing deficient facilities will result in flooding of private and public facilities, so ultimate solutions for the watershed will most likely include improving the deficient facilities to mitigate the overflow conditions. Accordingly, there is little to be gained in trying to accurately quantify the potential for diversions.

The Rio San Jose and Zuni Canyon Arroyo each have large complex watersheds located upstream of the detailed study area that contribute runoff to the Rio San Jose through the detailed study area. The Rio San Jose watershed located upstream and west of the detailed study area includes approximately 1,020 square miles of land area, significant water storage facilities, very flat gradients and broad floodplains. The Zuni Canyon Arroyo watershed includes approximately 45 square miles of land area located southwest of Milan, which contributes runoff to the Rio San Jose through an existing culvert under the Interstate 40 (I-40) embankment. The existing culvert regulates discharge and water is detained upstream of the I-40 embankment in large storm events.

Due to budget constraints and the size and complexities of the Rio San Jose and Zuni Canyon watersheds, the project scope limited hydrologic analysis to the detailed study area. Peak flow rates to be utilized in the Rio San Jose and Grants Canyon Arroyo for hydraulic analysis were to be the flow rates published in the effective Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS). Upon

completion of initial hydrologic modeling in accordance with NMDOT Drainage Manual procedures it became evident that the modeled flow rates from the local basins alone were significantly higher than the flow rates published in the effective FEMA FIS for all of Grants Canyon Arroyo and the portion of the Rio San Jose located downstream of the confluence with Grants Canyon Arroyo.

After review of the initial hydrologic modeling, the USACE requested calibration of the hydrologic model to at least one significant historic flood event in order to validate the higher predicted flow rates or potentially reduce the discrepancy between the model predicted flow rates, FEMA FIS published flow rates, and rates predicted and published by the US Geological Survey (USGS) at gage stations on the Rio San Jose and Grants Canyon Arroyo. Subsequent meetings were held with USACE personnel to discuss and agree on potential methods of calibration and the model calibration was completed based on a significant 2005 Grants Canyon Arroyo flood event. HEC-HMS predicted flow rates were significantly reduced through this calibration. Details related to the calibration effort are presented in Section 2.2.7 of this report.

It was also agreed in discussions with USACE personnel that the peak flow rates from the calibrated model should be utilized in the hydraulic modeling of the Rio San Jose and Grants Canyon Arroyo instead of the FEMA FIS rates if they were significantly larger than the FIS rates. In the case of Grants Canyon Arroyo this was straight forward as the entire watershed was included in the detailed study area. In the case of the Rio San Jose, generating model predictions for peak flow rates required additional assumptions and model components to account for potential flow contributions from the Zuni Canyon Arroyo and off-site Rio San Jose watersheds during the local runoff event peak flows.

In the case of the Zuni Canyon watershed, a single Zuni Canyon basin was added to the HEC-HMS model along with a storage element to represent the significant existing flood storage area upstream of the I-40 embankment. The stage discharge capacity of the modeled outlet from the storage area was based on the capacity of the existing 84" culvert under I-40 that connects the Zuni Canyon watershed to the Rio San Jose. The stage storage volume was based on recent topographic mapping of the area. The modeling indicated that the 100 year flood would be contained by the storage area without overtopping, and released over time through the existing culvert to the Rio San Jose. The peak from the Zuni Canyon watershed is reduced and lagged through this detention so it has minimal impact on peak rates in the Rio San Jose from the local watersheds downstream.

In the case of the Rio San Jose watershed located upstream of the detailed study area, peak flow data for USGS gage station number 08343000 was reviewed and assumptions were developed based on the data. This gage is located on the Rio San Jose in Grants near the El Morro Road crossing. Peak streamflow measurements have been recorded at this site for a period of record from 1950 to 2004 and 2007 to the present. The available records between 1950 and 2009 for the site indicate that streamflow has only exceeded 400 cfs three times during that period of record and has not exceeded 400 cfs since 1957. Given the very high frequency of streamflow values below 400 cfs, it is conservative to assume that there is very low probability that the Rio San Jose will contribute over 400 cfs to the peak rates in the Rio San Jose from local watersheds in the 10 and 100 year runoff events. Thus, a base flow element was added to the Rio San Jose at the upstream limits of the detailed study area within the HEC-HMS model. A constant flow rate of 400 cfs is simulated by this element for both the 10 and 100 year events to reflect that timing of the peak of this flow is unknown and the possibility that the flow could be of long duration if it is the result of an upstream reservoir release.

The above noted gage is below the point that the flow from Zuni Canyon Arroyo enters the Rio San Jose and thus gaged peak flows includes the impacts from Zuni Canyon runoff. Given that the flows from Zuni Canyon Arroyo are represented separately in the model, the base flow of 400 cfs appears to be conservative. However, given the very large size of the Rio San Jose watershed and the many unknown, variables that may be in play there, a conservative approach appears to be justified.

2.2 Hydrologic Characteristics

2.2.1 Watershed Delineation

Watershed and sub-basin delineation was based on USGS Quad Sheet contours obtained from the New Mexico Resource Geographic Information System program (RGIS) in the majority of offsite watershed area, and 2-foot vertical interval contours generated from photogrammetry for the majority of the study focus area. Figure 2-4 in Appendix Section 2 shows the topographic mapping utilized in this study.

The watershed analyzed in this study encompasses a 40.5 square mile region stretching from the western toe of Black Mesa on the west to a divide in the Zuni Mountains on the east. The boundary of the watershed analyzed in this study is shown on Figure 1-1 in Appendix Section 1. The watershed was divided into 109 drainage basins as shown on Figure 2-6 in Appendix Section 2.

The Rio San Jose is the major drainage outfall from the Study Area. Runoff from the Study Area watershed is conveyed to the Rio San Jose in a number of natural and man-made tributaries. The largest of these tributaries originates in Grants Canyon northeast of Grants and will be referred to as Grants Canyon Arroyo. The Grants Canyon Arroyo discharges to the Rio San Jose just upstream of Nimitz Road.

Drainage flow paths within the watershed were determined based on topographic mapping, aerial photography, and site investigation.

2.2.2 Hydrologic Soil Groups

Soil characteristics, composition, and structure influence runoff potential by affecting the rate that precipitation is able to infiltrate the soil. The infiltration rate is the key factor in determining the amount of rainfall that will be held in the soil and how much contributes to surface runoff. Soils with a high infiltration rate generally have low runoff potential while soils with a low infiltration rate typically have a high runoff potential.

The drainage basins delineated in this study contain a total of approximately 40.5 square miles and consist of numerous soil classes. This study focused on the hydrologic soil group associated with each particular soil class as defined by the Natural Resources Conservation Service (NRCS). The NRCS separates hydrologic soil groups based on the rate of water infiltration with Group A soils having high infiltration rates and low runoff potential and Group D soils having low infiltration rates and high runoff potential. The groups are more specifically defined as follows:

Group A: Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission (greater than 0.30 in/hr).

Group B: Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission (0.15 to 0.30 in/hr).

Group C: Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission (0.05 to 0.15 in/hr).

Group D: Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission (0 to 0.05 in/hr).

Soil group boundaries were obtained from the New Mexico Resource Geographic Information System (NMRGIS). Figure 2-1 in Appendix Section 2 illustrates the coverage of hydrologic soil groups for the study area based on the NMRGIS data. The following table provides a summary of the hydrologic soil groups that comprise the study area for this report. As shown in the table, over 62% of the study area contains soils with high runoff potential.

Percent Composition of Hydrologic Soil Groups for the Study Area

Hydrologic Soil Group	Area (ac)	Percent Composition
A	0	0%
B	4,378	16.9%
C	5,306	20.5%
D	16,223	62.6%

2.2.3 Climate and Precipitation

The study area is located in southern New Mexico, which is included in the semiarid southwestern United States by NOAA Atlas 14. This region receives just over 11 inches of average annual precipitation with the majority of the precipitation events occurring between the months of May and October. Typical rainfall events for this region include brief, intense summer thunderstorms that deliver significant amounts of rainfall in relatively short periods according to the Western Regional Climate Center. These intense storm events coupled with typically sparse vegetative cover often lead to flash flooding. Historic stream gage data indicates that the majority of the significant runoff events occur July through September in the Study Area.

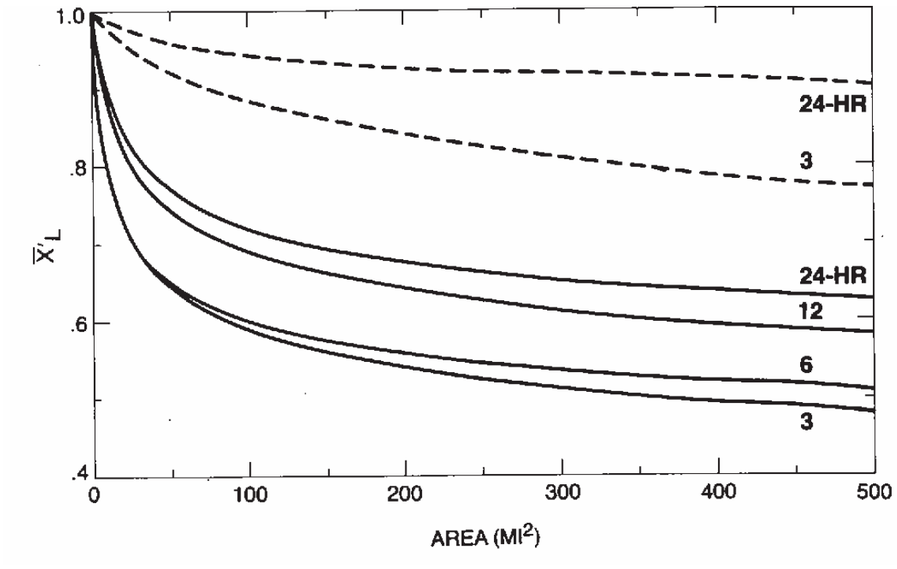
Rainfall depths for storm events with 10 and 100-year frequencies were utilized in runoff calculations for this study. Point precipitation frequency estimates were obtained from NOAA Atlas 14 for the location at 35.18° N latitude and 107.80° W longitude, which is near the geographic center of the study watershed. Rainfall depths of 1.86 inches and 2.76 inches were utilized for the 24-hour, 10 and 100-year frequency storms, respectively.

In accordance with the NMDOT Drainage Manual, a Modified NOAA-SCS rainfall distribution was generated to simulate storm events utilizing the 10 and 100-year rainfall depths. The Modified NOAA-SCS rainfall distribution utilizes NOAA peak rainfall intensities rearranged around the storm peak at six hours to create a unique Type II-a storm distribution for each location in New Mexico. Tables 2-24 thru 2-26 in Appendix

Section 2 show the Modified NOAA-SCS rainfall distributions for the 10 and 100-year storm events with depth-area rainfall reduction ratios applied as discussed in the following paragraphs.

In small watersheds there is a high probability that the entire watershed may receive the design point rainfall for a particular storm event. However, as watershed size increases it becomes less likely that the entire watershed will receive the design point rainfall and thus it is appropriate to reduce the point rainfall relative to the size of the watershed.

The size of the watershed analyzed in the current study warranted the application of depth-area rainfall reduction ratios as determined by Zehr and Myers (1984) for the calculation of peak flows at select analysis points. In the current study, the depth-area rainfall reduction ratio was determined to be 84% based on the 20.6 square mile watershed upstream of the confluence of the Grants Canyon Arroyo and the Rio San Jose. Thus, only 84% of the 24-hour point rainfall was utilized in the hydrologic model to calculate peak flow rates along the Rio San Jose below the confluence with the Grants Canyon Arroyo. 100 percent of the 24-hour point rainfall was utilized in the calculation of flow rates in the remainder of the detailed study area.



Depth-area rainfall reduction ratios for 3-, 6-, 12-, and 24-hour durations for western New Mexico. X'_L represents reduction ratio to be applied to rainfall values based on watershed area. Dashed lines represent 3-hour and 24-hour durations for Chicago and are shown for comparison only. Source: NWS HYDRO-40 (1984)

Depth-area ratios were determined to represent the spatial variation of rainfall events with respect to drainage basin size. The figure shown on the lower left side of this page shows the depth-area relationships utilized in the current study. The use of the reduced point rainfall is only valid for areas with large watersheds. Thus, peak rates were generated in separate model runs using 100% and 84% of the point rainfall for the Study Area. A rainfall depth-area ratio of 77%, corresponding to a drainage area of approximately 45 square miles, was applied to the rainfall distribution used to model the Zuni Canyon drainage basin. While the full output tables from both model runs are contained in Appendix Section 2, the peak rates from the 84% model are only carried forward for presentation and application at Analysis Points 96, 97, 98, 99, 100, and 102.

2.2.4 Time of Concentration

The SCS Unit Hydrograph method requires user input of the lag time (T_{lag}) for each drainage basin in order to develop a hydrograph. The lag time parameter for the HEC-HMS hydrologic model was determined from the time of concentration (T_c) values by utilizing the following relationship (NEH, 1972):

$$T_{lag} = 0.6T_c$$

The time of concentration represents the time required for runoff from the most hydraulically remote point in the basin to travel to a point of interest within the basin. The flow regime for surface runoff consists of several types of conveyance depending on the location within the basin and the amount of contributing runoff. The travel time (T_t) for each type of conveyance is dependent on basin characteristics and parameters of each flow segment. Times of concentration for this study were determined by combining individual travel times for overland flow, shallow concentrated flow, and channel flow segments.

Travel times for the overland flow segments of the basins were calculated using the following Kinematic Wave Equation for overland flow (SCS TR-55, 1986):

$$T_t = \frac{0.42}{P_2^{0.5}}\left[\frac{nL}{\sqrt{S}}\right]^{0.8}$$ where,

T_t = travel time (min)
n = Manning's roughness coefficient for overland flow
L = length of flow path (ft)
S = slope of flow path (ft/ft)
P_2 = 2-year, 24-hour rainfall depth (in)

SCS TR-55 (1986) recommends a maximum flow length of 300 ft be used for overland flow since runoff typically begins to concentrate into shallow concentrated flow after this distance depending on the geometry of the land. A Manning's roughness coefficient of n=0.06 was used to represent the land cover for the semi-arid desert study area. The coefficient of n=0.06 corresponds to cultivated soils with residue cover less than or equal to 20% (SCS TR-55, 1986). The study area was estimated to contain 20% or less of residue cover when considering a sheet flow depth of 0.1 ft.

Shallow concentrated flow represents runoff that has concentrated in rills and small gullies, but has not yet concentrated into larger open channels. Travel time associated with shallow concentrated flow for this study was calculated using the following equation (FHWA, 2002):

$$T_t = \frac{L}{*k*S^{0.5}}$$ where,

T_t = travel time (min)
k = dimensionless function of land cover
L = length of flow path (ft)
S = slope of flow path (ft/ft)
α = unit conversion equal to 1980 in CU units

A "k" land cover factor of 0.619 pertains to small upland gullies (McCuen et al., 1995) and was used in shallow concentrated flow calculations for this study.

The transition point between shallow concentrated and open channel flow was determined by evaluating the drainage network characteristics of each basin. Open channel flow is typically assumed to begin where channels are evident on aerial photographs, USGS quadrangle sheets, or where surveyed channel cross sections are obtained (SCS TR-55, 1986). Open channel flow for this study was determined to begin where two or more shallow concentrated flow segments with significant drainage areas combined into a single drainage channel. Discharge rates used in the estimation of travel times were approximated by estimating the size of the contributing drainage area and assuming a runoff yield of 1 cfs/ac for rural, undeveloped areas and 2 cfs/ac for developed areas. Channel velocities based on Manning's equation normal depth calculations were used to determine the travel time. The Manning's roughness coefficients for open channel flow were estimated to be n=0.030 or n=0.065 depending on the characteristics of each channel. Channel parameters such as longitudinal slope, bottom width, and side slopes were approximated from topographic mapping, aerial photographs, and site inspection.

The travel times for the overland, shallow concentrated, and channel flow segments were combined to determine the time of concentration for each basin. Table 2-21 in Appendix Section 2 provides a summary of the time of concentration calculations for this study. The table below provides a statistical summary of the time of concentration values for the basins analyzed in this study.

Summary of Time of Concentration Statistics

Time of Concentration	
Minimum	0.10 hrs
Maximum	2.32 hrs
Average	0.51 hrs

2.2.5 Land Use/Cover

Land cover for the rural, undeveloped areas of the analyzed watershed that are outside of the existing land planning or zoning maps were determined based on aerial photography, site investigation, and GIS spatial data from the USGS National GAP Program. Vegetation in the rural, undeveloped regions of the studied watershed consists primarily of desert woodlands and grasses. Pinyon-Juniper Woodlands are common in the upper slope areas of the watershed, while sparse grasses are more prevalent in the flatter areas. In the rural, undeveloped portion of the watershed, Pinyon-Juniper Woodlands cover approximately 62% and the sparse grasses cover approximately 28%. The photos on the following page are representative of the vegetation found in the rural portions of the watershed.

Future land use within the Study Area was determined based on generalizations of allowable land uses as shown on the current Grants and Milan zoning maps. The land use descriptions and impervious area assumptions presented on the following page were assigned for City of Grants and Village of Milan areas and are shown on Figure 2-2 in Appendix Section 2 of this report. Table 2-20 in Appendix Section 2 of this report includes the future land use descriptions and impervious area assumptions used in the future condition hydrologic analysis. The average pervious portion of each category of land use was assumed to be open space/ lawn grass in fair condition.



Typical land cover in the rural portions of the watershed. Pinyon-Juniper Woodlands on the slopes in the background with sparse grass in the flatter areas of the foreground.





Close up views of typical grass cover in the rural portions of the watershed

Residential 2 to 3 acre lots

Assumed 2 to 3-acre lots to develop consistent with patterns of existing development with a sparse street grid. 10% of this area was assumed to be impervious.

Residential 1 to 2 DU/AC

Assumed 1 to 2 DU/Acre lots to develop consistent with patterns of existing development throughout the area. These areas have moderately dense street grids and thus 25% of this area was assumed to be impervious.

Residential 3 to 5 DU/AC

Assumed 3 to 5 DU/Acre lots to develop consistent with patterns of existing development throughout the area. 40% of this area was assumed to be impervious.

Residential 6 to 8 DU/AC

Assumed 6 to 8 DU/Acre lots to develop consistent with patterns of existing development throughout the area. 65% of this area was assumed to be impervious.

Industrial

Assumed 70% impervious based on NRCS average recommended value adjusted slightly to reflect local development patterns.

Commercial

Assumed 85% impervious based on NRCS average recommended value adjusted slightly to reflect local development patterns.

Parks/Golf Course

Assumed 5% impervious

I-40 ROW/ Airport Runway

Estimated percent impervious based on the specific location analyzed due to significant variations in the corridors.

Existing land use within the Study Area was determined using similar classification of land use areas within Grants and Milan as were utilized in the future condition land use analysis. Undeveloped regions of the study watersheds were evaluated as native vegetation land cover to account for the variation in land use between the existing and future condition. Generally, the most significant increases in CN value from the existing to future condition are seen along the southern and eastern limits of Grants. Other

areas within Grants and Milan that included undeveloped land in the existing condition demonstrated increases in CN values when evaluating the future condition.

Areas of Grants and Milan along the Black Mesa are anticipated to see little change in CN value with development. Some anticipated development on existing HSG D soils and rock may actually reduce runoff potential in the future condition. Table 2-19 in Appendix Section 2 of this report includes the existing land use descriptions and impervious area assumptions used in the existing condition hydrologic analysis. In areas where the anticipated differences between the existing and future conditions were found to be very minor, the future condition land use assumptions were utilized in both the existing and future condition analysis.

2.2.6 Runoff Curve Numbers

The SCS developed runoff curve numbers (CNs) to represent the physical characteristics of a watershed when calculating excess rainfall from a storm event. Factors such as hydrologic soil group, cover type, land treatment, hydrologic condition, and antecedent moisture condition contribute to the CN value and in turn influence calculated runoff rates and volumes. The relationship between CN and excess rainfall is such that increased CN values correlate to higher runoff values. SCS runoff curve numbers were developed to represent the existing and future land use for the drainage basins in the study area using recommend values from NMDOT (1995). CN values are used in HEC-HMS to determine the amount of excess rainfall over a specific basin area.

Normal weighted CN values were assigned to each drainage basin based on the land cover, hydrologic soil group, and antecedent moisture condition. Normal CNs reflecting antecedent moisture condition II were selected based on recommendations from NMDOT (1995). Land cover and hydrologic soil group characteristics that were evaluated for each basin for the existing and future land use conditions are detailed in Tables 2-19 and 2-20 in Appendix Section 2, respectively.

It should be noted the normal weighted CNs that were calculated and utilized in the initial hydrologic modeling effort, were uniformly reduced to 89% of the normal values in the calibration of the hydrologic model as described in the following section. The reduced CN values utilized in the calibrated HEC-HMS model are also shown on Tables 2-19 and 2-20 in Appendix Section 2. Reduction of CNs results in increased initial abstraction and thus less runoff being simulated by the model. The reduced CN values reflect an antecedent moisture condition approximately midway between I and II for the given land covers and hydrologic soil groups. Additional discussion of the calibration process is included in the following section.

2.2.7 Model Calibration

HEC-HMS model calibration was accomplished in the following steps:

- General research to identify historic flood events for which the magnitude of both rainfall and the resultant flood could be quantified.
- Specific research and interviews to better document and quantify the selected calibration flood event.
- Hydraulic modeling to estimate the peak flow rate associated with the selected calibration flood based on eyewitness observations.
- Simulation of the approximate record rainfall patterns and depths associated with the selected calibration flood event in the HEC-HMS model.
- Uniform reduction of curve numbers (by ratio) throughout the modeled contributing watershed to reduce the simulated runoff from the calibration event to approximate the estimated peak flow rate of the selected calibration flood.
- Meeting with USACE personnel to discuss methodology and initial findings and obtain general concurrence with the calibration approach.
- Application of the calibrated (uniformly reduced) curve numbers throughout the HEC –HMS model for the detailed study area.
- Comparison of model results with results from other methods and published values.

Our research revealed scattered rainfall depth reports for several significant storms and several reports of flooding through the years. The research also indicated that significant rainfall is generally not widespread through the detailed study area and the most reliable raingage records are for the airport, a location that is difficult to assess resulting runoff from. Thus, finding both rainfall and runoff records for the same event proved to be difficult.

Streamflow gages have been maintained by the USGS in two locations within the Study Area for several years. One is on the Rio San Jose, and has a very large complex watershed with several controls and broad floodplains making it inapplicable to calibration of a hydrologic model for the detailed study area. The second gage was maintained on the Grants Canyon Arroyo at the upstream side of the Roosevelt Avenue crossing (USGS Gaging Station Number 08343100). This gage has 34 years of record data for a 13.8 square mile watershed located entirely within the detailed study area. However, we were unable to find good raingage records for the watershed to correlate with flood events at the gage and the gage was taken out of service in 1995 prior to the availability of NEXRAD rainfall records.

We found several newspaper accounts of a significant flood event associated with the Grants Canyon Arroyo that occurred on August 11, 2005. Given the availability of

NEXRAD rainfall records for this storm, it was selected as the event to be used for calibration of the HEC-HMS model. The Grants Canyon stream gage was not active in 2005, but the storm event was unique in that several clues to the magnitude of the flooding were provided in the news articles and the event was recent enough that we could find and interview eyewitnesses of the flood.

Several locations for the calibration point were considered. After evaluation it was decided that the Roosevelt Avenue Crossing over Grants Canyon Arroyo had the strongest correlating data related to the flood. Other locations such as the Washington Avenue Bridge had significant news accounts but some of the data appeared to be conflicting and one report indicated blockage in the culverts.

Several news articles were reviewed and interviews were conducted with individuals that witnessed the flooding that occurred in the area of the Roosevelt Avenue crossing during the calibration storm event. Copies of relevant articles and interview summaries are contained on Pages 7 through 13 in Appendix Section 5 of this report. An exhibit showing the calibration area and estimated flood limits of the calibration flood is contained on Page 15 of Appendix Section 5 of this report.

One account of the flooding was recorded from an interview with an employee at the office for the El Malpais National Monument located on the south side of Roosevelt Avenue adjacent to the west side of the Grants Canyon Arroyo. The employee was temporarily prevented from leaving the facility due to high floodwaters. The account of the event indicated that the building sustained flooding on the ground level due to high water levels in the parking areas on the east and west sides of the building. Existing topography was used along with the account of the flooding to determine a reasonable range of floodwater depths at Roosevelt Avenue.

A second account of the flooding was obtained from an interview with a City of Grants employee that observed the flooding first hand. The individual indicated that approximately one foot of water was flowing across Roosevelt Avenue at the time he arrived at that location. The individual also noted that he had not been onsite during the peak of the storm runoff and that one to two feet of depth may have been possible over Roosevelt Avenue.

The personal and news article accounts of the flooding due to the calibration storm were utilized to estimate a peak flood stage in the Grants Canyon Arroyo at the Roosevelt Avenue location. The HEC-RAS hydraulic model of the Grants Canyon Arroyo was used to estimate the flow rate associated with this flood stage though iteration and interpolation. The peak flood stage elevation of the calibration flood was estimated to be approximately 6455.5. Modeled flow rates of 7,000 and 8,000 cfs resulted in calculated water surface elevation just below and just above the calibration flood level. Thus, the calibration flood rate at the Roosevelt Avenue crossing was established at approximately 7,500 cfs.

National Climate Data Center NEXRAD rainfall data obtained for the calibration storm was used to create a storm hyetograph approximating the calibration event. This hyetograph was used in the HEC-HMS model to simulate the calibration storm in the watershed contributing to the calibration point. Rainfall depths were varied across the watershed to approximate the variation in depths indicated by NEXRAD data for the calibration storm. Individual basins within the Grants Canyon watershed were assigned a rainfall depth based on the approximate geographic location and basin area in an effort to represent the spatial distribution and magnitude of the calibration storm event. The NEXRAD data indicates that rainfall depths in the Grants Canyon watershed ranged from 1.0 to 5.0 inches in the calibration storm. NEXRAD imagery for the calibration storm and hyetograph values are included on Pages 2,3, and 4 of Appendix Section 5.

A HEC-HMS simulation of the calibration event was then executed with normal curve numbers determined as described in previous sections. The predicted flow rate at the calibration point was significantly higher than the 7,500 cfs calibration flood rate. Additional simulations were made of the calibration event using uniform reductions (by ratio) of the normal CN values in order to window in on uniformly reduced CNs that would result in prediction of a flow rate close to the calibration target flow rate (7,500 cfs). The reduction factor was determined to be 0.89. A HEC-HMS simulation of the calibration event with the CNs reduced to 0.89 of the normal CNs predicted a peak flow of 7,631 cfs and was determined to be close enough to the target. A hydraulic calculation was then performed using HEC-RAS and the 7,631 cfs flow rate. The hydraulic model calculated a flood depth of 6455.6 at this flow rate. Thus, a uniform normal CN reduction factor of 0.89 was adopted for application throughout the detailed study area for the purpose of predicting peak flow rates in the major waterways.

The reduced CNs were applied to the HEC-HMS model covering the entire detailed study area. Then, simulations were made for the 24 hour, 10 and 100 year recurrence events using the Modified NOAA-SCS rainfall distribution applied as discussed in previous sections of this report. Predicted peak flow rates were summarized and compared to results from other prediction methods and published values at three major analysis points. These points are:

- AP 28 at the Roosevelt Crossing of Grants Canyon Arroyo.
- AP 96 at the confluence of the Rio San Jose and Grants Canyon Arroyo
- AP 100 at the railroad crossing of the Rio San Jose at the downstream limit of the detailed study area.

A comparison summary table of the predicted flow rates at these points is provided below.

Flood Study Comparison Table

Analysis Point	Recurrence Interval	Predicted Peak Discharge (cfs)					
		Current DMP HEC-HMS[1]		USGS[2] SIR 2008-5119 Region 6 Equation	USGS[3] SIR 2008-5119 Weighted Estimate	FEMA[4] FIS	May 2000 Grants Master Drainage Plan
		Existing	Future				
28	10-year	874	883	1,341	885	1,040	n/a
	100-year	3,197	3,215	3,526	2,666	3,020	4,700
96	10-year	1,203	1,220	1,963	1,432	559	n/a
	100-year	3,526	3,570	4,471	3,480	2,440	4,900
100	10-year	1,399	1,484	2,127	1,523	559	n/a
	100-year	4,273	4,470	5,235	3,734	2,440	6,100

Notes Regarding Values in the Comparison Table:

1. The "Current DMP HEC-HMS" column of the above table includes flow rates at AP 28 that were predicted with 100% of the total point rainfall depth throughout the Grants Canyon watershed. Flow rates at AP 96 and AP 100 were predicted with 84% of the total point rainfall depth throughout the detailed study area, a base flow of 400 cfs to account for potential Rio San Jose contributions from upstream of the detailed study area, and detained flow from the Zuni Canyon culvert under I-40. 77% of the total point rainfall depth was applied to the Zuni Canyon watershed. The rainfall depth reductions were based on depth-area reduction ratios presented in NWS HYDRO-40 (1984).

2. The "USGS SIR 2008-5119 Region 6 Equation" column of the above table includes straight results of equations at AP 28. Values presented at AP 96 and AP 100 are the results of the equations plus 400 cfs to put them on the same basis as the Current DMP values. The 400 cfs accounts for potential contributions from the very large and partially controlled Rio San Jose watershed upstream of the detailed study area. Only the detailed study area contributing to the APs was used in the calculations. The Zuni Canyon Arroyo contribution to the peak flow is very limited due to lagging, and thus it was ignored in these calculations. The utilized equations are included on Page 14 of Appendix Section 5 of this report.

3. The "USGS SIR 2008-5119 Weighted Estimate" column of the above table includes values at AP 28 that reflect recalculated weighted estimates for USGS Gaging Station Number 08343100 to account for a larger contributing watershed as determined in the current detailed study. Equivalent record lengths en_{10}=3.13 and en_{100}=7.77 were utilized in the weighting equation presented in SIR 2008-5119. Values at AP 96 and AP 100 were calculated using the drainage area ratio adjustment equation presented in SIR 2008-5119 for un-gaged sites on a stream having a nearby gaging station. The weighted estimate values at AP 28 (described above) were used as rates at the gaged site. The base flow of 400 cfs was added to the results of the equation as described in Note 3. It should be noted that at AP 100, the (un-gaged watershed area/gaged watershed area) ratio = 1.86. The recommended upper limit for application of the equation is a ratio of 1.5. The utilized equations are included on Page 14 of Appendix Section 5 of this report.

4. The "FEMA FIS" column of the above table includes flow rates presented in the FEMA Flood Insurance Study for Cibola County, New Mexico, effective date December 17, 2010.

The current predicted values appear to be reasonable in comparison with the other values presented in the comparison table contained on this page.

The SIR 2008-5119 regional regression equations for Region 6 only use "watershed area" to describe characteristics of the watershed of interest. Other characteristics that influence runoff rates such as watershed slope and annual and single event precipitation depths are not included. Of these characteristics, only slope associated with the subject watershed is indicated to be above average for the Region 6 station watersheds. Average annual and 10 and 100 year - 6 and 24 hour event precipitation depths for the subject watershed are well below average and near the bottom of the range of values presented for the gage station watersheds indicated to be included in the development of the Region 6 equations. The subject watershed size is also near the bottom of the range and falls well below average. Given the above, and the fact the regression equation estimates at USGS Gaging Station Number 08343100 (Grants Canyon at Roosevelt) are significantly higher than values calculated for the station, it seems likely that the equations may over predict runoff in the subject watershed.

As could be expected, the majority of the current predicted values are more similar to the values predicted by the weighted estimate as these values relate to a local station. However, given the magnitude of the recent flood that was used in the calibration of the model, the 100 year weighted estimate values at AP 28 (the calibration point), seem low.

The current predicted values are similar to the FEMA FIS flows rates at AP 28. The FIS flow rates at AP 96 and 100 located downstream of the confluence of the Rio San Jose and Grants Canyon Arroyo seem low as they are lower than the rates that the FIS presents for the Grants Canyon Arroyo alone.

2.3 Hydrologic Modeling Results

HEC-HMS model output has been summarized on various figures contained in Appendix Section 2. Tables 2-1 and 2-2 provide a comparison of the existing and future runoff values for the drainage basins and analysis points included in the study. Tables 2-3 and 2-4 provide a summary of the existing condition peak rates from each drainage basin and analysis point in the Study Area. Tables 2-5 and 2-6 provide a summary of the future condition peak rates from each drainage basin and analysis point in the Study Area. A complete summary of the peak flow rates for all future condition model elements is also included on Tables 2-7 through 2-18 in Appendix Section 2. Peak flow rates, runoff volumes, contributing watershed areas, and modeled time to peak are summarized in the table presented on this page for key analysis points throughout the watershed.

It should be noted that the predicted peak flow rates for the existing and future conditions are nearly identical for the majority of the analysis points along the Rio San Jose and Grants Canyon Arroyo. The largest difference in existing and future 100 year flow rates for these two streams is approximately 6 percent. This small difference is not considered significant enough to warrant a separate hydraulic modeling effort. Peak flow rates utilized in the hydraulic analysis prepared for this report reflect the future condition.

HEC-HMS Summary of Key DMP Analysis Points

Analysis Point	Q_{10} (cfs)	Q_{100} (cfs)	Runoff Volume 100-yr (ac-ft)	Watershed Area (sq. mi.)	Time of Peak
5	418	1,417	215.3	6.66	6:41
13	715	2,744	385.2	10.85	6:55
14	96	323	40.9	1.16	6:40
16	446	1,328	178.5	4.26	6:48
17	76	195	18.9	0.35	6:26
18	107	268	26.5	0.46	6:27
20	103	314	26.1	0.60	6:18
28	883	3,215	511.7	13.77	7:03
30	998	316	22.0	0.50	6:08
31	41	115	6.3	0.12	6:03
34B	61	174	15.2	0.34	6:05
35	141	336	23.4	0.36	6:09
36	57	142	7.8	0.13	6:04
37	52	121	15.5	0.28	6:25
38	68	163	19.6	0.35	6:28
39	885	3,225	516.6	13.90	7:06
40	70	200	18.9	0.42	6:23
42	491	1,495	208.9	4.97	6:53
57	56	200	21.2	0.56	6:07
59	65	231	23.4	0.61	6:09
61	15	52	4.0	0.10	6:10
63B	44	153	18.6	0.50	6:06
65	16	53	3.7	0.09	6:07
70	96	329	33.1	0.81	6:07
72	72	206	13.0	0.25	6:07
82	147	431	43.1	0.98	6:23
85	89	244	16.1	0.30	6:10
96*,**	1,220	3,570	2,056.8	20.58	7:17
97*,**	1,236	3,603	2,070.4	20.88	7:17
98*,**	1,247	3,626	2,079.9	21.24	7:20
99*,**	1,495	4,541	2,230.4	26.57	7:18
100*,**	1,484	4,470	2,226.6	26.67	7:22
102*,**	1,617	4,840	2,291.4	28.06	7:21

*Peak rates for analysis points calculated using 84% of the 24-hour point rainfall depth to account for the size of the watershed. (Refer to Section 3.2.3)

**Flow rates and runoff volumes skewed due to addition of baseflow element in HEC-HMS. Area listed does not include contributing area from the Zuni Canyon basin.

3. Hydraulic Analysis

3.1 Scope

The detailed hydraulic analysis performed in Phase 1 of the current study was limited to the Rio San Jose and Grants Canyon Arroyo and associated major structures. During site visits and data collection for the project the general locations, sizes, and general conditions of other drainage structures that were discovered were noted. The general locations of these drainage structures are presented on Figures 3-1 through 3-8, and information related to the structures is contained in Table 3-1 of Appendix Section 3. For the structures that lay outside of the Rio San Jose and Grants Canyon Arroyo a non-detailed assessment of the capacity of the culvert to convey the 10 and 100-year tributary flow rates was made and is presented in Table 3-1.

3.2 Methodology

The major channels and associated structures were analyzed with the USACE Hydrologic Engineering Center–River Analysis System (HEC-RAS). In summary, the hydraulic analysis performed in the scope of this study includes 10 stream miles of the two major channels and 21 major crossing structures. The analyzed crossing structures include bridges, box culverts, arch culverts and pipe culverts in various configurations.

As previously mentioned, Figures 3-1 through 3-8 and Table 3-1 contained in Appendix Section 3 of this report show the locations of the channels and crossing structures included in the analysis and provide a summary of information related to the structures. Appendix Section 3 also contains cross sections, profiles, and tabular output from the HEC-RAS models.

3.3 Data Sources

3.3.1 Topographic Data

Topographic data utilized in the hydraulic analysis varies throughout the Study Area. As shown on Figure 2-4 in Appendix Section 2, Wilson & Company prepared topographic mapping at two foot contour intervals for the majority of the City of Grants and the Village of Milan (area of focus). This mapping was prepared from aerial photogrammetry and is based on North American Vertical Datum 88 (NAVD88).

A limited field structure survey was performed by Wilson & Company for the project. This survey provided horizontal and vertical information for the majority of the culverts analyzed.

3.3.2 Manning's Roughness Values

Manning's roughness coefficients (n-values) were estimated for the various reaches of the analyzed channels based on site visits and photographs. The Cowan Method as presented in "Open Channel Hydraulics", Ven Te Chow, Ph.D., 1959, was utilized in the estimates. With the Cowan Method, six primary factors affecting the n-value are assigned values and then the six values are added together to obtain the section value. Material, irregularity, cross section variation, obstructions, vegetation, and degree of meandering are the factors considered in the method.

Except where the bottoms of structures are expected to be covered with sediment, roughness values utilized in the analysis of drainage structures are consistent with the values presented in the NMDOT Drainage Manual Volume 2, November, 1998. The n-value represents the resistance to flow that is associated with a particular conveyance structure. Structures with smooth surfaces and little cross sectional variation provide minimal resistance and thus low n-values are utilized to model them. Structures with rough surfaces, dense vegetation, or considerable cross sectional variation require high n-values to represent the associated higher resistance to flow.

Manning's n-values that ranged from 0.030 to 0.058 were utilized for the majority of the channel sections and n-values of 0.040 to 0.085 were utilized in the overbank areas analyzed in this study. For the limited channel or structure segments with concrete paved inverts or sides that are anticipated to stay clean or were in un-scoured condition, the n-value of 0.013 was utilized. Due to significant variation across the majority of the cross sections, separate n-values were utilized for the left and right overbanks and the main channel. These n-values were based on generalized conditions across the particular element of the cross section.

3.3.3 Hydrologic Flows

The primary 100 year flow rates utilized in the current HEC-RAS hydraulic analysis of the Rio San Jose and the Grants Canyon Arroyo are the greater of the effective FEMA FIS rates or current HEC-HMS analysis predicted peak flow rates. For comparison purposes only, the 100 year FEMA FIS flow rates were included in the hydraulic analysis for all reaches and output associated with the FIS rates is included in summary tables and profiles in this report. Additional details about the rates that were utilized in the hydraulic analysis are provided in the following paragraphs. The utilized flow rates are shown graphically on Figures 3-9 through 3-15 and Figures 3-16 and 3-17.

The 100 year flow rate utilized for the analyzed portion of the Rio San Jose located upstream of the confluence with the Grants Canyon Arroyo is the 2,440 cfs rate utilized in the FEMA FIS. This rate is larger than the current study predicted rate which is based on a peak from the local basins with a relatively small contribution (400 cfs) from the very large watershed located upstream of the detailed study area. The FEMA FIS rate is more reflective of the peak that may occur from events in the larger watershed and thus is the more appropriate rate for use in this reach. The 10 year rates utilized in this reach increase from the FIS rate of 559 cfs at the upstream end to 1,059 cfs as predicted by the current hydrologic study.

The current hydrologic study predicts 10 and 100 year flow rates that are larger than the effective FEMA FIS rates in the analyzed reach of the Rio San Jose located downstream of the confluence with the Grants Canyon Arroyo. Thus, the current study rates were utilized in the hydraulic analysis of this reach. The utilized 100 year rates range from 3,570 cfs just downstream of the confluence to 4,470 cfs at the downstream end. The 10 year flow rates utilized for this reach range from 1,220 cfs just downstream of the confluence to 1,484 cfs at the downstream end. It should be noted that according to the FIS, flow data from the USGS gage station on the Rio San Jose located just upstream of the El Morro Road was utilized to establish the FIS flow rates for the Rio San Jose through the current study area. This gage station is located upstream of the confluence with Grants Canyon Arroyo and the points of discharge from the majority of the urbanized basins of Grants. Thus, the FIS flow rates do not appear to reflect the significant influence that the local basins have on the peak flow rates in this reach.

The current hydrologic study predicts 100 year flow rates that are larger than the effective FEMA FIS rates in the analyzed reach of Grants Canyon Arroyo. Thus, the current study rates were utilized in the hydraulic analysis of this reach. The utilized 10 and 100 year rates for the reach are 883 cfs and 3,215 cfs, respectively. While the current 100 year predicted rate is approximately 6.5 percent larger than the FIS rate for the reach, it pales in comparison with the peak flow rate of the 2005 flood which was estimated to be around 7,500 cfs in this reach.

Table 3-1 contained in Appendix Section 3 relates the various structures to corresponding analysis points in the HEC-HMS model. Table 3-1 also presents the 10 and 100-year peak flow rates to be conveyed by each structure. These peak flow rates assume that all upstream structures within the detailed study area are adequate to convey the runoff from the associated watershed with no upstream diversions or detention occurring. This assumption does not apply to the Zuni Canyon Arroyo watershed or portions of the Rio San Jose watershed located upstream of the detailed study area.

3.3.4 Ineffective Flow Areas

Accurate modeling of drainage systems that have inadequate capacity and are subject to diversions of flow is complex. Both the Rio San Jose and the Grants Canyon Arroyo have reaches where the banks are higher than adjacent land areas. Thus, when the channel capacity is exceeded, flow will leave the channel and will be conveyed in areas behind the channel embankments. Once this flow leaves the embanked channel section, it will travel outside of the main channel until it reaches a point where it can flow back over the embankment and into the main channel.

Without application of artificial constraints, the HEC-RAS program will simply balance flow across analyzed cross sections based on elevation and hydraulic properties without regard to the physical constraints that may separate the main channel from the overbank areas. This can lead to inaccurate calculations due to inaccurate placement of flow in the model. Therefore, the ineffective flow area tool, applied with engineering judgment, was utilized in the model in an effort to manage these issues associated with automated flow balancing across each analysis section.

The ineffective flow area tool allows the user to define cross sections to replicate surveyed conditions but then block off areas of the cross section. The ineffective areas are then excluded from the hydraulic calculations. Thus, areas of the cross sections that are below the calculated water surface, but are in locations that would prevent them from receiving and conveying flow or certain rates of flow, can be regulated for more accurate hydraulic calculation.

Judgment was made as the hydraulic models were assembled regarding the portions of sections to make ineffective. The ineffective flow areas were then adjusted through subsequent model runs to achieve a reasonable balance of flow across the modeled sections. Generally, where the model indicated that flow would be contained within the embanked section, lower areas outside the channel embankments were made ineffective unless it was evident that flow lost from the upstream channel section(s) would be conveyed outside of the embankment. Where flow outside of the embankments was indicated, the effective area outside of the embankment was adjusted in an effort to maintain the approximately the same flow rate outside the embankment as was lost upstream, until a point was reached where flow could physically re-enter the main channel.

While there are some inaccuracies associated with this process, it is believed to provide a reasonable approximation of the actual conditions, and is much more accurate than simply letting the model automatically balance the cross section for the embanked channel through the detailed study area.

3.3.5 Flow Regime

All HEC-RAS models utilized in this study were computed in sub-critical flow regime consistent with FEMA floodplain modeling techniques. Computed Froude number values associated with the Rio San Jose were well below 1.0. Due to the steeper gradients present in the Grants Canyon Arroyo, the Froude numbers are higher, but still are generally well below 1.0, consistent with sub-critical flow.

3.3.6 Culvert Input

Culvert and bridge elevations, sizes, lengths, and overflow elevations as determined by the supplemental field or aerial survey were input into the HEC-RAS models. Entrance conditions were determined based on survey data, site observations, and/or photos of the modeled facilities.

3.4 Results of the Hydraulic Analysis

The hydraulic analysis indicates that nearly all of the existing channels and structures within the Study Area are inadequate to convey the peak flow rates associated with the 100-year frequency storm events without overtopping or flooding adjacent infrastructure. This is of particular concern given that in many cases, existing channel banks extend above the adjacent grade and in some of those cases embankment sections are narrow and appear to consist of loosely compacted soil. Overtopping of these embankments would likely lead to full breaching of the embankments resulting in additional flooding of adjacent neighborhoods. Based on the analysis, the majority of the facilities analyzed do appear to have capacity to convey the 10-year design flow. The table included on this page presents 10 and 100-year peak flow rates used in the evaluation of major facilities in the Study Area as well as an indication as to the adequacy the facility to convey the 10 and 100-year design storms.

Appendix Section 3 contains information related to the hydraulic analysis. Figures 3-1 through 3-8 provide the location of the analyzed structures. Table 3-1 contains a partial inventory of the existing drainage structures in the Study Area along with information related to location, physical characteristics, and general condition of included facilities.

Appendix Section 3 also contains photo based exhibits showing the modeled cross sections, a plot of the HEC-RAS profile and cross sections, and a HEC-RAS profile summary table for both of the major channels modeled with this study. Full HEC-RAS output reports for the analysis will only be distributed on request.

Summary of 10 and 100-Year Design Flows and Drainage Structure Adequacy

Structure ID	Structure Location	Q_{10} (cfs)	Q_{100} (cfs)	Adequate Capacity to Pass Q10	Adequate Capacity to Pass Q100
17	Rio San Jose @ Highway 605	559	2,440	Yes	No
27	Rio San Jose @ Milan Railroad Bridge	559	2,440	Yes	No
28	Rio San Jose @ Santa Fe Ave, Milan	559	2,440	Yes	No
51	Rio San Jose @ Sand Street	639	2,440	No	No
52	Rio San Jose @ Clay street	639	2,440	No	No
53	Rio San Jose @ Airport Road	639	2,440	Yes	No
54	Rio San Jose @ Milan Street	639	2,440	Yes	No
66	Rio San Jose @ El Moro Road	929	2,440	Yes	No
70	Rio San Jose @ Railroad Bridge/5th St.	966	2,440	Yes	Yes
71	Rio San Jose @ Santa Fe, Grants	984	2,440	Yes	Yes
73	Rio San Jose @ High Street	996	2,440	No	No
74	Rio San Jose @ City Park Ped. Bridge	996	2,440	No	No
75	Rio San Jose @ Amphitheater Ped. Bridge.	996	2,440	No	No
79	Rio San Jose @ Second Street	1024	2,440	Yes	No
85	Rio San Jose @ First Street	1024	2,440	Yes	No
86	Rio San Jose @ Anderman Street	1024	2,440	Yes	No
92	Grants Canyon Arroyo @ College Boulevard	883	3,215	No	No
94	Grants Canyon Arroyo @ Roosevelt Ave	883	3,215	Yes	No
99	Grants Canyon Arroyo @ Washington Ave.	883	3,215	Yes	No
100	Rio San Jose @ Nimitz Drive	1,236	3,603	Yes	No
105	Rio San Jose @ George Hanosh Blvd.	1,247	3,626	No	No
106	Rio San Jose @ McBride Road	1,495	4,541	Yes	No
107	Rio San Jose @ Lower Rail Bridge, Grants	1,484	4,470	Yes	Yes

Flow depths calculated by the current HEC-RAS models for the Rio San Jose and Grants Canyon models were compared with rating curve information from the USGS for the Rio San Jose at Grants and Grants Canyon at Grants stream gage locations. Rating curves for these locations appear to have been based on limited direct stream measurements for flow rates much less than the flow rates evaluated in this study. Limited information is available pertaining to flow depth calculations for flow rates at the upper limits of the rating curves. Brief descriptions of the comparisons are included in the following paragraphs.

The results of the Rio San Jose HEC-RAS hydraulic model prepared for the current study were compared to the current USGS rating information for the Rio San Jose at Grants gage. This gage location is at a natural channel section approximately 300 feet upstream of the El Morro Road crossing of the Rio San Jose. The largest flow rate included in the rating for this gage is 340 cfs. The flow depth calculated by the current HEC-RAS model for this rate is approximately 3.3 feet and the flow depth of the gage rating is listed as 3.6 feet. The difference of 0.3 feet in flow depth can likely be attributed to changes in vegetation or channel configuration between the time of the recorded measurements and the current condition. The difference is also within the anticipated level of accuracy of the existing topography utilized to define the modeled cross section for the current model. Thus, it appears that the HEC-RAS model prepared and utilized for the current study correlates relatively well to the USGS stream gage information at this specific location on the Rio San Jose.

The results of the Grants Canyon Arroyo HEC-RAS hydraulic model prepared for the current study were compared to the USGS rating information that was effective when the Grants Canyon at Grants gage was discontinued in 1995. This gage was located at the upstream end of the Roosevelt Avenue culverts. The rating for this gage appears to include a series of direct stream measurements for flow rates around 100 cfs. A flow rate of 100 cfs correlates to a flow depth of 1.2 feet based on the USGS rating information. Larger stream flows are identified in the development of the rating curve, but it is unclear what type of indirect measurement was utilized in the calculation of the corresponding flow rate. The current HEC-RAS model for the Roosevelt Avenue crossing on the Grants Canyon Arroyo indicates flow depth of approximately 0.9 feet for a flow rate of 100 cfs. The USGS rating information indicates that a flow depth of 5.2 feet corresponds to a flow rate of 1,600 cfs, but the method of calculation for this flow rate is unclear. The current HEC-RAS model for this location indicates a flow depth of 6.7 feet for a flow rate of 1,600 cfs. The difference in the flow depths produced by the USGS rating and the HEC-RAS model may likely be explained by the influence of the culverts crossing Roosevelt Avenue. While the difference is relatively small for minor flow rates, the impact of the culverts on the upstream flow depth is greatly magnified for high flow rates such as the 1,600 cfs included as the upper limit of the gage rating. While detailed information as to the calculation of the 1,600 cfs flow rate is unavailable, separate culvert calculations were unable to produce a flow rate near 1,600 cfs based on a headwater depth of 5.2 feet.

4. FEMA Floodplain

The Federal Emergency Management Agency (FEMA) recently updated the flood insurance rate maps (FIRMs) for Cibola County, New Mexico and Incorporated areas. The updated floodplain areas from the effective FIRM mapping dated December 17, 2010 are shown on Figure 1-2 in Appendix Section 1. It is our understanding that while new hydraulic modeling has been done for unincorporated areas of Cibola County though this process, the floodplain areas in the Village of Milan and City of Grants are based on the previous FEMA mapping effort which was made effective in 1982. Thus, the FEMA floodplain mapping may not accurately reflect channel and overbank modifications which have occurred since that time.

According to a news article published in the Cibola Beacon in 2004, 270 structures were located within the FEMA 100-year regulatory floodplain at that time. It is assumed that that number is larger at the present. Data available from FEMA indicates that there were 96 flood insurance policies in-force in Grants and 48 policies in-force in Milan as of July 31, 2010. The combined in-force premiums associated with the 144 policies is $85,217 according to the FEMA data.

The number of flood insurance policies in Grants and Milan will likely increase over time as homes sell or are refinanced and owners are required to purchase flood insurance.

5. Drainage/Flooding Problems

The potential for flooding exists in many locations throughout the Study Area, as demonstrated on a regular basis during storm events. This potential has been documented in previous studies and is further quantified by the hydrologic and hydraulic analysis performed for the current study. The tables contained in Sub-Section 3.4 and Appendix Section 3 provide the 10 and 100-year flow rates expected at the analyzed structures and an indication of the adequacy of the structures to pass the 10 and 100-year analysis peak flow rate. Nearly all of the structures analyzed in this study were found to be inadequate to pass the 100-year peak rate. Several structures were found to be marginal or inadequate to pass the 10-year peak rate.

Appendix Section 4 contains summaries of meetings held with local government agency personnel and residents to discuss historic drainage problems. Appendix Section 4 also includes some summaries of newspaper clippings, photographs related to flooding and drainage problems, and brief summaries of existing drainage reports that were reviewed in the scope of the current study.

A brief discussion of some of the most significant drainage problems associated with various facilities in the Study Area follows this paragraph. Culvert and channel structures included in the discussion are shown on Figures 3-1 through 3-8, contained in Appendix Section 3 of this report.

5.1 Grants Canyon Arroyo

Due to a relatively steep watershed and narrow, incised upstream channel sections, the Grants Canyon Arroyo is subject to flashy, relatively high peak rates on a fairly frequent basis. Much of the channel section though the City of Grants is relatively well maintained, with the exception of a short reach north of Roosevelt which according to City personnel is under the control of the U.S. Forest Service and City maintenance of the channel is not allowed.

The effective FEMA FIRM shows that a significant corridor adjacent to the arroyo is within the 100-year floodplain. This floodplain was established based on a 100-year peak flow rate of 3,020 cfs. While portions of the arroyo have been improved since the analysis that established the floodplain was completed, the channel still lacks capacity to convey the 3,020 cfs 100-year flow. Existing street crossing structures have approximately half or less of the capacity to convey the 100-year flow. In addition, the hydrological analysis performed for the current study indicates that the 100-year future condition flow in the channel may be slightly higher.

All three of the existing crossing structures are beginning to show some signs of deterioration. The culverts crossing College Boulevard are in very poor condition as the end sections are all missing and the adjacent slope paving is undermined. According to City personnel, this crossing structure is overtopped nearly every summer. This crossing structure is very important as it appears to provide the only paved access to a residential community.



Downstream end of the College Boulevard culverts showing significant deterioration

The crossing at Roosevelt Avenue lacks capacity to pass the 100-year runoff event. Flow in excess of culvert capacity will pass over the roadway and could impact the City cemetery on the east side of the channel and other adjacent development on the west. Some lowering of the channel bed is evident on the downstream end of the crossing and the outlet paving is being undermined.

The crossing at Washington Avenue presents significant concerns in that it lacks the capacity to pass the 100-year runoff event and flow in excess of the culvert capacity has the potential to spread east and west of the crossing to low points in adjacent residential neighborhoods.

Portions of the channel are well incised and relate well vertically to the adjacent land. The banks of other portions of the channel are elevated above adjacent areas and could be more problematic. These sections can not readily accept drainage from adjacent areas and thus if flow is lost from the channel at a given point, it is generally prevented from re-entering the channel downstream. In addition the elevated embankments (levees) must be maintained in good condition or they pose a safety hazard.



Downstream end of the Roosevelt Avenue culverts showing evidence of bed lowering in the downstream channel



Downstream end of the Washington culverts. The high point in the roadway above the culverts will divert overflow east and west from the channel



Leveed reach of Rio San Jose north of McBride Road

5.2 Rio San Jose

Approximately 8 miles of the Rio San Jose is located in the Study Area. While the majority of the river has capacity to convey the 10-year FEMA effective flow without significant flooding, nearly the entire river located within the Study Area presents significant flooding hazards to adjacent areas in larger events.

Nearly all of the problems associated with the Rio San Jose though the Study Area can be categorized as one or more of the following:

- **Poor vertical relationship with adjacent land areas**
  Many reaches off the channel are not located in the low point of the valley and/ or are not sufficiently incised to drain adjacent land areas. Many of these reaches have earthen levees constructed on both sides. The condition of these levees is unknown. The levees could present a safety hazard if they are not structurally adequate or maintained in good condition. They are problematic in that they do not allow for drainage to enter the channel from adjacent areas.

- **Inadequate cross section**
  Several channel reaches lack adequate capacity to convey the runoff from large runoff events. Among the worst of these reaches are the reach between High Street and Anderman Street in downtown Grants and the reach between the North Street and Highway 605 in Milan. These sections need to be deeper, wider or both in order to contain large flood flows.



Rio San Jose channel between Airport Road and Milan Street

- **Flat longitudinal gradients**
  The channel slope is very slight in the lower portion of the Study Area with some areas at less than one foot of fall per thousand feet of channel. These areas are prone to collecting sediment from runoff originating in steep watersheds such as those that exist in Grants and Zuni Canyons.



Sediment deposit in the Rio San Jose upstream of the McBride Road culverts

- **Crossing structures with inadequate capacity**
  Only a few of the street and railroad crossing structures are adequate to convey the 100-year flow. Many are marginal for conveyance of the full 10-year flow. These structures impede flow in the channel and in many locations will result in significant flow being diverted out of the channel and into neighborhoods and behind levees in significant runoff events. The hydraulic analysis indicates that diversions will occur in some locations in the 10-year runoff event.





Culverts at High Street (left) and 2nd Street (right) are examples of culverts that lack adequate capacity

- **Crossing Structures that are Deteriorating**
  Several of the culvert structures are showing signs of significant deterioration. The existing culvert pipe material is corrugated galvanized metal. Some are arch sections with concrete inverts and others are full pipe sections. Many are showing some signs of deterioration where sediment laden flow has abraded protective coatings and corrosion of the steel has occurred. The culverts crossing George Hanosh Boulevard are among the worst of these with holes corroded completely though the inverts. This type of pipe damage can lead to rapid failures of the entire street crossing due to piping of flow outside the culvert which erodes the soil around the pipe. Concrete portions of the culverts are generally in better condition but are also showing signs of abrasion and degradation.





Hole corroded in culvert pipe under George Hanosh Boulevard (left), abraded and degraded concrete at the culvert under First Street (right)

5.3 First and Second Streets

First and Second Streets between Roosevelt and the Rio San Jose have flat gradients, lack significant storm sewer systems and receive runoff from a large watershed that extends up the eastern slope and includes a portion of the top of Black Mesa. The finished floor elevations of structures adjacent to the streets vary significantly, with some elevated well above the street and some at street grade or lower. Some of these structures experience the threat of flooding several times in a normal rainy season.

Portions of these streets are subject to fairly frequent closure during and after rainfall events due to high water. According to City personnel, the portion of First Street between Washington Avenue and Adams Avenue is the worst area in the City for frequent flooding problems. Second Street north of Jefferson Street has also been identified as an area subject to frequent flooding.

Drainage problems associated with the High School Campus are common to the problems associated with this area. The drainage ditch that lies in front of the campus adjacent to the west side of Second Street has very limited conveyance capacity due to flat gradients and relatively small culverts at driveway crossings.

The area is not well elevated above the Rio San Jose which is the major outfall for the area. Thus, most of the area is included in the FEMA 100-year regulatory floodplain associated with the Rio San Jose and the potential for adequate gravity flow storm sewer outfalls from the area is currently very limited.



Drainage channel along the west side of Second Street adjacent to the High School Campus

5.4 Civic Center Area

This area, situated at the intersection of Iron Avenue and High Street, is low, has relatively flat grades and receives runoff from a significant watershed that originates on the southeast slope of Black Mesa. Some of the buildings in this area have finished floors that are at or below adjacent streets and are subject to flooding on a relatively frequent basis. Street drainage is poor due to the flat longitudinal slopes and lack of a significant drainage system. Pooling of water in the street occurs during and after even relatively small rainfall events.

Much of the area is located in the 100-year FEMA regulatory floodplain associated with the Rio San Jose. With this poor vertical relationship to the major outfall channel, the potential for constructing adequate gravity flow storm sewer outfalls from the area to the Rio San Jose is very limited.



Pooling in High Street at Iron Avenue (Civic Center Area) after a small rainstorm

5.5 Milan Heights

The Milan Heights area is located north of the railroad tracks along the southwest slope of Black Mesa. The southwest corner of the area is within the 100-year FEMA floodplain associated with the Rio San Jose. Other select areas are subject to shallow flooding and erosion from runoff developed on the relatively steep side slopes and top of the mesa. In significant storm events the area can experience two peaks in runoff. The first peak developed rather quickly on the mesa side slopes and the second developed more slowly on the relatively flat mesa top. The top and the side slopes of the mesa are made up of soil and rock with moderate to high runoff potential.

It appears that development occurred in the area without the benefit of significant drainage planning or drainage infrastructure development. Over the years, it appears that limited drainage improvements have been constructed in the area, however, existing facilities still fall short of the needed capacity to manage significant storm events.

The streets generally consist of rural sections (no curb and gutter). Adequate roadside ditches are lacking throughout much of the area. Ditches that exist are small, and driveways crossing the ditches generally have very small culverts. The ditches and culverts are also subject to sedimentation from soil particles transported from the steep slopes of the mesa in runoff. When these roadside ditches overflow, runoff is diverted through private property.

At least one of the existing diversion channels in the area lacks adequate easements or right-of-way and thus is difficult to maintain. Additional diversion channels and outfall channels or storm sewers are needed to control the runoff.



Typical street in Milan Heights with inadequate roadside ditches and driveway culverts

5.6 North Street Arroyo

The North Street Arroyo between Santa Fe Avenue and the Rio San Jose serves as an important outfall for a significant portion of the Milan Heights area. Unfortunately, the arroyo lacks capacity to convey even the 10-year flow without overtopping. Capacity is limited by flat longitudinal gradients, shallow cross section, and very limited culvert capacity at street crossings.

The arroyo does provide a marginal outfall for some adjacent streets such as the portion of Uranium Avenue in front of the Village of Milan offices. However, in large storm events, water must pool in these streets until the flow depth in the arroyo decreases to a point that can accept the flow from adjacent areas.





North Street Arroyo from north of Uranium Avenue (left) and flowing full in 1999 (right)

5.7 5th Street Railroad Crossing

The 5th street crossing under the railroad parallels the Rio San Jose. The street is only slightly elevated above the adjacent channel bed and is separated from the channel by a relatively short concrete wall. The portion of the Rio San Jose channel confined by the wall is narrow and lacks significant capacity. In addition the street crossing is in a sump condition under the railroad bridge and lacks a gravity based outfall. Thus, when flow is lost from the channel at this location or storm events generate runoff in the directly contributing area, the water is evacuated via an adjacent, small capacity pump station. The road must be closed when significant flow is present in the Rio San Jose.



Fifth Street crossing under the railroad bridge adjacent to the Rio San Jose

5.8 Other Local Drainage Problems

There is a multitude of drainage problems throughout the Study Area that have not been specifically identified in this report. Exclusion from this text is not intended to discount the importance of finding solutions to these problems. However, the resources available for this study are not sufficient to identify and find solutions for all of the problems. Many of the local problems throughout the Study Area have roots in the problems identified above. Achieving adequate capacity and inverts in the core outfall systems could remove hundreds of properties from the regulatory floodplain and either solve many of the localized drainage problems or make their solutions much easier to obtain.

6. Summary and Recommendations

The primary goals of Phase 1 of the current drainage master planning effort were to quantify 10 and 100-year runoff, determine existing hydraulic capacity, and to identify drainage problems. Given the flooding history in and around the Study Area, most of the problems identified in this report will not come as a surprise to those who live, work, or are familiar with the area.

Significant findings of the Phase 1 effort included the following:

- Flood threats to the study area have three major sources.

    1. The watershed of the Rio San Jose above the Study Area encompasses over 1,000 square miles. While gage records on the Rio San Jose indicate that historic flow peak rates from the watershed have been relatively low due to significant reservoir and floodplain storage upstream, the FEMA effective 100-year peak flow, as presented in the effective Flood Insurance Studies (FIS) for Grants and Milan, would flood hundreds of structures in the Study Area. The current hydrologic study indicates that the 100-year peak flow in the Rio San Jose through a portion of the Study Area may be significantly larger than reported by FEMA in the FIS.

    2. In contrast, the watershed of the Grants Canyon Arroyo at the confluence with the Rio San Jose is approximately 20 square miles in size but due to the steepness of the watershed and lack of significant floodplain storage, higher peak rates are expected in the Grants Canyon Arroyo than in the upstream reaches of the Rio San Jose. An occurrence of the 100-year peak flow in this arroyo will flood a significant number of structures located within Grants. Due to inadequate capacity at street crossings, flow will likely be diverted into adjacent neighborhoods in large flow events.

    3. Local runoff developed within the Study Area and on Black Mesa is the most frequent flood threat to the Study Area. Local drainage problems occur frequently on the slopes of Black Mesa and the flatter portions of the Study Area due to inadequate capacity or density of stormwater collection and conveyance facilities and lack of adequate outfalls.

- The majority of the existing major drainage conveyance infrastructure in the Study Area is insufficient to convey runoff from the analyzed 100-year frequency storm event. A good portion of the major drainage infrastructure appears to have been designed for the 10-year frequency storm.

- In several locations, the major outfall channels are not located at the low point in the valleys or have banks that are in a levee condition. Thus, it is difficult to drain adjacent areas to the channels and in many cases the channels present a flood hazard to the adjacent areas.

- In most locations in the Study Area the existing channels are not sufficiently incised to serve as adequate drainage outfalls for adjacent areas.

- It is recognized that many problems exist in the Study Area that have not been specifically identified in this report. Due to the complexity of the Study Area and limitation of resources, the study has been focused on what is believed to be the most significant core problems.

- It is the recommendation of the study team that the primary effort in working toward improving the drainage systems and reducing flood hazards in the Study Area should be focused on the major outfall channels. If possible, the capacity of the channels and associated crossing structures should be increased to match or exceed the peak runoff rates of the 100-year frequency event. Inverts of the channels should be lowered to provide adequate outfalls for adjacent areas and reduce or eliminate leveed sections to the extent practical. If adequate capacity with lowered channel inverts in the core channels can be achieved, hundreds of properties could be removed from the regulatory floodplain and solutions to many of the more localized drainage problems would become much more effective and achievable.

- Prior to final design of major facilities along the Rio San Jose, a more extensive detailed analysis of the associated 100-year flow rate should be considered. The analysis should take into consideration the effects of potential elimination of floodplain storage both upstream and within the study area. This analysis is not included in the scope of the current project.

Bibliography

"Analysis of the Magnitude and Frequency of Peak Discharge and Maximum Observed Peak Discharge in New Mexico and Surrounding Areas" (SIR 2008-5119), U.S. Geological Survey in cooperation with the New Mexico Department of Transportation, Waltemeyer, Scott D., 2008.

"Depth-Area Ratios in the Semi-Arid Southwest United States", NOAA Technical Memorandum NWS HYDRO-40, Zehr, Raymond M. and Meyers, Vance A., NOAA Office of Hydrology, Silver Spring, Maryland, August 1984.

"Drainage Design Criteria", New Mexico Department of Transportation, February 2004.

"Drainage Manual: Volume 1, Hydrology", New Mexico State Highway and Transportation Department, December 1995.

"Drainage Manual: Volume 2, Hydraulics", New Mexico State Highway and Transportation Department, December 1995.

"Highway Hydrology", Hydraulic Design Series No. 2, Second Edition, Federal Highway Administration (FHWA), October 2002.

"Hydrology: Hydraulic Design Series No. 2", McCuen, R. H., Johnson, P. A., and Ragan, R. M., Federal Highway Administration (FHWA), 1995.

"National Engineering Handbook", Section 4: Hydrology, Kent, Kenneth M., 1972.

"New Mexico Resource Geographic Information System Program," University of New Mexico, http://rgis.unm.edu/intro.cfm. June 2009.

"Open Channel Hydraulics", Chow, Ven Te, McGraw Hill, 1959

"Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 4.0, G. M. Bonnin, D. Martin, B. Lin, T. Parzybok, M. Yekta, and D. Riley, NOAA, National Weather Service, Silver Spring, Maryland, 2006.

"Southwest Regional GAP Analysis Project-Land Cover Descriptions", USGS National Gap Analysis Program, RS/GIS Laboratory, College of Natural Resources, Utah State University, 2005.

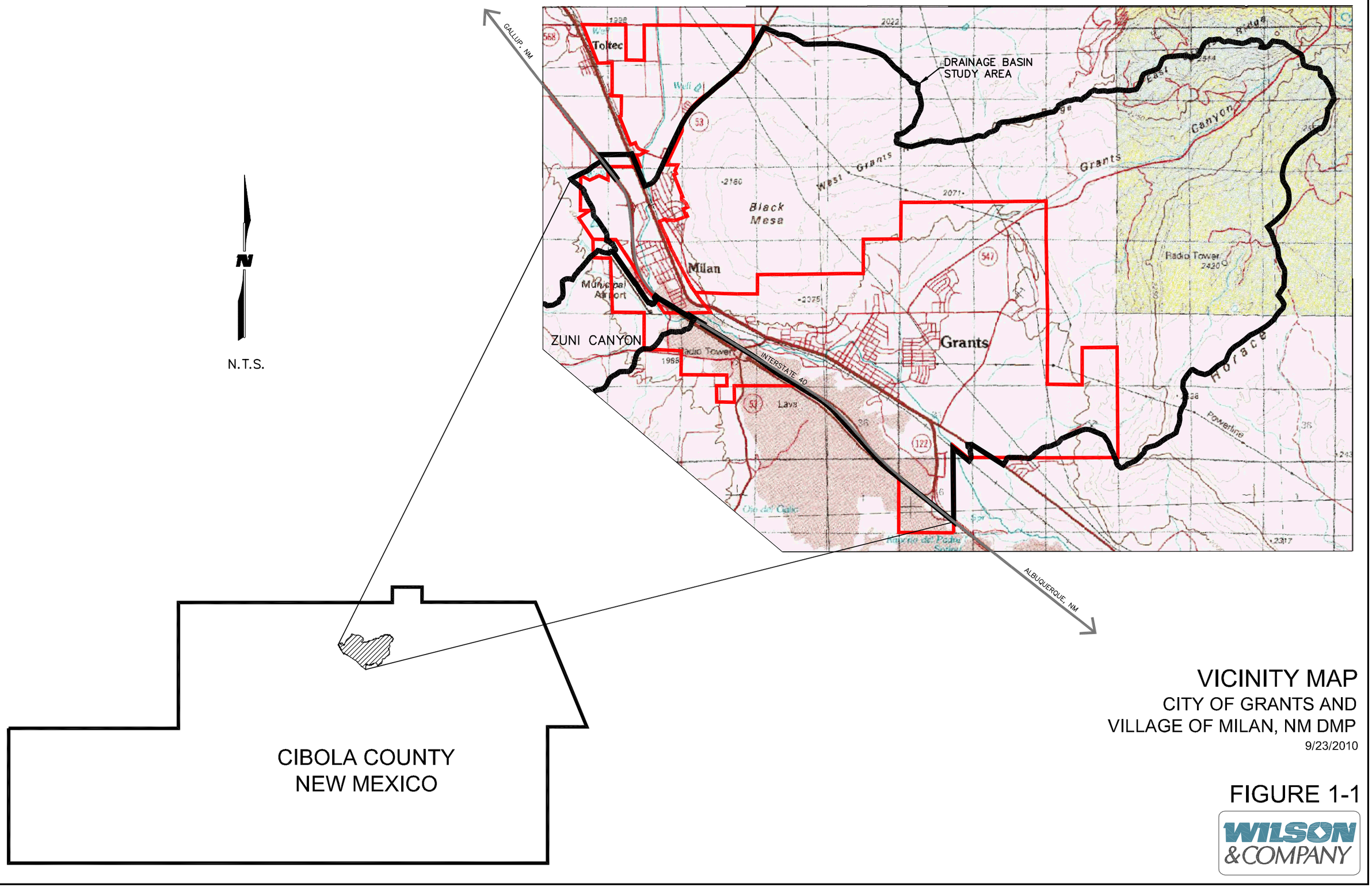
"Urban Hydrology for Small Watersheds", Technical Release 55, U.S. Soil Conservation Service, June 1986.

"Web Soil Survey", Natural Resources Conservation Service, http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm, May 2009.

"Western Regional Climate Center", http://www.wrcc.dri.edu/index.html, July 2009.

Appendix Section 1 - General Exhibits

Figures	Description
1-1	Vicinity Map
1-2	FEMA Floodplain



VICINITY MAP

CITY OF GRANTS AND
VILLAGE OF MILAN, NM DMP

9/23/2010

FIGURE 1-1

WILSON & COMPANY

ZUNI CANYON BASIN

N

0 2,000 4,000

LEGEND

- (X) DRAINAGE BASIN ID
- BASIN BOUNDARY
- FEMA DESIGNATED DRAINAGE CHANNEL
- 100-YR FEMA FLOODPLAIN (ZONE A1-A30)
- 500-YR FEMA FLOODPLAIN (ZONE B)

SOURCE: FEMA DFIRM MAPPING FOR CIBOLA COUNTY, NEW MEXICO AND INCORPORATED AREAS CONDUCTED BY URS CORP. EFFECTIVE DATE OF DFIRM MAPPING CONDUCTED FOR BOTH INCORPORATED AND UNINCORPORATED AREAS OF CIBOLA COUNTY IS DECEMBER 17, 2010. "ZONES A1-A30" REFERS TO AREAS WHERE BASE FLOOD ELEVATIONS AND FLOOD HAZARD FACTORS HAVE BEEN DETERMINED. ZONE B INDICATED AREAS BETWEEN LIMITS OF THE 100-YR FLOOD AND 500-YR FLOOD; OR CERTAIN AREAS SUBJECT TO 100-YR FLOODING WITH AVERAGE DEPTHS LESS THAN ONE (1) FOOT OR WHERE THE CONTRIBUTING DRAINAGE AREA IS LESS THAN ONE SQUARE MILE; OR AREAS PROTECTED BY LEVEES FROM THE BASE FLOOD.

FEMA FLOODPLAIN

CITY OF GRANTS AND VILLAGE OF MILAN, NM DMP

09/18/2010

FIGURE 1-2

WILSON & COMPANY

Appendix Section 2 - Hydrology

Figures

2-1	Hydrologic Soil Groups
2-2	Future Land Use/Cover
2-3	Composite CN Values – Future Land Use Condition
2-4	Existing Topography
2-5	HEC-HMS Routing Diagram
2-6	Drainage Basins
2-7	Analysis Points Overall Key Map
2-8	Analysis Points Insert Map 1
2-9	Analysis Points Insert Map 2
2-10	Analysis Points Insert Map 3
2-11	Analysis Points Insert Map 4
2-12	Analysis Points Insert Map 5
2-13	Analysis Points Insert Map 6

Tables

2-1	Drainage Basin Summary – Comparison of Existing and Future Values
2-2	Analysis Point Summary – Comparison of Existing and Future Values
2-3	Drainage Basin Summary – Existing Condition
2-4	Analysis Point Summary - Existing Condition
2-5	Drainage Basin Summary - Future Condition
2-6	Analysis Point Summary - Future Condition
2-7	HEC-HMS Model Results, Future Basin Summary, 10-yr, 24-hr, 100%
2-8	HEC-HMS Model Results, Future Junction Summary,10-yr, 24-hr, 100%
2-9	HEC-HMS Model Results, Future Reach Summary, 10-yr, 24-hr, 100%
2-10	HEC-HMS Model Results, Future Basin Summary, 10-yr, 24-hr, 84%
2-11	HEC-HMS Model Results, Future Junction Summary,10-yr, 24-hr, 84%
2-12	HEC-HMS Model Results, Future Reach Summary, 10-yr, 24-hr, 84%
2-13	HEC-HMS Model Results, Future Basin Summary, 100-yr, 24-hr, 100%
2-14	HEC-HMS Model Results, Future Junction Summary,100-yr, 24-hr, 100%
2-15	HEC-HMS Model Results, Future Reach Summary, 100-yr, 24-hr, 100%
2-16	HEC-HMS Model Results, Future Basin Summary, 100-yr, 24-hr, 84%
2-17	HEC-HMS Model Results, Future Junction Summary,100-yr, 24-hr, 84%
2-18	HEC-HMS Model Results, Future Reach Summary, 100-yr, 24-hr, 84%
2-19	Existing Land Use Condition Composite Curve Number (CN) Calculations
2-20	Future Land Use Condition Composite Curve Number (CN) Calculations
2-21	Lag Time Calculations
2-22	Channel Flow Segment Assumptions for Lag Time Calculations
2-23	HEC-HMS Routing Reach Characteristics
2-24	Rainfall Depths and Distributions 100%
2-25	Rainfall Depths and Distributions 84%
2-26	Rainfall Depths and Distributions 77%
2-27	Zuni Canyon Flow Contribution to Rio San Jose through Grants

ZUNI CANYON BASIN

SAND

SANTA FE/US 66

I-40

ROOSEVELT

MESA

SAKELARES

GEORGE HANOSH

LEGEND

- HYDROLOGIC SOIL GROUP B
- HYDROLOGIC SOIL GROUP C
- HYDROLOGIC SOIL GROUP D
- (X) DRAINAGE BASIN ID
- DRAINAGE BASIN BOUNDARY
- GRANTS/MILAN BOUNDARIES
- ROADWAYS/STREETS

NOTE: HYDROLOGIC SOIL GROUPS BASED ON NATURAL RESOURCE CONSERVATION SERVICE (NRCS) SOILS DATA FOR CIBOLA COUNTY, NEW MEXICO. APPARENT SOIL TRENDS WERE USED TO ESTIMATE HYDROLOGIC SOIL GROUPS FOR BASINS THAT INCLUDE NATIONAL FOREST LAND WHICH IS NOT INCLUDED IN THE NRCS SOIL SURVEY.

N

0 2,000 4,000

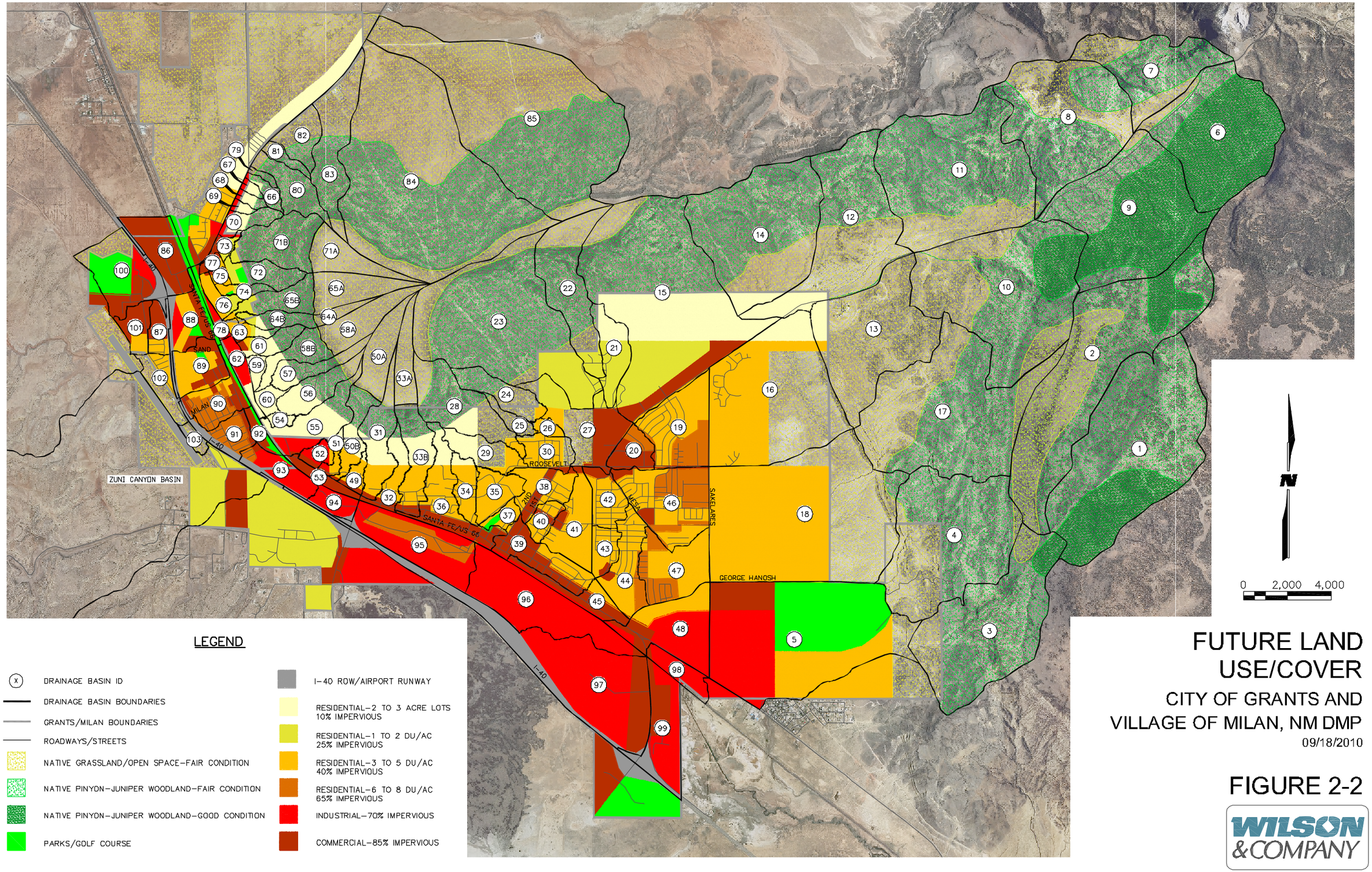
HYDROLOGIC SOIL GROUPS

CITY OF GRANTS AND VILLAGE OF MILAN, NM DMP

09/18/2010

FIGURE 2-1

WILSON & COMPANY



LEGEND

- (X) DRAINAGE BASIN ID
- DRAINAGE BASIN BOUNDARIES
- GRANTS/MILAN BOUNDARIES
- ROADWAYS/STREETS
- NATIVE GRASSLAND/OPEN SPACE–FAIR CONDITION
- NATIVE PINYON–JUNIPER WOODLAND–FAIR CONDITION
- NATIVE PINYON–JUNIPER WOODLAND–GOOD CONDITION
- PARKS/GOLF COURSE
- I–40 ROW/AIRPORT RUNWAY
- RESIDENTIAL–2 TO 3 ACRE LOTS 10% IMPERVIOUS
- RESIDENTIAL–1 TO 2 DU/AC 25% IMPERVIOUS
- RESIDENTIAL–3 TO 5 DU/AC 40% IMPERVIOUS
- RESIDENTIAL–6 TO 8 DU/AC 65% IMPERVIOUS
- INDUSTRIAL–70% IMPERVIOUS
- COMMERCIAL–85% IMPERVIOUS

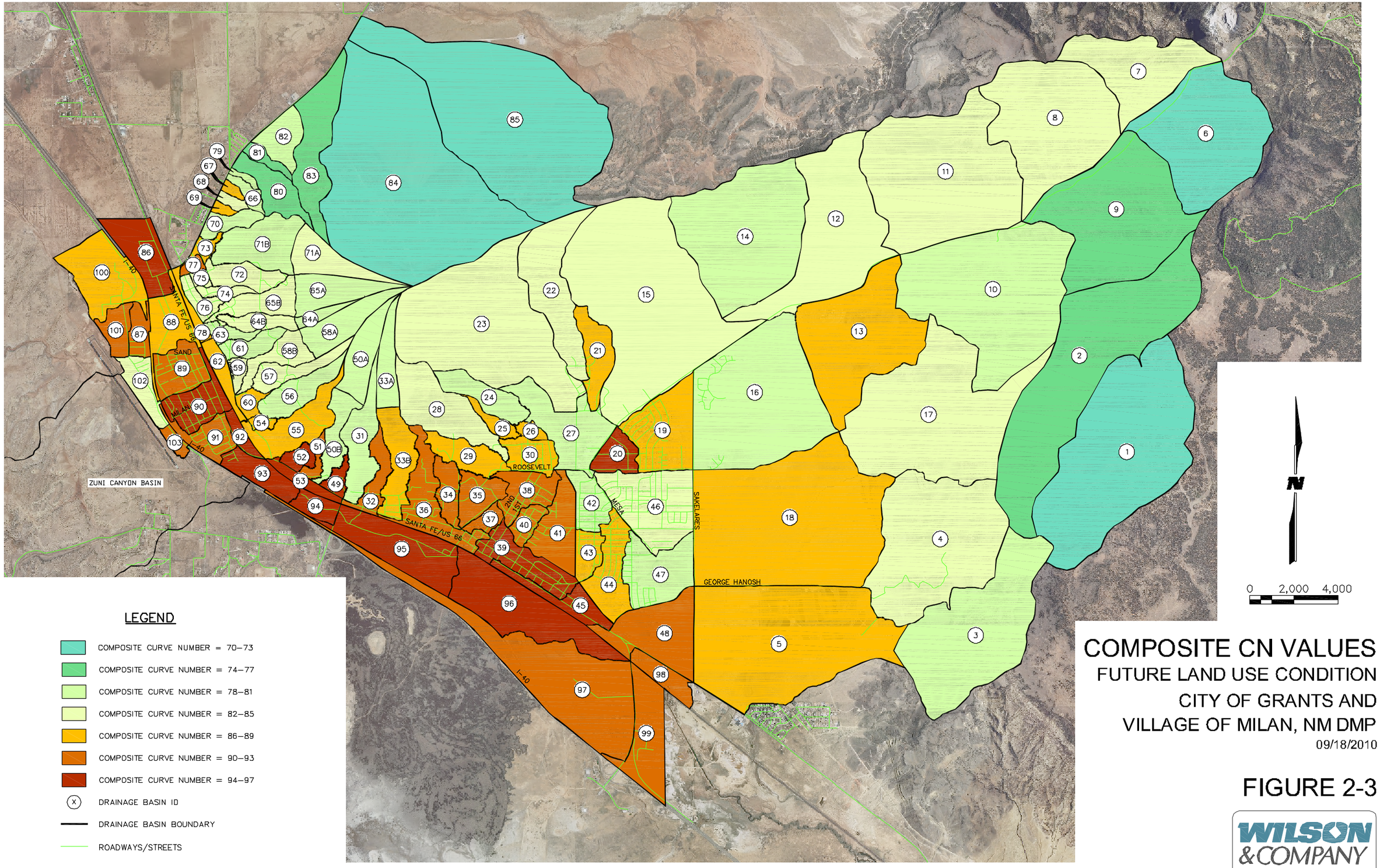
FUTURE LAND USE/COVER

CITY OF GRANTS AND VILLAGE OF MILAN, NM DMP

09/18/2010

FIGURE 2-2

WILSON & COMPANY



LEGEND

- COMPOSITE CURVE NUMBER = 70–73
- COMPOSITE CURVE NUMBER = 74–77
- COMPOSITE CURVE NUMBER = 78–81
- COMPOSITE CURVE NUMBER = 82–85
- COMPOSITE CURVE NUMBER = 86–89
- COMPOSITE CURVE NUMBER = 90–93
- COMPOSITE CURVE NUMBER = 94–97
- (X) DRAINAGE BASIN ID
- DRAINAGE BASIN BOUNDARY
- ROADWAYS/STREETS

COMPOSITE CN VALUES

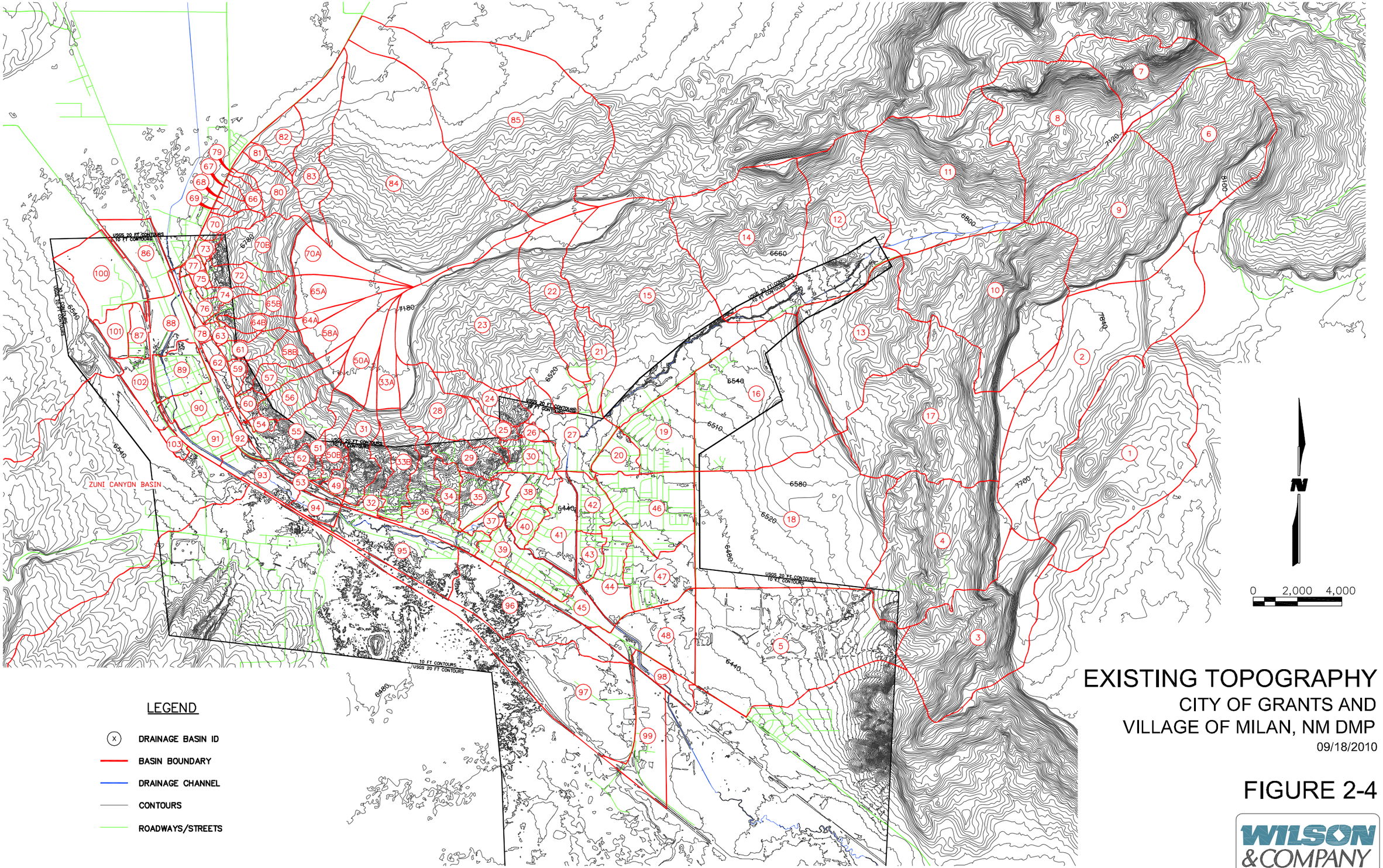
FUTURE LAND USE CONDITION

CITY OF GRANTS AND VILLAGE OF MILAN, NM DMP

09/18/2010

FIGURE 2-3

WILSON & COMPANY



EXISTING TOPOGRAPHY

CITY OF GRANTS AND VILLAGE OF MILAN, NM DMP

09/18/2010

FIGURE 2-4

WILSON & COMPANY

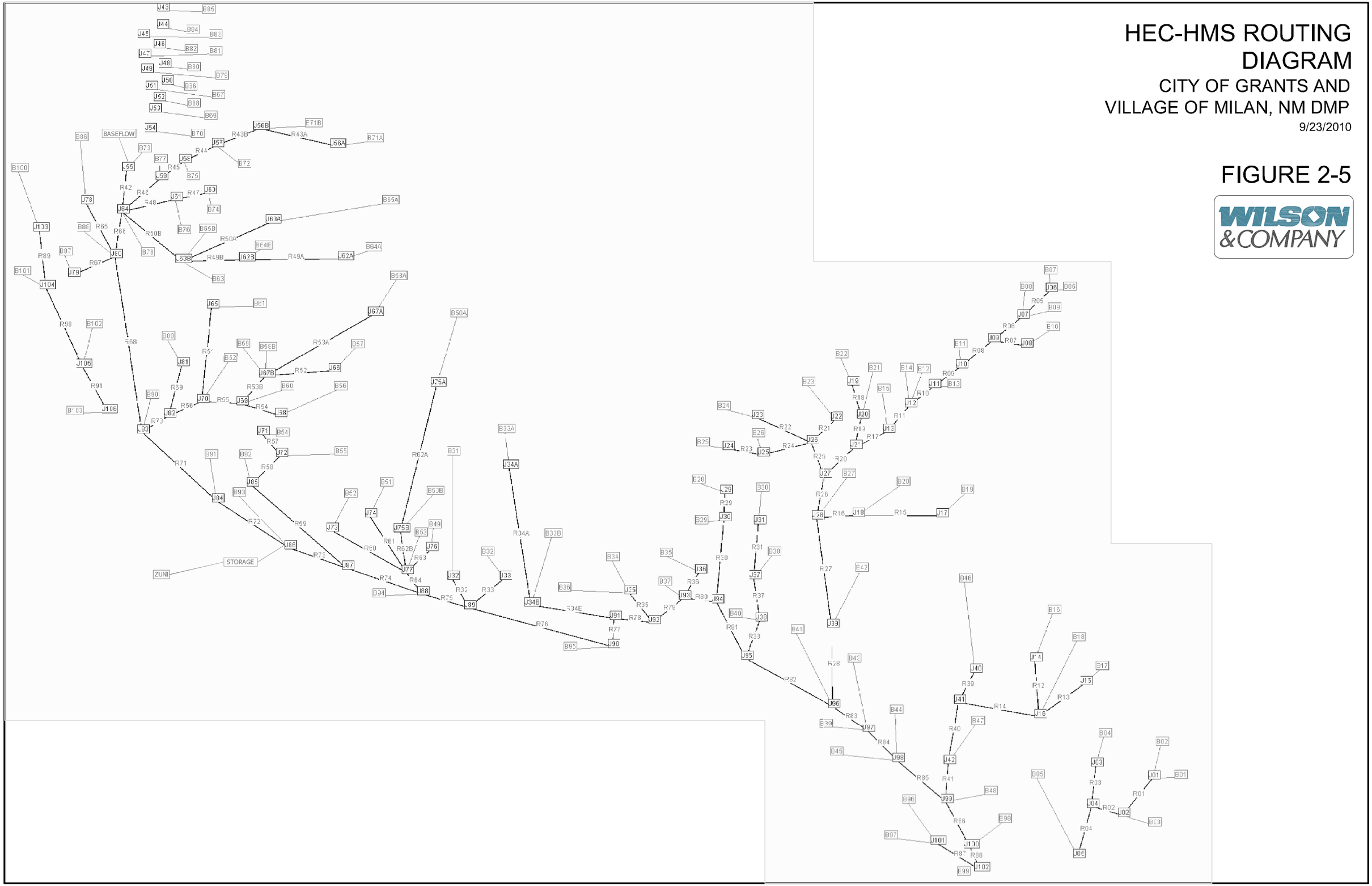
HEC-HMS ROUTING DIAGRAM

CITY OF GRANTS AND
VILLAGE OF MILAN, NM DMP

9/23/2010

FIGURE 2-5

WILSON & COMPANY



ESTIMATED RIO SAN JOSE BASEFLOW OF 400 CFS ADDED TO HEC-HMS MODEL UPSTREAM OF HIGHWAY 605

ZUNI CANYON BASIN

SANTA FE/US 66

ROOSEVELT

SAKE LARES

GEORGE HANOSH

I-40

0 2,000 4,000

N

LEGEND

- (X) DRAINAGE BASIN ID
- BASIN BOUNDARY
- ROADWAYS/STREETS

DRAINAGE BASINS

CITY OF GRANTS AND VILLAGE OF MILAN, NM DMP

09/18/2010

FIGURE 2-6

WILSON & COMPANY

SEE INSERT MAP 1

SEE INSERT MAP 2

SEE INSERT MAP 3

SEE INSERT MAP 4

SEE INSERT MAP 5

SEE INSERT MAP 6

ZUNI CANYON BASIN

LEGEND

- DRAINAGE BASIN ID
- BASIN BOUNDARY
- ANALYSIS POINT ID
- ROADWAYS/STREETS

N

0 2,000 4,000

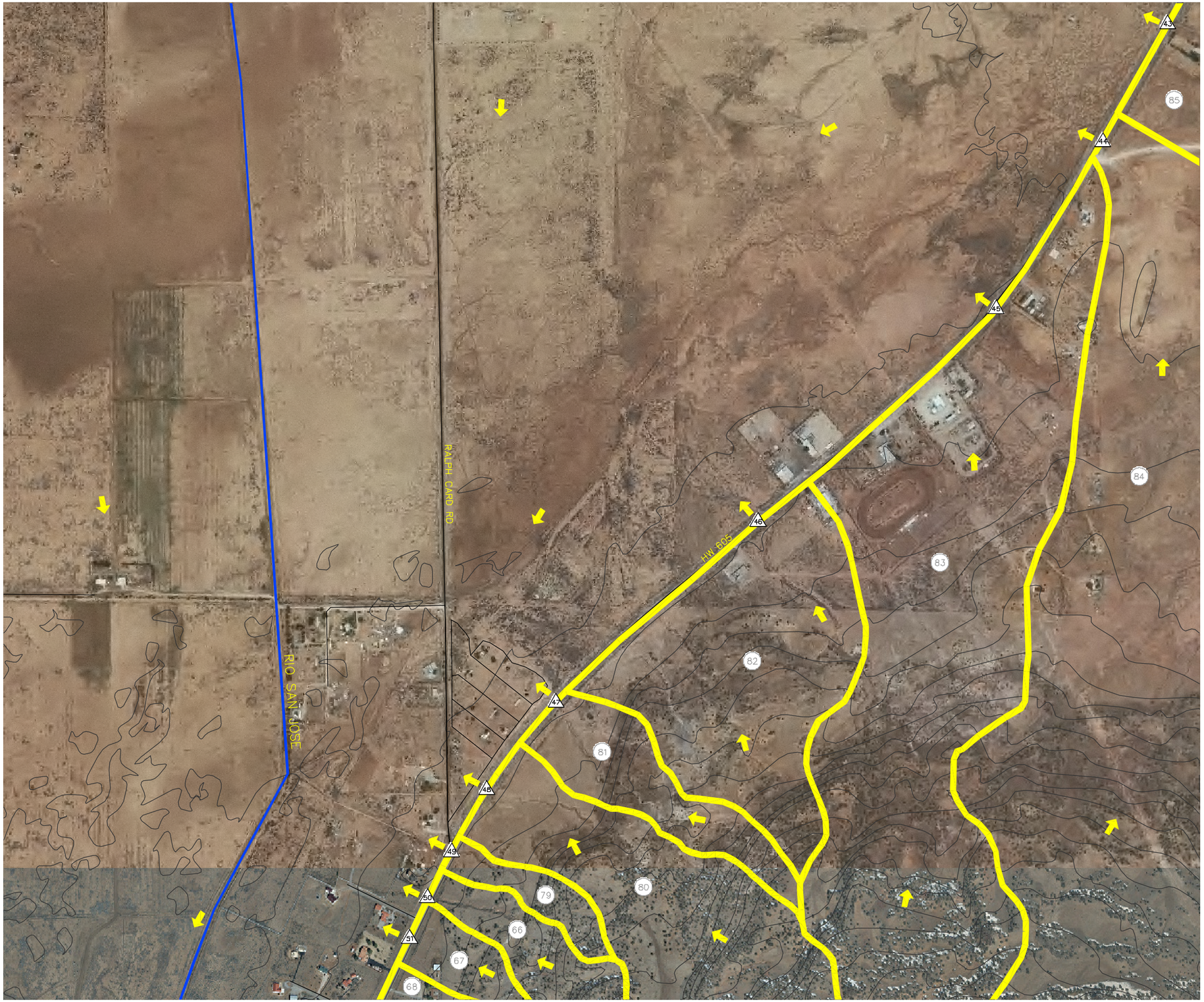
ANALYSIS POINTS OVERALL KEY MAP

CITY OF GRANTS AND
VILLAGE OF MILAN, NM DMP

09/18/2010

FIGURE 2-7

WILSON & COMPANY





0 400 800

LEGEND

- (X) DRAINAGE BASIN ID
- BASIN BOUNDARY
- △X ANALYSIS POINT ID
- ROADWAYS/STREETS
- FLOW ARROWS
- 20' USGS CONTOURS

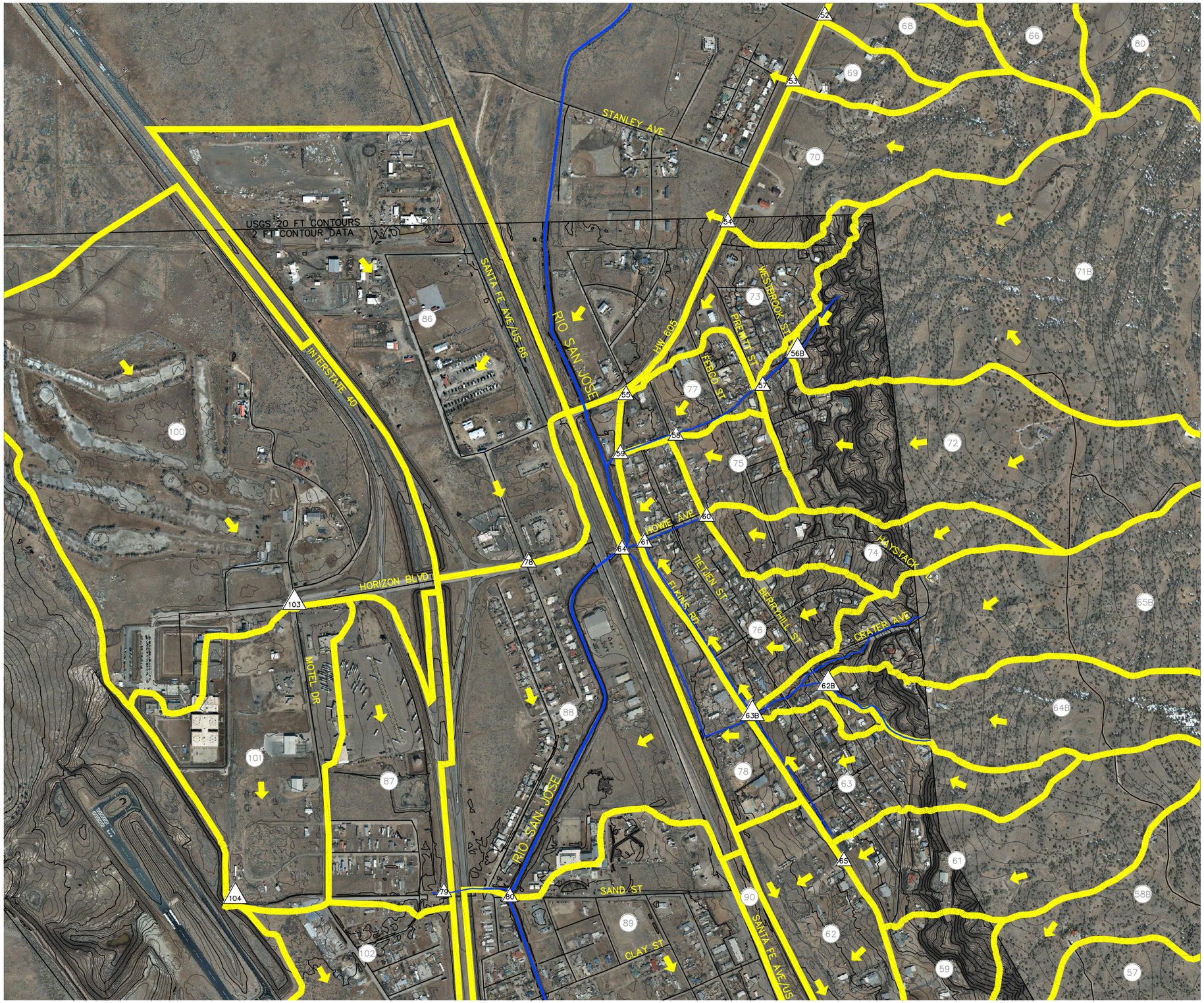
ANALYSIS POINTS INSERT MAP 1

CITY OF GRANTS AND
VILLAGE OF MILAN, NM DMP

09/22/2010

FIGURE 2-8

WILSON & COMPANY



N

0 400 800

LEGEND

- (X) DRAINAGE BASIN ID
- BASIN BOUNDARY
- X ANALYSIS POINT ID
- ROADWAYS/STREETS
- FLOW ARROWS

ANALYSIS POINTS INSERT MAP 2

CITY OF GRANTS AND
VILLAGE OF MILAN, NM DMP

09/22/2010

FIGURE 2-9

WILSON & COMPANY

M:\DSV\10-600-033-04\CAD\EXHIBITS\Phase 1 Exhibits\Analysis Points.dwg, 9/29/2010 7:22:58 AM



N

0 400 800

LEGEND

- (X) DRAINAGE BASIN ID
- BASIN BOUNDARY
- X ANALYSIS POINT ID
- ROADWAYS/STREETS
- FLOW ARROWS

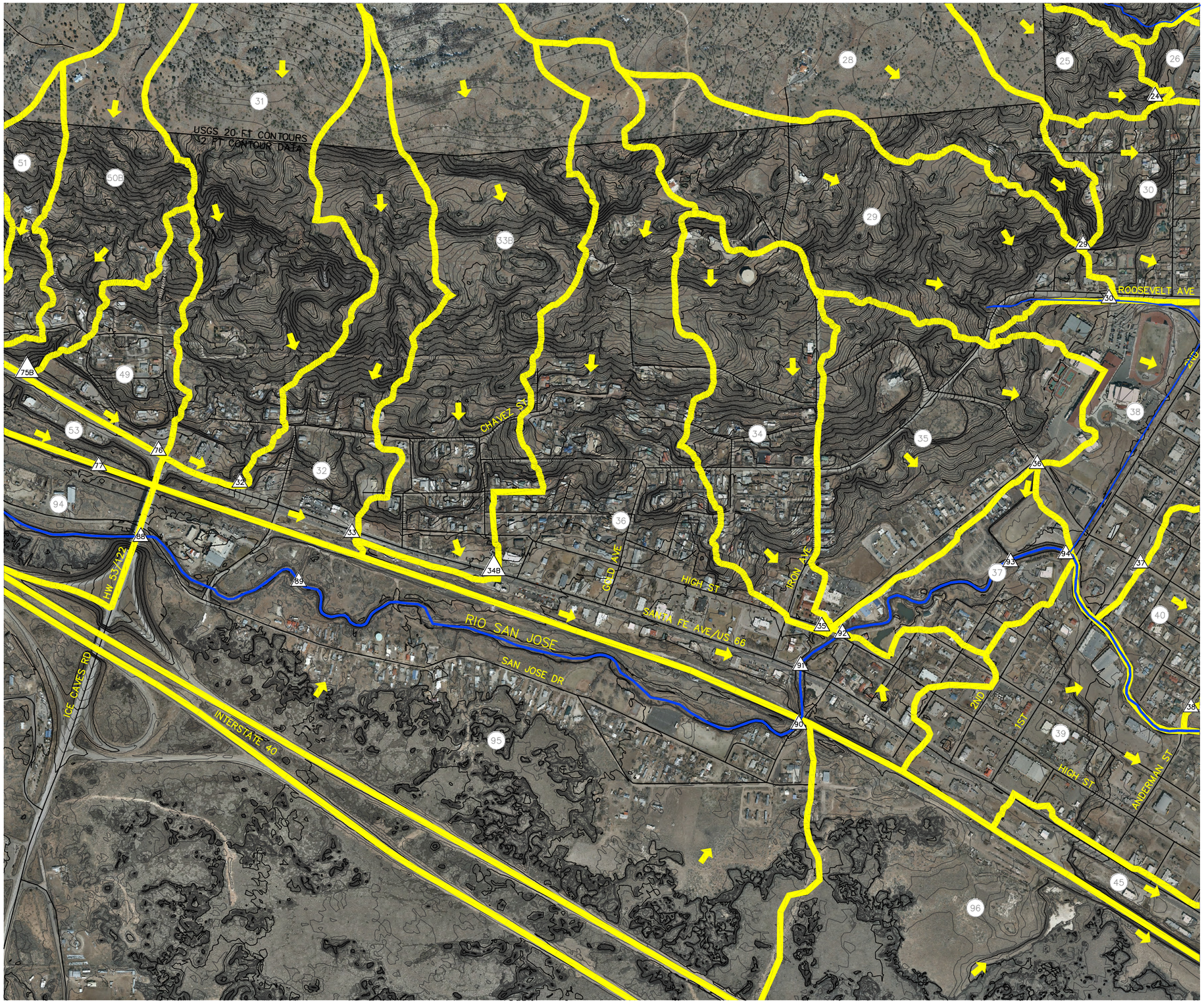
ANALYSIS POINTS INSERT MAP 3

CITY OF GRANTS AND
VILLAGE OF MILAN, NM DMP

09/22/2010

FIGURE 2-10

WILSON & COMPANY



LEGEND

- (X) DRAINAGE BASIN ID
- BASIN BOUNDARY
- △X ANALYSIS POINT ID
- ROADWAYS/STREETS
- FLOW ARROWS

ANALYSIS POINTS INSERT MAP 4

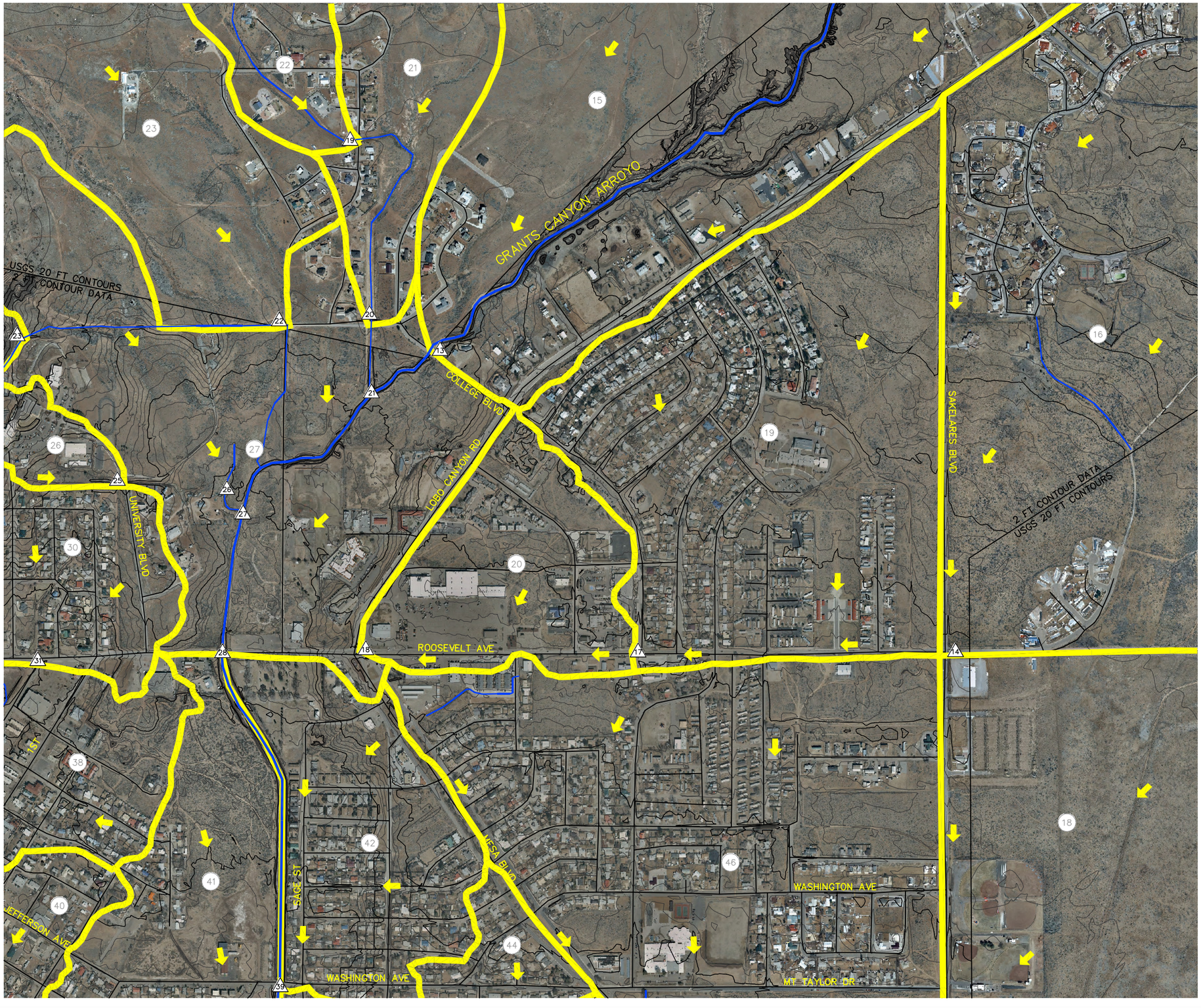
CITY OF GRANTS AND
VILLAGE OF MILAN, NM DMP

09/22/2010

FIGURE 2-11

WILSON & COMPANY

M:\DS\10-600-033-000\CADD\EXHIBITS\Phase 1 Exhibits\Analysis Points.dwg, 9/29/2010 7:29:02 AM



N

0 400 800

LEGEND

- (X) DRAINAGE BASIN ID
- BASIN BOUNDARY
- (X) ANALYSIS POINT ID
- ROADWAYS/STREETS
- FLOW ARROWS

ANALYSIS POINTS INSERT MAP 5

CITY OF GRANTS AND
VILLAGE OF MILAN, NM DMP

09/22/2010

FIGURE 2-12

WILSON & COMPANY

M:\DSI\10-600-433-00\CADD\EXHIBITS\Phase 1 Exhibits\Analysis Points.dwg, 9/29/2010 2:44:58 PM



N

0 400 800

LEGEND

- (X) DRAINAGE BASIN ID
- BASIN BOUNDARY
- X ANALYSIS POINT ID
- ROADWAYS/STREETS
- FLOW ARROWS

ANALYSIS POINTS INSERT MAP 6

CITY OF GRANTS AND
VILLAGE OF MILAN, NM DMP

09/22/2010

FIGURE 2-13

WILSON & COMPANY

M:\DSI\10\600\433\00\CADD\EXHIBITS\Phase 1 Exhibits\Analysis Points.dwg, 9/29/2010 7:33:39 AM

Drainage Basin Summary Table

Comparison of Existing and Future Values

City of Grants and Village of Milan, New Mexico DMP

		Existing Condition			Future Condition								Existing Condition			Future Condition					
Basin	**Area (sq. mi.)**	**Existing CN Value**	**Existing Q_{10} (cfs)**	**Existing Q_{100} (cfs)**	**Future CN Value**	**Future Q_{10} (cfs)**	**Future Q_{100} (cfs)**	**Percent Change in CN**	**Percent Change in Q_{10}**	**Percent Change in Q_{100}**	**Basin**	**Area (sq. mi.)**	**Existing CN Value**	**Existing Q_{10} (cfs)**	**Existing Q_{100} (cfs)**	**Future CN Value**	**Future Q_{10} (cfs)**	**Future Q_{100} (cfs)**	**Percent Change in CN**	**Percent Change in Q_{10}**	**Percent Change in Q_{100}**
1	1.55	62	19	167	62	19	167	0%	0%	0%	**54**	0.02	78	8	22	78	8	22	0%	0%	0%
2	1.48	67	44	201	67	44	201	0%	0%	0%	**55**	0.23	78	64	184	78	64	184	0%	0%	0%
3	1.06	70	80	308	70	80	308	0%	0%	0%	**56**	0.16	74	29	107	74	29	107	0%	0%	0%
4	1.12	74	178	584	74	178	584	0%	0%	0%	**57**	0.12	74	23	85	74	23	85	0%	0%	0%
5	1.45	74	166	511	79	286	729	7%	73%	43%	**58A**	0.18	72	16	53	72	16	53	0%	0%	0%
6	0.94	65	32	187	65	32	187	0%	0%	0%	**58B**	0.12	73	18	68	73	18	68	0%	0%	0%
7	0.52	74	71	222	74	71	222	0%	0%	0%	**59**	0.03	73	5	20	73	5	20	0%	0%	0%
8	0.99	74	137	430	74	137	430	0%	0%	0%	**60**	0.05	78	14	40	78	14	40	0%	0%	0%
9	1.13	66	41	213	66	41	213	0%	0%	0%	**61**	0.09	75	16	53	75	16	53	0%	0%	0%
10	1.39	72	137	472	72	137	472	0%	0%	0%	**62**	0.08	78	16	42	78	16	42	0%	0%	0%
11	1.34	73	156	512	73	156	512	0%	0%	0%	**63**	0.05	76	9	28	76	9	28	0%	0%	0%
12	0.93	75	123	365	74	110	339	0%	-11%	-7%	**64A**	0.04	72	4	14	72	4	14	0%	0%	0%
13	0.85	77	178	499	77	178	499	0%	0%	0%	**64B**	0.08	73	12	46	73	12	46	0%	0%	0%
14	1.07	72	114	394	71	99	362	0%	-13%	-8%	**65A**	0.19	72	16	53	72	16	53	0%	0%	0%
15	1.69	72	187	650	74	243	764	3%	30%	18%	**65B**	0.14	73	22	89	73	22	89	0%	0%	0%
16	1.16	70	72	273	72	96	323	3%	32%	18%	**66**	0.04	72	5	19	72	5	19	0%	0%	0%
17	1.37	74	197	621	74	197	621	0%	0%	0%	**67**	0.02	76	6	18	76	6	18	0%	0%	0%
18	1.74	75	169	490	77	210	564	4%	24%	15%	**68**	0.03	74	6	20	74	6	20	0%	0%	0%
19	0.35	76	56	158	79	76	195	4%	38%	23%	**69**	0.02	77	6	17	77	6	17	0%	0%	0%
20	0.11	82	36	85	84	43	96	2%	20%	14%	**70**	0.08	75	13	42	75	13	42	0%	0%	0%
21	0.17	79	42	110	78	38	102	-1%	-10%	-7%	**71A**	0.18	74	19	57	74	19	57	0%	0%	0%
22	0.44	74	67	213	74	67	213	0%	0%	0%	**71B**	0.27	72	36	141	72	36	141	0%	0%	0%
23	1.28	73	159	525	73	159	525	0%	0%	0%	**72**	0.12	73	18	62	73	18	62	0%	0%	0%
24	0.16	76	31	92	76	31	92	0%	0%	0%	**73**	0.04	77	9	26	77	9	26	0%	0%	0%
25	0.05	79	15	40	79	15	40	0%	0%	0%	**74**	0.04	74	6	21	74	6	21	0%	0%	0%
26	0.03	79	11	28	79	11	28	0%	0%	0%	**75**	0.02	74	4	14	74	4	14	0%	0%	0%
27	0.33	67	17	80	76	60	172	13%	258%	115%	**76**	0.06	73	9	32	73	9	32	0%	0%	0%
28	0.35	74	58	199	74	58	199	0%	0%	0%	**77**	0.02	81	9	23	81	9	23	0%	0%	0%
29	0.15	79	43	118	79	43	118	0%	0%	0%	**78**	0.04	76	8	23	76	8	23	0%	0%	0%
30	0.12	78	41	115	78	41	115	0%	0%	0%	**79**	0.02	72	2	8	72	2	8	0%	0%	0%
31	0.22	76	48	153	76	48	153	0%	0%	0%	**80**	0.16	69	14	56	69	14	56	0%	0%	0%
32	0.11	81	37	91	81	37	91	0%	0%	0%	**81**	0.04	69	4	14	69	4	14	0%	0%	0%
33A	0.13	72	10	33	72	10	33	0%	0%	0%	**82**	0.13	71	14	53	71	14	53	0%	0%	0%
34B	0.21	78	61	174	78	61	174	0%	0%	0%	**83**	0.35	69	26	109	69	26	109	0%	0%	0%
34	0.10	81	41	103	81	41	103	0%	0%	0%	**84**	2.14	65	58	337	65	58	337	0%	0%	0%
35	0.13	81	57	142	81	57	142	0%	0%	0%	**85**	1.87	64	31	188	64	31	188	0%	0%	0%
36	0.26	83	106	247	83	106	247	0%	0%	0%	**86**	0.22	84	68	149	84	68	149	0%	0%	0%
37	0.05	80	12	31	80	12	31	0%	0%	0%	**87**	0.08	82	24	57	82	24	57	0%	0%	0%
38	0.16	81	31	73	81	31	73	0%	0%	0%	**88**	0.18	80	44	110	80	44	110	0%	0%	0%
39	0.21	84	78	171	84	78	171	0%	0%	0%	**89**	0.17	81	54	131	81	54	131	0%	0%	0%
40	0.07	82	19	44	82	19	44	0%	0%	0%	**90**	0.17	83	56	128	83	56	128	0%	0%	0%
41	0.22	78	29	75	80	35	86	3%	22%	14%	**91**	0.12	83	43	98	83	43	98	0%	0%	0%
42	0.13	75	23	73	75	23	73	0%	0%	0%	**92**	0.05	83	18	42	83	18	42	0%	0%	0%
43	0.09	77	15	41	77	15	41	0%	0%	0%	**93**	0.14	80	28	69	84	41	89	4%	44%	28%
44	0.22	76	34	96	77	38	103	1%	12%	8%	**94**	0.08	81	21	51	84	28	62	4%	32%	21%
45	0.13	85	49	105	85	49	105	0%	0%	0%	**95**	0.39	83	137	312	84	150	332	1%	10%	6%
46	0.42	72	43	147	76	70	200	5%	64%	36%	**96**	0.51	82	118	273	84	141	309	2%	19%	13%
47	0.29	69	18	74	75	41	121	9%	125%	63%	**97**	0.88	79	124	312	82	164	377	4%	32%	21%
48	0.36	74	41	128	82	95	221	11%	130%	73%	**98**	0.10	82	39	93	82	39	93	0%	0%	0%
49	0.04	82	26	58	82	26	58	0%	0%	0%	**99**	0.30	83	143	331	83	143	331	0%	0%	0%
50A	0.18	72	14	48	72	14	48	0%	0%	0%	**100**	0.33	79	31	77	79	31	77	0%	0%	0%
50B	0.12	76	31	99	76	31	99	0%	0%	0%	**101**	0.09	82	27	64	82	27	64	0%	0%	0%
51	0.04	81	15	38	81	15	38	0%	0%	0%	**102**	0.12	73	8	25	73	8	25	0%	0%	0%
52	0.05	80	23	58	84	34	73	6%	47%	27%	**103**	0.03	81	11	27	81	11	27	0%	0%	0%
53	0.06	86	32	67	86	32	67	0%	0%	0%											

Note:
Peak rates based on full 24-hour point rainfall depths.

Table 2-1

Analysis Point Summary Table

Comparison of Existing and Future Values

City of Grants and Village of Milan, New Mexico DMP

		Existing Condition		Future Condition						Existing Condition		Future Condition			
Analysis Point	Area (sq. mi.)	Existing Q_{10} (cfs)	Existing Q_{100} (cfs)	Future Q_{10} (cfs)	Future Q_{100} (cfs)	Percent Change in Q_{10}	Percent Change in Q_{100}	Analysis Point	Area (sq. mi.)	Existing Q_{10} (cfs)	Existing Q_{100} (cfs)	Future Q_{10} (cfs)	Future Q_{100} (cfs)	Percent Change in Q_{10}	Percent Change in Q_{100}
1	3.03	62	344	62	344	0	0	**56A**	0.18	19	57	19	57	0%	0%
2	4.08	89	492	89	492	0	0	**56B**	0.44	38	141	38	141	0%	0%
3	1.12	178	584	178	584	0	0	**57**	0.56	56	200	56	200	0%	0%
4	5.20	227	793	227	793	0%	0%	**58**	0.58	59	211	59	211	0%	0%
5	6.66	347	1,240	418	1,417	20%	14%	**59**	0.61	65	231	65	231	0%	0%
6	1.46	100	408	100	408	0%	0%	**60**	0.04	6	21	6	21	0%	0%
7	3.59	245	989	245	989	0%	0%	**61**	0.10	15	52	15	52	0%	0%
8	1.39	137	472	137	472	0%	0%	**62A**	0.04	4	14	4	14	0%	0%
9	4.98	356	1,424	356	1,424	0%	0%	**62B**	0.12	12	46	12	46	0%	0%
10	6.32	452	1,839	452	1,839	0%	0%	**63A**	0.19	16	53	16	53	0%	0%
11	7.17	506	2,064	506	2,064	0%	0%	**63B**	0.50	44	153	44	153	0%	0%
12	9.16	657	2,572	643	2,540	-2%	-1%	**64**	1.28	536	866	536	866	0%	0%
13	10.85	719	2,753	715	2,744	-1%	0%	**65**	0.09	16	53	16	53	0%	0%
14	1.16	72	273	96	323	32%	18%	**66**	0.12	23	85	23	85	0%	0%
15	1.37	197	621	197	621	0%	0%	**67A**	0.18	16	53	16	53	0%	0%
16	4.26	368	1,193	446	1,328	21%	11%	**67B**	0.45	45	172	45	172	0%	0%
17	0.35	56	158	76	195	38%	23%	**68**	0.16	29	107	29	107	0%	0%
18	0.46	80	221	107	268	34%	21%	**69**	0.65	84	310	84	310	0%	0%
19	0.44	67	213	67	213	0%	0%	**70**	0.81	96	329	96	329	0%	0%
20	0.60	106	321	103	314	-3%	-2%	**71**	0.02	8	22	8	22	0%	0%
21	11.45	752	2,839	747	2,828	-1%	0%	**72**	0.25	72	206	72	206	0%	0%
22	1.28	159	525	159	525	0%	0%	**73**	0.05	23	58	34	73	47%	27%
23	0.16	31	92	31	92	0%	0%	**74**	0.04	15	38	15	38	0%	0%
24	0.05	15	40	15	40	0%	0%	**75A**	0.18	14	48	14	48	0%	0%
25	0.08	23	59	23	59	0%	0%	**75B**	0.30	31	100	31	100	0%	0%
26	1.52	207	662	207	662	0%	0%	**76**	0.04	26	58	26	58	0%	0%
27	12.98	833	3,074	829	3,063	-1%	0%	**77**	0.49	114	292	125	308	9%	5%
28	13.77	874	3,197	883	3,215	1%	1%	**78**	0.22	68	149	68	149	0%	0%
29	0.35	58	199	58	199	0%	0%	**79**	0.08	24	57	24	57	0%	0%
30	0.50	98	316	98	316	0%	0%	**80**	1.76	639	1,079	639	1,079	0%	0%
31	0.12	41	115	41	115	0%	0%	**81**	0.17	54	131	54	131	0%	0%
32	0.22	48	153	48	153	0%	0%	**82**	0.98	147	431	147	431	0%	0%
33	0.11	37	91	37	91	0%	0%	**83**	2.91	787	1,513	787	1,513	0%	0%
34A	0.13	10	33	10	33	0%	0%	**84**	3.04	778	1,466	778	1,466	0%	0%
34B	0.34	61	174	61	174	0%	0%	**85**	0.30	89	244	89	244	0%	0%
35	0.36	141	336	141	336	0%	0%	**86**	48.51	857	1,703	863	1,718	1%	1%
36	0.13	57	142	57	142	0%	0%	**87**	48.81	881	1,780	887	1,796	1%	1%
37	0.28	52	121	52	121	0%	0%	**88**	49.38	921	1,887	929	1,907	1%	1%
38	0.35	68	163	68	163	0%	0%	**89**	49.70	934	1,921	942	1,941	1%	1%
39	13.90	876	3,207	885	3,225	1%	1%	**90**	50.09	955	1,983	966	2,007	1%	1%
40	0.42	43	147	70	200	64%	36%	**91**	50.43	973	2,034	984	2,058	1%	1%
41	4.68	386	1,274	475	1,431	23%	12%	**92**	50.79	984	2,077	996	2,102	1%	1%
42	4.97	394	1,317	491	1,495	25%	14%	**93**	50.96	989	2,093	1,002	2,118	1%	1%
43	1.87	31	188	31	188	0%	0%	**94**	51.46	1,011	2,141	1,024	2,166	1%	1%
44	2.14	58	337	58	337	0%	0%	**95**	51.80	1,045	2,225	1,059	2,251	1%	1%
45	0.35	26	109	26	109	0%	0%	**96***	65.92	1,203	3,526	1,220	3,570	1%	1%
46	0.13	14	53	14	53	0%	0%	**97***	66.22	1,210	3,558	1,236	3,603	2%	1%
47	0.04	4	14	4	14	0%	0%	**98***	66.57	1,218	3,578	1,247	3,626	2%	1%
48	0.16	14	56	14	56	0%	0%	**99***	71.90	1,415	4,348	1,495	4,541	6%	4%
49	0.02	2	8	2	8	0%	0%	**100***	72.01	1,399	4,273	1,484	4,470	6%	5%
50	0.04	5	19	5	19	0%	0%	**101**	1.39	230	558	292	656	27%	18%
51	0.02	6	18	6	18	0%	0%	**102***	73.40	1,498	4,578	1,617	4,840	8%	6%
52	0.03	6	20	6	20	0%	0%	**103**	0.33	31	77	31	77	0%	0%
53	0.02	6	17	6	17	0%	0%	**104**	0.42	33	81	33	81	0%	0%
54	0.08	13	42	13	42	0%	0%	**105**	0.54	33	85	33	85	0%	0%
55	0.04	409	426	409	426	0%	0%	**106**	0.57	33	86	33	86	0%	0%

Note:
*Peak rates for Analysis Points 96, 97, 98, 99, 100, and 102 were calculated using 84% of the 24-hour point rainfall depth to account for the size of the watershed. (Refer to report Section 3.2.3)

Table 2-2

Drainage Basin Summary Table
Existing Condition
City of Grants and Village of Milan, New Mexico DMP

Basin	Area (sq. mi.)	Q_{10} (cfs)	Q_{100} (cfs)	100-Yr Runoff Volume (ac-ft)	Basin	Area (sq. mi.)	Q_{10} (cfs)	Q_{100} (cfs)	100-Yr Runoff Volume (ac-ft)
1	1.55	19	167	25	**54**	0.02	8	22	1
2	1.48	44	201	36	**55**	0.23	64	184	12
3	1.06	80	308	33	**56**	0.16	29	107	6
4	1.12	178	584	45	**57**	0.12	23	85	5
5	1.45	166	511	58	**58A**	0.18	16	53	7
6	0.94	32	187	20	**58B**	0.12	18	68	5
7	0.52	71	222	21	**59**	0.03	5	20	1
8	0.99	137	430	40	**60**	0.05	14	40	2
9	1.13	41	213	26	**61**	0.09	16	53	4
10	1.39	137	472	50	**62**	0.08	16	42	4
11	1.34	156	512	51	**63**	0.05	9	28	2
12	0.93	123	365	40	**64A**	0.04	4	14	2
13	0.85	178	499	41	**64B**	0.08	12	46	3
14	1.07	114	394	38	**65A**	0.19	16	53	7
15	1.69	187	650	60	**65B**	0.14	22	89	5
16	1.16	72	273	36	**66**	0.04	5	19	2
17	1.37	197	621	55	**67**	0.02	6	18	1
18	1.74	169	490	74	**68**	0.03	6	20	1
19	0.35	56	158	16	**69**	0.02	6	17	1
20	0.11	36	85	7	**70**	0.08	13	42	3
21	0.17	42	110	9	**71A**	0.18	19	57	7
22	0.44	67	213	18	**71B**	0.27	36	141	10
23	1.28	159	525	49	**72**	0.12	18	62	5
24	0.16	31	92	7	**73**	0.04	9	26	2
25	0.05	15	40	3	**74**	0.04	6	21	2
26	0.03	11	28	2	**75**	0.02	4	14	1
27	0.33	17	80	8	**76**	0.06	9	32	2
28	0.35	58	199	14	**77**	0.02	9	23	1
29	0.15	43	118	8	**78**	0.04	8	23	2
30	0.12	41	115	6	**79**	0.02	2	8	1
31	0.22	48	153	10	**80**	0.16	14	56	5
32	0.11	37	91	6	**81**	0.04	4	14	1
33A	0.13	10	33	5	**82**	0.13	14	53	4
34B	0.21	61	174	11	**83**	0.35	26	109	10
34	0.10	41	103	6	**84**	2.14	58	337	45
35	0.13	57	142	8	**85**	1.87	31	188	36
36	0.26	106	247	17	**86**	0.22	68	149	16
37	0.05	12	31	3	**87**	0.08	24	57	5
38	0.16	31	73	9	**88**	0.18	44	110	10
39	0.21	78	171	15	**89**	0.17	54	131	10
40	0.07	19	44	4	**90**	0.17	56	128	12
41	0.22	29	75	11	**91**	0.12	43	98	8
42	0.13	23	73	6	**92**	0.05	18	42	3
43	0.09	15	41	4	**93**	0.14	28	69	8
44	0.22	34	96	10	**94**	0.08	21	51	5
45	0.13	49	105	10	**95**	0.39	137	312	26
46	0.42	43	147	15	**96**	0.51	118	273	32
47	0.29	18	74	8	**97**	0.88	124	312	47
48	0.36	41	128	15	**98**	0.10	39	93	6
49	0.04	26	58	3	**99**	0.30	143	331	20
50A	0.18	14	48	6	**100**	0.33	31	77	18
50B	0.12	31	99	6	**101**	0.09	27	64	6
51	0.04	15	38	2	**102**	0.12	8	25	4
52	0.05	23	58	3	**103**	0.03	11	27	2
53	0.06	32	67	5					

Note:
Peak rates based on full 24-hour point rainfall depths.

Table 2-3

Analysis Point Summary Table
Existing Condition
City of Grants and Village of Milan, New Mexico DMP

Analysis Point	Area (sq. mi.)	Q_{10} (cfs)	Q_{100} (cfs)	100-Yr Runoff Volume (ac-ft)	Analysis Point	Area (sq. mi.)	Q_{10} (cfs)	Q_{100} (cfs)	100-Yr Runoff Volume (ac-ft)
1	3.03	62	344	62	**56A**	0.18	19	57	7
2	4.08	89	492	94	**56B**	0.44	38	141	17
3	1.12	178	584	45	**57**	0.56	56	200	21
4	5.20	227	793	138	**58**	0.58	59	211	22
5	6.66	347	1,240	196	**59**	0.61	65	231	23
6	1.46	100	408	41	**60**	0.04	6	21	2
7	3.59	245	989	107	**61**	0.10	15	52	4
8	1.39	137	472	50	**62A**	0.04	4	14	2
9	4.98	356	1,424	156	**62B**	0.12	12	46	5
10	6.32	452	1,839	206	**63A**	0.19	16	53	7
11	7.17	506	2,064	247	**63B**	0.50	44	153	19
12	9.16	657	2,572	324	**64****	1.28	536	866	843
13	10.85	719	2,753	382	**65**	0.09	16	53	4
14	1.16	72	273	36	**66**	0.12	23	85	5
15	1.37	197	621	55	**67A**	0.18	16	53	7
16	4.26	368	1,193	164	**67B**	0.45	45	172	17
17	0.35	56	158	16	**68**	0.16	29	107	6
18	0.46	80	221	23	**69**	0.65	84	310	26
19	0.44	67	213	18	**70**	0.81	96	329	33
20	0.60	106	321	27	**71**	0.02	8	22	1
21	11.45	752	2,839	408	**72**	0.25	72	206	13
22	1.28	159	525	49	**73**	0.05	23	58	3
23	0.16	31	92	7	**74**	0.04	15	38	2
24	0.05	15	40	3	**75A**	0.18	14	48	6
25	0.08	23	59	4	**75B**	0.30	31	100	12
26	1.52	207	662	60	**76**	0.04	26	58	3
27	12.98	833	3,074	468	**77**	0.49	114	292	24
28	13.77	874	3,197	498	**78**	0.22	68	149	16
29	0.35	58	199	14	**79**	0.08	24	57	5
30	0.50	98	316	22	**80****	1.76	639	1,079	873
31	0.12	41	115	6	**81**	0.17	54	131	10
32	0.22	48	153	10	**82**	0.98	147	431	43
33	0.11	37	91	6	**83****	2.91	787	1,513	927
34A	0.13	10	33	5	**84****	3.04	778	1,466	934
34B	0.34	61	174	15	**85**	0.30	89	244	16
35	0.36	141	336	23	**86****	48.51	857	1,703	1,649
36	0.13	57	142	8	**87****	48.81	881	1,780	1,663
37	0.28	52	121	16	**88****	49.38	921	1,887	1,688
38	0.35	68	163	20	**89****	49.70	934	1,921	1,702
39	13.90	876	3,207	503	**90****	50.09	955	1,983	1,721
40	0.42	43	147	15	**91****	50.43	973	2,034	1,735
41	4.68	386	1,274	178	**92****	50.79	984	2,077	1,758
42	4.97	394	1,317	186	**93****	50.96	989	2,093	1,765
43	1.87	31	188	36	**94****	51.46	1,011	2,141	1,786
44	2.14	58	337	45	**95****	51.80	1,045	2,225	1,803
45	0.35	26	109	10	**96*,****	65.92	1,203	3,526	2,037
46	0.13	14	53	4	**97*,****	66.22	1,210	3,558	2,051
47	0.04	4	14	1	**98*,****	66.57	1,218	3,578	2,060
48	0.16	14	56	5	**99*,****	71.90	1,415	4,348	2,186
49	0.02	2	8	1	**100*,****	72.01	1,399	4,273	2,182
50	0.04	5	19	2	**101**	1.39	230	558	79
51	0.02	6	18	1	**102*,****	73.40	1,498	4,578	2,237
52	0.03	6	20	1	**103**	0.33	31	77	18
53	0.02	6	17	1	**104**	0.42	33	81	23
54	0.08	13	42	3	**105**	0.54	33	85	26
55**	0.04	409	426	795	**106**	0.57	33	86	28

Note:
*Peak rates for Analysis Points 96, 97, 98, 99, 100, and 102 were calculated using 84% of the 24-hour point rainfall depth to account for the size of the watershed. (Refer to report Section 3.2.3)
**Flow rates and runoff volumes skewed due to addition of baseflow element in HEC-HMS.

Table 2-4

Drainage Basin Summary Table
Future Condition
City of Grants and Village of Milan, New Mexico DMP

Basin	Area (sq. mi.)	Q_{10} (cfs)	Q_{100} (cfs)	Basin	Area (sq. mi.)	Q_{10} (cfs)	Q_{100} (cfs)
1	1.55	19	167	**54**	0.02	8	22
2	1.48	44	201	**55**	0.23	64	184
3	1.06	80	308	**56**	0.16	29	107
4	1.12	178	584	**57**	0.12	23	85
5	1.45	286	729	**58A**	0.18	16	53
6	0.94	32	187	**58B**	0.12	18	68
7	0.52	71	222	**59**	0.03	5	20
8	0.99	137	430	**60**	0.05	14	40
9	1.13	41	213	**61**	0.09	16	53
10	1.39	137	472	**62**	0.08	16	42
11	1.34	156	512	**63**	0.05	9	28
12	0.93	110	339	**64A**	0.04	4	14
13	0.85	178	499	**64B**	0.08	12	46
14	1.07	99	362	**65A**	0.19	16	53
15	1.69	243	764	**65B**	0.14	22	89
16	1.16	96	323	**66**	0.04	5	19
17	1.37	197	621	**67**	0.02	6	18
18	1.74	210	564	**68**	0.03	6	20
19	0.35	76	195	**69**	0.02	6	17
20	0.11	43	96	**70**	0.08	13	42
21	0.17	38	102	**71A**	0.18	19	57
22	0.44	67	213	**71B**	0.27	36	141
23	1.28	159	525	**72**	0.12	18	62
24	0.16	31	92	**73**	0.04	9	26
25	0.05	15	40	**74**	0.04	6	21
26	0.03	11	28	**75**	0.02	4	14
27	0.33	60	172	**76**	0.06	9	32
28	0.35	58	199	**77**	0.02	9	23
29	0.15	43	118	**78**	0.04	8	23
30	0.12	41	115	**79**	0.02	2	8
31	0.22	48	153	**80**	0.16	14	56
32	0.11	37	91	**81**	0.04	4	14
33A	0.13	10	33	**82**	0.13	14	53
34B	0.21	61	174	**83**	0.35	26	109
34	0.10	41	103	**84**	2.14	58	337
35	0.13	57	142	**85**	1.87	31	188
36	0.26	106	247	**86**	0.22	68	149
37	0.05	12	31	**87**	0.08	24	57
38	0.16	31	73	**88**	0.18	44	110
39	0.21	78	171	**89**	0.17	54	131
40	0.07	19	44	**90**	0.17	56	128
41	0.22	35	86	**91**	0.12	43	98
42	0.13	23	73	**92**	0.05	18	42
43	0.09	15	41	**93**	0.14	41	89
44	0.22	38	103	**94**	0.08	28	62
45	0.13	49	105	**95**	0.39	150	332
46	0.42	70	200	**96**	0.51	141	309
47	0.29	41	121	**97**	0.88	164	377
48	0.36	95	221	**98**	0.10	39	93
49	0.04	26	58	**99**	0.30	143	331
50A	0.18	14	48	**100**	0.33	31	77
50B	0.12	31	99	**101**	0.09	27	64
51	0.04	15	38	**102**	0.12	8	25
52	0.05	34	73	**103**	0.03	11	27
53	0.06	32	67				

Note:
Peak rates based on full 24-hour point rainfall depths.

Table 2-5

Analysis Point Summary Table
Future Condition
City of Grants and Village of Milan, New Mexico DMP

Analysis Point	Area (sq. mi.)	Q_{10} (cfs)	Q_{100} (cfs)	Analysis Point	Area (sq. mi.)	Q_{10} (cfs)	Q_{100} (cfs)
1	3.03	62	344	**56A**	0.18	19	57
2	4.08	89	492	**56B**	0.44	38	141
3	1.12	178	584	**57**	0.56	56	200
4	5.20	227	793	**58**	0.58	59	211
5	6.66	418	1,417	**59**	0.61	65	231
6	1.46	100	408	**60**	0.04	6	21
7	3.59	245	989	**61**	0.10	15	52
8	1.39	137	472	**62A**	0.04	4	14
9	4.98	356	1,424	**62B**	0.12	12	46
10	6.32	452	1,839	**63A**	0.19	16	53
11	7.17	506	2,064	**63B**	0.50	44	153
12	9.16	643	2,540	**64****	1.28	536	866
13	10.85	715	2,744	**65**	0.09	16	53
14	1.16	96	323	**66**	0.12	23	85
15	1.37	197	621	**67A**	0.18	16	53
16	4.26	446	1,328	**67B**	0.45	45	172
17	0.35	76	195	**68**	0.16	29	107
18	0.46	107	268	**69**	0.65	84	310
19	0.44	67	213	**70**	0.81	96	329
20	0.60	103	314	**71**	0.02	8	22
21	11.45	747	2,828	**72**	0.25	72	206
22	1.28	159	525	**73**	0.05	34	73
23	0.16	31	92	**74**	0.04	15	38
24	0.05	15	40	**75A**	0.18	14	48
25	0.08	23	59	**75B**	0.30	31	100
26	1.52	207	662	**76**	0.04	26	58
27	12.98	829	3,063	**77**	0.49	125	308
28	13.77	883	3,215	**78**	0.22	68	149
29	0.35	58	199	**79**	0.08	24	57
30	0.50	98	316	**80****	1.76	639	1,079
31	0.12	41	115	**81**	0.17	54	131
32	0.22	48	153	**82**	0.98	147	431
33	0.11	37	91	**83****	2.91	787	1,513
34A	0.13	10	33	**84****	3.04	778	1,466
34B	0.34	61	174	**85**	0.30	89	244
35	0.36	141	336	**86****	48.51	863	1,718
36	0.13	57	142	**87****	48.81	887	1,796
37	0.28	52	121	**88****	49.38	929	1,907
38	0.35	68	163	**89****	49.70	942	1,941
39	13.90	885	3,225	**90****	50.09	966	2,007
40	0.42	70	200	**91****	50.43	984	2,058
41	4.68	475	1,431	**92****	50.79	996	2,102
42	4.97	491	1,495	**93****	50.96	1,002	2,118
43	1.87	31	188	**94****	51.46	1,024	2,166
44	2.14	58	337	**95****	51.80	1,059	2,251
45	0.35	26	109	**96*,****	65.92	1,220	3,570
46	0.13	14	53	**97*,****	66.22	1,236	3,603
47	0.04	4	14	**98*,****	66.57	1,247	3,626
48	0.16	14	56	**99*,****	71.90	1,495	4,541
49	0.02	2	8	**100*,****	72.01	1,484	4,470
50	0.04	5	19	**101**	1.39	292	656
51	0.02	6	18	**102*,****	73.40	1,617	4,840
52	0.03	6	20	**103**	0.33	31	77
53	0.02	6	17	**104**	0.42	33	81
54	0.08	13	42	**105**	0.54	33	85
55**	0.04	409	426	**106**	0.57	33	86

Notes:
*Peak rates for Analysis Points 96, 97, 98, 99, 100, and 102 were calculated using 84% of the 24-hour point rainfall depth to account for the size of the watershed. (Refer to report Section 3.2.3)
**Flow rates and runoff volumes skewed due to addition of baseflow element in HEC-HMS.

Table 2-6

HEC-HMS Model Results - 10-yr (w/ 100% Rainfall Depth) - Basins

City of Grants and Village of Milan, New Mexico Drainage Master Plan

Hydrologic Element	Drainage Area (sq. mi.)	Peak Discharge HMS (cfs)	Time of Peak	Runoff Depth (in)	Runoff Volume (ac-ft)	Average Yield (cfs/ac)
B01	1.55	19	07:05	0.06	4.8	0.0
B02	1.48	44	07:16	0.13	10.1	0.0
B03	1.06	80	06:35	0.19	10.6	0.1
B04	1.12	178	06:20	0.29	17.1	0.2
B05	1.45	286	06:35	0.44	33.9	0.3
B06	0.94	32	06:36	0.10	4.9	0.1
B07	0.52	71	06:27	0.28	8.0	0.2
B08	0.99	137	06:26	0.28	15.1	0.2
B09	1.13	41	06:44	0.11	6.8	0.1
B10	1.39	137	06:33	0.23	17.3	0.2
B11	1.34	156	06:29	0.26	18.4	0.2
B12	0.93	110	06:36	0.28	14.0	0.2
B13	0.85	178	06:20	0.37	17.0	0.3
B14	1.07	99	06:29	0.21	12.0	0.1
B15	1.69	243	06:24	0.29	25.6	0.2
B16	1.16	96	06:46	0.23	14.3	0.1
B17	1.37	197	06:24	0.29	20.8	0.2
B18	1.74	210	06:58	0.37	34.1	0.2
B19	0.35	76	06:29	0.44	8.2	0.3
B20	0.11	43	06:18	0.64	3.7	0.6
B21	0.17	38	06:21	0.41	3.6	0.4
B22	0.44	67	06:21	0.29	6.6	0.2
B23	1.28	159	06:26	0.26	17.7	0.2
B24	0.16	31	06:18	0.34	2.9	0.3
B25	0.05	15	06:11	0.44	1.2	0.4
B26	0.03	11	06:05	0.44	0.7	0.5
B27	0.33	60	06:23	0.34	6.1	0.3
B28	0.35	58	06:18	0.29	5.3	0.3
B29	0.15	43	06:10	0.44	3.4	0.5
B30	0.12	41	06:04	0.41	2.7	0.5
B31	0.22	48	06:08	0.34	3.9	0.3
B32	0.11	37	06:12	0.52	2.9	0.5
B33A	0.13	10	06:51	0.23	1.6	0.1
B33B	0.21	61	06:07	0.41	4.5	0.5
B34	0.10	41	06:06	0.52	2.8	0.6
B35	0.13	57	06:05	0.52	3.6	0.7
B36	0.26	106	06:13	0.60	8.3	0.6
B37	0.05	12	06:22	0.48	1.2	0.4
B38	0.16	31	06:48	0.51	4.3	0.3
B39	0.21	78	06:23	0.64	7.3	0.6
B40	0.07	19	06:28	0.55	1.9	0.4
B41	0.22	35	06:55	0.47	5.5	0.3
B42	0.13	23	06:18	0.31	2.2	0.3
B43	0.09	15	06:33	0.37	1.7	0.3
B44	0.22	38	06:33	0.37	4.4	0.3
B45	0.13	49	06:27	0.69	4.8	0.6
B46	0.42	70	06:27	0.34	7.6	0.3
B47	0.29	41	06:32	0.31	4.8	0.2
B48	0.36	95	06:33	0.55	10.7	0.4
B49	0.04	26	06:02	0.56	1.3	0.9
B50A	0.18	14	06:48	0.23	2.2	0.1
B50B	0.12	31	06:05	0.34	2.3	0.4
B51	0.04	15	06:07	0.52	1.1	0.6
B52	0.05	34	06:02	0.65	1.7	1.1
B53	0.06	32	06:11	0.74	2.3	0.8

HEC-HMS Model Results - 10-yr (w/ 100% Rainfall Depth) - Basins

City of Grants and Village of Milan, New Mexico Drainage Master Plan

Hydrologic Element	Drainage Area (sq. mi.)	Peak Discharge HMS (cfs)	Time of Peak	Runoff Depth (in)	Runoff Volume (ac-ft)	Average Yield (cfs/ac)
B54	0.02	8	06:02	0.41	0.5	0.6
B55	0.23	64	06:08	0.41	5.1	0.4
B56	0.16	29	06:05	0.29	2.4	0.3
B57	0.12	23	06:04	0.29	1.8	0.3
B58A	0.18	16	06:43	0.23	2.3	0.1
B58B	0.12	18	06:18	0.26	1.6	0.2
B59	0.03	5	06:18	0.26	0.5	0.2
B60	0.05	14	06:06	0.41	1.0	0.5
B61	0.09	16	06:10	0.31	1.4	0.3
B62	0.08	16	06:26	0.41	1.6	0.3
B63	0.05	9	06:17	0.34	0.9	0.3
B64A	0.04	4	06:33	0.23	0.5	0.2
B64B	0.08	12	06:18	0.26	1.1	0.2
B65A	0.19	16	06:45	0.23	2.3	0.1
B65B	0.14	22	06:06	0.26	2.0	0.2
B66	0.04	5	06:21	0.23	0.5	0.2
B67	0.02	6	06:02	0.34	0.3	0.5
B68	0.03	6	06:03	0.29	0.4	0.3
B69	0.02	6	06:02	0.38	0.3	0.5
B70	0.08	13	06:18	0.31	1.3	0.3
B71A	0.18	19	06:44	0.28	2.6	0.2
B71B	0.27	36	06:18	0.24	3.3	0.2
B72	0.12	18	06:20	0.26	1.7	0.2
B73	0.04	9	06:09	0.37	0.7	0.4
B74	0.04	6	06:20	0.29	0.6	0.3
B75	0.02	4	06:05	0.29	0.3	0.3
B76	0.06	9	06:19	0.26	0.9	0.2
B77	0.02	9	06:07	0.52	0.6	0.6
B78	0.04	8	06:21	0.34	0.8	0.3
B79	0.02	2	06:18	0.24	0.2	0.2
B80	0.16	14	06:20	0.17	1.4	0.1
B81	0.04	4	06:24	0.17	0.4	0.1
B82	0.13	14	06:21	0.21	1.5	0.2
B83	0.35	26	06:26	0.17	3.2	0.1
B84	2.14	58	06:51	0.10	11.1	0.0
B85	1.87	31	07:22	0.08	8.2	0.0
B86	0.22	68	06:34	0.64	7.6	0.5
B87	0.08	24	06:21	0.56	2.2	0.5
B88	0.18	44	06:27	0.48	4.6	0.4
B89	0.17	54	06:17	0.52	4.6	0.5
B90	0.17	56	06:25	0.60	5.5	0.5
B91	0.12	43	06:21	0.60	3.9	0.5
B92	0.05	18	06:16	0.60	1.5	0.6
B93	0.14	41	06:36	0.64	4.7	0.5
B94	0.08	28	06:22	0.64	2.6	0.6
B95	0.39	150	06:21	0.64	13.5	0.6
B96	0.51	141	06:41	0.64	17.5	0.4
B97	0.88	164	06:57	0.55	25.7	0.3
B98	0.10	39	06:11	0.56	3.0	0.6
B99	0.30	143	06:07	0.60	9.5	0.8
B100	0.33	31	07:38	0.43	7.6	0.1
B101	0.09	27	06:26	0.55	2.7	0.5
B102	0.12	8	07:13	0.25	1.6	0.1
B103	0.03	11	06:15	0.52	0.9	0.5

TABLE 2-7

HEC-HMS Model Results - 10-yr (w/ 100% Rainfall Depth) - Junctions

City of Grants and Village of Milan, New Mexico Drainage Master Plan

Hydrologic Element	Drainage Area (sq. mi.)	Peak Discharge HMS (cfs)	Time of Peak	Runoff Depth (in)	Runoff Volume (ac-ft)	Average Yield (cfs/ac)
J01	3.03	62	07:12	0.09	14.9	0.0
J02	4.08	89	07:15	0.12	25.2	0.0
J03	1.12	178	06:20	0.29	17.1	0.2
J04	5.20	227	06:41	0.15	41.8	0.1
J05	6.66	418	06:55	0.21	75.1	0.1
J06	1.46	100	06:31	0.17	12.9	0.1
J07	3.59	245	06:40	0.18	34.7	0.1
J08	1.39	137	06:33	0.23	17.3	0.2
J09	4.98	356	06:48	0.19	51.8	0.1
J10	6.32	452	06:52	0.21	70.0	0.1
J11	7.17	506	07:01	0.23	86.6	0.1
J12	9.16	643	06:54	0.23	112.2	0.1
J13	10.85	715	07:08	0.24	136.6	0.1
J14	1.16	96	06:46	0.23	14.3	0.1
J15	1.37	197	06:24	0.29	20.8	0.2
J16	4.26	446	06:59	0.30	68.8	0.2
J17	0.35	76	06:29	0.44	8.2	0.3
J18	0.46	107	06:33	0.49	11.9	0.4
J19	0.44	67	06:21	0.29	6.6	0.2
J20	0.60	103	06:25	0.32	10.2	0.3
J21	11.45	747	07:09	0.24	146.7	0.1
J22	1.28	159	06:26	0.26	17.7	0.2
J23	0.16	31	06:18	0.34	2.9	0.3
J24	0.05	15	06:11	0.44	1.2	0.4
J25	0.08	23	06:17	0.44	1.9	0.4
J26	1.52	207	06:33	0.28	22.4	0.2
J27	12.98	829	07:11	0.24	168.7	0.1
J28	13.77	883	07:15	0.25	186.3	0.1
J29	0.35	58	06:18	0.29	5.3	0.3
J30	0.50	98	06:12	0.33	8.8	0.3
J31	0.12	41	06:04	0.41	2.7	0.5
J32	0.22	48	06:08	0.34	3.9	0.3
J33	0.11	37	06:12	0.52	2.9	0.5
J34A	0.13	10	06:51	0.23	1.6	0.1
J34B	0.34	61	06:07	0.34	6.1	0.3
J35	0.36	141	06:11	0.58	11.1	0.6
J36	0.13	57	06:05	0.52	3.6	0.7
J37	0.28	52	06:32	0.46	6.8	0.3
J38	0.35	68	06:38	0.47	8.7	0.3
J39	13.90	885	07:19	0.25	188.0	0.1
J40	0.42	70	06:27	0.34	7.6	0.3
J41	4.68	475	07:06	0.30	76.1	0.2
J42	4.97	491	07:10	0.30	80.7	0.2
J43	1.87	31	07:22	0.08	8.2	0.0
J44	2.14	58	06:51	0.10	11.1	0.0
J45	0.35	26	06:26	0.17	3.2	0.1
J46	0.13	14	06:21	0.21	1.5	0.2
J47	0.04	4	06:24	0.17	0.4	0.1
J48	0.16	14	06:20	0.17	1.4	0.1
J49	0.02	2	06:18	0.24	0.2	0.2
J50	0.04	5	06:21	0.23	0.5	0.2
J51	0.02	6	06:02	0.34	0.3	0.5
J52	0.03	6	06:03	0.29	0.4	0.3
J53	0.02	6	06:02	0.38	0.3	0.5
J54	0.08	13	06:18	0.31	1.3	0.3
J55*	0.04	409	06:09	425.40	794.1	18.2

*Flow rates and runoff volumes skewed due to addition of baseflow element in HEC-HMS.

HEC-HMS Model Results - 10-yr (w/ 100% Rainfall Depth) - Junctions

City of Grants and Village of Milan, New Mexico Drainage Master Plan

Hydrologic Element	Drainage Area (sq. mi.)	Peak Discharge HMS (cfs)	Time of Peak	Runoff Depth (in)	Runoff Volume (ac-ft)	Average Yield (cfs/ac)
J56A	0.18	19	06:44	0.28	2.6	0.2
J56B	0.44	38	06:19	0.25	6.0	0.1
J57	0.56	56	06:19	0.26	7.7	0.2
J58	0.58	59	06:21	0.26	8.0	0.2
J59	0.61	65	06:22	0.27	8.6	0.2
J60	0.04	6	06:20	0.29	0.6	0.3
J61	0.10	15	06:19	0.27	1.5	0.2
J62A	0.04	4	06:33	0.23	0.5	0.2
J62B	0.12	12	06:18	0.25	1.6	0.2
J63A	0.19	16	06:45	0.23	2.3	0.1
J63B	0.50	44	06:18	0.25	6.7	0.1
J64*	1.28	536	06:24	11.87	811.6	0.7
J65	0.09	16	06:10	0.31	1.4	0.3
J66	0.12	23	06:04	0.29	1.8	0.3
J67A	0.18	16	06:43	0.23	2.3	0.1
J67B	0.45	45	06:18	0.26	6.1	0.2
J68	0.16	29	06:05	0.29	2.4	0.3
J69	0.65	84	06:09	0.27	9.5	0.2
J70	0.81	96	06:20	0.29	12.6	0.2
J71	0.02	8	06:02	0.41	0.5	0.6
J72	0.25	72	06:09	0.41	5.5	0.4
J73	0.05	34	06:02	0.65	1.7	1.1
J74	0.04	15	06:07	0.52	1.1	0.6
J75A	0.18	14	06:48	0.23	2.2	0.1
J75B	0.30	31	06:05	0.28	4.5	0.2
J76	0.04	26	06:02	0.56	1.3	0.9
J77	0.49	125	06:10	0.41	10.8	0.4
J78	0.22	68	06:34	0.64	7.6	0.5
J79	0.08	24	06:21	0.56	2.2	0.5
J80*	1.76	639	06:37	8.81	825.7	0.6
J81	0.17	54	06:17	0.52	4.6	0.5
J82	0.98	147	06:23	0.33	17.1	0.2
J83*	2.91	787	06:45	5.46	848.0	0.4
J84*	3.04	778	06:51	5.26	851.7	0.4
J85	0.30	89	06:13	0.44	7.0	0.5
J86*	48.51	863	07:05	0.41	1065.5	0.0
J87*	48.81	887	07:04	0.41	1072.2	0.0
J88*	49.38	929	07:08	0.41	1084.7	0.0
J89*	49.70	942	07:09	0.41	1091.0	0.0
J90*	50.09	966	07:17	0.41	1102.9	0.0
J91*	50.43	984	07:16	0.41	1108.8	0.0
J92*	50.79	996	07:16	0.41	1119.7	0.0
J93*	50.96	1,002	07:19	0.41	1123.7	0.0
J94*	51.46	1,024	07:19	0.41	1132.2	0.0
J95*	51.80	1,059	07:21	0.41	1140.2	0.0
J96*	65.92	1,951	07:24	0.38	1331.2	0.0
J97*	66.22	1,967	07:23	0.38	1340.1	0.0
J98*	66.57	1,980	07:26	0.38	1347.8	0.0
J99*	71.90	2,468	07:26	0.37	1436.1	0.1
J100*	72.01	2,436	07:31	0.37	1436.2	0.1
J101	1.39	292	06:48	0.58	43.2	0.3
J102*	73.40	2,656	07:29	0.38	1478.6	0.1
J103	0.33	31	07:38	0.43	7.6	0.1
J104	0.42	33	07:54	0.45	10.2	0.1
J105	0.54	33	08:47	0.39	11.1	0.1
J106	0.57	33	08:55	0.39	12.0	0.1

*Flow rates and runoff volumes skewed due to addition of baseflow element in HEC-HMS.

TABLE 2-8

HEC-HMS Model Results - 10-yr (w/ 100% Rainfall Depth) - Reaches

City of Grants and Village of Milan, New Mexico Drainage Master Plan

Hydrologic Element	Drainage Area (sq. mi.)	Peak Discharge HMS (cfs)	Time of Peak	Runoff Depth (in)	Runoff Volume (ac-ft)	Average Yield (cfs/ac)
R01	3.03	62	07:31	0.09	14.6	0.0
R02	4.08	89	07:32	0.11	24.9	0.0
R03	1.12	177	06:35	0.28	16.9	0.2
R04	5.20	225	07:00	0.15	41.2	0.1
R05	1.46	100	06:46	0.16	12.8	0.1
R06	3.59	244	06:50	0.18	34.4	0.1
R07	1.39	137	06:34	0.23	17.3	0.2
R08	4.98	356	06:54	0.19	51.6	0.1
R09	6.32	450	07:01	0.21	69.6	0.1
R10	7.17	505	07:08	0.23	86.2	0.1
R11	9.16	636	07:09	0.23	111.0	0.1
R12	1.16	95	07:11	0.23	14.1	0.1
R13	1.37	196	06:44	0.28	20.6	0.2
R14	4.26	444	07:06	0.30	68.5	0.2
R15	0.35	76	06:36	0.44	8.2	0.3
R16	0.46	107	06:35	0.49	11.9	0.4
R17	10.85	714	07:09	0.24	136.5	0.1
R18	0.44	67	06:27	0.28	6.6	0.2
R19	0.60	103	06:26	0.32	10.2	0.3
R20	11.45	744	07:12	0.24	146.3	0.1
R21	1.28	159	06:33	0.26	17.6	0.2
R22	0.16	31	06:36	0.34	2.9	0.3
R23	0.05	15	06:18	0.44	1.2	0.4
R24	0.08	23	06:21	0.44	1.9	0.4
R25	1.52	206	06:34	0.28	22.4	0.2
R26	12.98	826	07:16	0.24	168.4	0.1
R27	13.77	882	07:19	0.25	185.8	0.1
R28	13.90	878	07:23	0.25	186.9	0.1
R29	0.35	58	06:20	0.29	5.3	0.3
R30	0.50	97	06:22	0.33	8.7	0.3
R31	0.12	31	06:24	0.39	2.6	0.4
R32	0.22	48	06:09	0.34	3.9	0.3
R33	0.11	37	06:13	0.52	2.9	0.5
R34A	0.13	10	07:00	0.23	1.6	0.1
R34B	0.34	60	06:14	0.34	6.1	0.3
R35	0.36	141	06:11	0.58	11.1	0.6
R36	0.13	47	06:12	0.51	3.5	0.6
R37	0.28	52	06:41	0.46	6.8	0.3
R38	0.35	68	06:39	0.47	8.7	0.3
R39	0.42	70	06:30	0.34	7.6	0.3
R40	4.68	473	07:10	0.30	75.9	0.2
R41	4.97	471	07:26	0.30	79.2	0.1
R42*	0.04	408	06:17	425.40	794.1	18.2
R43A	0.18	19	06:51	0.28	2.6	0.2
R43B	0.44	38	06:19	0.25	6.0	0.1
R44	0.56	56	06:21	0.26	7.7	0.2
R45	0.58	59	06:22	0.26	8.0	0.2
R46	0.61	65	06:24	0.27	8.6	0.2
R47	0.04	6	06:22	0.29	0.6	0.3

*Flow rates and runoff volumes skewed due to addition of baseflow element in HEC-HMS.

HEC-HMS Model Results - 10-yr (w/ 100% Rainfall Depth) - Reaches

City of Grants and Village of Milan, New Mexico Drainage Master Plan

Hydrologic Element	Drainage Area (sq. mi.)	Peak Discharge HMS (cfs)	Time of Peak	Runoff Depth (in)	Runoff Volume (ac-ft)	Average Yield (cfs/ac)
R48	0.10	15	06:20	0.27	1.5	0.2
R49A	0.04	4	06:46	0.23	0.5	0.2
R49B	0.12	12	06:20	0.25	1.6	0.2
R50A	0.19	16	06:52	0.23	2.3	0.1
R50B	0.50	43	06:27	0.25	6.7	0.1
R51	0.09	16	06:34	0.32	1.4	0.3
R52	0.12	23	06:06	0.29	1.8	0.3
R53A	0.18	16	06:48	0.23	2.3	0.1
R53B	0.45	45	06:21	0.25	6.1	0.2
R54	0.16	29	06:08	0.29	2.4	0.3
R55	0.65	84	06:09	0.27	9.5	0.2
R56	0.81	96	06:23	0.29	12.5	0.2
R57	0.02	8	06:09	0.41	0.5	0.6
R58	0.25	72	06:13	0.41	5.5	0.4
R59	0.30	87	06:24	0.43	7.0	0.5
R60	0.05	34	06:10	0.65	1.7	1.1
R61	0.04	15	06:13	0.52	1.1	0.6
R62A	0.18	14	06:56	0.23	2.2	0.1
R62B	0.30	31	06:10	0.28	4.4	0.2
R63	0.04	25	06:04	0.56	1.3	0.9
R64	0.49	115	06:18	0.41	10.7	0.4
R65	0.22	66	06:47	0.63	7.5	0.5
R66*	1.28	527	06:34	11.87	811.5	0.6
R67	0.08	24	06:23	0.55	2.2	0.5
R68*	1.76	627	06:49	8.81	825.6	0.6
R69	0.17	52	06:24	0.51	4.6	0.5
R70	0.98	140	06:32	0.32	16.9	0.2
R71*	2.91	759	06:52	5.46	847.7	0.4
R72*	3.04	776	06:59	5.26	851.5	0.4
R73*	48.51	862	07:08	0.41	1065.2	0.0
R74*	48.81	885	07:10	0.41	1071.4	0.0
R75*	49.38	928	07:12	0.41	1084.2	0.0
R76*	49.70	940	07:20	0.41	1089.4	0.0
R77*	50.09	965	07:18	0.41	1102.7	0.0
R78*	50.43	983	07:18	0.41	1108.6	0.0
R79*	50.79	995	07:20	0.41	1119.0	0.0
R80*	50.96	1,001	07:20	0.41	1123.5	0.0
R81*	51.46	1,023	07:22	0.41	1131.5	0.0
R82*	51.80	1,049	07:26	0.41	1138.8	0.0
R83*	65.92	1,950	07:24	0.38	1331.1	0.0
R84*	66.22	1,961	07:27	0.38	1338.6	0.0
R85*	66.57	1,972	07:28	0.38	1346.2	0.0
R86*	71.90	2,435	07:31	0.37	1433.2	0.1
R87	1.39	285	07:04	0.57	42.6	0.3
R88*	72.01	2,435	07:32	0.37	1435.9	0.1
R89	0.33	31	07:57	0.42	7.4	0.1
R90	0.42	31	08:49	0.42	9.5	0.1
R91	0.54	33	08:57	0.38	11.1	0.1
Zuni	45.34	533	08:21	0.09	212.4	0.0

*Flow rates and runoff volumes skewed due to addition of baseflow element in HEC-HMS.

TABLE 2-9

HEC-HMS Model Results - 10-yr (w/ 84% Rainfall Depth) - Basins

City of Grants and Village of Milan, New Mexico Drainage Master Plan

Hydrologic Element	Drainage Area (sq. mi.)	Peak Discharge HMS (cfs)	Time of Peak	Runoff Depth (in)	Runoff Volume (ac-ft)	Average Yield (cfs/ac)
B01	1.55	2	07:25	0.02	1.4	0.0
B02	1.48	16	07:25	0.06	4.6	0.0
B03	1.06	35	06:40	0.10	5.5	0.1
B04	1.12	95	06:22	0.17	10.0	0.1
B05	1.45	173	06:37	0.28	22.1	0.2
B06	0.94	8	06:44	0.04	2.0	0.0
B07	0.52	37	06:31	0.17	4.7	0.1
B08	0.99	71	06:30	0.17	8.9	0.1
B09	1.13	12	06:53	0.05	2.9	0.0
B10	1.39	67	06:38	0.13	9.7	0.1
B11	1.34	79	06:34	0.15	10.6	0.1
B12	0.93	57	06:40	0.17	8.3	0.1
B13	0.85	102	06:23	0.23	10.7	0.2
B14	1.07	46	06:35	0.11	6.5	0.1
B15	1.69	127	06:27	0.17	15.1	0.1
B16	1.16	46	06:50	0.13	8.0	0.1
B17	1.37	103	06:27	0.17	12.3	0.1
B18	1.74	122	07:00	0.23	21.4	0.1
B19	0.35	46	06:31	0.29	5.3	0.2
B20	0.11	29	06:20	0.45	2.6	0.4
B21	0.17	22	06:23	0.26	2.3	0.2
B22	0.44	35	06:24	0.17	3.9	0.1
B23	1.28	80	06:30	0.15	10.2	0.1
B24	0.16	17	06:22	0.21	1.8	0.2
B25	0.05	9	06:15	0.29	0.8	0.3
B26	0.03	6	06:06	0.29	0.5	0.3
B27	0.33	33	06:26	0.21	3.7	0.2
B28	0.35	32	06:20	0.17	3.1	0.1
B29	0.15	25	06:12	0.29	2.2	0.3
B30	0.12	22	06:05	0.26	1.7	0.3
B31	0.22	26	06:18	0.21	2.4	0.2
B32	0.11	22	06:14	0.35	2.0	0.3
B33A	0.13	5	06:55	0.13	0.9	0.1
B33B	0.21	33	06:09	0.26	2.9	0.2
B34	0.10	25	06:07	0.35	1.8	0.4
B35	0.13	34	06:06	0.35	2.4	0.4
B36	0.26	68	06:14	0.41	5.7	0.4
B37	0.05	8	06:24	0.31	0.8	0.3
B38	0.16	19	06:49	0.34	2.8	0.2
B39	0.21	52	06:25	0.45	5.1	0.4
B40	0.07	12	06:30	0.38	1.3	0.3
B41	0.22	22	06:57	0.31	3.6	0.2
B42	0.13	13	06:22	0.19	1.3	0.2
B43	0.09	9	06:35	0.23	1.1	0.2
B44	0.22	22	06:35	0.23	2.8	0.2
B45	0.13	33	06:28	0.49	3.4	0.4
B46	0.42	39	06:30	0.21	4.7	0.1
B47	0.29	22	06:35	0.19	2.9	0.1
B48	0.36	61	06:35	0.38	7.3	0.3
B49	0.04	16	06:02	0.38	0.9	0.6
B50A	0.18	7	06:52	0.13	1.2	0.1
B50B	0.12	16	06:17	0.21	1.4	0.2
B51	0.04	9	06:08	0.35	0.7	0.4
B52	0.05	23	06:02	0.45	1.2	0.7
B53	0.06	21	06:12	0.53	1.6	0.6

HEC-HMS Model Results - 10-yr (w/ 84% Rainfall Depth) - Basins

City of Grants and Village of Milan, New Mexico Drainage Master Plan

Hydrologic Element	Drainage Area (sq. mi.)	Peak Discharge HMS (cfs)	Time of Peak	Runoff Depth (in)	Runoff Volume (ac-ft)	Average Yield (cfs/ac)
B54	0.02	4	06:03	0.26	0.3	0.3
B55	0.23	35	06:18	0.26	3.2	0.2
B56	0.16	15	06:18	0.17	1.4	0.2
B57	0.12	12	06:17	0.17	1.0	0.2
B58A	0.18	8	06:47	0.13	1.3	0.1
B58B	0.12	10	06:19	0.15	0.9	0.1
B59	0.03	3	06:19	0.15	0.3	0.1
B60	0.05	7	06:07	0.26	0.6	0.3
B61	0.09	9	06:19	0.19	0.9	0.2
B62	0.08	9	06:28	0.26	1.1	0.2
B63	0.05	5	06:21	0.21	0.5	0.2
B64A	0.04	2	06:38	0.13	0.3	0.1
B64B	0.08	6	06:19	0.15	0.6	0.1
B65A	0.19	8	06:48	0.13	1.3	0.1
B65B	0.14	12	06:18	0.15	1.1	0.1
B66	0.04	3	06:23	0.13	0.3	0.1
B67	0.02	3	06:02	0.21	0.2	0.3
B68	0.03	3	06:16	0.17	0.2	0.2
B69	0.02	3	06:03	0.23	0.2	0.3
B70	0.08	7	06:22	0.19	0.8	0.2
B71A	0.18	10	06:47	0.17	1.6	0.1
B71B	0.27	18	06:19	0.13	1.9	0.1
B72	0.12	9	06:21	0.15	1.0	0.1
B73	0.04	5	06:19	0.23	0.4	0.2
B74	0.04	3	06:22	0.17	0.4	0.1
B75	0.02	2	06:18	0.17	0.2	0.1
B76	0.06	5	06:20	0.15	0.5	0.1
B77	0.02	5	06:08	0.35	0.4	0.4
B78	0.04	4	06:24	0.21	0.5	0.2
B79	0.02	1	06:20	0.13	0.1	0.1
B80	0.16	5	06:23	0.08	0.7	0.1
B81	0.04	1	06:30	0.08	0.2	0.0
B82	0.13	7	06:24	0.11	0.8	0.1
B83	0.35	11	06:33	0.08	1.6	0.0
B84	2.14	15	07:08	0.04	4.5	0.0
B85	1.87	7	07:36	0.03	3.0	0.0
B86	0.22	45	06:35	0.45	5.3	0.3
B87	0.08	16	06:23	0.38	1.5	0.3
B88	0.18	27	06:29	0.31	3.0	0.2
B89	0.17	33	06:19	0.35	3.1	0.3
B90	0.17	37	06:27	0.41	3.8	0.3
B91	0.12	28	06:23	0.41	2.7	0.4
B92	0.05	12	06:18	0.41	1.0	0.4
B93	0.14	27	06:37	0.45	3.3	0.3
B94	0.08	19	06:24	0.45	1.8	0.4
B95	0.39	100	06:23	0.45	9.4	0.4
B96	0.51	94	06:42	0.45	12.2	0.3
B97	0.88	106	06:59	0.37	17.5	0.2
B98	0.10	24	06:13	0.38	2.0	0.4
B99	0.30	90	06:08	0.41	6.5	0.5
B100	0.33	19	07:41	0.28	4.9	0.1
B101	0.09	18	06:28	0.38	1.9	0.3
B102	0.12	4	07:17	0.15	0.9	0.1
B103	0.03	7	06:18	0.35	0.6	0.3

TABLE 2-10

HEC-HMS Model Results - 10-yr (w/ 84% Rainfall Depth) Junctions

City of Grants and Village of Milan, New Mexico Drainage Master Plan

Hydrologic Element	Drainage Area (sq. mi.)	Peak Discharge HMS (cfs)	Time of Peak	Runoff Depth (in)	Runoff Volume (ac-ft)	Average Yield (cfs/ac)
J01	3.03	18	07:25	0.04	6.0	0.0
J02	4.08	35	06:40	0.05	11.3	0.0
J03	1.12	95	06:22	0.17	10.0	0.1
J04	5.20	107	06:51	0.08	21.0	0.0
J05	6.66	201	07:05	0.12	42.8	0.0
J06	1.46	42	06:36	0.09	6.7	0.0
J07	3.59	100	06:48	0.10	18.4	0.0
J08	1.39	67	06:38	0.13	9.7	0.1
J09	4.98	147	06:59	0.11	27.9	0.0
J10	6.32	204	06:47	0.11	38.3	0.1
J11	7.17	241	06:57	0.13	48.6	0.1
J12	9.16	304	07:04	0.13	63.1	0.1
J13	10.85	327	07:21	0.13	77.3	0.0
J14	1.16	46	06:50	0.13	8.0	0.1
J15	1.37	103	06:27	0.17	12.3	0.1
J16	4.26	229	07:10	0.18	41.3	0.1
J17	0.35	46	06:31	0.29	5.3	0.2
J18	0.46	65	06:36	0.32	7.9	0.2
J19	0.44	35	06:24	0.17	3.9	0.1
J20	0.60	55	06:30	0.19	6.2	0.1
J21	11.45	342	07:22	0.14	83.5	0.0
J22	1.28	80	06:30	0.15	10.2	0.1
J23	0.16	17	06:22	0.21	1.8	0.2
J24	0.05	9	06:15	0.29	0.8	0.3
J25	0.08	13	06:19	0.29	1.3	0.3
J26	1.52	106	06:40	0.16	13.2	0.1
J27	12.98	380	07:24	0.14	96.4	0.0
J28	13.77	425	07:02	0.15	107.7	0.0
J29	0.35	32	06:20	0.17	3.1	0.1
J30	0.50	55	06:20	0.20	5.4	0.2
J31	0.12	22	06:05	0.26	1.7	0.3
J32	0.22	26	06:18	0.21	2.4	0.2
J33	0.11	22	06:14	0.35	2.0	0.3
J34A	0.13	5	06:55	0.13	0.9	0.1
J34B	0.34	33	06:09	0.21	3.8	0.2
J35	0.36	89	06:13	0.39	7.6	0.4
J36	0.13	34	06:06	0.35	2.4	0.4
J37	0.28	34	06:36	0.30	4.5	0.2
J38	0.35	43	06:45	0.31	5.8	0.2
J39	13.90	428	07:08	0.15	108.6	0.0
J40	0.42	39	06:30	0.21	4.7	0.1
J41	4.68	241	07:03	0.18	45.7	0.1
J42	4.97	253	07:07	0.18	48.5	0.1
J43	1.87	7	07:36	0.03	3.0	0.0
J44	2.14	15	07:08	0.04	4.5	0.0
J45	0.35	11	06:33	0.08	1.6	0.0
J46	0.13	7	06:24	0.11	0.8	0.1
J47	0.04	1	06:30	0.08	0.2	0.0
J48	0.16	5	06:23	0.08	0.7	0.1
J49	0.02	1	06:20	0.13	0.1	0.1
J50	0.04	3	06:23	0.13	0.3	0.1
J51	0.02	3	06:02	0.21	0.2	0.3
J52	0.03	3	06:16	0.17	0.2	0.2
J53	0.02	3	06:03	0.23	0.2	0.3
J54	0.08	7	06:22	0.19	0.8	0.2
J55*	0.04	405	06:19	425.26	793.8	18.1

*Flow rates and runoff volumes skewed due to addition of baseflow element in HEC-HMS.

HEC-HMS Model Results - 10-yr (w/ 84% Rainfall Depth) Junctions

City of Grants and Village of Milan, New Mexico Drainage Master Plan

Hydrologic Element	Drainage Area (sq. mi.)	Peak Discharge HMS (cfs)	Time of Peak	Runoff Depth (in)	Runoff Volume (ac-ft)	Average Yield (cfs/ac)
J56A	0.18	10	06:47	0.17	1.6	0.1
J56B	0.44	19	06:19	0.14	3.4	0.1
J57	0.56	28	06:20	0.15	4.4	0.1
J58	0.58	30	06:22	0.15	4.6	0.1
J59	0.61	34	06:23	0.15	5.0	0.1
J60	0.04	3	06:22	0.17	0.4	0.1
J61	0.10	8	06:22	0.16	0.9	0.1
J62A	0.04	2	06:38	0.13	0.3	0.1
J62B	0.12	6	06:19	0.14	0.9	0.1
J63A	0.19	8	06:48	0.13	1.3	0.1
J63B	0.50	23	06:19	0.15	3.8	0.1
J64*	1.28	471	06:28	11.76	804.0	0.6
J65	0.09	9	06:19	0.19	0.9	0.2
J66	0.12	12	06:17	0.17	1.0	0.2
J67A	0.18	8	06:47	0.13	1.3	0.1
J67B	0.45	24	06:19	0.15	3.5	0.1
J68	0.16	15	06:18	0.17	1.4	0.2
J69	0.65	45	06:21	0.16	5.5	0.1
J70	0.81	54	06:21	0.17	7.4	0.1
J71	0.02	4	06:03	0.26	0.3	0.3
J72	0.25	40	06:11	0.26	3.5	0.2
J73	0.05	23	06:02	0.45	1.2	0.7
J74	0.04	9	06:08	0.35	0.7	0.4
J75A	0.18	7	06:52	0.13	1.2	0.1
J75B	0.30	16	06:17	0.16	2.6	0.1
J76	0.04	16	06:02	0.38	0.9	0.6
J77	0.49	76	06:12	0.27	7.0	0.2
J78	0.22	45	06:35	0.45	5.3	0.3
J79	0.08	16	06:23	0.38	1.5	0.3
J80*	1.76	536	06:42	8.68	813.6	0.5
J81	0.17	33	06:19	0.35	3.1	0.3
J82	0.98	85	06:25	0.20	10.5	0.1
J83*	2.91	615	06:48	5.33	827.7	0.3
J84*	3.04	612	06:57	5.13	830.2	0.3
J85	0.30	51	06:16	0.28	4.6	0.3
J86*	48.51	762	09:18	0.40	1042.7	0.0
J87*	48.81	764	09:30	0.40	1047.0	0.0
J88*	49.38	769	09:33	0.40	1055.1	0.0
J89*	49.70	770	09:24	0.40	1059.0	0.0
J90*	50.09	774	09:29	0.40	1066.9	0.0
J91*	50.43	776	09:30	0.40	1070.5	0.0
J92*	50.79	779	09:22	0.40	1077.9	0.0
J93*	50.96	781	09:26	0.40	1080.5	0.0
J94*	51.46	785	09:29	0.40	1085.6	0.0
J95*	51.80	803	07:30	0.39	1090.8	0.0
J96*	65.92	1,220	07:18	0.34	1201.0	0.0
J97*	66.22	1,236	07:17	0.34	1207.1	0.0
J98*	66.57	1,247	07:22	0.34	1212.1	0.0
J99*	71.90	1,495	07:32	0.33	1265.7	0.0
J100*	72.01	1,484	07:41	0.33	1265.8	0.0
J101	1.39	191	06:49	0.40	29.7	0.2
J102*	73.40	1,617	07:36	0.33	1294.9	0.0
J103	0.33	19	07:41	0.28	4.9	0.1
J104	0.42	20	07:59	0.30	6.7	0.1
J105	0.54	20	09:07	0.25	7.1	0.1
J106	0.57	20	09:18	0.25	7.7	0.1

*Flow rates and runoff volumes skewed due to addition of baseflow element in HEC-HMS.

TABLE 2-11

HEC-HMS Model Results - 10-yr (w/ 84% Rainfall Dpeth) Reaches

City of Grants and Village of Milan, New Mexico Drainage Master Plan

Hydrologic Element	Drainage Area (sq. mi.)	Peak Discharge HMS (cfs)	Time of Peak	Runoff Depth (in)	Runoff Volume (ac-ft)	Average Yield (cfs/ac)
R01	3.03	18	07:55	0.04	5.8	0.0
R02	4.08	35	07:01	0.05	11.1	0.0
R03	1.12	94	06:41	0.17	9.9	0.1
R04	5.20	106	07:15	0.07	20.7	0.0
R05	1.46	42	06:57	0.08	6.5	0.0
R06	3.59	99	07:00	0.10	18.2	0.0
R07	1.39	67	06:40	0.13	9.7	0.1
R08	4.98	146	07:06	0.10	27.7	0.0
R09	6.32	203	06:58	0.11	38.0	0.1
R10	7.17	241	07:06	0.13	48.4	0.1
R11	9.16	300	07:23	0.13	62.2	0.1
R12	1.16	46	07:21	0.13	7.8	0.1
R13	1.37	102	06:52	0.17	12.1	0.1
R14	4.26	227	07:19	0.18	41.1	0.1
R15	0.35	46	06:40	0.28	5.3	0.2
R16	0.46	65	06:39	0.32	7.9	0.2
R17	10.85	326	07:22	0.13	77.2	0.0
R18	0.44	35	06:32	0.17	3.9	0.1
R19	0.60	55	06:32	0.19	6.2	0.1
R20	11.45	340	07:26	0.14	83.2	0.0
R21	1.28	80	06:39	0.15	10.1	0.1
R22	0.16	17	06:44	0.21	1.8	0.2
R23	0.05	9	06:23	0.29	0.8	0.3
R24	0.08	13	06:23	0.29	1.3	0.3
R25	1.52	106	06:40	0.16	13.1	0.1
R26	12.98	379	07:27	0.14	96.0	0.0
R27	13.77	424	07:08	0.15	107.2	0.0
R28	13.90	420	07:16	0.15	107.8	0.0
R29	0.35	32	06:22	0.17	3.1	0.1
R30	0.50	54	06:31	0.20	5.3	0.2
R31	0.12	18	06:32	0.25	1.6	0.2
R32	0.22	26	06:20	0.21	2.4	0.2
R33	0.11	22	06:16	0.35	2.0	0.3
R34A	0.13	5	07:05	0.13	0.9	0.1
R34B	0.34	33	06:18	0.21	3.8	0.2
R35	0.36	89	06:14	0.39	7.6	0.4
R36	0.13	29	06:16	0.34	2.4	0.3
R37	0.28	34	06:48	0.30	4.4	0.2
R38	0.35	43	06:47	0.31	5.8	0.2
R39	0.42	39	06:34	0.21	4.7	0.1
R40	4.68	241	07:08	0.18	45.6	0.1
R41	4.97	242	07:37	0.18	47.5	0.1
R42*	0.04	405	06:21	425.26	793.8	18.1
R43A	0.18	10	06:56	0.17	1.5	0.1
R43B	0.44	19	06:20	0.14	3.4	0.1
R44	0.56	28	06:23	0.15	4.4	0.1
R45	0.58	29	06:24	0.15	4.6	0.1
R46	0.61	33	06:27	0.15	5.0	0.1
R47	0.04	3	06:24	0.17	0.4	0.1

*Flow rates and runoff volumes skewed due to addition of baseflow element in HEC-HMS.

HEC-HMS Model Results - 10-yr (w/ 84% Rainfall Depth) Reaches

City of Grants and Village of Milan, New Mexico Drainage Master Plan

Hydrologic Element	Drainage Area (sq. mi.)	Peak Discharge HMS (cfs)	Time of Peak	Runoff Depth (in)	Runoff Volume (ac-ft)	Average Yield (cfs/ac)
R48	0.10	8	06:22	0.16	0.9	0.1
R49A	0.04	2	06:55	0.13	0.3	0.1
R49B	0.12	6	06:22	0.14	0.9	0.1
R50A	0.19	8	06:58	0.13	1.3	0.1
R50B	0.50	23	06:31	0.14	3.8	0.1
R51	0.09	9	06:47	0.19	0.9	0.2
R52	0.12	12	06:19	0.17	1.0	0.2
R53A	0.18	8	06:54	0.13	1.3	0.1
R53B	0.45	24	06:22	0.15	3.5	0.1
R54	0.16	15	06:20	0.17	1.4	0.2
R55	0.65	45	06:21	0.16	5.5	0.1
R56	0.81	53	06:25	0.17	7.4	0.1
R57	0.02	4	06:11	0.26	0.3	0.3
R58	0.25	39	06:16	0.26	3.5	0.2
R59	0.30	50	06:30	0.28	4.5	0.3
R60	0.05	22	06:11	0.46	1.2	0.7
R61	0.04	9	06:16	0.35	0.7	0.4
R62A	0.18	7	07:02	0.13	1.2	0.1
R62B	0.30	16	06:23	0.16	2.6	0.1
R63	0.04	16	06:04	0.38	0.9	0.6
R64	0.49	70	06:22	0.27	7.0	0.2
R65	0.22	44	06:50	0.44	5.2	0.3
R66*	1.28	464	06:39	11.76	803.9	0.6
R67	0.08	16	06:25	0.38	1.5	0.3
R68*	1.76	528	06:54	8.68	813.5	0.5
R69	0.17	32	06:28	0.34	3.1	0.3
R70	0.98	79	06:37	0.20	10.3	0.1
R71*	2.91	602	06:58	5.33	827.5	0.3
R72*	3.04	611	07:05	5.13	830.1	0.3
R73*	48.51	762	09:20	0.40	1042.5	0.0
R74*	48.81	764	09:36	0.40	1046.3	0.0
R75*	49.38	769	09:36	0.40	1054.6	0.0
R76*	49.70	770	09:38	0.40	1057.5	0.0
R77*	50.09	774	09:30	0.40	1066.8	0.0
R78*	50.43	776	09:31	0.40	1070.4	0.0
R79*	50.79	779	09:27	0.40	1077.4	0.0
R80*	50.96	781	09:28	0.40	1080.3	0.0
R81*	51.46	785	09:32	0.40	1085.1	0.0
R82*	51.80	800	07:40	0.39	1089.5	0.0
R83*	65.92	1,220	07:18	0.34	1200.9	0.0
R84*	66.22	1,232	07:23	0.34	1205.9	0.0
R85*	66.57	1,242	07:27	0.34	1210.9	0.0
R86*	71.90	1,482	07:41	0.33	1263.8	0.0
R87	1.39	187	07:08	0.39	29.3	0.2
R88*	72.01	1,483	07:42	0.33	1265.6	0.0
R89	0.33	19	08:04	0.27	4.8	0.1
R90	0.42	19	09:08	0.27	6.2	0.1
R91	0.54	20	09:18	0.25	7.1	0.1
Zuni	45.34	533	08:21	0.09	212.4	0.0

*Flow rates and runoff volumes skewed due to addition of baseflow element in HEC-HMS.

TABLE 2-12

HEC-HMS Model Results - 100-yr (w/ 100% Rainfall Depth) - Basins

City of Grants and Village of Milan, New Mexico Drainage Master Plan

Hydrologic Element	Drainage Area (sq. mi.)	Peak Discharge HMS (cfs)	Time of Peak	Runoff Depth (in)	Runoff Volume (ac-ft)	Average Yield (cfs/ac)
B01	1.55	167	06:45	0.30	25.1	0.2
B02	1.48	201	07:05	0.46	36.4	0.2
B03	1.06	308	06:27	0.58	32.7	0.5
B04	1.12	584	06:10	0.76	45.3	0.8
B05	1.45	729	06:32	1.01	78.2	0.8
B06	0.94	187	06:24	0.40	20.0	0.3
B07	0.52	222	06:23	0.76	21.1	0.7
B08	0.99	430	06:22	0.76	40.1	0.7
B09	1.13	213	06:34	0.43	26.0	0.3
B10	1.39	472	06:28	0.67	49.5	0.5
B11	1.34	512	06:25	0.71	50.6	0.6
B12	0.93	339	06:32	0.75	37.3	0.6
B13	0.85	499	06:16	0.91	41.2	0.9
B14	1.07	362	06:23	0.62	35.5	0.5
B15	1.69	764	06:19	0.76	68.1	0.7
B16	1.16	323	06:40	0.66	40.9	0.4
B17	1.37	621	06:19	0.76	55.3	0.7
B18	1.74	564	06:53	0.90	83.0	0.5
B19	0.35	195	06:26	1.01	18.9	0.9
B20	0.11	96	06:16	1.32	7.6	1.4
B21	0.17	102	06:17	0.96	8.5	1.0
B22	0.44	213	06:14	0.76	17.6	0.8
B23	1.28	525	06:21	0.71	48.6	0.6
B24	0.16	92	06:13	0.86	7.3	0.9
B25	0.05	40	06:09	1.02	2.8	1.2
B26	0.03	28	06:04	1.02	1.6	1.5
B27	0.33	172	06:19	0.85	15.2	0.8
B28	0.35	199	06:07	0.76	14.2	0.9
B29	0.15	118	06:08	1.02	7.9	1.3
B30	0.12	115	06:03	0.96	6.3	1.5
B31	0.22	153	06:06	0.86	9.8	1.1
B32	0.11	91	06:10	1.13	6.4	1.3
B33A	0.13	33	06:45	0.66	4.5	0.4
B33B	0.21	174	06:05	0.96	10.7	1.3
B34	0.10	103	06:05	1.13	6.0	1.6
B35	0.13	142	06:04	1.13	7.8	1.7
B36	0.26	247	06:11	1.25	17.4	1.5
B37	0.05	31	06:19	1.07	2.6	1.0
B38	0.16	73	06:44	1.12	9.3	0.7
B39	0.21	171	06:21	1.32	15.0	1.3
B40	0.07	44	06:26	1.19	4.2	1.0
B41	0.22	86	06:52	1.06	12.3	0.6
B42	0.13	73	06:12	0.81	5.7	0.9
B43	0.09	41	06:29	0.90	4.2	0.7
B44	0.22	103	06:29	0.90	10.7	0.7
B45	0.13	105	06:25	1.38	9.7	1.2
B46	0.42	200	06:23	0.85	18.9	0.8
B47	0.29	121	06:28	0.80	12.4	0.7
B48	0.36	221	06:31	1.19	23.0	1.0
B49	0.04	58	06:02	1.19	2.7	2.1
B50A	0.18	48	06:43	0.66	6.3	0.4
B50B	0.12	99	06:04	0.86	5.7	1.3
B51	0.04	38	06:06	1.13	2.4	1.5
B52	0.05	73	06:01	1.32	3.4	2.4
B53	0.06	67	06:10	1.46	4.5	1.8

HEC-HMS Model Results - 100-yr (w/ 100% Rainfall Depth) - Basins

City of Grants and Village of Milan, New Mexico Drainage Master Plan

Hydrologic Element	Drainage Area (sq. mi.)	Peak Discharge HMS (cfs)	Time of Peak	Runoff Depth (in)	Runoff Volume (ac-ft)	Average Yield (cfs/ac)
B54	0.02	22	06:02	0.96	1.1	1.7
B55	0.23	184	06:07	0.96	11.9	1.2
B56	0.16	107	06:04	0.76	6.4	1.1
B57	0.12	85	06:03	0.76	4.7	1.1
B58A	0.18	53	06:38	0.66	6.5	0.5
B58B	0.12	68	06:05	0.71	4.5	0.9
B59	0.03	20	06:05	0.71	1.3	0.9
B60	0.05	40	06:04	0.96	2.3	1.4
B61	0.09	53	06:07	0.81	3.7	1.0
B62	0.08	42	06:22	0.96	3.9	0.9
B63	0.05	28	06:11	0.86	2.1	0.9
B64A	0.04	14	06:28	0.67	1.5	0.5
B64B	0.08	46	06:05	0.71	3.0	0.9
B65A	0.19	53	06:39	0.66	6.6	0.4
B65B	0.14	89	06:04	0.71	5.4	1.0
B66	0.04	19	06:11	0.67	1.5	0.7
B67	0.02	18	06:01	0.86	0.8	1.5
B68	0.03	20	06:02	0.76	1.0	1.2
B69	0.02	17	06:02	0.91	0.8	1.5
B70	0.08	42	06:12	0.81	3.3	0.9
B71A	0.18	57	06:39	0.75	7.0	0.5
B71B	0.27	141	06:05	0.67	9.5	0.8
B72	0.12	62	06:09	0.71	4.7	0.8
B73	0.04	26	06:07	0.91	1.7	1.1
B74	0.04	21	06:10	0.76	1.6	0.8
B75	0.02	14	06:04	0.76	0.8	1.1
B76	0.06	32	06:08	0.71	2.4	0.8
B77	0.02	23	06:06	1.13	1.4	1.5
B78	0.04	23	06:16	0.85	1.9	0.8
B79	0.02	8	06:07	0.67	0.6	0.8
B80	0.16	56	06:09	0.54	4.6	0.5
B81	0.04	14	06:16	0.54	1.3	0.5
B82	0.13	53	06:12	0.63	4.4	0.6
B83	0.35	109	06:19	0.54	10.2	0.5
B84	2.14	337	06:39	0.40	45.2	0.2
B85	1.87	188	07:07	0.36	36.0	0.2
B86	0.22	149	06:31	1.31	15.5	1.1
B87	0.08	57	06:18	1.19	4.8	1.2
B88	0.18	110	06:24	1.07	10.3	1.0
B89	0.17	131	06:14	1.13	10.2	1.2
B90	0.17	128	06:23	1.25	11.5	1.2
B91	0.12	98	06:19	1.25	8.2	1.2
B92	0.05	42	06:13	1.25	3.1	1.4
B93	0.14	89	06:34	1.31	9.6	1.0
B94	0.08	62	06:20	1.32	5.3	1.3
B95	0.39	332	06:19	1.32	27.6	1.3
B96	0.51	309	06:38	1.31	35.9	0.9
B97	0.88	377	06:54	1.18	55.2	0.7
B98	0.10	93	06:09	1.19	6.4	1.4
B99	0.30	331	06:06	1.26	19.7	1.8
B100	0.33	77	07:33	0.99	17.5	0.4
B101	0.09	64	06:23	1.19	5.8	1.1
B102	0.12	25	07:07	0.70	4.4	0.3
B103	0.03	27	06:12	1.13	2.0	1.3

TABLE 2-13

HEC-HMS Model Results - 100-yr (w/ 100% Rainfall Depth) - Junctions

City of Grants and Village of Milan, New Mexico Drainage Master Plan

Hydrologic Element	Drainage Area (sq. mi.)	Peak Discharge HMS (cfs)	Time of Peak	Runoff Depth (in)	Runoff Volume (ac-ft)	Average Yield (cfs/ac)
J01	3.03	344	06:54	0.38	61.5	0.2
J02	4.08	492	06:52	0.43	93.8	0.2
J03	1.12	584	06:10	0.76	45.3	0.8
J04	5.20	793	06:34	0.50	138.3	0.2
J05	6.66	1,417	06:41	0.61	215.3	0.3
J06	1.46	408	06:24	0.53	41.1	0.4
J07	3.59	989	06:30	0.56	107.0	0.4
J08	1.39	472	06:28	0.67	49.5	0.5
J09	4.98	1,424	06:35	0.59	156.1	0.4
J10	6.32	1,839	06:37	0.61	206.4	0.5
J11	7.17	2,064	06:42	0.65	246.9	0.4
J12	9.16	2,540	06:45	0.65	319.1	0.4
J13	10.85	2,744	06:55	0.67	385.2	0.4
J14	1.16	323	06:40	0.66	40.9	0.4
J15	1.37	621	06:19	0.76	55.3	0.7
J16	4.26	1,328	06:48	0.79	178.5	0.5
J17	0.35	195	06:26	1.01	18.9	0.9
J18	0.46	268	06:27	1.08	26.5	0.9
J19	0.44	213	06:14	0.76	17.6	0.8
J20	0.60	314	06:18	0.81	26.1	0.8
J21	11.45	2,828	06:57	0.67	411.2	0.4
J22	1.28	525	06:21	0.71	48.6	0.6
J23	0.16	92	06:13	0.86	7.3	0.9
J24	0.05	40	06:09	1.02	2.8	1.2
J25	0.08	59	06:13	1.02	4.4	1.1
J26	1.52	662	06:25	0.74	60.2	0.7
J27	12.98	3,063	07:00	0.68	470.8	0.4
J28	13.77	3,215	07:03	0.70	511.7	0.4
J29	0.35	199	06:07	0.76	14.2	0.9
J30	0.50	316	06:08	0.83	22.0	1.0
J31	0.12	115	06:03	0.96	6.3	1.5
J32	0.22	153	06:06	0.86	9.8	1.1
J33	0.11	91	06:10	1.13	6.4	1.3
J34A	0.13	33	06:45	0.66	4.5	0.4
J34B	0.34	174	06:05	0.85	15.2	0.8
J35	0.36	336	06:09	1.22	23.4	1.5
J36	0.13	142	06:04	1.13	7.8	1.7
J37	0.28	121	06:25	1.04	15.5	0.7
J38	0.35	163	06:28	1.06	19.6	0.7
J39	13.90	3,225	07:06	0.70	516.6	0.4
J40	0.42	200	06:23	0.85	18.9	0.8
J41	4.68	1,431	06:51	0.79	196.9	0.5
J42	4.97	1,495	06:53	0.79	208.9	0.5
J43	1.87	188	07:07	0.36	36.0	0.2
J44	2.14	337	06:39	0.40	45.2	0.2
J45	0.35	109	06:19	0.54	10.2	0.5
J46	0.13	53	06:12	0.63	4.4	0.6
J47	0.04	14	06:16	0.54	1.3	0.5
J48	0.16	56	06:09	0.54	4.6	0.5
J49	0.02	8	06:07	0.67	0.6	0.8
J50	0.04	19	06:11	0.67	1.5	0.7
J51	0.02	18	06:01	0.86	0.8	1.5
J52	0.03	20	06:02	0.76	1.0	1.2
J53	0.02	17	06:02	0.91	0.8	1.5
J54	0.08	42	06:12	0.81	3.3	0.9
J55*	0.04	426	06:07	425.94	795.1	19.0

*Flow rates and runoff volumes skewed due to addition of baseflow element in HEC-HMS.

HEC-HMS Model Results - 100-yr (w/ 100% Rainfall Depth) - Junctions

City of Grants and Village of Milan, New Mexico Drainage Master Plan

Hydrologic Element	Drainage Area (sq. mi.)	Peak Discharge HMS (cfs)	Time of Peak	Runoff Depth (in)	Runoff Volume (ac-ft)	Average Yield (cfs/ac)
J56A	0.18	57	06:39	0.75	7.0	0.5
J56B	0.44	141	06:05	0.70	16.5	0.5
J57	0.56	200	06:07	0.70	21.2	0.6
J58	0.58	211	06:08	0.71	22.0	0.6
J59	0.61	231	06:09	0.72	23.4	0.6
J60	0.04	21	06:10	0.76	1.6	0.8
J61	0.10	52	06:10	0.73	4.0	0.8
J62A	0.04	14	06:28	0.67	1.5	0.5
J62B	0.12	46	06:05	0.70	4.5	0.6
J63A	0.19	53	06:39	0.66	6.6	0.4
J63B	0.50	153	06:06	0.70	18.6	0.5
J64*	1.28	866	06:12	12.33	842.8	1.1
J65	0.09	53	06:07	0.81	3.7	1.0
J66	0.12	85	06:03	0.76	4.7	1.1
J67A	0.18	53	06:38	0.66	6.5	0.5
J67B	0.45	172	06:05	0.70	16.9	0.6
J68	0.16	107	06:04	0.76	6.4	1.1
J69	0.65	310	06:06	0.74	25.6	0.7
J70	0.81	329	06:07	0.76	33.1	0.6
J71	0.02	22	06:02	0.96	1.1	1.7
J72	0.25	206	06:07	0.96	13.0	1.3
J73	0.05	73	06:01	1.32	3.4	2.4
J74	0.04	38	06:06	1.13	2.4	1.5
J75A	0.18	48	06:43	0.66	6.3	0.4
J75B	0.30	100	06:04	0.74	11.9	0.5
J76	0.04	58	06:02	1.19	2.7	2.1
J77	0.49	308	06:08	0.95	24.9	1.0
J78	0.22	149	06:31	1.31	15.5	1.1
J79	0.08	57	06:18	1.19	4.8	1.2
J80*	1.76	1,079	06:29	9.31	872.9	1.0
J81	0.17	131	06:14	1.13	10.2	1.2
J82	0.98	431	06:23	0.82	43.1	0.7
J83*	2.91	1,513	06:34	5.96	926.7	0.8
J84*	3.04	1,466	06:42	5.77	934.0	0.8
J85	0.30	244	06:10	1.01	16.1	1.3
J86*	48.51	1,718	06:51	0.64	1654.5	0.1
J87*	48.81	1,796	06:51	0.64	1669.1	0.1
J88*	49.38	1,907	06:54	0.64	1695.6	0.1
J89*	49.70	1,941	06:57	0.64	1709.5	0.1
J90*	50.09	2,007	07:04	0.65	1729.5	0.1
J91*	50.43	2,058	07:05	0.65	1743.9	0.1
J92*	50.79	2,102	07:05	0.65	1766.5	0.1
J93*	50.96	2,118	07:08	0.65	1773.9	0.1
J94*	51.46	2,166	07:09	0.65	1794.8	0.1
J95*	51.80	2,251	07:11	0.66	1811.6	0.1
J96*	65.92	5,473	07:10	0.66	2331.7	0.1
J97*	66.22	5,526	07:10	0.67	2350.5	0.1
J98*	66.57	5,559	07:12	0.67	2365.0	0.1
J99*	71.90	7,001	07:11	0.67	2587.5	0.2
J100*	72.01	6,860	07:15	0.67	2583.1	0.1
J101	1.39	656	06:46	1.23	91.1	0.7
J102*	73.40	7,415	07:14	0.68	2672.1	0.2
J103	0.33	77	07:33	0.99	17.5	0.4
J104	0.42	81	07:41	1.03	23.1	0.3
J105	0.54	85	08:17	0.91	26.3	0.2
J106	0.57	86	08:24	0.92	28.3	0.2

*Flow rates and runoff volumes skewed due to addition of baseflow element in HEC-HMS.

TABLE 2-14

HEC-HMS Model Results - 100-yr (w/ 100% Rainfall Depth) - Reaches

City of Grants and Village of Milan, New Mexico Drainage Master Plan

Hydrologic Element	Drainage Area (sq. mi.)	Peak Discharge HMS (cfs)	Time of Peak	Runoff Depth (in)	Runoff Volume (ac-ft)	Average Yield (cfs/ac)
R01	3.03	344	07:03	0.38	61.1	0.2
R02	4.08	492	07:02	0.43	93.3	0.2
R03	1.12	576	06:23	0.75	45.0	0.8
R04	5.20	789	06:48	0.49	137.1	0.2
R05	1.46	408	06:33	0.52	40.9	0.4
R06	3.59	988	06:37	0.56	106.6	0.4
R07	1.39	472	06:29	0.67	49.4	0.5
R08	4.98	1423	06:39	0.59	155.8	0.4
R09	6.32	1832	06:43	0.61	205.7	0.5
R10	7.17	2058	06:47	0.64	246.3	0.4
R11	9.16	2506	06:56	0.65	317.1	0.4
R12	1.16	320	06:57	0.66	40.5	0.4
R13	1.37	618	06:34	0.75	55.0	0.7
R14	4.26	1326	06:53	0.78	178.0	0.5
R15	0.35	195	06:31	1.01	18.9	0.9
R16	0.46	268	06:29	1.08	26.4	0.9
R17	10.85	2736	06:57	0.67	385.1	0.4
R18	0.44	212	06:18	0.76	17.6	0.8
R19	0.60	314	06:19	0.81	26.1	0.8
R20	11.45	2817	07:02	0.67	410.7	0.4
R21	1.28	524	06:26	0.71	48.5	0.6
R22	0.16	92	06:25	0.85	7.3	0.9
R23	0.05	40	06:14	1.02	2.8	1.2
R24	0.08	59	06:15	1.01	4.4	1.1
R25	1.52	662	06:26	0.74	60.2	0.7
R26	12.98	3054	07:04	0.68	470.0	0.4
R27	13.77	3212	07:06	0.70	510.9	0.4
R28	13.90	3201	07:09	0.69	514.4	0.4
R29	0.35	199	06:09	0.76	14.2	0.9
R30	0.50	306	06:16	0.83	21.9	1.0
R31	0.12	89	06:15	0.93	6.1	1.1
R32	0.22	153	06:07	0.86	9.8	1.1
R33	0.11	91	06:11	1.13	6.4	1.3
R34A	0.13	33	06:52	0.66	4.5	0.4
R34B	0.34	173	06:10	0.85	15.2	0.8
R35	0.36	335	06:09	1.22	23.4	1.5
R36	0.13	120	06:09	1.11	7.7	1.4
R37	0.28	120	06:32	1.03	15.4	0.7
R38	0.35	163	06:29	1.06	19.6	0.7
R39	0.42	200	06:26	0.85	18.9	0.8
R40	4.68	1429	06:54	0.79	196.6	0.5
R41	4.97	1436	07:08	0.78	206.0	0.5
R42*	0.04	423	06:12	425.94	795.1	18.9
R43A	0.18	57	06:44	0.75	7.0	0.5
R43B	0.44	141	06:06	0.70	16.5	0.5
R44	0.56	199	06:08	0.70	21.2	0.6
R45	0.58	210	06:09	0.71	22.0	0.6
R46	0.61	229	06:11	0.72	23.3	0.6
R47	0.04	21	06:12	0.76	1.6	0.8

*Flow rates and runoff volumes skewed due to addition of baseflow element in HEC-HMS.

HEC-HMS Model Results - 100-yr (w/ 100% Rainfall Depth) - Reaches

City of Grants and Village of Milan, New Mexico Drainage Master Plan

Hydrologic Element	Drainage Area (sq. mi.)	Peak Discharge HMS (cfs)	Time of Peak	Runoff Depth (in)	Runoff Volume (ac-ft)	Average Yield (cfs/ac)
R48	0.10	52	06:10	0.73	4.0	0.8
R49A	0.04	14	06:36	0.66	1.5	0.5
R49B	0.12	46	06:07	0.70	4.5	0.6
R50A	0.19	53	06:44	0.66	6.6	0.4
R50B	0.50	147	06:14	0.70	18.5	0.5
R51	0.09	52	06:23	0.80	3.6	0.9
R52	0.12	84	06:04	0.76	4.7	1.1
R53A	0.18	53	06:41	0.66	6.5	0.5
R53B	0.45	167	06:07	0.70	16.9	0.6
R54	0.16	106	06:06	0.76	6.4	1.1
R55	0.65	308	06:06	0.74	25.6	0.7
R56	0.81	322	06:09	0.76	33.1	0.6
R57	0.02	22	06:07	0.96	1.1	1.6
R58	0.25	204	06:10	0.96	13.0	1.3
R59	0.30	236	06:19	1.00	16.0	1.2
R60	0.05	73	06:08	1.33	3.4	2.4
R61	0.04	38	06:11	1.13	2.4	1.5
R62A	0.18	48	06:48	0.66	6.2	0.4
R62B	0.30	98	06:07	0.74	11.9	0.5
R63	0.04	58	06:03	1.19	2.7	2.1
R64	0.49	287	06:13	0.95	24.7	0.9
R65	0.22	145	06:41	1.30	15.3	1.0
R66*	1.28	815	06:26	12.32	842.6	1.0
R67	0.08	57	06:20	1.19	4.8	1.2
R68*	1.76	1043	06:40	9.31	872.5	0.9
R69	0.17	127	06:20	1.12	10.1	1.2
R70	0.98	412	06:28	0.81	42.7	0.7
R71*	2.91	1412	06:43	5.96	925.8	0.8
R72*	3.04	1459	06:49	5.77	933.6	0.8
R73*	48.51	1,715	06:53	0.64	1653.1	0.1
R74*	48.81	1,786	06:56	0.64	1665.6	0.1
R75*	49.38	1,903	06:57	0.64	1693.2	0.1
R76*	49.70	1,931	07:06	0.64	1701.9	0.1
R77*	50.09	2,002	07:05	0.65	1728.7	0.1
R78*	50.43	2,054	07:06	0.65	1743.0	0.1
R79*	50.79	2,096	07:08	0.65	1763.6	0.1
R80*	50.96	2,114	07:09	0.65	1772.9	0.1
R81*	51.46	2,163	07:12	0.65	1792.0	0.1
R82*	51.80	2,218	07:15	0.65	1805.1	0.1
R83*	65.92	5,472	07:10	0.66	2331.3	0.1
R84*	66.22	5,497	07:12	0.66	2344.7	0.1
R85*	66.57	5,507	07:14	0.66	2358.6	0.1
R86*	71.90	6,852	07:15	0.67	2576.6	0.1
R87	1.39	642	06:58	1.21	90.1	0.7
R88*	72.01	6,854	07:16	0.67	2582.0	0.1
R89	0.33	77	07:47	0.98	17.3	0.4
R90	0.42	77	08:23	0.97	21.9	0.3
R91	0.54	85	08:24	0.91	26.2	0.2
Zuni	45.34	2484	08:08	0.33	801.2	0.1

*Flow rates and runoff volumes skewed due to addition of baseflow element in HEC-HMS.

TABLE 2-15

HEC-HMS Model Results - 100-yr (w/ 84% Rainfall Depth) - Basins

City of Grants and Village of Milan, New Mexico Drainage Master Plan

Hydrologic Element	Drainage Area (sq. mi.)	Peak Discharge HMS (cfs)	Time of Peak	Runoff Depth (in)	Runoff Volume (ac-ft)	Average Yield (cfs/ac)
B01	1.55	75	06:49	0.16	13.4	0.1
B02	1.48	111	07:09	0.28	21.9	0.1
B03	1.06	181	06:29	0.37	20.7	0.3
B04	1.12	359	06:12	0.51	30.2	0.5
B05	1.45	495	06:33	0.71	55.2	0.5
B06	0.94	96	06:27	0.23	11.5	0.2
B07	0.52	141	06:25	0.50	14.1	0.4
B08	0.99	272	06:23	0.50	26.7	0.4
B09	1.13	112	06:36	0.25	15.3	0.2
B10	1.39	288	06:29	0.43	32.2	0.3
B11	1.34	319	06:26	0.47	33.4	0.4
B12	0.93	214	06:33	0.50	24.9	0.4
B13	0.85	328	06:17	0.62	28.4	0.6
B14	1.07	217	06:25	0.40	22.8	0.3
B15	1.69	483	06:21	0.50	45.4	0.4
B16	1.16	197	06:42	0.43	26.6	0.3
B17	1.37	392	06:21	0.50	36.9	0.4
B18	1.74	373	06:54	0.62	57.4	0.3
B19	0.35	133	06:27	0.71	13.3	0.6
B20	0.11	69	06:17	0.97	5.6	1.0
B21	0.17	68	06:18	0.67	5.9	0.6
B22	0.44	133	06:16	0.51	11.7	0.5
B23	1.28	327	06:23	0.47	32.0	0.4
B24	0.16	59	06:15	0.58	5.0	0.6
B25	0.05	27	06:10	0.71	2.0	0.8
B26	0.03	19	06:05	0.72	1.1	1.0
B27	0.33	112	06:21	0.58	10.4	0.5
B28	0.35	121	06:09	0.51	9.4	0.5
B29	0.15	78	06:08	0.71	5.5	0.8
B30	0.12	76	06:04	0.67	4.4	1.0
B31	0.22	96	06:06	0.58	6.7	0.7
B32	0.11	63	06:11	0.81	4.6	0.9
B33A	0.13	20	06:47	0.43	2.9	0.2
B33B	0.21	114	06:06	0.67	7.5	0.9
B34	0.10	71	06:05	0.81	4.3	1.1
B35	0.13	97	06:04	0.81	5.6	1.2
B36	0.26	174	06:11	0.92	12.7	1.0
B37	0.05	21	06:20	0.76	1.9	0.7
B38	0.16	51	06:45	0.81	6.7	0.5
B39	0.21	123	06:22	0.97	11.0	0.9
B40	0.07	31	06:27	0.86	3.0	0.7
B41	0.22	59	06:53	0.76	8.7	0.4
B42	0.13	46	06:13	0.54	3.9	0.5
B43	0.09	27	06:30	0.62	2.9	0.5
B44	0.22	68	06:30	0.62	7.4	0.5
B45	0.13	76	06:25	1.03	7.2	0.9
B46	0.42	131	06:25	0.58	12.9	0.5
B47	0.29	78	06:29	0.54	8.4	0.4
B48	0.36	156	06:32	0.86	16.6	0.7
B49	0.04	42	06:02	0.87	2.0	1.5
B50A	0.18	29	06:44	0.43	4.1	0.3
B50B	0.12	63	06:04	0.59	3.9	0.8
B51	0.04	26	06:07	0.81	1.7	1.0
B52	0.05	53	06:02	0.98	2.5	1.7
B53	0.06	49	06:10	1.09	3.4	1.3

HEC-HMS Model Results - 100-yr (w/ 84% Rainfall Depth) - Basins

City of Grants and Village of Milan, New Mexico Drainage Master Plan

Hydrologic Element	Drainage Area (sq. mi.)	Peak Discharge HMS (cfs)	Time of Peak	Runoff Depth (in)	Runoff Volume (ac-ft)	Average Yield (cfs/ac)
B54	0.02	15	06:02	0.67	0.8	1.1
B55	0.23	121	06:07	0.67	8.3	0.8
B56	0.16	64	06:04	0.51	4.2	0.6
B57	0.12	51	06:03	0.51	3.1	0.7
B58A	0.18	32	06:39	0.43	4.2	0.3
B58B	0.12	40	06:06	0.47	2.9	0.5
B59	0.03	12	06:06	0.47	0.9	0.5
B60	0.05	26	06:05	0.67	1.6	0.9
B61	0.09	33	06:08	0.54	2.5	0.6
B62	0.08	28	06:24	0.67	2.7	0.6
B63	0.05	18	06:13	0.58	1.5	0.6
B64A	0.04	9	06:29	0.43	1.0	0.3
B64B	0.08	27	06:06	0.47	2.0	0.5
B65A	0.19	32	06:41	0.43	4.3	0.3
B65B	0.14	52	06:05	0.47	3.6	0.6
B66	0.04	11	06:15	0.43	1.0	0.4
B67	0.02	11	06:01	0.59	0.6	1.0
B68	0.03	12	06:02	0.51	0.7	0.8
B69	0.02	11	06:02	0.63	0.6	1.0
B70	0.08	26	06:13	0.54	2.2	0.5
B71A	0.18	36	06:41	0.50	4.7	0.3
B71B	0.27	80	06:06	0.44	6.1	0.5
B72	0.12	37	06:11	0.47	3.1	0.5
B73	0.04	16	06:08	0.63	1.2	0.7
B74	0.04	13	06:12	0.51	1.1	0.5
B75	0.02	8	06:04	0.51	0.5	0.6
B76	0.06	19	06:09	0.47	1.6	0.5
B77	0.02	16	06:07	0.81	1.0	1.1
B78	0.04	15	06:18	0.58	1.3	0.6
B79	0.02	5	06:08	0.43	0.4	0.4
B80	0.16	32	06:19	0.34	2.9	0.3
B81	0.04	8	06:21	0.34	0.8	0.3
B82	0.13	31	06:17	0.40	2.8	0.4
B83	0.35	63	06:22	0.34	6.4	0.3
B84	2.14	172	06:43	0.23	26.1	0.1
B85	1.87	95	07:13	0.20	20.3	0.1
B86	0.22	108	06:32	0.97	11.4	0.8
B87	0.08	40	06:19	0.86	3.4	0.8
B88	0.18	75	06:25	0.76	7.3	0.7
B89	0.17	91	06:15	0.81	7.3	0.8
B90	0.17	91	06:24	0.91	8.4	0.8
B91	0.12	70	06:20	0.91	6.0	0.9
B92	0.05	30	06:14	0.92	2.3	1.0
B93	0.14	64	06:34	0.97	7.1	0.7
B94	0.08	45	06:21	0.97	3.9	0.9
B95	0.39	239	06:20	0.97	20.3	0.9
B96	0.51	222	06:39	0.97	26.5	0.7
B97	0.88	265	06:55	0.86	40.0	0.5
B98	0.10	65	06:10	0.86	4.6	1.0
B99	0.30	234	06:06	0.92	14.4	1.2
B100	0.33	53	07:35	0.70	12.3	0.3
B101	0.09	45	06:24	0.86	4.2	0.8
B102	0.12	16	07:09	0.46	2.9	0.2
B103	0.03	19	06:14	0.81	1.5	0.9

TABLE 2-16

HEC-HMS Model Results - 100-yr (w/ 84% Rainfall Depth) - Junctions

City of Grants and Village of Milan, New Mexico Drainage Master Plan

Hydrologic Element	Drainage Area (sq. mi.)	Peak Discharge HMS (cfs)	Time of Peak	Runoff Depth (in)	Runoff Volume (ac-ft)	Average Yield (cfs/ac)
J01	3.03	176	07:00	0.22	35.3	0.1
J02	4.08	253	07:04	0.26	55.7	0.1
J03	1.12	359	06:12	0.51	30.2	0.5
J04	5.20	481	06:35	0.31	85.4	0.1
J05	6.66	869	06:46	0.39	139.6	0.2
J06	1.46	235	06:26	0.33	25.6	0.3
J07	3.59	569	06:34	0.35	67.6	0.2
J08	1.39	288	06:29	0.43	32.2	0.3
J09	4.98	822	06:40	0.38	99.6	0.3
J10	6.32	1054	06:42	0.39	132.8	0.3
J11	7.17	1170	06:48	0.42	160.7	0.3
J12	9.16	1423	06:52	0.43	207.9	0.2
J13	10.85	1563	07:02	0.44	251.8	0.2
J14	1.16	197	06:42	0.43	26.6	0.3
J15	1.37	392	06:21	0.50	36.9	0.4
J16	4.26	849	06:51	0.53	120.4	0.3
J17	0.35	133	06:27	0.71	13.3	0.6
J18	0.46	183	06:29	0.77	18.9	0.6
J19	0.44	133	06:16	0.51	11.7	0.5
J20	0.60	200	06:21	0.55	17.7	0.5
J21	11.45	1619	07:03	0.44	269.3	0.2
J22	1.28	327	06:23	0.47	32.0	0.4
J23	0.16	59	06:15	0.58	5.0	0.6
J24	0.05	27	06:10	0.71	2.0	0.8
J25	0.08	40	06:15	0.71	3.1	0.8
J26	1.52	415	06:28	0.49	40.1	0.4
J27	12.98	1766	07:05	0.45	309.1	0.2
J28	13.77	1871	07:07	0.46	337.8	0.2
J29	0.35	121	06:09	0.51	9.4	0.5
J30	0.50	198	06:09	0.57	15.0	0.6
J31	0.12	76	06:04	0.67	4.4	1.0
J32	0.22	96	06:06	0.58	6.7	0.7
J33	0.11	63	06:11	0.81	4.6	0.9
J34A	0.13	20	06:47	0.43	2.9	0.2
J34B	0.34	114	06:06	0.58	10.4	0.5
J35	0.36	235	06:09	0.89	17.0	1.0
J36	0.13	97	06:04	0.81	5.6	1.2
J37	0.28	86	06:27	0.74	11.0	0.5
J38	0.35	114	06:32	0.76	13.9	0.5
J39	13.90	1878	07:10	0.46	341.1	0.2
J40	0.42	131	06:25	0.58	12.9	0.5
J41	4.68	910	06:56	0.53	132.9	0.3
J42	4.97	947	06:59	0.53	141.0	0.3
J43	1.87	95	07:13	0.20	20.3	0.1
J44	2.14	172	06:43	0.23	26.1	0.1
J45	0.35	63	06:22	0.34	6.4	0.3
J46	0.13	31	06:17	0.40	2.8	0.4
J47	0.04	8	06:21	0.34	0.8	0.3
J48	0.16	32	06:19	0.34	2.9	0.3
J49	0.02	5	06:08	0.43	0.4	0.4
J50	0.04	11	06:15	0.43	1.0	0.4
J51	0.02	11	06:01	0.59	0.6	1.0
J52	0.03	12	06:02	0.51	0.7	0.8
J53	0.02	11	06:02	0.63	0.6	1.0
J54	0.08	26	06:13	0.54	2.2	0.5
J55*	0.04	416	06:08	425.66	794.6	18.6

*Flow rates and runoff volumes skewed due to addition of baseflow element in HEC-HMS.

HEC-HMS Model Results - 100-yr (w/ 84% Rainfall Depth) - Junctions

City of Grants and Village of Milan, New Mexico Drainage Master Plan

Hydrologic Element	Drainage Area (sq. mi.)	Peak Discharge HMS (cfs)	Time of Peak	Runoff Depth (in)	Runoff Volume (ac-ft)	Average Yield (cfs/ac)
J56A	0.18	36	06:41	0.50	4.7	0.3
J56B	0.44	81	06:06	0.46	10.8	0.3
J57	0.56	115	06:08	0.46	13.9	0.3
J58	0.58	122	06:09	0.46	14.5	0.3
J59	0.61	136	06:10	0.48	15.5	0.3
J60	0.04	13	06:12	0.51	1.1	0.5
J61	0.10	31	06:12	0.48	2.6	0.5
J62A	0.04	9	06:29	0.43	1.0	0.3
J62B	0.12	27	06:06	0.46	2.9	0.3
J63A	0.19	32	06:41	0.43	4.3	0.3
J63B	0.50	91	06:07	0.46	12.2	0.3
J64*	1.28	680	06:15	12.08	826.1	0.8
J65	0.09	33	06:08	0.54	2.5	0.6
J66	0.12	51	06:03	0.51	3.1	0.7
J67A	0.18	32	06:39	0.43	4.2	0.3
J67B	0.45	103	06:05	0.46	11.1	0.4
J68	0.16	64	06:04	0.51	4.2	0.6
J69	0.65	186	06:07	0.49	17.0	0.4
J70	0.81	199	06:08	0.51	22.1	0.4
J71	0.02	15	06:02	0.67	0.8	1.1
J72	0.25	135	06:07	0.67	9.1	0.8
J73	0.05	53	06:02	0.98	2.5	1.7
J74	0.04	26	06:07	0.81	1.7	1.0
J75A	0.18	29	06:44	0.43	4.1	0.3
J75B	0.30	63	06:04	0.49	7.9	0.3
J76	0.04	42	06:02	0.87	2.0	1.5
J77	0.49	212	06:09	0.67	17.5	0.7
J78	0.22	108	06:32	0.97	11.4	0.8
J79	0.08	40	06:19	0.86	3.4	0.8
J80*	1.76	842	06:32	9.04	848.0	0.7
J81	0.17	91	06:15	0.81	7.3	0.8
J82	0.98	267	06:21	0.56	29.3	0.4
J83*	2.91	1120	06:38	5.70	885.3	0.6
J84*	3.04	1093	06:45	5.50	890.8	0.6
J85	0.30	162	06:11	0.71	11.3	0.8
J86*	48.51	1,357	07:03	0.62	1608.8	0.0
J87*	48.81	1,398	06:58	0.62	1618.8	0.0
J88*	49.38	1,470	07:03	0.62	1636.6	0.0
J89*	49.70	1,499	07:05	0.62	1645.6	0.0
J90*	50.09	1,542	07:12	0.62	1658.6	0.0
J91*	50.43	1,577	07:12	0.62	1668.2	0.0
J92*	50.79	1,602	07:11	0.62	1684.4	0.0
J93*	50.96	1,612	07:14	0.62	1689.1	0.0
J94*	51.46	1,650	07:15	0.62	1703.0	0.1
J95*	51.80	1,705	07:17	0.62	1714.3	0.1
J96*	65.92	3,570	07:17	0.59	2056.8	0.1
J97*	66.22	3,603	07:17	0.59	2070.4	0.1
J98*	66.57	3,626	07:20	0.59	2079.9	0.1
J99*	71.90	4,541	07:18	0.58	2230.4	0.1
J100*	72.01	4,470	07:22	0.58	2226.6	0.1
J101	1.39	465	06:46	0.90	66.5	0.5
J102*	73.40	4,840	07:21	0.59	2291.4	0.1
J103	0.33	53	07:35	0.70	12.3	0.3
J104	0.42	55	07:47	0.73	16.4	0.2
J105	0.54	57	08:29	0.64	18.4	0.2
J106	0.57	57	08:37	0.65	19.8	0.2

*Flow rates and runoff volumes skewed due to addition of baseflow element in HEC-HMS.

TABLE 2-17

HEC-HMS Model Results - 100-yr (w/ 84% Rainfall Depth) - Reaches

City of Grants and Village of Milan, New Mexico Drainage Master Plan

Hydrologic Element	Drainage Area (sq. mi.)	Peak Discharge HMS (cfs)	Time of Peak	Runoff Depth (in)	Runoff Volume (ac-ft)	Average Yield (cfs/ac)
R01	3.03	176	07:13	0.22	35.0	0.1
R02	4.08	253	07:16	0.25	55.3	0.1
R03	1.12	355	06:27	0.50	30.1	0.5
R04	5.20	476	06:51	0.30	84.4	0.1
R05	1.46	235	06:37	0.33	25.6	0.3
R06	3.59	569	06:42	0.35	67.4	0.2
R07	1.39	288	06:30	0.43	32.2	0.3
R08	4.98	821	06:44	0.37	99.4	0.3
R09	6.32	1048	06:49	0.39	132.3	0.3
R10	7.17	1167	06:54	0.42	160.2	0.3
R11	9.16	1414	07:03	0.42	206.4	0.2
R12	1.16	195	07:02	0.43	26.3	0.3
R13	1.37	390	06:38	0.50	36.8	0.4
R14	4.26	848	06:57	0.53	120.0	0.3
R15	0.35	132	06:33	0.71	13.3	0.6
R16	0.46	183	06:31	0.77	18.9	0.6
R17	10.85	1562	07:03	0.43	251.7	0.2
R18	0.44	133	06:22	0.50	11.7	0.5
R19	0.60	200	06:21	0.55	17.7	0.5
R20	11.45	1617	07:08	0.44	269.0	0.2
R21	1.28	325	06:29	0.47	32.0	0.4
R22	0.16	59	06:29	0.58	5.0	0.6
R23	0.05	27	06:15	0.71	2.0	0.8
R24	0.08	40	06:18	0.71	3.1	0.8
R25	1.52	415	06:29	0.49	40.1	0.4
R26	12.98	1764	07:09	0.45	308.5	0.2
R27	13.77	1870	07:11	0.46	337.3	0.2
R28	13.90	1870	07:14	0.46	339.6	0.2
R29	0.35	121	06:10	0.51	9.4	0.5
R30	0.50	193	06:18	0.56	14.9	0.6
R31	0.12	58	06:18	0.65	4.3	0.7
R32	0.22	96	06:08	0.58	6.7	0.7
R33	0.11	63	06:12	0.81	4.6	0.9
R34A	0.13	20	06:54	0.43	2.9	0.2
R34B	0.34	113	06:12	0.58	10.4	0.5
R35	0.36	234	06:10	0.89	17.0	1.0
R36	0.13	81	06:10	0.80	5.5	1.0
R37	0.28	85	06:35	0.73	10.9	0.5
R38	0.35	114	06:33	0.76	13.9	0.5
R39	0.42	131	06:28	0.58	12.9	0.5
R40	4.68	909	06:59	0.53	132.7	0.3
R41	4.97	909	07:14	0.52	138.9	0.3
R42*	0.04	415	06:13	425.65	794.6	18.5
R43A	0.18	36	06:46	0.50	4.7	0.3
R43B	0.44	81	06:07	0.46	10.8	0.3
R44	0.56	115	06:10	0.46	13.9	0.3
R45	0.58	121	06:10	0.46	14.5	0.3
R46	0.61	135	06:13	0.48	15.4	0.3
R47	0.04	13	06:14	0.51	1.1	0.5

*Flow rates and runoff volumes skewed due to addition of baseflow element in HEC-HMS.

HEC-HMS Model Results - 100-yr (w/ 84% Rainfall Depth) - Reaches

City of Grants and Village of Milan, New Mexico Drainage Master Plan

Hydrologic Element	Drainage Area (sq. mi.)	Peak Discharge HMS (cfs)	Time of Peak	Runoff Depth (in)	Runoff Volume (ac-ft)	Average Yield (cfs/ac)
R48	0.10	31	06:12	0.48	2.6	0.5
R49A	0.04	9	06:39	0.43	1.0	0.3
R49B	0.12	27	06:08	0.46	2.9	0.3
R50A	0.19	32	06:47	0.43	4.3	0.3
R50B	0.50	88	06:16	0.46	12.2	0.3
R51	0.09	32	06:27	0.55	2.5	0.6
R52	0.12	51	06:05	0.51	3.1	0.7
R53A	0.18	32	06:43	0.43	4.2	0.3
R53B	0.45	98	06:08	0.46	11.1	0.3
R54	0.16	64	06:06	0.51	4.2	0.6
R55	0.65	185	06:07	0.49	17.0	0.4
R56	0.81	195	06:11	0.51	22.1	0.4
R57	0.02	15	06:08	0.67	0.7	1.1
R58	0.25	134	06:11	0.67	9.1	0.8
R59	0.30	157	06:21	0.71	11.3	0.8
R60	0.05	53	06:09	0.98	2.5	1.7
R61	0.04	26	06:12	0.81	1.7	1.0
R62A	0.18	29	06:50	0.43	4.1	0.3
R62B	0.30	62	06:08	0.49	7.9	0.3
R63	0.04	41	06:03	0.87	2.0	1.5
R64	0.49	197	06:15	0.67	17.4	0.6
R65	0.22	104	06:43	0.96	11.3	0.7
R66*	1.28	658	06:29	12.08	826.0	0.8
R67	0.08	40	06:21	0.86	3.4	0.8
R68*	1.76	818	06:43	9.04	847.9	0.7
R69	0.17	88	06:21	0.80	7.2	0.8
R70	0.98	262	06:30	0.55	29.0	0.4
R71*	2.91	1058	06:46	5.70	884.8	0.6
R72*	3.04	1088	06:53	5.50	890.5	0.6
R73*	48.51	1,357	07:04	0.62	1607.5	0.0
R74*	48.81	1,395	07:04	0.62	1615.4	0.0
R75*	49.38	1,469	07:06	0.62	1634.3	0.0
R76*	49.70	1,493	07:14	0.62	1638.3	0.0
R77*	50.09	1,539	07:13	0.62	1657.8	0.0
R78*	50.43	1,574	07:13	0.62	1667.4	0.0
R79*	50.79	1,598	07:15	0.62	1681.7	0.0
R80*	50.96	1,609	07:15	0.62	1688.1	0.0
R81*	51.46	1,648	07:18	0.62	1700.4	0.1
R82*	51.80	1,674	07:22	0.62	1708.5	0.1
R83*	65.92	3,570	07:18	0.58	2056.4	0.1
R84*	66.22	3,589	07:20	0.58	2065.4	0.1
R85*	66.57	3,601	07:22	0.58	2074.8	0.1
R86*	71.90	4,466	07:23	0.58	2221.9	0.1
R87	1.39	455	07:00	0.89	65.7	0.5
R88*	72.01	4,466	07:23	0.58	2225.7	0.1
R89	0.33	53	07:51	0.69	12.2	0.2
R90	0.42	53	08:33	0.69	15.5	0.2
R91	0.54	57	08:37	0.64	18.3	0.2
Zuni	45.34	2484	08:08	0.33	801.2	0.1

*Flow rates and runoff volumes skewed due to addition of baseflow element in HEC-HMS.

TABLE 2-18

Composite CN Value Based on Hydrologic Soil Group and Estimated Existing Land Cover

City of Grants and Village of Milan, New Mexico Drainage Master Plan

9/27/2010

Basin ID	Basin Area (ac)	Basin Area (sm)	INTER-MOUNTAIN BASINS SEMI-DESERT GRASSLAND-FAIR LAND COVER CONDITION*						COLORADO PLATEAU PINYON-JUNIPER WOODLAND-FAIR LAND COVER CONDITION*						COLORADO PLATEAU PINYON-JUNIPER WOODLAND-GOOD LAND COVER CONDITION*				DEVELOPED LAND AREAS**																								Basin Total Area (ac)	Normal Weighted CN	Calibrated CN (89%)
			HSG "B"		HSG "C"		HSG "D"		HSG "B"		HSG "C"		HSG "D"		HSG "C"		HSG "D"		HSG "B"									HSG "C"									HSG "D"											
			Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN			
1	992	1.550							19	58	703	73			243	61	27	71																								992	70	62
2	946	1.478			377	81					457	73			112	61																								946	75	67
3	675	1.055	11	71			72	89	6	58	117	73	432	80	9	61	29	71																								675	79	70
4	716	1.119			11	81	236	89			12	73	457	80																										1	5%	88	716	83	74
5	930	1.453	272	71			304	89											31	5%	71																	323	5%	88	930	83	74
6	600	0.938					29	89					95	80			476	71																								600	73	65
7	335	0.524					115	89					220	80																												335	83	74
8	636	0.993					219	89					417	80																												636	83	74
9	723	1.130					11	89			12	73	250	80	44	61	407	71																								723	74	66
10	892	1.394			59	81	283	89			77	73	354	80			120	71																								892	81	72
11	856	1.337	13	71			168	89			6	73	669	80																												856	82	73
12	593	0.927	43	71			296	89					255	80																												593	84	75
13	546	0.853	42	71	38	81	466	89																																		546	87	77
14	683	1.067			139	81	38	89	7	58	11	73	488	80																												683	80	72
15	1079	1.686	303	71	10	81	266	89					451	80					50	85%	94																					1079	80	72
16	740	1.157	333	71			186	89											35	10%	73	160	40%	81																26	10%	88	740	78	70
17	877	1.370					317	89			78	73	482	80																												877	83	74
18	1110	1.735	306	71			784	89					21	80																												1110	84	75
19	224	0.351			90	81																																				224	86	76
20	69	0.108			10	81																																			69	92	82
21	107	0.167					77	89					5	80																												107	89	79
22	278	0.435			28	81	78	89					157	80																												278	83	74
23	821	1.282	5	71	30	81	194	89					591	80																												821	82	73
24	103	0.160					57	89					46	80																												103	85	76
25	33	0.052					32	89					1	80																												33	89	79
26	19	0.030					1	89											4	40%	81																					19	89	79
27	214	0.334	163	71			36	89																																		214	76	67
28	224	0.350			29	81	48	89			3	73	112	80																												224	83	74
29	93	0.145					37	89																																		93	89	79
30	79	0.123	13	71			3	89											2	40%	81	3	85%	94																		79	88	78
31	137	0.215			19	81							48	80																												137	85	76
32	68	0.106											5	80																												68	91	81
33A	82	0.128			82	81																																			82	81	72
33B	134	0.209					3	89					38	80																												134	88	78
34	64	0.100																																								64	91	81
35	83	0.130																																								83	91	81
36	167	0.260					5	89																																		167	93	83
37	30	0.046																																								30	90	80
38	100	0.156																	17	40%	81	2	85%	94																		100	91	81
39	136	0.213																																								136	95	84
40	42	0.066																																								42	92	82
41	139	0.217	20	71			78	89														8	85%	94																	139	87	78
42	85	0.133																	64	40%	81	12	85%	94																		85	84	75
43	56	0.088																	26	40%	81	1	85%	94																		56	87	77
44	142	0.222					55	89											71	40%	81	4	65%	88																		142	85	76
45	84	0.131																																								84	95	85
46	266	0.416	70	71															113	40%	81	65	65%	88	17	85%	94															266	81	72
47	185	0.289	118	71															5	40%	81	52	65%	88																		185	77	69
48	232	0.363	90	71			96	89																				3	70%	93	2	85%	95						35	70%	95	6	85%	96	232	83	74
49	28	0.043																																						2	10%	88	20	40%	91	6	85%	96	28	92	82
50A	113	0.177			113	81																																				113	81	72
50B	79	0.124					1	89					36	80																										24	10%	88	18	40%	91	2	85%	96	79	85	76
51	25	0.039																																						6	10%	88	14	40%	91	3	70%	95	2	85%	96	25	92	81
52	31	0.048					29	89																																		2	70%	95							31	89	80
53	37	0.058																																								1	70%	95	36	85%	96				37	96	86

HSG = Hydrologic Soil Group as defined by the Natural Resources Conservation Service.

* Land use description for native areas from USGS National Gap Analysis Program. 2005. Southwest Regional GAP Analysis Project-Land Cover Descriptions. RS/GIS Laboratory, College of Natural Resources, Utah State University. Curve numbers adjusted to reflect good, fair, and poor land cover conditions as defined by NMSTHD, 1995.

** Curve numbers for developed areas assume fair condition lawns in combination with fair condition Inter-Mountain Basins Semi-Desert Grassland: CN B = 70, CN C = 80, CN D = 87

TABLE 2-19

Composite CN Value Based on Hydrologic Soil Group and Estimated Existing Land Cover

City of Grants and Village of Milan, New Mexico Drainage Master Plan

9/27/2010

Basin ID	Basin Area (ac)	Basin Area (sm)	INTER-MOUNTAIN BASINS SEMI-DESERT GRASSLAND-FAIR LAND COVER CONDITION*						COLORADO PLATEAU PINYON-JUNIPER WOODLAND-FAIR LAND COVER CONDITION*						COLORADO PLATEAU PINYON-JUNIPER WOODLAND-GOOD LAND COVER CONDITION*				DEVELOPED LAND AREAS**																					Basin Total Area (ac)	Normal Weighted CN	Calibrated CN (89%)
			HSG "B"		HSG "C"		HSG "D"		HSG "B"		HSG "C"		HSG "D"		HSG "C"		HSG "D"		HSG "B"									HSG "C"									HSG "D"											
			Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN			
54	14	0.021																														14	10%	88									14	88	78
55	149	0.233			6	81							33	80																		3	5%	88	79	10%	88	29	70%	95	1	85%	96	149	87	78
56	100	0.157			15	81					1	73	43	80																		43	10%	88									100	84	74
57	75	0.116			18	81							31	80																		26	10%	88									75	83	74
58A	117	0.183			117	81																																					117	81	72
58B	75	0.117			1	81	1	89					54	80																		20	10%	88									75	82	73
59	22	0.034																	9	10%	73											13	10%	88									22	82	73
60	29	0.045																														29	10%	88									29	88	78
61	54	0.085											24	80					1	10%	73				2	40%	81	4	85%	94		20	10%	88	4	25%	90						54	84	75
62	49	0.076																	5	10%	73	29	70%	90								4	5%	88	7	10%	88	5	70%	95				49	88	78
63	30	0.047											3	80					14	40%	81	3	85%	94								5	10%	88	3	25%	90	3	40%	91				30	85	76
64A	27	0.042			27	81																																					27	81	72
64B	50	0.078											38	80																		4	10%	88	8	25%	90							50	82	73
65A	119	0.186			118	81	1	89																																			119	81	72
65B	92	0.143					1	89					74	80					1	25%	77	3	40%	81								13	25%	90	1	40%	91							92	82	73
66	27	0.043					1	89					24	80					1	70%	90											2	10%	88										27	81	72
67	11	0.018											1	80					2	10%	73	3	70%	90								6	10%	88										11	86	76
68	16	0.025											5	80					3	10%	73	3	70%	90								5	10%	88										16	83	74
69	11	0.017											1	80					1	10%	73	3	70%	90								6	10%	88										11	86	77
70	49	0.076											24	80					3	10%	73	8	70%	90								13	10%	88	1	70%	95							49	84	75
71A	112	0.175			79	81	32	89					1	80																													112	83	74
71B	170	0.265											162	80																					8	25%	90								170	80	72
72	79	0.124											58	80					4	25%	77	1	40%	81								8	5%	88	10	25%	90							79	82	73
73	23	0.035																	9	25%	77	1	70%	90	7	85%	94					1	10%	88	5	25%	90	1	70%	95				23	86	77
74	26	0.040					10	89					8	80					1	5%	71	7	40%	81																					26	83	74
75	13	0.020																	11	40%	81	2	85%	94																					13	83	74
76	40	0.062																	1	5%	71	7	25%	77	25	40%	81	1	85%	94					6	25%	90								40	82	73
77	15	0.023																	3	40%	81	12	85%	94																					15	91	81
78	27	0.042																	6	5%	71	1	40%	81	13	70%	90	2	85%	94		2	5%	88	2	70%	95							27	86	76
79	10	0.016	1	71			1	89					8	80																													10	80	72
80	102	0.160	8	71			2	89	10	58			83	80																													102	77	69
81	28	0.044	9	71			2	89	1	58			16	80																													28	77	69
82	84	0.132	28	71			26	89					28	80					2	10%	73																						84	80	71
83	226	0.353	87	71	4	81	23	89	1	58			106	80					5	10%	73																						226	77	69
84	1369	2.138	479	71	32	81	88	89	3	58	767	73																															1369	73	65
85	1198	1.873	604	71	13	81	32	89	5	58	546	73																															1198	72	64
86	141	0.221																	1	5%	71	8	40%	81	48	85%	94					7	5%	88	1	40%	91	78	85%	96				141	94	84
87	48	0.075																	5	40%	81	10	85%	94								14	40%	91	4	40%	91	15	85%	96				48	92	82
88	115	0.180																	8	5%	71	6	30%	78	10	40%	81	18	85%	94		11	5%	88	12	30%	90	20	40%	91	14	70%	95	15	85%	96	115	89	80
89	108	0.169																	4	5%	71	13	40%	81	14	85%	94					42	40%	91	5	40%	91	30	85%	96			87				108	91	81
90	111	0.173																														9	5%	88	3	40%	91	14	40%	91	57	65%	94	28	85%	96	111	94	83
91	79	0.123																														23	30%	90	45	65%	94	2	70%	95	9	85%	96				79	93	83
92	30	0.047																														9	5%	88	1	70%	95	20	85%	96				30	94	83
93	88	0.137					53	89																								2	5%	88	20	30%	90	7	65%	94	5	70%	95				88	90	80
94	48	0.075					27	89																								15	40%	91	6	70%	95							48	90	81
95	252	0.393											197	93																		10	40%	91	45	65%	94							252	93	83
96	328	0.513									41	87	284	93																		3	60%	94										328	92	82
97	562	0.878									279	87	133	93																		149	20%	89										562	89	79
98	65	0.101																	33	70%	90										1	85%	95										29	70%	95	2	85%	96				65	92	82
99	189	0.295																													7	40%	87	74	70%	93	54	85%	95	23	40%	91	27	70%	95	5	85%	96	189	93	83
100	211	0.330	2	71			40	89											4	5%	71	25	40%	81	24	70%	90	14	85%	94		69	5%	88	2	40%	91	3	70%	95	30	85%	96				211	89	79
101	59	0.092	2	71															10	40%	81	9	85%	94								7	40%	91	32	85%	96										59	92	82
102	76	0.118	23	71	21	81													1	40%	81	1	40%	81								3	30%	90	21	40%	91	6	20%	89							76	82	73
103	22	0.034					15	89																								4	90%	97	2	30%	90	1	25%	90							22	91	81

HSG = Hydrologic Soil Group as defined by the Natural Resources Conservation Service.

* Land use description for native areas from USGS National Gap Analysis Program. 2005. Southwest Regional GAP Analysis Project-Land Cover Descriptions. RS/GIS Laboratory, College of Natural Resources, Utah State University. Curve numbers adjusted to reflect good, fair, and poor land cover conditions as defined by NMSTHD, 1995.

** Curve numbers for developed areas assume fair condition lawns in combination with fair condition Inter-Mountain Basins Semi-Desert Grassland: CN B = 70, CN C = 80, CN D = 87

TABLE 2-19 cont.

Composite CN Value Based on Hydrologic Soil Group and Estimated Future Land Cover

City of Grants and Village of Milan, New Mexico Drainage Master Plan

9/27/2010

Basin ID	Basin Area (ac)	Basin Area (sm)	INTER-MOUNTAIN BASINS SEMI-DESERT GRASSLAND-FAIR LAND COVER CONDITION*						COLORADO PLATEAU PINYON-JUNIPER WOODLAND-FAIR LAND COVER CONDITION*						COLORADO PLATEAU PINYON-JUNIPER WOODLAND-GOOD LAND COVER CONDITION*				DEVELOPED LAND AREAS**																					Basin Total Area (ac)	Normal Weighted CN	Calibrated CN (89%)
			HSG "B"		HSG "C"		HSG "D"		HSG "B"		HSG "C"		HSG "D"		HSG "C"		HSG "D"		HSG "B"										HSG "C"										HSG "D"												
			Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN			
1	992	1.550							19	58	703	73			243	61	27	71																									992	70	62
2	946	1.478			377	81					457	73			112	61																									946	75	67
3	675	1.055	11	71			72	89	6	58	117	73	432	80	9	61	29	71																									675	79	70
4	716	1.119			11	81	236	89			12	73	457	80																											1	5%	88	716	83	74
5	930	1.453	12	71			30	89											31	5%	71	135	40%	81	84	70%	90	41	85%	94											323	5%	88	49	40%	91	176	70%	95	50	85%	96				930	88	79
6	600	0.938					29	89					95	80			476	71																									600	73	65
7	335	0.524					115	89					220	80																													335	83	74
8	636	0.993					219	89					417	80																													636	83	74
9	723	1.130					11	89			12	73	250	80	44	61	407	71																									723	74	66
10	892	1.394			59	81	283	89			77	73	354	80			120	71																									892	81	72
11	856	1.337	13	71			168	89			6	73	669	80																													856	82	73
12	593	0.927	43	71			229	89					255	80					8	10%	73																				59	10%	88	593	84	74
13	546	0.853	42	71	38	81	432	89																																	30	10%	88	4	40%	91								546	87	77
14	683	1.067			105	81	38	89	7	58	11	73	488	80					26	10%	73																				8	10%	88	683	80	71
15	1079	1.686	1	71	10	81	46	89					451	80					103	10%	73	106	25%	77	9	40%	81	86	85%	94											211	10%	88	58	25%	90								1079	83	74
16	740	1.157	174	71			155	89											35	10%	73	319	40%	81																	26	10%	88	32	40%	91								740	81	72
17	877	1.370					317	89			78	73	482	80																													877	83	74
18	1110	1.735	56	71			368	89					21	80					250	40%	81																				415	40%	91											1110	87	77
19	224	0.351																													157	40%	87	63	65%	92	5	85%	95											224	89	79
20	69	0.108																													1	40%	87	20	65%	92	48	85%	95											69	94	84
21	107	0.167					1	89					5	80					8	25%	77																				35	10%	88	58	25%	90								107	88	78
22	278	0.435			28	81	66	89					157	80																												1	10%	88	26	25%	90								278	83	74
23	821	1.282			30	81	93	89					591	80					5	25%	77																				101	25%	90											821	82	73
24	103	0.160					50	89					46	80																												1	25%	90	6	40%	91								103	85	76
25	33	0.052					32	89					1	80																																								33	89	79
26	19	0.030					1	89											4	40%	81																				14	40%	91											19	89	79
27	214	0.334	63	71			11	89											2	25%	77	5	40%	81	76	85%	94	1	65%	88											46	25%	90	9	40%	91	2	85%	96							214	85	76
28	224	0.350			29	81	48	89			3	73	112	80																											24	10%	88	10	40%	91								224	83	74
29	93	0.145					37	89																																	35	10%	88	22	40%	91								93	89	79
30	79	0.123	13	71			3	89											2	40%	81	3	85%	94																	57	40%	91	1	85%	96								79	88	78
31	137	0.215			19	81							48	80																											33	10%	88	34	40%	91	4	85%	96							137	85	76
32	68	0.106											5	80																											20	10%	88	30	40%	91	13	85%	96							68	91	81
33A	82	0.128			82	81																																																	82	81	72
33B	134	0.209					3	89					38	80																													38	10%	88	44	40%	91	11	85%	96							134	88	78
34	64	0.100																																								9	10%	88	56	40%	91		85%	96							64	91	81
35	83	0.130																																								83	40%	91											83	91	81
36	167	0.260					5	89																																	1	5%	88	23	10%	88	72	40%	91	3	70%	95	62	85%	96	167	93	83
37	30	0.046																																								11	5%	88	18	40%	91	1	85%	96							30	90	80
38	100	0.156																	17	40%	81	2	85%	94																	53	40%	91	27	85%	96								100	91	81
39	136	0.213																																								45	40%	91	2	70%	95	90	85%	96							136	95	84
40	42	0.066																																								34	40%	91	9	85%	96								42	92	82
41	139	0.217																	21	40%	81	8	85%	94																	107	40%	91	3	85%	96								139	90	80
42	85	0.133																	64	40%	81	12	85%	94																	9	40%	91											85	84	75
43	56	0.088																	26	40%	81	1	85%	94																	27	40%	91	2	85%	96								56	87	77
44	142	0.222																	71	40%	81	4	65%	88																	48	40%	91	16	65%	94	4	85%	96							142	87	77
45	84	0.131																																								15	40%	91	10	70%	95	59	85%	96							84	95	85
46	266	0.416																	142	40%	81	102	65%	88	22	85%	94																													266	85	76
47	185	0.289																	112	40%	81	52	65%	88	9	85%	94														1	40%	91	10	65%	94	1	85%	96							185	85	75
48	232	0.363																	90	70%	90										6	70%	93	3	85%	95				54	40%	91	42	70%	95	37	85%	96							232	92	82
49	28	0.043																																							2	10%	88	20	40%	91	6	85%	96							28	92	82
50A	113	0.177			113	81																																																113	81	72
50B	79	0.124					1	89					36	80																													24	10%	88	18	40%	91	2	85%	96							79	85	76
51	25	0.039																																								6	10%	88	14	40%	91	3	70%	95	2	85%	96				25	92	81
52	31	0.048																																								3	40%	91	23	70%	95	5	85%	96							31	95	84
53	37	0.058																																											1	70%	95	36	85%	96								37	96	86

HSG = Hydrologic Soil Group as defined by the Natural Resources Conservation Service.

* Land use description for native areas from USGS National Gap Analysis Program. 2005. Southwest Regional GAP Analysis Project-Land Cover Descriptions. RS/GIS Laboratory, College of Natural Resources, Utah State University. Curve numbers adjusted to reflect good, fair, and poor land cover conditions as defined by NMSTHD, 1995.

** Curve numbers for developed areas assume fair condition lawns in combination with fair condition Inter-Mountain Basins Semi-Desert Grassland: CN B = 70, CN C = 80, CN D = 87

TABLE 2-20

Composite CN Value Based on Hydrologic Soil Group and Estimated Future Land Cover

City of Grants and Village of Milan, New Mexico Drainage Master Plan

9/27/2010

Basin ID	Basin Area (ac)	Basin Area (sm)	INTER-MOUNTAIN BASINS SEMI-DESERT GRASSLAND-FAIR LAND COVER CONDITION*						COLORADO PLATEAU PINYON-JUNIPER WOODLAND-FAIR LAND COVER CONDITION*						COLORADO PLATEAU PINYON-JUNIPER WOODLAND-GOOD LAND COVER CONDITION*				DEVELOPED LAND AREAS**																								Basin Total Area (ac)	Normal Weighted CN	Calibrated CN (89%)
			HSG "B"		HSG "C"		HSG "D"		HSG "B"		HSG "C"		HSG "D"		HSG "C"		HSG "D"		HSG "B"									HSG "C"									HSG "D"											
			Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN	Area (ac)	Imp. %	CN			
54	14	0.021																														14	10%	88											14	88	78
55	149	0.233			6	81							33	80																		3	5%	88	79	10%	88	29	70%	95	1	85%	96				149	87	78
56	100	0.157			15	81					1	73	43	80																		43	10%	88											100	84	74
57	75	0.116			18	81							31	80																		26	10%	88											75	83	74
58A	117	0.183			117	81																																						117	81	72
58B	75	0.117			1	81	1	89					54	80																		20	10%	88											75	82	73
59	22	0.034																	9	10%	73											13	10%	88											22	82	73
60	29	0.045																														29	10%	88											29	88	78
61	54	0.085											24	80					1	10%	73				2	40%	81	4	85%	94		20	10%	88	4	25%	90								54	84	75
62	49	0.076																	5	10%	73	29	70%	90								4	5%	88	7	10%	88	5	70%	95							49	88	78
63	30	0.047											3	80					14	40%	81	3	85%	94								5	10%	88	3	25%	90	3	40%	91							30	85	76
64A	27	0.042			27	81																																							27	81	72
64B	50	0.078											38	80																		4	10%	88	8	25%	90								50	82	73
65A	119	0.186			118	81	1	89																																					119	81	72
65B	92	0.143					1	89					74	80					1	25%	77	3	40%	81								13	25%	90	1	40%	91								92	82	73
66	27	0.043					1	89					24	80					1	70%	90											2	10%	88											27	81	72
67	11	0.018											1	80					2	10%	73	3	70%	90								6	10%	88											11	86	76
68	16	0.025											5	80					3	10%	73	3	70%	90								5	10%	88											16	83	74
69	11	0.017											1	80					1	10%	73	3	70%	90								6	10%	88											11	86	77
70	49	0.076											24	80					3	10%	73	8	70%	90								13	10%	88	1	70%	95								49	84	75
71A	112	0.175			79	81	32	89					1	80																															112	83	74
71B	170	0.265											162	80																					8	25%	90									170	80	72
72	79	0.124											58	80					4	25%	77	1	40%	81								8	5%	88	10	25%	90								79	82	73
73	23	0.035																	9	25%	77	1	70%	90	7	85%	94					1	10%	88	5	25%	90	1	70%	95					23	86	77
74	26	0.040					10	89					8	80					1	5%	71	7	40%	81																					26	83	74
75	13	0.020																	11	40%	81	2	85%	94																					13	83	74
76	40	0.062																	1	5%	71	7	25%	77	25	40%	81	1	85%	94					6	25%	90									40	82	73
77	15	0.023																	3	40%	81	12	85%	94																					15	91	81
78	27	0.042																	6	5%	71	1	40%	81	13	70%	90	2	85%	94		2	5%	88	2	70%	95								27	86	76
79	10	0.016	1	71			1	89					8	80																															10	80	72
80	102	0.160	8	71			2	89	10	58			83	80																															102	77	69
81	28	0.044	9	71			2	89	1	58			16	80																															28	77	69
82	84	0.132	28	71			26	89					28	80					2	10%	73																									84	80	71
83	226	0.353	87	71	4	81	23	89	1	58			106	80					5	10%	73																									226	77	69
84	1369	2.138	479	71	32	81	88	89	3	58	767	73																																	1369	73	65
85	1198	1.873	604	71	13	81	32	89	5	58	546	73																																	1198	72	64
86	141	0.221																	1	5%	71	8	40%	81	48	85%	94					7	5%	88	1	40%	91	78	85%	96					141	94	84
87	48	0.075																	5	40%	81	10	85%	94								14	40%	91	4	40%	91	15	85%	96					48	92	82
88	115	0.180																	8	5%	71	6	30%	78	10	40%	81	18	85%	94		11	5%	88	12	30%	90	20	40%	91	14	70%	95	15	85%	96	115	89	80
89	108	0.169																	4	5%	71	13	40%	81	14	85%	94					42	40%	91	5	40%	91	30	85%	96			87				108	91	81
90	111	0.173																														9	5%	88	3	40%	91	14	40%	91	57	65%	94	28	85%	96	111	94	83
91	79	0.123																														23	30%	90	45	65%	94	2	70%	95	9	85%	96				79	93	83
92	30	0.047																														9	5%	88	1	70%	95	20	85%	96							30	94	83
93	88	0.137																														2	5%	88	13	30%	90	7	65%	94	62	70%	95	3	85%	96	88	94	84
94	48	0.075																														6	40%	91	41	70%	95	2	85%	96			87				48	94	84
95	252	0.393																														10	40%	91	89	65%	94	151	70%	95	2	85%	96				252	94	84
96	328	0.513																														3	60%	94	1	65%	94	283	70%	95							328	94	84
97	562	0.878																														1	40%	87	197	70%	93	82	85%	95	149	20%	89	125	70%	95	8	85%	96	562	93	82
98	65	0.101																	33	70%	90											1	85%	95											29	70%	95	2	85%	96	65	92	82
99	189	0.295																														7	40%	87	74	70%	93	54	85%	95	23	40%	91	27	70%	95	5	85%	96	189	93	83
100	211	0.330	2	71			40	89											4	5%	71	25	40%	81	24	70%	90	14	85%	94													69	5%	88	2	40%	91	3	70%	95	30	85%	96	211	89	79
101	59	0.092	2	71															10	40%	81	9	85%	94																			7	40%	91	32	85%	96							59	92	82
102	76	0.118	23	71	21	81													1	40%	81	1	40%	81																			3	30%	90	21	40%	91	6	20%	89				76	82	73
103	22	0.034					15	89																																			4	90%	97	2	30%	90	1	25%	90				22	91	81

HSG = Hydrologic Soil Group as defined by the Natural Resources Conservation Service.

* Land use description for native areas from USGS National Gap Analysis Program. 2005. Southwest Regional GAP Analysis Project-Land Cover Descriptions. RS/GIS Laboratory, College of Natural Resources, Utah State University. Curve numbers adjusted to reflect good, fair, and poor land cover conditions as defined by NMSTHD, 1995.

** Curve numbers for developed areas assume fair condition lawns in combination with fair condition Inter-Mountain Basins Semi-Desert Grassland: CN B = 70, CN C = 80, CN D = 87

TABLE 2-20 cont.

Lag Time Calculations

City of Grants and Village of Milan, New Mexico Drainage Master Plan

9/27/2010

BASIN	OVERLAND FLOW (Kinematic Wave Equation) $t_t = \frac{0.42}{P_2^{0.5}}\left[\frac{nL}{\sqrt{S}}\right]^{0.8}$							SHALLOW CONCENTRATED FLOW							CHANNEL FLOW							Tc	Lag
	Manning's n (overland)	2-yr, 24-hr (in)	Length (ft)	Max El. (ft)	Min El. (ft)	Slope (%)	Tt (min)	"k" Factor	Length (ft)	Max El. (ft)	Min El. (ft)	Slope (%)	Vel (fps)	Tt (min)	Manning's n (channel)	Length (ft)	Max El. (ft)	Min El. (ft)	Slope (%)	Vel (fps)	Tt (min)	TOTAL (min)	(min)
1	0.060	1.28	300	7980	7920	20.0%	7.1	0.619	3660	7920	7740	4.9%	4.5	13.5	0.040	7830	7740	7620	1.5%	4.4	29.7	50	30
2	0.060	1.28	300	8036	8032	1.3%	21.1	0.619	4910	8032	7840	3.9%	4.0	20.3	0.065	11850	7840	7620	1.9%	4.7	42.0	83	50
3	0.060	1.28	300	7660	7653	2.3%	16.9	0.619	1240	7653	7600	4.3%	4.2	4.9	0.046	7820	7600	6620	12.5%	9.3	14.0	36	21
4	0.060	1.28	300	7626	7480	48.7%	5.0	0.619	3390	7480	6760	21.2%	9.4	6.0	0.058	4540	6760	6542	4.8%	9.6	7.9	19	11
5	0.060	1.28	300	6720	6666	18.0%	7.4	0.619	370	6666	6608	15.7%	8.1	0.8	0.046 0.040	6110 3440	6608 6450	6450 6424	2.6% 0.8%	5.9 2.7	17.3 21.2	47	28
6	0.060	1.28	300	8360	8280	26.7%	6.4	0.619	5470	8280	7200	19.7%	9.1	10.0	0.035	3100	7200	7118	2.6%	5.0	10.3	27	16
7	0.060	1.28	300	8068	8051	5.7%	11.8	0.619	5600	8051	7169	15.8%	8.1	11.5	0.035	2150	7169	7118	2.4%	4.4	8.1	31	19
8	0.060	1.28	300	8142	8000	47.3%	5.1	0.619	5590	8000	7113	15.9%	8.1	11.4	0.058	5790	7113	6870	4.2%	7.0	13.8	30	18
9	0.060	1.28	300	8062	8056	2.0%	17.9	0.619 0.619	700 5100	8056 8040	8040 7085	2.3% 18.7%	3.1 8.8	3.8 9.6	0.058	4180	7085	6872	5.1%	8.0	8.7	40	24
10	0.060	1.28	300	7862	7857	1.7%	19.3	0.619	4570	7857	6980	19.2%	8.9	8.5	0.058	2730	6980	6780	7.3%	5.1	8.9	37	22
11	0.060	1.28	300	7614	7575	13.0%	8.5	0.619	5950	7575	6800	13.0%	7.4	13.5	0.058	4740	6800	6684	2.4%	6.8	11.6	34	20
12	0.060	1.28	300	7291	7240	17.0%	7.6	0.619	5470	7240	6680	10.2%	6.5	13.9	0.058 0.058	2920 3970	6680 6594	6594 6530	2.9% 1.6%	4.4 5.9	11.1 11.2	44	26
13	0.060	1.28	300	7080	7047	11.0%	9.1	0.619	1180	7047	6860	15.8%	8.1	2.4	0.046	5900	6860	6614	4.2%	7.1	13.8	25	15
14	0.060	1.28	300	7433	7420	4.3%	13.2	0.619	3030	7420	6840	19.1%	8.9	5.7	0.058	5030	6840	6532	6.1%	7.9	10.6	29	18
15	0.060	1.28	100	7300	7220	80.0%	1.7	0.619	4960	7220	6550	13.5%	7.5	11.0	0.040 0.046	2750 2500	6550 6488	6488 6470	2.3% 0.7%	7.3 5.6	6.3 7.4	26	16

TABLE 2-21

Lag Time Calculations

City of Grants and Village of Milan, New Mexico Drainage Master Plan

9/27/2010

BASIN	OVERLAND FLOW (Kinematic Wave Equation) $t_t = \frac{0.42}{P_2^{0.5}}\left[\frac{nL}{\sqrt{S}}\right]^{0.8}$							SHALLOW CONCENTRATED FLOW							CHANNEL FLOW							Tc	Lag
	Manning's n (overland)	2-yr, 24-hr (in)	Length (ft)	Max El. (ft)	Min El. (ft)	Slope (%)	Tt (min)	"k" Factor	Length (ft)	Max El. (ft)	Min El. (ft)	Slope (%)	Vel (fps)	Tt (min)	Manning's n (channel)	Length (ft)	Max El. (ft)	Min El. (ft)	Slope (%)	Vel (fps)	Tt (min)	TOTAL (min)	(min)
16	0.060	1.28	100	6684	6632	52.0%	2.0	0.619	2100	6632	6566	3.1%	3.6	9.7	0.035	6760	6566	6488	1.2%	2.7	41.7	53	32
17	0.060	1.28	300	7800	7600	66.7%	4.4	0.619	5190	7600	6840	14.6%	7.8	11.1	0.046	6520	6840	6600	3.7%	9.2	11.8	27	16
18	0.060	1.28	300	6790	6782	2.7%	16.0	0.619	1320	6782	6620	12.3%	7.2	3.1	0.040	9990	6620	6454	1.7%	3.0	55.5	75	45
19	0.060	1.28	100	6528	6526	2.0%	7.4	0.619	2480	6526	6502	1.0%	2.0	20.6	0.016	3130	6502	6478	0.8%	5.0	10.4	38	23
20	0.060	1.28	100	6490	6488	2.0%	7.4	0.619	450	6488	6486	0.4%	1.4	5.5	0.016 0.016	1310 1710	6486 6477	6477 6470	0.7% 0.4%	3.4 3.5	6.4 8.1	28	17
21	0.060	1.28	300	6791	6740	17.0%	7.6	0.619	3610	6740	6497	6.7%	5.3	11.4	0.035	1560	6497	6482	1.0%	3.6	7.2	26	16
22	0.060	1.28	100	7280	7220	60.0%	1.9	0.619	6240	7220	6531	11.0%	6.8	15.3	0.035	1500	6531	6501	2.0%	6.7	3.7	21	13
23	0.060	1.28	100	7240	7180	60.0%	1.9	0.619	4020	7180	6840	8.5%	5.9	11.3	0.046	7100	6840	6480	5.1%	7.8	15.2	28	17
24	0.060	1.28	300	6957	6920	12.3%	8.7	0.619	3300	6920	6640	8.5%	6.0	9.2	0.040	2100	6640	6502	6.6%	7.9	4.4	22	13
25	0.060	1.28	300	6720	6700	6.7%	11.1	0.619	1770	6700	6572	7.2%	5.5	5.4	0.040	900	6572	6498	8.2%	6.4	2.3	19	11
26	0.060	1.28	100	6540	6518	22.0%	2.9	0.619	1830	6518	6472	2.5%	3.2	9.4								12	7
27	0.060	1.28	100	6589	6583	6.0%	4.8	0.619	4100	6583	6456	3.1%	3.6	19.0	0.040	1130	6456	6448	0.7%	4.0	4.7	29	17
28	0.060	1.28	100	7140	7070	70.0%	1.8	0.619	4360	7070	6606	10.6%	6.7	10.9	0.040	1890	6606	6468	7.3%	10.9	2.9	16	9
29	0.060	1.28	300	6872	6816	18.7%	7.3	0.619	1850	6816	6612	11.0%	6.8	4.5	0.040	2520	6612	6458	6.1%	9.4	4.5	16	10
30	0.060	1.28	100	6584	6568	16.0%	3.2	0.619	250	6568	6556	4.8%	4.5	0.9	0.016	2620	6556	6440	4.4%	6.8	6.4	11	6

TABLE 2-21 cont.

Lag Time Calculations

City of Grants and Village of Milan, New Mexico Drainage Master Plan

9/27/2010

BASIN	OVERLAND FLOW (Kinematic Wave Equation) $t_t = \frac{0.42}{P_2^{0.5}}\left[\frac{nL}{\sqrt{S}}\right]^{0.8}$							SHALLOW CONCENTRATED FLOW							CHANNEL FLOW							Tc	Lag
	Manning's n	2-yr, 24-hr	Length	Max El.	Min El.	Slope	Tt	"k" Factor	Length	Max El.	Min El.	Slope	Vel	Tt	Manning's n	Length	Max El.	Min El.	Slope	Vel	Tt	TOTAL	
	(overland)	(in)	(ft)	(ft)	(ft)	(%)	(min)		(ft)	(ft)	(ft)	(%)	(fps)	(min)	(channel)	(ft)	(ft)	(ft)	(%)	(fps)	(min)	(min)	(min)
31	0.060	1.28	100	7140	7080	60.0%	1.9	0.619	2240	7080	6742	15.1%	7.9	4.7	0.040	3340	6742	6492	7.5%	9.1	6.1	13	8
32	0.060	1.28	300	6940	6923	5.7%	11.8	0.619	1330	6923	6706	16.3%	8.3	2.7	0.040 0.035	1520 1360	6706 6558	6558 6486	9.7% 5.3%	8.2 8.2	3.1 2.8	20	12
33A	0.060	1.28	300	7180	7177	1.0%	23.7	0.619	4130	7177	7140	0.9%	1.9	35.6								59	36
33B	0.060	1.28	100	7140	7100	40.0%	2.2	0.619	3180	7100	6638	14.5%	7.8	6.8	0.040 0.030	1920 800	6638 6506	6506 6478	6.9% 3.5%	10.7 9.0	3.0 1.5	14	8
34	0.060	1.28	100	6742	6716	26.0%	2.7	0.619	2060	6716	6554	7.9%	5.7	6.0	0.016 0.030	1140 1480	6554 6502	6502 6448	4.6% 3.6%	8.7 8.1	2.2 3.0	14	8
35	0.060	1.28	100	6620	6612	8.0%	4.3	0.619	1000	6612	6508	10.4%	6.6	2.5	0.035 0.016	1140 500	6508 6446	6446 6442	5.4% 0.8%	5.9 4.0	3.2 2.1	12	7
36	0.060	1.28	300	6940	6900	13.3%	8.4	0.619	2350	6900	6632	11.4%	6.9	5.7	0.040 0.016 0.016	1450 830 1790	6632 6504 6470	6504 6470 6446	8.8% 4.1% 1.3%	9.7 9.2 9.3	2.5 1.5 3.2	21	13
37	0.060	1.28	100	6448	6445	3.0%	6.3	0.619	130	6445	6444	0.8%	1.8	1.2	0.035	2060	6444	6436	0.4%	1.5	22.9	30	18
38	0.060	1.28	100	6456	6454	2.0%	7.4	0.619 0.619	580 2580	6454 6442	6442 6438	2.1% 0.2%	2.9 0.8	3.3 53.5								64	39
39	0.060	1.28	100	6458	6457	1.0%	9.8								0.016	5170	6457	6432	0.5%	3.5	24.6	34	21
40	0.060	1.28	100	6441	6440	1.0%	9.8	0.619	2050	6440	6434	0.3%	1.1	30.9								41	24
41	0.060	1.28	100	6451	6450	1.0%	9.8	0.619	2570	6450	6434	0.6%	1.6	26.6	0.040	2950	6434	6428	0.2%	1.3	37.8	74	45
42	0.060	1.28	100	6468	6467	1.0%	9.8	0.619	550	6467	6448	3.5%	3.8	2.4	0.016	2060	6448	6436	0.6%	4.1	8.4	21	12
43	0.060	1.28	100	6455	6454	1.0%	9.8								0.016 0.016 0.040	910 960 1400	6454 6434 6430	6434 6430 6428	2.2% 0.4% 0.1%	4.7 3.5 1.0	3.2 4.6 23.3	41	25
44	0.060	1.28	100	6463	6462	1.0%	9.8								0.016 0.040	3380 1940	6462 6426	6426 6420	1.1% 0.3%	5.1 1.6	11.0 20.2	41	25

TABLE 2-21 cont.

Lag Time Calculations

City of Grants and Village of Milan, New Mexico Drainage Master Plan

9/27/2010

BASIN	OVERLAND FLOW (Kinematic Wave Equation) $t_t = \frac{0.42}{P_2^{0.5}}\left[\frac{nL}{\sqrt{S}}\right]^{0.8}$							SHALLOW CONCENTRATED FLOW							CHANNEL FLOW							Tc	Lag
	Manning's n (overland)	2-yr, 24-hr (in)	Length (ft)	Max El. (ft)	Min El. (ft)	Slope (%)	Tt (min)	"k" Factor	Length (ft)	Max El. (ft)	Min El. (ft)	Slope (%)	Vel (fps)	Tt (min)	Manning's n (channel)	Length (ft)	Max El. (ft)	Min El. (ft)	Slope (%)	Vel (fps)	Tt (min)	TOTAL (min)	(min)
45	0.060	1.28	100	6458	6455	3.0%	6.3								0.016 0.040	5520 570	6455 6426	6426 6422	0.5% 0.7%	3.3 1.7	27.9 5.6	40	24
46	0.060	1.28	100	6485	6484	1.0%	9.8	0.619	800	6484	6478	0.8%	1.8	7.5	0.016 0.016 0.016	1380 1170 2320	6478 6468 6462	6468 6462 6448	0.7% 0.5% 0.6%	4.1 4.2 6.0	5.6 4.6 6.4	34	20
47	0.060	1.28	100	6464	6463	1.0%	9.8	0.619	1760	6463	6448	0.9%	1.9	15.6	0.040 0.016	2050 1180	6448 6428	6428 6422	1.0% 0.5%	3.4 5.7	10.0 3.5	39	23
48	0.060	1.28	100	6452	6451	1.0%	9.8	0.619	330	6451	6448	0.9%	1.9	2.8	0.030 0.040	1800 1940	6448 6422	6422 6418	1.4% 0.2%	3.1 1.3	9.7 24.9	47	28
49	0.060	1.28	100	6712	6694	18.0%	3.1	0.619	280	6694	6648	16.4%	8.3	0.6	0.020	1610	6648	6516	8.2%	7.9	3.4	7	4
50A	0.060	1.28	300	7180	7177	1.0%	23.7	0.619	3930	7177	7140	0.9%	2.0	33.0								57	34
50B	0.060	1.28	100	7140	7060	80.0%	1.7	0.619	1320	7060	6860	15.2%	8.0	2.8	0.040	3310	6860	6504	10.8%	10.9	5.1	10	6
51	0.060	1.28	300	6805	6780	8.3%	10.1	0.619	2300	6780	6528	11.0%	6.8	5.7								16	9
52	0.060	1.28	100	6708	6692	16.0%	3.2	0.619	1590	6692	6538	9.7%	6.4	4.2								7	4
53	0.060	1.28	100	6600	6586	14.0%	3.4	0.619	610	6586	6538	7.9%	5.7	1.8	0.046 0.035	760 1940	6538 6504	6504 6484	4.5% 1.0%	3.7 2.5	3.4 12.9	22	13
54	0.060	1.28	100	6670	6632	38.0%	2.3	0.619	1310	6632	6536	7.3%	5.5	3.9								6	4
55	0.060	1.28	100	7140	7080	60.0%	1.9	0.619	870	7080	6920	18.4%	8.8	1.7	0.040 0.058	3410 1370	6920 6544	6544 6512	11.0% 2.3%	8.3 4.5	6.8 5.1	15	9
56	0.060	1.28	100	7140	7080	60.0%	1.9	0.619	1340	7080	6840	17.9%	8.6	2.6	0.040	2560	6840	6570	10.5%	7.0	6.1	11	6
57	0.060	1.28	100	7140	7080	60.0%	1.9	0.619	2580	7080	6680	15.5%	8.0	5.3	0.040	890	6680	6564	13.0%	8.7	1.7	9	5
58A	0.060	1.28	300	7177	7174	1.0%	23.7	0.619	3350	7174	7140	1.0%	2.1	27.1								51	30

TABLE 2-21 cont.

Lag Time Calculations

City of Grants and Village of Milan, New Mexico Drainage Master Plan

9/27/2010

BASIN	OVERLAND FLOW (Kinematic Wave Equation) $t_t = \frac{0.42}{P_2^{0.5}}\left[\frac{nL}{\sqrt{S}}\right]^{0.8}$							SHALLOW CONCENTRATED FLOW							CHANNEL FLOW							Tc	Lag
	Manning's n (overland)	2-yr, 24-hr (in)	Length (ft)	Max El. (ft)	Min El. (ft)	Slope (%)	Tt (min)	"k" Factor	Length (ft)	Max El. (ft)	Min El. (ft)	Slope (%)	Vel (fps)	Tt (min)	Manning's n (channel)	Length (ft)	Max El. (ft)	Min El. (ft)	Slope (%)	Vel (fps)	Tt (min)	TOTAL (min)	(min)
58B	0.060	1.28	100	7140	7100	40.0%	2.2	0.619	2670	7100	6720	14.2%	7.7	5.8	0.040	2190	6720	6534	8.5%	10.7	3.4	11	7
59	0.060	1.28	100	6690	6674	16.0%	3.2	0.619	860	6674	6550	14.4%	7.8	1.8	0.035	1050	6550	6534	1.5%	2.7	6.5	12	7
60	0.060	1.28	100	6646	6641	5.0%	5.2	0.619	1430	6641	6532	7.6%	5.6	4.2	0.035	330	6532	6530	0.6%	2.5	2.2	12	7
61	0.060	1.28	300	7010	6940	23.3%	6.7	0.619	2900	6940	6556	13.2%	7.4	6.5	0.035	430	6556	6552	0.9%	3.1	2.3	16	9
62	0.060	1.28	100	6552	6550	2.0%	7.4	0.619	520	6550	6536	2.7%	3.4	2.6	0.040	2980	6536	6518	0.6%	2.1	23.7	34	20
63	0.060	1.28	300	6840	6810	10.0%	9.4	0.619	2060	6810	6552	12.5%	7.2	4.7	0.040	1150	6552	6538	1.2%	3.5	5.5	20	12
64A	0.060	1.28	300	7169	7166	1.0%	23.7	0.619	1880	7166	7140	1.4%	2.4	13.0								37	22
64B	0.060	1.28	100	7140	7090	50.0%	2.1	0.619	4030	7090	6564	13.1%	7.4	9.1								11	7
65A	0.060	1.28	300	7183	7180	1.0%	23.7	0.619	3660	7180	7140	1.1%	2.1	28.6								52	31
65B	0.060	1.28	100	7140	7090	50.0%	2.1	0.619	1700	7090	6820	15.9%	8.1	3.5	0.040	3320	6820	6536	8.6%	10.9	5.1	11	6
66	0.060	1.28	300	6800	6780	6.7%	11.1	0.619	1450	6780	6630	10.3%	6.6	3.7	0.040	740	6630	6580	6.8%	4.3	2.9	18	11
67	0.060	1.28	100	6720	6696	24.0%	2.8	0.619	1140	6696	6580	10.2%	6.5	2.9								6	3
68	0.060	1.28	100	6749	6740	9.0%	4.1	0.619	1400	6740	6580	11.4%	6.9	3.4								7	4
69	0.060	1.28	100	6720	6693	27.0%	2.6	0.619	1230	6693	6575	9.6%	6.3	3.2								6	4
70	0.060	1.28	300	6842	6800	14.0%	8.2	0.619	630	6800	6720	12.7%	7.3	1.4	0.046 0.035	1800 1120	6720 6580	6580 6554	7.8% 2.3%	5.0 4.6	6.0 4.1	20	12

TABLE 2-21 cont.

Lag Time Calculations

City of Grants and Village of Milan, New Mexico Drainage Master Plan

9/27/2010

BASIN	OVERLAND FLOW (Kinematic Wave Equation) $t_t = \frac{0.42}{P_2^{0.5}}\left[\frac{nL}{\sqrt{S}}\right]^{0.8}$							SHALLOW CONCENTRATED FLOW							CHANNEL FLOW							Tc	Lag
	Manning's n	2-yr, 24-hr	Length	Max El.	Min El.	Slope	Tt	"k" Factor	Length	Max El.	Min El.	Slope	Vel	Tt	Manning's n	Length	Max El.	Min El.	Slope	Vel	Tt	TOTAL	
	(overland)	(in)	(ft)	(ft)	(ft)	(%)	(min)		(ft)	(ft)	(ft)	(%)	(fps)	(min)	(channel)	(ft)	(ft)	(ft)	(%)	(fps)	(min)	(min)	(min)
71A	0.060	1.28	300	7180	7177	1.0%	23.7	0.619	3640	7177	7140	1.0%	2.1	29.5								53	32
71B	0.060	1.28	100	7140	7100	40.0%	2.2	0.619	1450	7100	6860	16.6%	8.3	2.9	0.040	3240	6860	6558	9.3%	9.4	5.7	11	7
72	0.060	1.28	300	7027	6990	12.3%	8.7	0.619	1140	6990	6800	16.7%	8.3	2.3	0.040 0.016	1970 1030	6800 6580	6580 6550	11.2% 2.9%	8.1 7.1	4.1 2.4	17	10
73	0.060	1.28	100	6658	6636	22.0%	2.9	0.619	1790	6636	6550	4.8%	4.5	6.7	0.035	1150	6550	6532	1.6%	4.1	4.7	14	9
74	0.060	1.28	300	6830	6804	8.7%	10.0	0.619	2390	6804	6548	10.7%	6.7	6.0	0.030	560	6548	6538	1.8%	5.4	1.7	18	11
75	0.060	1.28	100	6576	6567	9.0%	4.1	0.619	1290	6567	6534	2.6%	3.3	6.6								11	6
76	0.060	1.28	100	6620	6612	8.0%	4.3	0.619	1280	6612	6532	6.3%	5.1	4.2	0.040	1120	6532	6524	0.7%	3.0	6.2	15	9
77	0.060	1.28	100	6554	6552	2.0%	7.4	0.619	1300	6552	6526	2.0%	2.9	7.5								15	9
78	0.060	1.28	100	6546	6542	4.0%	5.6	0.619	440	6542	6532	2.3%	3.1	2.4	0.040	2040	6532	6524	0.4%	2.0	17.0	25	15
79	0.060	1.28	300	6745	6710	11.7%	8.9	0.619	650	6710	6620	13.8%	7.6	1.4	0.035	660	6620	6580	6.1%	3.8	2.9	13	8
80	0.060	1.28	100	7160	7115	45.0%	2.1	0.619	3400	7115	6720	11.6%	7.0	8.1	0.040	1870	6720	6575	7.8%	7.0	4.5	15	9
81	0.060	1.28	300	6855	6840	5.0%	12.4	0.619	1030	6840	6680	15.5%	8.1	2.1	0.040	1360	6680	6575	7.7%	3.7	6.1	21	12
82	0.060	1.28	300	6845	6800	15.0%	8.0	0.619	1360	6800	6640	11.8%	7.0	3.2	0.035	1800	6640	6580	3.3%	3.9	7.7	19	11
83	0.060	1.28	100	7160	7110	50.0%	2.1	0.619	2310	7110	6840	11.7%	7.0	5.5	0.035 0.035	3500 1800	6840 6580	6580 6565	7.4% 0.8%	7.4 3.9	7.9 7.7	23	14
84	0.060	1.28	100	7200	7160	40.0%	2.2	0.619	4370	7160	6700	10.5%	6.6	11.0	0.035	8890	6700	6565	1.5%	4.4	33.7	47	28

TABLE 2-21 cont.

Lag Time Calculations

City of Grants and Village of Milan, New Mexico Drainage Master Plan

9/27/2010

BASIN	OVERLAND FLOW (Kinematic Wave Equation) $t_t = \frac{0.42}{P_2^{0.5}}\left[\frac{nL}{\sqrt{S}}\right]^{0.8}$							SHALLOW CONCENTRATED FLOW							CHANNEL FLOW							Tc	Lag
	Manning's n (overland)	2-yr, 24-hr (in)	Length (ft)	Max El. (ft)	Min El. (ft)	Slope (%)	Tt (min)	"k" Factor	Length (ft)	Max El. (ft)	Min El. (ft)	Slope (%)	Vel (fps)	Tt (min)	Manning's n (channel)	Length (ft)	Max El. (ft)	Min El. (ft)	Slope (%)	Vel (fps)	Tt (min)	TOTAL (min)	(min)
85	0.060	1.28	300	7200	7120	26.7%	6.4	0.619	4490	7120	6680	9.8%	6.4	11.7	0.035	11600	6680	6570	0.9%	3.0	64.4	83	50
86	0.060	1.28	100	6536	6535	1.0%	9.8	0.619	1280	6535	6528	0.5%	1.5	14.1	0.030	3590	6528	6522	0.2%	2.4	24.9	49	29
87	0.060	1.28	100	6525	6524	1.0%	9.8								0.016 0.040	1510 670	6524 6520	6520 6518	0.3% 0.3%	1.9 1.6	13.2 7.0	30	18
88	0.060	1.28	100	6529	6528	1.0%	9.8								0.016 0.030	3420 220	6528 6520	6520 6516	0.2% 1.8%	2.2 7.6	25.9 0.5	36	22
89	0.060	1.28	100	6531	6530	1.0%	9.8	0.619	860	6530	6519	1.3%	2.3	6.2	0.016	1410	6519	6516	0.2%	2.5	9.4	25	15
90	0.060	1.28	100	6519	6518	1.0%	9.8								0.016 0.046	1410 1830	6518 6517	6517 6508	0.1% 0.5%	1.6 2.5	14.7 12.2	37	22
91	0.060	1.28	100	6520	6519	1.0%	9.8								0.016 0.035	2430 340	6519 6505	6514 6504	0.2% 0.3%	2.1 2.5	19.3 2.3	31	19
92	0.060	1.28	100	6520	6519	1.0%	9.8								0.025	1940	6519	6508	0.6%	2.2	14.7	25	15
93	0.060	1.28	100	6515	6514	1.0%	9.8	0.619	1610	6514	6511	0.2%	0.9	30.4	0.040 0.035	1850 720	6514 6486	6486 6482	1.5% 0.6%	3.9 3.8	7.9 3.2	51	31
94	0.060	1.28	100	6489	6488	1.0%	9.8	0.619	1980	6488	6478	0.5%	1.5	22.7								33	20
95	0.060	1.28	100	6492	6490	2.0%	7.4	0.619	330	6490	6486	1.2%	2.2	2.4	0.020 0.035	2320 3100	6486 6466	6466 6446	0.9% 0.6%	3.5 5.1	11.0 10.1	31	19
96	0.060	1.28	100	6474	6472	2.0%	7.4	0.619	1080	6472	6450	2.0%	2.9	6.2	0.035 0.040	2970 5090	6450 6430	6430 6416	0.7% 0.3%	3.6 2.8	13.8 30.3	58	35
97	0.060	1.28	100	6459	6448	11.0%	3.8	0.619	2110	6448	6432	0.8%	1.8	19.8	0.046	5380	6432	6416	0.3%	1.6	56.0	80	48
98	0.060	1.28	100	6418	6417	1.0%	9.8	0.619	420	6417	6414	0.7%	1.7	4.1	0.040 0.030	550 810	6414 6410	6410 6409	0.7% 0.1%	1.4 1.8	6.5	20	12
99	0.060	1.28	100	6424	6420	4.0%	5.6	0.619	130	6420	6418	1.5%	2.5	0.9	0.020	1530	6418	6409	0.6%	3.0	8.5	15	9

TABLE 2-21 cont.

Lag Time Calculations

City of Grants and Village of Milan, New Mexico Drainage Master Plan

9/27/2010

BASIN	OVERLAND FLOW (Kinematic Wave Equation) $t_t = \frac{0.42}{P_2^{0.5}}\left[\frac{nL}{\sqrt{S}}\right]^{0.8}$							SHALLOW CONCENTRATED FLOW							CHANNEL FLOW							Tc	Lag
	Manning's n (overland)	2-yr, 24-hr (in)	Length (ft)	Max El. (ft)	Min El. (ft)	Slope (%)	Tt (min)	"k" Factor	Length (ft)	Max El. (ft)	Min El. (ft)	Slope (%)	Vel (fps)	Tt (min)	Manning's n (channel)	Length (ft)	Max El. (ft)	Min El. (ft)	Slope (%)	Vel (fps)	Tt (min)	TOTAL (min)	(min)
100	0.060	1.28	300	6528	6527	0.3%	36.7	0.619	4270	6527	6522	0.1%	0.7	101.8								139	83
101	0.060	1.28	100	6525	6524	1.0%	9.8	0.619	510	6524	6523	0.2%	0.9	9.4	0.013 0.040	1820 800	6523 6522	6522 6520	0.1% 0.3%	2.4 2.9	12.6 4.6	36	22
102	0.060	1.28	100	6525	6524	1.0%	9.8	0.619	3900	6524	6518	0.2%	0.8	81.1								91	55
103	0.060	1.28	100	6520	6518	2.0%	7.4	0.619	700	6518	6514	0.6%	1.5	7.6	0.040	1090	6514	6508	0.6%	2.0	9.1	24	14

TABLE 2-21 cont.

Channel Flow Segment Assumptions for Lag Time Calculations

City of Grants and Village of Milan, New Mexico Drainage Master Plan

9/17/2010

Basin/ Channel	n	Slope	SS:1	Bottom Width	Estimated Q (cfs)*	Velocity (ft/s)**
1	0.040	1.5	10	100	500	4.4
2	0.065	2.1	10	40	700	4.7
3	0.046	12.5	2	40	300	9.3
4	0.058	4.8	1	20	600	9.6
5a	0.046	2.6	5	10	200	5.9
5b	0.040	0.8	50	100	400	2.7
6	0.035	2.6	20	100	400	5.0
7	0.035	2.4	20	100	300	4.4
8	0.058	4.2	2	30	400	7.0
9	0.058	5.1	2	30	500	8.0
10	0.058	7.3	50	100	600	5.1
11	0.058	2.4	2	20	500	6.8
12a	0.058	2.9	3	60	300	4.4
12b	0.058	1.6	2	20	500	5.9
13	0.046	4.2	2	20	200	7.1
14	0.058	6.1	2	20	300	7.9
15a	0.040	2.3	2	30	400	7.3
15b	0.046	0.7	3	30	900	5.6
16	0.035	1.2	50	200	300	2.7
17	0.046	3.7	2	20	500	9.2
18	0.040	1.7	50	80	200	3.0
19	0.016	0.8	Street Section		75	5.0
20a	0.016	0.7	Street Section		15	3.4
20b	0.016	0.4	Street Section		40	3.5
21	0.035	1.0	3	30	100	3.6
22	0.035	2.0	3	30	300	6.7
23	0.046	5.1	10	30	500	7.8
24	0.040	6.6	3	5	70	7.9
25	0.040	8.2	4	5	30	6.4
27	0.040	0.7	4	20	200	4.0
28	0.040	7.3	3	5	200	10.9
29	0.040	6.1	3	5	150	9.4
30	0.016	4.4	Street Section		15	6.8
31	0.040	7.5	3	5	100	9.1
32a	0.040	9.4	4	5	60	8.2
32b	0.035	5.3	3	10	100	8.2
33a	0.040	6.9	3	5	200	10.7
33b	0.030	3.5	4	20	250	9.0
34a	0.016	4.6	Street Section		40	8.7
34b	0.030	3.6	4	10	120	8.1
35a	0.035	5.4	4	10	40	5.9
35b	0.016	0.8	10	30	50	4.0
36a	0.040	8.8	3	5	100	9.7
36b	0.016	4.1	Street Section		60	9.2
36c	0.016	1.3	Street Section		65	9.3
37	0.035	0.4	2	30	20	1.5
39	0.016	0.5	Street Section		30	3.5
41	0.040	0.2	50	40	140	1.3
42	0.016	0.6	Street Section		45	4.1
43a	0.016	2.2	Street Section		10	4.7
43b	0.016	0.4	Street Section		40	3.5
43c	0.040	0.1	50	40	70	1.0
44a	0.016	1.1	Street Section		40	5.1
44b	0.040	0.3	50	60	180	1.6
45a	0.016	0.5	Street Section		25	3.3
45b	0.040	0.7	50	80	90	1.7
46a	0.016	0.7	Street Section		35	4.1
46b	0.016	0.5	Street Section		65	4.2
46c	0.016	0.6	Street Section		200	6.0
47a	0.040	1.0	5	20	90	3.4
47b	0.016	0.5	20	3	300	5.7
48a	0.030	1.4	5	20	30	3.1
48b	0.040	0.2	50	80	160	1.3
49	0.020	8.2	Street Section		10	7.9
50	0.040	10.8	5	10	200	10.9
53a	0.046	4.5	2	5	10	3.7
53b	0.035	1.0	4	40	50	2.5
55a	0.040	11.2	4	5	50	8.3
55b	0.058	2.4	5	10	150	4.5
56	0.040	10.5	3	10	40	7.0
57	0.040	13.0	4	5	50	8.7
58	0.040	8.5	3	10	200	10.7
59	0.035	1.5	10	20	30	2.7
60	0.035	0.6	5	10	30	2.5
61	0.035	0.7	3	10	40	3.1
62	0.040	0.6	8	30	50	2.1
63	0.040	1.2	8	10	80	3.5
65	0.040	8.6	3	10	200	10.9
66	0.040	6.8	5	20	30	4.3
70a	0.046	7.8	5	10	30	5.0
70b	0.035	2.3	3	10	40	4.6
71	0.040	9.3	4	10	130	9.4
72a	0.040	11.2	3	5	40	8.1
72b	0.016	2.9	Street Section		35	7.1
73	0.035	1.6	3	10	40	4.1
74	0.030	1.8	3	3	40	5.4
76	0.040	0.7	3	10	50	3.0
78	0.040	0.4	5	10	30	2.0
79	0.035	6.1	5	10	10	3.8
80	0.040	7.8	5	20	100	7.0
81	0.040	7.7	5	10	10	3.7
82	0.035	3.3	5	10	20	3.9
83a	0.035	7.4	5	20	100	7.4
83b	0.035	0.8	10	20	200	3.9
84	0.035	1.5	50	100	700	4.4
85	0.035	0.9	50	200	500	3.0
86	0.030	0.2	10	30	160	2.4
87a	0.016	0.3	80	3	30	1.9
87b	0.040	0.3	20	10	70	1.6
88a	0.016	0.2	Street Section		40	2.2
88b	0.030	1.8	3	5	160	7.6
89	0.016	0.2	Street Section		60	2.5
90a	0.016	0.1	Street Section		30	1.6
90b	0.046	0.4	4	10	90	2.5
91a	0.016	0.2	Street Section		30	2.1
91b	0.035	0.3	2	30	100	2.5
92	0.025	0.6	20	10	20	2.2
93a	0.040	1.5	3	10	50	3.9
93b	0.035	0.6	4	15	140	3.8
95a	0.020	0.9	Street Section		50	3.5
95b	0.035	0.6	2	20	300	5.1
96a	0.035	0.7	10	30	200	3.6
96b	0.040	0.3	10	50	300	2.5
97	0.046	0.3	50	100	300	1.6
98a	0.040	0.7	10	15	10	1.4
98b	0.030	0.1	2	30	80	1.8
99	0.020	0.6	Street Section		20	3.0
101a	0.013	0.1	Street Section		40	2.4
101b	0.040	0.3	3	3	100	2.9
103	0.040	0.6	4	15	20	2.0

* Flowrate estimated by assuming an average yield of contributing area of 2 cfs/ac for basins within Grants/Milan limits and 1 cfs/ac for basins outside the Grants/Milan for most cases. Some basins deviate from this pattern based on individual characteristics.

** Velocity determined using normal depth calculations with Manning's equation.

TABLE 2-22

HEC-HMS Routing Reach Characteristics

City of Grants and Village of Milan, New Mexico Drainage Master Plan

9/17/2010

Reach	Length (ft)	Max El. (ft)	Min El. (ft)	Slope (ft/ft)	Manning's n (channel)	Width (ft)	Side Slope (z:1)
R01	8930	7620	6616	0.112	0.046	40	2
R02	6460	6616	6450	0.026	0.046	10	5
R03	6350	6544	6450	0.015	0.058	10	2
R04	3480	6450	6424	0.007	0.040	100	50
R05	6080	7118	6880	0.039	0.058	30	2
R06	4160	6880	6747	0.032	0.058	R06 Eight Pt Section	
R07	780	6776	6747	0.037	0.040	10	2
R08	2510	6747	6684	0.025	0.058	R08 Eight Pt Section	
R09	4560	6684	6610	0.016	0.058	R09 Eight Pt Section	
R10	4320	6610	6530	0.019	0.058	10	1.5
R11	7590	6530	6468	0.008	0.046	15	2.0
R12	5220	6486	6452	0.007	0.040	50	10
R13	9630	6600	6452	0.015	0.040	20	3
R14	2230	6452	6430	0.010	0.046	40	20
R15	2180	6478	6470	0.004	0.016	Arterial Street	
R16	1110	6470	6452	0.016	0.016	Arterial Street	
R17	610	6468	6464	0.007	0.046	R17 Eight Pt Section	
R18	1970	6502	6480	0.011	0.035	30	3
R19	550	6480	6464	0.029	0.035	30	2
R20	1560	6464	6456	0.005	0.040	R20 Eight Pt Section	
R21	1490	6474	6458	0.011	0.040	50	50
R22	2670	6500	6458	0.016	0.040	100	20
R23	1270	6498	6470	0.022	0.035	30	20
R24	830	6470	6458	0.014	0.040	5	5
R25	290	6458	6454	0.014	0.040	5	4
R26	1110	6454	6448	0.005	0.040	R26 Eight Pt Section	
R27	2850	6448	6426	0.008	0.030	40	3
R28	2190	6426	6422	0.002	0.030	40	3
R29	680	6468	6456	0.018	0.035	3	2
R30	3150	6456	6436	0.006	0.035	8	2
R31	2610	6440	6438	0.001	0.016	Residential Street	
R32	1050	6490	6476	0.013	0.013	5	3
R33	720	6482	6476	0.008	0.013	5	3
R34A	2720	6638	6478	0.059	0.037	4	10
R34B	2550	6478	6452	0.010	0.016	Arterial Street	
R35	100	6449	6448	0.010	0.016	Arterial Street	
R36	990	6440	6438	0.002	0.040	5	2
R37	2610	6438	6434	0.002	0.016	Residential Street	
R38	270	6434	6428	0.022	0.040	50	50
R39	1020	6448	6430	0.018	0.040	20	10
R40	1840	6430	6422	0.004	0.016	3	20
R41	2130	6422	6418	0.002	0.046	100	50
R42	1430	6524	6521	0.002	0.035	20	2
R43A	3240	6860	6558	0.093	0.040	10	4
R43B	380	6556	6548	0.021	0.035	5	3
R44	800	6548	6532	0.020	0.035	5	3
R45	440	6532	6526	0.014	0.035	1	3
R46	860	6526	6521	0.006	0.035	20	2
R47	550	6538	6524	0.025	0.040	5	3

Reach	Length (ft)	Max El. (ft)	Min El. (ft)	Slope (ft/ft)	Manning's n (channel)	Width (ft)	Side Slope (z:1)
R48	150	6524	6521	0.020	0.035	5	3
R49A	4030	7090	6564	0.131	0.040	10	3
R49B	700	6560	6536	0.034	0.046	10	3
R50A	3320	6820	6536	0.086	0.040	10	3
R50B	2080	6536	6524	0.006	0.040	10	5
R51	3290	6550	6520	0.009	0.040	30	8
R52	820	6564	6532	0.039	0.035	1	1
R53A	2190	6720	6534	0.085	0.040	10	3
R53B	450	6532	6530	0.004	0.040	10	8
R54	1130	6570	6530	0.035	0.035	3	2
R55	270	6530	6518	0.044	0.040	10	3
R56	720	6518	6514	0.006	0.040	10	5
R57	1200	6536	6512	0.020	0.046	3	8
R58	600	6512	6507	0.008	0.040	10	50
R59	2860	6507	6486	0.007	0.040	15	4
R60	2380	6538	6484	0.023	0.046	15	4
R61	1570	6528	6484	0.028	0.046	10	4
R62A	3310	6860	6504	0.108	0.040	10	5
R62B	1280	6504	6484	0.016	0.046	10	4
R63	580	6496	6484	0.021	0.040	15	3
R64	1150	6484	6480	0.003	0.040	50	10
R65	3190	6522	6520	0.001	0.016	Residential Street	
R66	3220	6521	6514	0.002	0.035	20	2
R67	580	6518	6514	0.007	0.030	5	3
R68	3600	6514	6506	0.002	0.035	15	2
R69	1510	6516	6515	0.001	0.016	Residential Street	
R70	1830	6514	6508	0.003	0.046	10	4
R71	2370	6506	6504	0.001	0.035	30	2
R72	3390	6504	6484	0.006	0.046	15	4
R73	720	6484	6482	0.003	0.040	15	4
R74	2150	6482	6476	0.003	0.035	15	3
R75	1530	6476	6470	0.004	0.040	20	2
R76	4780	6470	6445	0.005	0.046	20	2
R77	430	6445	6444	0.002	0.040	20	2
R78	430	6444	6443	0.002	0.035	20	2
R79	1800	6443	6435	0.004	0.040	15	2
R80	540	6435	6434	0.002	0.035	20	2
R81	2050	6434	6424	0.005	0.035	20	2
R82	2620	6424	6421	0.001	0.030	30	1.5
R83	260	6421	6420	0.004	0.030	40	1.5
R84	2470	6420	6414	0.002	0.030	40	1
R85	1690	6414	6412	0.001	0.030	40	1
R86	2600	6412	6409	0.001	0.030	35	1
R87	2590	6416	6412	0.002	0.040	100	10
R88	430	6409	6408	0.002	0.030	30	1.5
R89	3140	6522	6520	0.001	0.020	Residential Street	
R90	4040	6520	6517	0.001	0.040	50	10
R91	1890	6517	6506	0.006	0.040	15	4

TABLE 2-23

NMDOT Hydrologic Data

Project:	**City of Grants and Village of Milan, New Mexico Drainage Master Plan**					
Location:	**Cibola County, New Mexico**					
Elevation:	**6700**					
Design Tr:	**100-Yr**					
Orographic Region:		**2**				
Physiographic Region:		**Central Mountain-Valley**				**6**
Rainfall						
	2-yr	**5-yr**	**10-yr**	**25-yr**	**50-yr**	**100-yr**
6-hr	1.02	1.30	1.53	1.84	2.08	2.35
24-hr	1.28	1.60	1.86	2.21	2.48	2.76

Note: Precipitation depths from NOAA Atlas 14 for Latitude 35.18 N and Longitude 107.8 W which represents the average precipitation depths for the watershed.

10-yr, 24-hr Modified NOAA-SCS Rainfall Distribution

Time	Depth (in)	Time	Depth (in)	Time	Depth (in)
0.00	0.00	8.00	0.00	16.00	1.76
0.25	0.01	8.25	0.01	16.25	1.76
0.50	0.01	8.50	0.01	16.50	1.76
0.75	0.02	8.75	0.02	16.75	1.77
1.00	0.02	9.00	0.02	17.00	1.77
1.25	0.03	9.25	0.03	17.25	1.77
1.50	0.03	9.50	0.03	17.50	1.78
1.75	0.04	9.75	0.04	17.75	1.78
2.00	0.04	10.00	0.04	18.00	1.78
2.25	0.05	10.25	0.05	18.25	1.79
2.50	0.05	10.50	0.05	18.50	1.79
2.75	0.06	10.75	0.06	18.75	1.79
3.00	0.06	11.00	0.06	19.00	1.80
3.25	0.07	11.25	0.07	19.25	1.80
3.50	0.08	11.50	0.08	19.50	1.80
3.75	0.08	11.75	0.08	19.75	1.81
4.00	0.09	12.00	0.09	20.00	1.81
4.25	0.10	12.25	0.10	20.25	1.81
4.50	0.11	12.50	0.11	20.50	1.81
4.75	0.12	12.75	0.12	20.75	1.82
5.00	0.13	13.00	0.13	21.00	1.82
5.25	0.18	13.25	0.18	21.25	1.82
5.50	0.23	13.50	0.23	21.50	1.83
5.75	0.34	13.75	0.34	21.75	1.83
6.00	1.10	14.00	1.10	22.00	1.83
6.25	1.36	14.25	1.36	22.25	1.84
6.50	1.48	14.50	1.48	22.50	1.84
6.75	1.53	14.75	1.53	22.75	1.84
7.00	1.58	15.00	1.58	23.00	1.85
7.25	1.59	15.25	1.59	23.25	1.85
7.50	1.60	15.50	1.60	23.50	1.85
7.75	1.61	15.75	1.61	23.75	1.86
				24.00	1.86

100-yr, 24-hr Modified NOAA-SCS Rainfall Distribution

Time	Depth (in)	Time	Depth (in)	Time	Depth (in)
0.00	0.00	8.00	2.39	16.00	2.61
0.25	0.01	8.25	2.41	16.25	2.61
0.50	0.02	8.50	2.42	16.50	2.62
0.75	0.02	8.75	2.43	16.75	2.62
1.00	0.03	9.00	2.44	17.00	2.63
1.25	0.04	9.25	2.45	17.25	2.63
1.50	0.05	9.50	2.46	17.50	2.64
1.75	0.05	9.75	2.46	17.75	2.64
2.00	0.06	10.00	2.47	18.00	2.65
2.25	0.07	10.25	2.48	18.25	2.65
2.50	0.08	10.50	2.49	18.50	2.65
2.75	0.08	10.75	2.49	18.75	2.66
3.00	0.09	11.00	2.50	19.00	2.66
3.25	0.10	11.25	2.51	19.25	2.67
3.50	0.11	11.50	2.52	19.50	2.67
3.75	0.13	11.75	2.52	19.75	2.68
4.00	0.14	12.00	2.53	20.00	2.68
4.25	0.15	12.25	2.53	20.25	2.69
4.50	0.16	12.50	2.54	20.50	2.69
4.75	0.18	12.75	2.54	20.75	2.70
5.00	0.19	13.00	2.55	21.00	2.70
5.25	0.26	13.25	2.55	21.25	2.71
5.50	0.34	13.50	2.56	21.50	2.71
5.75	0.51	13.75	2.56	21.75	2.72
6.00	1.63	14.00	2.57	22.00	2.72
6.25	2.02	14.25	2.57	22.25	2.73
6.50	2.20	14.50	2.58	22.50	2.73
6.75	2.27	14.75	2.58	22.75	2.74
7.00	2.34	15.00	2.59	23.00	2.74
7.25	2.36	15.25	2.59	23.25	2.75
7.50	2.37	15.50	2.60	23.50	2.75
7.75	2.38	15.75	2.60	23.75	2.76
				24.00	2.76

TABLE 2-24

NMDOT Hydrologic Data

Project:	**City of Grants and Village of Milan, New Mexico Drainage Master Plan**					
Location:	**Cibola County, New Mexico**					
Elevation:	**6700**					
Design Tr:	**100-Yr**					
Orographic Region:	**2**					
Physiographic Region:	**Central Mountain-Valley**					**6**
Rainfall						
	2-yr	**5-yr**	**10-yr**	**25-yr**	**50-yr**	**100-yr**
6-hr	1.02	1.30	1.53	1.84	2.08	2.35
24-hr	1.28	1.60	1.86	2.21	2.48	2.76

Note: Precipitation depths from NOAA Atlas 14 for Latitude 35.18 N and Longitude 107.8 W which represents the average precipitation depths for the watershed.

10-yr, 24-hr Modified NOAA-SCS Rainfall Distribution (84% Area Reduction Factor)

Time	Depth (in)	Time	Depth (in)	Time	Depth (in)
0.00	0.00	8.00	1.35	16.00	1.48
0.25	0.00	8.25	1.36	16.25	1.48
0.50	0.01	8.50	1.37	16.50	1.48
0.75	0.01	8.75	1.37	16.75	1.48
1.00	0.02	9.00	1.38	17.00	1.49
1.25	0.02	9.25	1.39	17.25	1.49
1.50	0.03	9.50	1.39	17.50	1.49
1.75	0.03	9.75	1.39	17.75	1.49
2.00	0.03	10.00	1.40	18.00	1.50
2.25	0.04	10.25	1.40	18.25	1.50
2.50	0.04	10.50	1.41	18.50	1.50
2.75	0.05	10.75	1.41	18.75	1.51
3.00	0.05	11.00	1.42	19.00	1.51
3.25	0.06	11.25	1.42	19.25	1.51
3.50	0.06	11.50	1.42	19.50	1.51
3.75	0.07	11.75	1.43	19.75	1.52
4.00	0.08	12.00	1.43	20.00	1.52
4.25	0.08	12.25	1.43	20.25	1.52
4.50	0.09	12.50	1.44	20.50	1.52
4.75	0.10	12.75	1.44	20.75	1.53
5.00	0.11	13.00	1.44	21.00	1.53
5.25	0.15	13.25	1.45	21.25	1.53
5.50	0.19	13.50	1.45	21.50	1.54
5.75	0.29	13.75	1.45	21.75	1.54
6.00	0.92	14.00	1.45	22.00	1.54
6.25	1.14	14.25	1.46	22.25	1.54
6.50	1.24	14.50	1.46	22.50	1.55
6.75	1.28	14.75	1.46	22.75	1.55
7.00	1.32	15.00	1.46	23.00	1.55
7.25	1.33	15.25	1.47	23.25	1.55
7.50	1.34	15.50	1.47	23.50	1.56
7.75	1.35	15.75	1.47	23.75	1.56
				24.00	1.56

100-yr, 24-hr Modified NOAA-SCS Rainfall Distribution (84% Area Reduction Factor)

Time	Depth (in)	Time	Depth (in)	Time	Depth (in)
0.00	0.00	8.00	2.01	16.00	2.19
0.25	0.01	8.25	2.02	16.25	2.19
0.50	0.01	8.50	2.03	16.50	2.20
0.75	0.02	8.75	2.04	16.75	2.20
1.00	0.03	9.00	2.05	17.00	2.21
1.25	0.03	9.25	2.06	17.25	2.21
1.50	0.04	9.50	2.06	17.50	2.21
1.75	0.04	9.75	2.07	17.75	2.22
2.00	0.05	10.00	2.07	18.00	2.22
2.25	0.06	10.25	2.08	18.25	2.23
2.50	0.06	10.50	2.09	18.50	2.23
2.75	0.07	10.75	2.09	18.75	2.23
3.00	0.08	11.00	2.10	19.00	2.24
3.25	0.09	11.25	2.11	19.25	2.24
3.50	0.10	11.50	2.11	19.50	2.25
3.75	0.11	11.75	2.12	19.75	2.25
4.00	0.11	12.00	2.13	20.00	2.25
4.25	0.12	12.25	2.13	20.25	2.26
4.50	0.13	12.50	2.13	20.50	2.26
4.75	0.15	12.75	2.14	20.75	2.27
5.00	0.16	13.00	2.14	21.00	2.27
5.25	0.22	13.25	2.15	21.25	2.27
5.50	0.28	13.50	2.15	21.50	2.28
5.75	0.43	13.75	2.15	21.75	2.28
6.00	1.37	14.00	2.16	22.00	2.29
6.25	1.70	14.25	2.16	22.25	2.29
6.50	1.84	14.50	2.17	22.50	2.29
6.75	1.90	14.75	2.17	22.75	2.30
7.00	1.97	15.00	2.17	23.00	2.30
7.25	1.98	15.25	2.18	23.25	2.31
7.50	1.99	15.50	2.18	23.50	2.31
7.75	2.00	15.75	2.19	23.75	2.31
				24.00	2.32

TABLE 2-25

NMDOT Hydrologic Data

Project:	**City of Grants and Village of Milan, New Mexico Drainage Master Plan**					
Location:	**Cibola County, New Mexico**					
Elevation:	**6700**					
Design Tr:	**100-Yr**					
Orographic Region:	**2**					
Physiographic Region:	**Central Mountain-Valley**					**6**
Rainfall						
	2-yr	**5-yr**	**10-yr**	**25-yr**	**50-yr**	**100-yr**
6-hr	1.02	1.30	1.53	1.84	2.08	2.35
24-hr	1.28	1.60	1.86	2.21	2.48	2.76

Note: Precipitation depths from NOAA Atlas 14 for Latitude 35.18 N and Longitude 107.8 W which represents the average precipitation depths for the watershed.

10-yr, 24-hr Modified NOAA-SCS Rainfall Distribution (77% Area Reduction Factor)

Time	Depth (in)	Time	Depth (in)	Time	Depth (in)
0.00	0.00	8.00	1.24	16.00	1.35
0.25	0.00	8.25	1.25	16.25	1.36
0.50	0.01	8.50	1.25	16.50	1.36
0.75	0.01	8.75	1.26	16.75	1.36
1.00	0.02	9.00	1.27	17.00	1.36
1.25	0.02	9.25	1.27	17.25	1.37
1.50	0.02	9.50	1.27	17.50	1.37
1.75	0.03	9.75	1.28	17.75	1.37
2.00	0.03	10.00	1.28	18.00	1.37
2.25	0.04	10.25	1.29	18.25	1.37
2.50	0.04	10.50	1.29	18.50	1.38
2.75	0.04	10.75	1.29	18.75	1.38
3.00	0.05	11.00	1.30	19.00	1.38
3.25	0.05	11.25	1.30	19.25	1.38
3.50	0.06	11.50	1.31	19.50	1.39
3.75	0.06	11.75	1.31	19.75	1.39
4.00	0.07	12.00	1.31	20.00	1.39
4.25	0.08	12.25	1.32	20.25	1.39
4.50	0.08	12.50	1.32	20.50	1.40
4.75	0.09	12.75	1.32	20.75	1.40
5.00	0.10	13.00	1.32	21.00	1.40
5.25	0.14	13.25	1.33	21.25	1.40
5.50	0.17	13.50	1.33	21.50	1.41
5.75	0.26	13.75	1.33	21.75	1.41
6.00	0.85	14.00	1.33	22.00	1.41
6.25	1.05	14.25	1.34	22.25	1.41
6.50	1.14	14.50	1.34	22.50	1.42
6.75	1.18	14.75	1.34	22.75	1.42
7.00	1.21	15.00	1.34	23.00	1.42
7.25	1.22	15.25	1.35	23.25	1.42
7.50	1.23	15.50	1.35	23.50	1.43
7.75	1.24	15.75	1.35	23.75	1.43
				24.00	1.43

100-yr, 24-hr Modified NOAA-SCS Rainfall Distribution (77% Area Reduction Factor)

Time	Depth (in)	Time	Depth (in)	Time	Depth (in)
0.00	0.00	8.00	1.84	16.00	2.01
0.25	0.01	8.25	1.85	16.25	2.01
0.50	0.01	8.50	1.86	16.50	2.01
0.75	0.02	8.75	1.87	16.75	2.02
1.00	0.02	9.00	1.88	17.00	2.02
1.25	0.03	9.25	1.88	17.25	2.03
1.50	0.03	9.50	1.89	17.50	2.03
1.75	0.04	9.75	1.90	17.75	2.03
2.00	0.05	10.00	1.90	18.00	2.04
2.25	0.05	10.25	1.91	18.25	2.04
2.50	0.06	10.50	1.91	18.50	2.04
2.75	0.06	10.75	1.92	18.75	2.05
3.00	0.07	11.00	1.93	19.00	2.05
3.25	0.08	11.25	1.93	19.25	2.06
3.50	0.09	11.50	1.94	19.50	2.06
3.75	0.10	11.75	1.94	19.75	2.06
4.00	0.11	12.00	1.95	20.00	2.07
4.25	0.11	12.25	1.95	20.25	2.07
4.50	0.12	12.50	1.96	20.50	2.07
4.75	0.13	12.75	1.96	20.75	2.08
5.00	0.15	13.00	1.96	21.00	2.08
5.25	0.20	13.25	1.97	21.25	2.08
5.50	0.26	13.50	1.97	21.50	2.09
5.75	0.39	13.75	1.97	21.75	2.09
6.00	1.26	14.00	1.98	22.00	2.10
6.25	1.56	14.25	1.98	22.25	2.10
6.50	1.69	14.50	1.98	22.50	2.10
6.75	1.75	14.75	1.99	22.75	2.11
7.00	1.80	15.00	1.99	23.00	2.11
7.25	1.81	15.25	2.00	23.25	2.11
7.50	1.82	15.50	2.00	23.50	2.12
7.75	1.83	15.75	2.00	23.75	2.12
				24.00	2.13

TABLE 2-26

Zuni Canyon Flow Contribution to Rio San Jose Through Grants

Culvert Calculator Report
Zuni Canyon Culvert-84" CMP Under I-40 to Rio San Jose

Solve For: Discharge

Culvert Summary					
Allowable HW Elevation	6,518.00	ft	Headwater Depth/Height	2.57	
Computed Headwater Eleva	6,518.00	ft	Discharge	602.86	cfs
Inlet Control HW Elev.	6,517.32	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	6,518.00	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	6,500.00	ft	Downstream Invert	6,498.00	ft
Length	200.00	ft	Constructed Slope	0.010000	ft/ft

Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	6.28	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	6.28	ft
Velocity Downstream	16.57	ft/s	Critical Slope	0.026809	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	7.00	ft
Section Size	84 inch		Rise	7.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	6,518.00	ft	Upstream Velocity Head	3.81	ft
Ke	0.90		Entrance Loss	3.43	ft

Inlet Control Properties					
Inlet Control HW Elev.	6,517.32	ft	Flow Control	N/A	
Inlet Type	Projecting		Area Full	38.5	ft²
K	0.03400		HDS 5 Chart	2	
M	1.50000		HDS 5 Scale	3	
C	0.05530		Equation Form	1	
Y	0.54000				

HEC-HMS Elevation-Area-Discharge Relationships for Zuni Canyon
Detention and Diversion at I-40

Elevation	Storage Surface Area (ac)	Storage Cummulative Volume (ac-ft)
6500	0.2	0.0
6502	0.7	0.9
6504	2.1	3.7
6506	4.2	10.0
6508	10.6	24.8
6510	24.5	59.9
6512	45.6	130.0
6514	70.5	246.1
6516	108.1	424.7
6518	180	712.8

Elevation	I-40-84" Culvert Discharge (cfs)
6500	0
6502	23
6504	85
6506	179
6508	296
6510	404
6512	460
6514	511
6516	558
6518	603

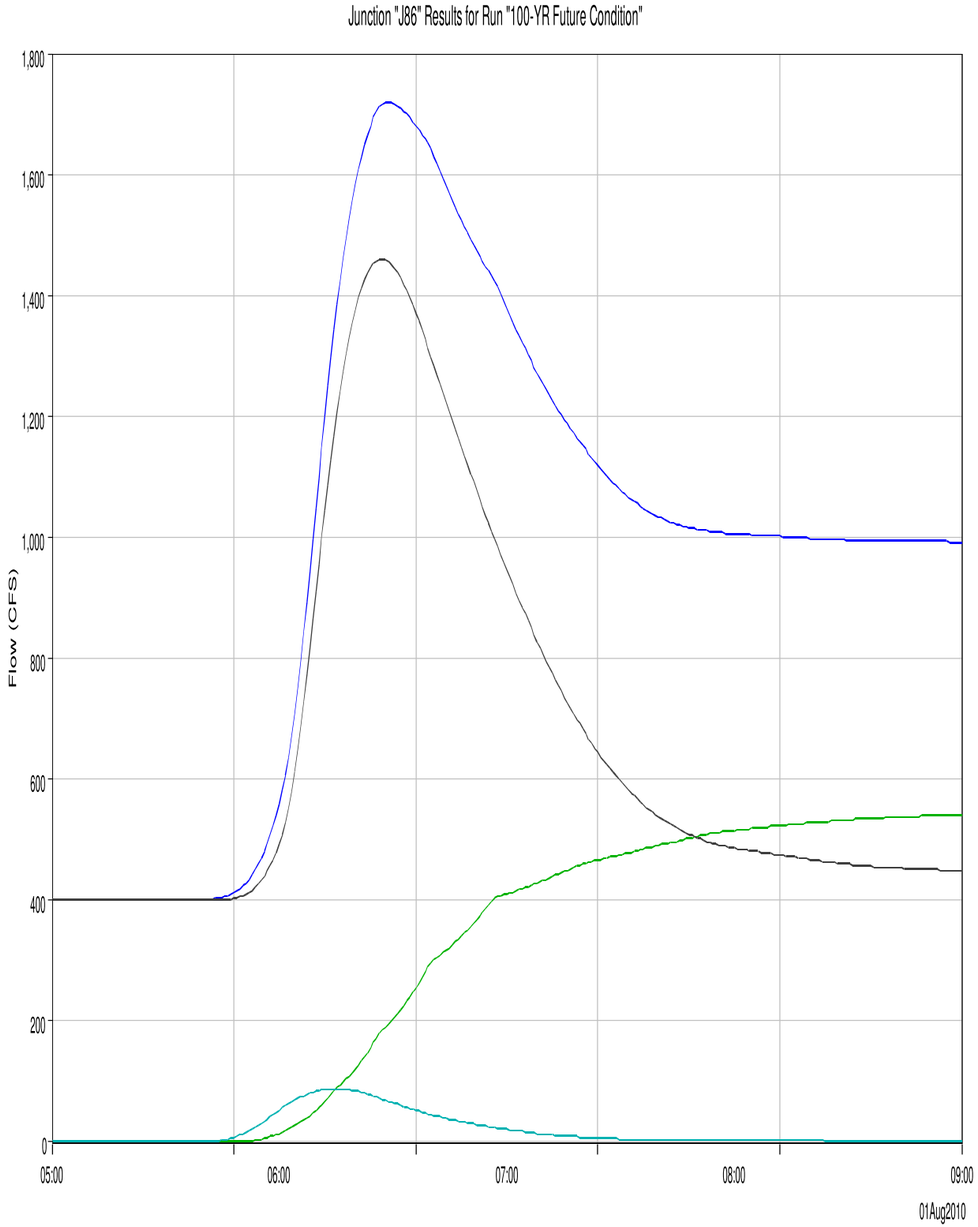
Zuni Canyon Basin Characteristics for HEC-HMS Model

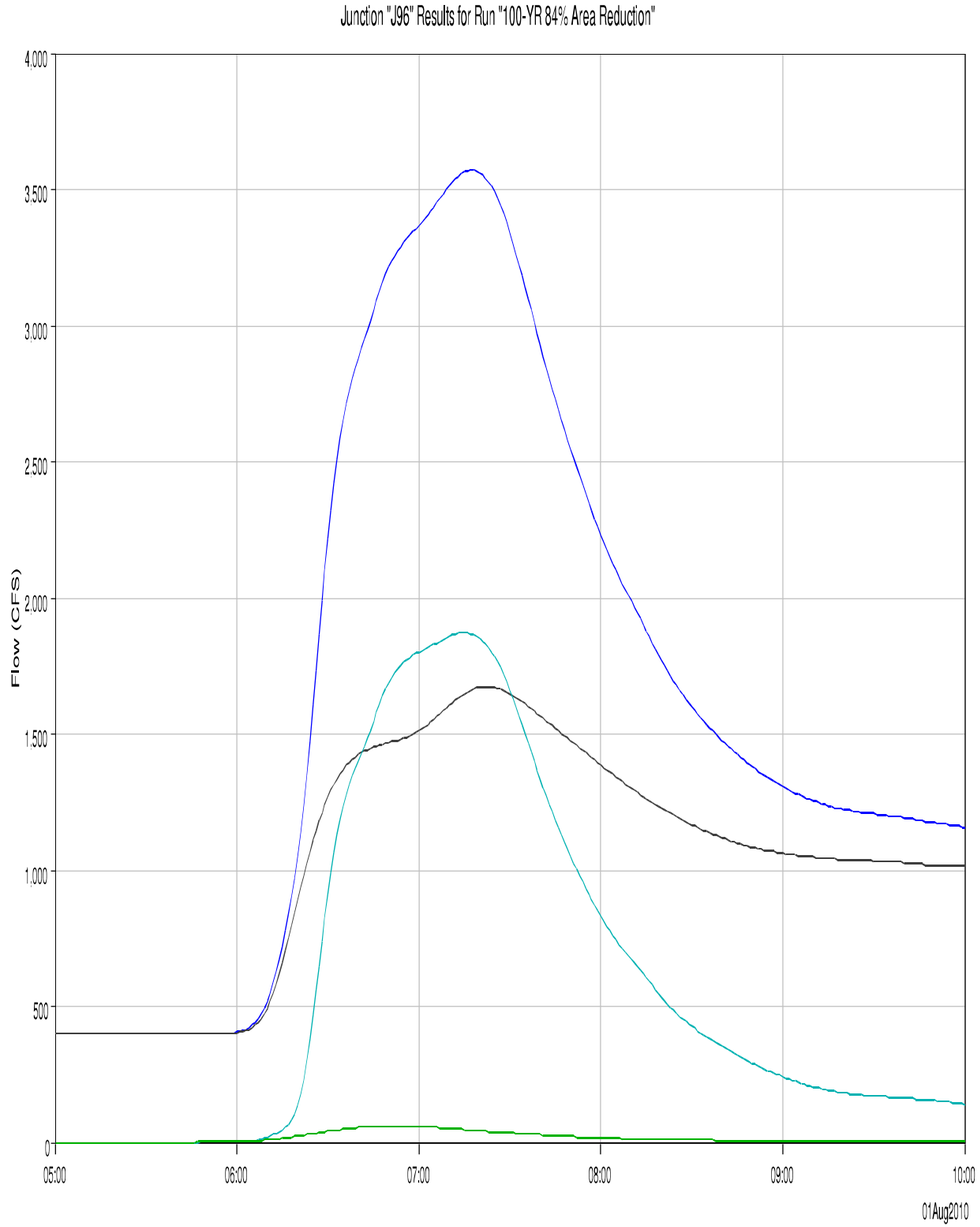
Area = 45.337 square miles
Lag Time = 109 minutes
Curve Number = 72
Modeled 24-hour Precipitation = 77% of NOAA Atlas 14 (Based on NWS HYDRO-40)
P_{10} = 1.43 inches
P_{100} = 2.13 inches
Effective FEMA Q_{100} = 2,440 cfs
Current HEC-HMS Q_{100} = 2,485 cfs (undetained)
Current HEC-HMS Q_{100} = 548 cfs (to Rio San Jose through 84" culvert)
Current HEC-HMS Q_{100} ~ 0 cfs (diverted)
Current HEC-HMS V_{100} = 801.2 ac-ft
Current HEC-HMS V_{100} = 379.2 ac-ft (storage)
Maximum Water Surface Elevation = 6515.5

The Zuni Canyon watershed is sizeable, lies adjacent to the detailed study area, and is tributary to the current studied reach of the Rio San Jose through an existing 84" culvert under I-40. This culvert discharges to the Rio San Jose approximately 1,500 linear feet east of Aspen Avenue in Milan. In order to simulate potential flow contribution from this watershed, a single Zuni Canyon basin was included in the HEC-HMS model. Predicted peak 100 year flow rates from the watershed are much larger than the capacity of the existing 84" I-40 culvert and topographic mapping indicates a significant flood storage area upstream of the I-40 embankment. Thus, the culvert will limit Zuni Canyon discharge to the Rio San Jose. The flood storage area located upstream of I-40 was input as a reservoir with stage storage based on topographic mapping and stage discharge based on the capacity of the existing 84" culvert as calculated with the Bentley CulvertMaster program. The utilized stage/storage/discharge curve and Zuni Canyon watershed characteristics are shown on this sheet. The model indicates a 100 year peak flow rate contribution from Zuni Canyon to the Rio San Jose of 548 cfs, with the maximum impounded water surface reaching elevation 6515.5 on the south side of I-40.

Table 2-27

HEC-HMS Model Future Condition Hydrographs for Analysis Points 86 and 96





Appendix Section 3 – Hydraulics

Hydraulic Analysis Index

Figures	Description	Page Range
3-1	Drainage Structures Inventory Key map	3
3-2	Drainage Structures Inventory Map 1	4
3-3	Drainage Structures Inventory Map 2	5
3-4	Drainage Structures Inventory Map 3	6
3-5	Drainage Structures Inventory Map 4	7
3-6	Drainage Structures Inventory Map 5	8
3-7	Drainage Structures Inventory Map 6	9
3-8	Drainage Structures Inventory Map 7	10
3-9	HEC-RAS Sections Map, Rio San Jose, Sta 435+00 to 383+00	11
3-10	HEC-RAS Sections Map, Rio San Jose, Sta 383+00 to 319+00	12
3-11	HEC-RAS Sections Map, Rio San Jose, Sta 319+00 to 253+00	13
3-12	HEC-RAS Sections Map, Rio San Jose, Sta 253+00 to 177+00	14
3-13	HEC-RAS Sections Map, Rio San Jose, Sta 177+00 to 131+00	15
3-14	HEC-RAS Sections Map, Rio San Jose, Sta 131+00 to 74+54	16
3-15	HEC-RAS Sections Map, Rio San Jose, Sta 74+54 to 10+00	17
	HEC-RAS Profile Summary Table, Rio San Jose	18-31
	HEC-RAS Bridge Summary Table, Rio San Jose	32
	HEC-RAS Culvert Summary Table, Rio San Jose	33
	HEC-RAS Profile Plots, Rio San Jose	34-40
	HEC-RAS Cross Section Plots, Rio San Jose	41-74
3-16	HEC-RAS Sections Map, Grants Canyon, Sta 0+00 to 42+00	75
3-17	HEC-RAS Sections Map, Grants Canyon, Sta 42+00 to 110+00	76
	HEC-RAS Profile Summary Table, Grants Canyon	77-79
	HEC-RAS Culvert Summary Table, Grants Canyon	80
	HEC-RAS Profile Plot, Grants Canyon	81
	HEC-RAS Cross Section Plots, Grants Canyon	82-88

Tables

3-1	Drainage Structure Inventory	1-2

Drainage Structure Inventory

City of Grants and Village of Milan, New Mexico Drainage Master Plan

9/22/2010

Structure ID	Analysis Point	Structure Location	Description/Size	Material	Assumed Hw/D	Q_{10} (cfs)	Sufficient Capacity to Pass Q_{10}	Q_{100} (cfs)	Sufficient Capacity to Pass Q_{100}	Structure Notes
1	43	HW 605 North of Milan	n/a	n/a	1.5	31	n/a	188	n/a	
2	44	HW 605 North of Milan	n/a	n/a	1.5	58	n/a	337	n/a	
3	45	HW 605 North of Milan	n/a	n/a	1.5	26	n/a	109	n/a	
4	46	HW 605 North of Milan	3-42"	CMP	1.5	14	Yes	53	Yes	Size and location obtained from report by Sulivan Design Group 1996
5	46*	HW 605 North of Milan	2-48"	CMP	1.5	14	Yes	53	Yes	Size and location obtained from report by Sulivan Design Group 1996
6	47	HW 605 North of Milan	1-48"	CMP	1.5	4	Yes	14	Yes	Size and location obtained from report by Sulivan Design Group 1996
7	48	HW 605 North of Milan	3-48"	CMP	1.5	14	Yes	56	Yes	Size and location obtained from report by Sulivan Design Group 1996
8	49	HW 605 North of Milan	1-54"	CMP	1.5	2	Yes	8	Yes	Size and location obtained from report by Sulivan Design Group 1996
9	50	HW 605 North of Milan	1-42"	CMP	1.5	5	Yes	19	Yes	Size and location obtained from report by Sulivan Design Group 1996
10	51	HW 605 North of Milan	1-36"	CMP	1.5	6	Yes	18	Yes	Size and location obtained from report by Sulivan Design Group 1996
11	52	HW 605 North of Milan	2-36"	CMP	1.5	6	Yes	20	Yes	Size and location obtained from report by Sulivan Design Group 1996
12	53	HW 605 North of Milan	1-42"	CMP	1.5	6	Yes	17	Yes	Size and location obtained from report by Sulivan Design Group 1996
13	54	HW 605 North of Milan	2-36"	CMP	1.5	13	Yes	42	Yes	Size and location obtained from report by Sulivan Design Group 1996
14	RSJ	Rio San Jose/Stanley Ave	1-36" 1-48"	CMP	1.5	559	No	2,440	No	Channel full of weeds
15	Basin 73	Berryhill St/HW 605	1-30"	CMP	1.4	9	Yes	26	Yes	
16	Basin 73	Elkins Rd/HW 605	1-36"	CMP	1.0	9	Yes	26	Yes	Downstream end of culvert damaged
17	RSJ	Rio San Jose/HW 605	Bridge	Concrete	n/a	559	Yes	2,440	No	
18	56B	Westbrook St	Culvert	n/a	n/a	38	n/a	141	n/a	
19	57	Prewitt St	Culvert	n/a	n/a	56	n/a	200	n/a	
20	57	Febco St	1-36" 1-58" x 39" Arch	CMP	1.2	56	Yes	200	No	
21	58	Berryhill St	1-36" 1-58" x 39" Arch	CMP	1.2	59	Yes	211	No	
22	59	Elkins Rd	Culvert	n/a	n/a	59	n/a	211	n/a	
23	60	Berryhill St/Howie Ave	2-42" x 24" Arch 1-24"	CMP	1.5	6	Yes	21	Yes	
24	61*	Elkins Rd/Howie Ave	3-24"	CMP	1.3	15	Yes	52	Yes	
25	61*	Elkins Rd/Howie Ave	1-48"	CMP	1.3	15	Yes	52	Yes	
26	61	Elkins Rd/Howie Ave	3-48"	CMP	1.5	15	Yes	52	Yes	
27	64	Rio San Jose/RR	RR Bridge	Steel	n/a	559	Yes	2,440	No	Backwater causes channel overflow upstream in 100-yr
28	64	Rio San Jose/Santa Fe Ave	8-10' x 5' CBC	Concrete	n/a	559	Yes	2,440	No	
29	60*	Febco St/Haystack Pl	1-18"	CMP	2.0	6	Yes	21	No	
30	Basin 65B	Haystack Pl/Crater Ave	1-15"	CMP	2.0	22	No	89	No	
31	Basin 65B	Haystack Pl/Crater Ave	2-54" x 40" Arch	CMP	1.2	22	Yes	89	Yes	
32	Basin 65B	Pintada Ave/Crater Ave	1-36" 1-54" x 40" Arch	CMP	1.2	22	Yes	89	Yes	
33	Basin 65B	Crater Ave	2-54" x 40" Arch	CMP	1.5	22	Yes	89	Yes	
34	Basin 65B	Crater Ave/Berryhill St	1-48" 1-36"	CMP	2.3	22	Yes	89	Yes	
35	62B*	Forest Park Rd	Diversion Channel	Earth	n/a	12	n/a	46	n/a	
36	62B	Berryhill St	1-54" x 40" Arch	CMP	1.3	12	Yes	46	Yes	
37	63B	Tietjen St/Crater Ave	2-54" x 39" Arch	CMP	1.6	44	Yes	153	Yes	
38	63B	Elkins Rd/Crater Ave	Culvert	n/a	n/a	44	n/a	153	n/a	
39	65*	Elkins Rd/Tietjen St	1-24" Storm Sewer w/ Inlet	RCP	1.0	16	No	53	No	
40	65	Elkins Rd/Forest Park Rd	1-24"	CMP	1.5	16	Yes	53	No	
41	65*	Elkins Rd/Forest Park Rd	1-24"	CMP	1.5	16	Yes	53	No	Ends of culvert buried with sediment
42	66	Minnick St	Culvert	n/a	n/a	23	n/a	85	n/a	
43	69	Elkins Rd/North St Ditch	1-48" w/ FES 1-48" with 4'x3' Grate Inlet	CMP	1.6	84	Yes	310	No	
44	70	RR/North St Ditch	Bridge	n/a	n/a	96	n/a	329	n/a	
45	70	Santa Fe Ave/North St Ditch	Bridge	n/a	n/a	96	n/a	329	n/a	
46	71	Elkins Rd/Black Mesa Rd	Culvert	n/a	n/a	8	n/a	22	n/a	
47	72	RR/Santa Fe Ave	Culvert	Concrete	n/a	72	n/a	206	n/a	Likely concrete box culverts, but not confimed
48	85	Santa Fe/ Aspen Ave	Culvert	Concrete	n/a	89	n/a	244	n/a	Likely concrete box culverts, but not confimed
49	79	I-40/Sand St	1-58" x 39" Arch	CMP	1.3	24	Yes	57	Yes	
50	79*	Pinon Dr/Sand St	2-58" x 39" Arch	CMP	1.2	24	Yes	57	Yes	
51	80	Rio San Jose/Sand St	2-12.5' x 5' CBC	Concrete	n/a	639	No	2,440	No	Backwater causes channel overflow upstream in 100-yr
52	80*	Rio San Jose/Clay St	~28' x 7.5' Bridge	Concrete	n/a	639	No	2,440	No	Backwater causes channel overflow upstream in 100-yr
53	80*	Rio San Jose/Airport Rd	2-12.5' x 6' CBC	Concrete	n/a	639	Yes	2,440	No	
54	80*	Rio San Jose/Milan St	~28' x 6.5' Bridge	Concrete	n/a	639	Yes	2,440	No	
55	Basin 90*	Milan St	Storm Sewer System w/ Inlets	RCP	n/a	56	n/a	128	n/a	
56	81	North St/Uranium Ave	Trench Drain	Steel	n/a	54	n/a	131	n/a	

* Corresponding Analysis Point determined based on nearby location relative to drainage structure. Actual flow reaching drainage structure may be higher or lower than flowrate for analysis point depending on existing drainage characteristics.

** Flowrate for drainage structure estimated using percentage of basin contributing to drainage structure location.

TABLE 3-1

Drainage Structure Inventory

City of Grants and Village of Milan, New Mexico Drainage Master Plan

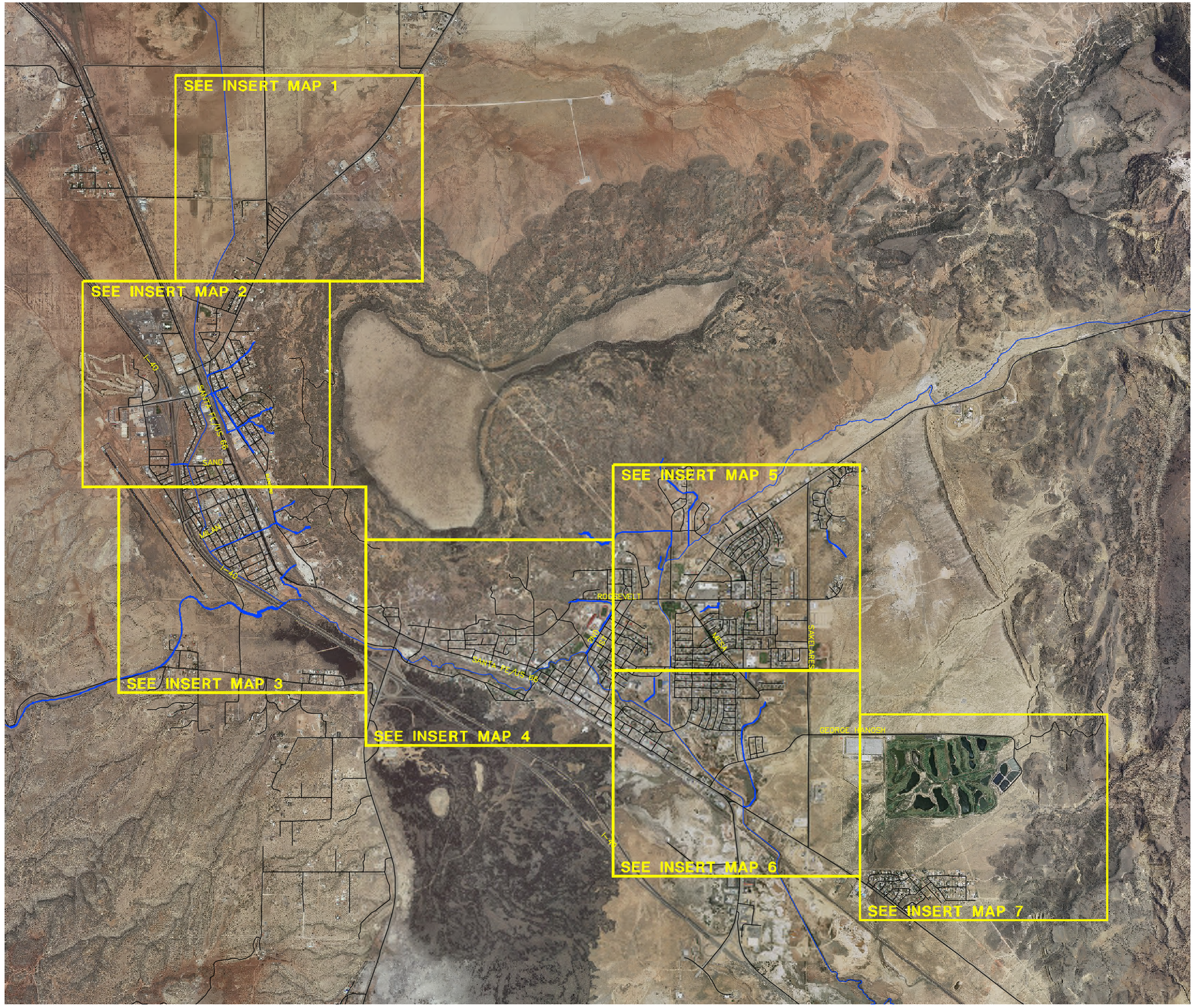
9/22/2010

Structure ID	Analysis Point	Structure Location	Description/Size	Material	Assumed Hw/D	Q_{10} (cfs)	Sufficient Capacity to Pass Q_{10}	Q_{100} (cfs)	Sufficient Capacity to Pass Q_{100}	Structure Notes
57	82	North St/Uranium Ave	3-36"	CMP	1.3	147	Yes	431	No	
58	82	North St Ditch	Drainage Ditch	Earth	n/a	147	No	431	No	Multiple driveway and street culverts limit capacity for channel
59	Zuni	Zuni Canyon Arroyo/Aspen Ave	1-72"	CMP	1.3	559	No	2,440	No	
60	Zuni	Zuni Canyon Arroyo/I-40	1-84"	CMP	2.1	559	Yes	2,440	No	
61	74	Cedar Dr/Santa Fe Ave	Culvert	n/a	n/a	15	n/a	38	n/a	
62	75B	Cedar Dr/Santa Fe Ave	1-5' x 6' CBC	Concrete	3.0	31	Yes	100	Yes	
63	75B*	Cedar Dr/Santa Fe Ave	1-24" Storm Sewer with 10' x 6.5' Area Inlet	CMP	2.0	31	Yes	100	No	
64	77	RR/ Ice Caves Rd	Culvert	Concrete	n/a	125	n/a	308	n/a	Likely concrete box culverts, but not confimed
65	76	Santa Fe Ave/Ice Caves Rd	Area and Curb Inletsw/Storm Sewer	n/a	n/a	26	n/a	58	n/a	
66	88	Rio San Jose/El Morro Rd	3-10' x 10' CBC	Concrete	n/a	929	Yes	2,440	No	
67	32*	Santa Fe Ave/El Morro Rd	Culvert	n/a	n/a	48	n/a	153	n/a	
68	33*	Santa Fe Ave/ El Morro Rd	Storm Sewer System w/ Inlets	RCP	n/a	37	n/a	91	n/a	
69	33*	RR/Acoma St	Culvert	Concrete	n/a	37	n/a	91	n/a	Likely concrete box culverts, but not confimed
70	90	Rio San Jose RR/5th St	RR Bridge and Concrete Channel	Steel/Concrete	n/a	966	Yes	2,440	Yes	
71	91	Rio San Jose/Santa Fe Ave	Bridge w/ Curb Inlets Nearby	Concrete	n/a	984	Yes	2,440	Yes	
72	35	High St/Mountain Rd	Trench Drain	Steel	n/a	141	n/a	336	n/a	
73	92	Rio San Jose/High St	3-4' x 10' CBC	Concrete	n/a	996	No	2,440	No	Heavy sedimentation present at the upstream end of the culverts
74	92	Rio San Jose/City Park	Pedestrian Bridge	Concrete	n/a	996	No	2,440	No	
75	92	Rio San Jose/Ampitheater	Pedestrian Bridge	Concrete	n/a	996	No	2,440	No	
76	36	Mountain Rd/Washington Ave	1-30"	CMP	1.0	57	No	142	No	
77	36	Mountain Rd/Washington Ave	1-15"	CMP	1.0	57	No	142	No	
78	36	Mountain Rd/Washington Ave	Drainage Ditch	Earth	n/a	57	No	142	No	
79	94	Rio San Jose/2nd St	2-9' x 6' CM Arch w/ Concrete Bottom	CMP/Concrete	n/a	1,024	Yes	2,440	No	Relatively good condition with some cracks in concrete slope paving
80	36**	Warren St/Roosevelt Ave	Culvert	n/a	n/a	7**	n/a	17**	n/a	
81	Basin 29*	Warren St/Roosevelt Ave	2-30"	CMP	1.4	34**	Yes	91**	No	
82	30*	Roosevelt Ave/Pena Dr	Drainage Ditch	Earth	n/a	98	No	316	No	South bank of channel limits capacity
83	30	Roosevelt Ave/Pena Dr	1-60"	CMP	1.1	98	No	316	No	
84	30*	2nd St	Drainage Ditch/ 1-58" x 39" Arch	Earth	1.2	98	No	316	No	
85	94	Rio San Jose/1st St	2-9' x 6' CM Arch w/ Concrete Bottom	CMP/Concrete	n/a	1,024	Yes	2,440	No	Some degradation of concrete, corrugated metal arches in relatively good condition
86	94*	Rio San Jose/Anderman St	3-9' x 6' CM Arch w/ Concrete Bottom	CMP/Concrete	n/a	1,024	Yes	2,440	No	Culvert inverts show degradation due to rust, concrete rundown at southeast side is broken, cracks present in sidewalk that appear to be caused by tilting of headwall
87	Basin 26*	University Blvd	1-30"	CMP	1.4	11	Yes	28	No	
88	25	University Blvd	1-36"	CMP	1.3	23	Yes	59	No	
89	19	North Dr	Culvert	n/a	n/a	67	n/a	213	n/a	
90	19	Northhills Blvd	Culvert	n/a	n/a	67	n/a	213	n/a	
91	20	Terrace Dr/College Blvd	2-48"	CMP	0.8	103	Yes	314	No	
92	13	Terrace Dr/College Blvd	3-54"	CMP	1.4	715	No	2,744	No	Culverts badly degraded with downstream end undermined and center FES missing
93	-	Lobo Canyon Rd	Storm Sewer System w/ Inlets	Smooth Interior Metal	n/a	-	n/a	-	n/a	
94	28	Grants Canyon Arroyo/Roosevelt Ave	4-8' x 6.5' CM Arch w/ Concrete Bottom	CMP/Concrete	n/a	883	Yes	3,215	No	Downstream cutoff wall nearly undermined, downstream utility line exposed
95	-	Roosevelt Ave/Ash St	Concrete Swale	Concrete	n/a	-	n/a	-	n/a	
96	Basin 42*	Sage St/Jackson Ave	Area Inlet and Storm Sewer	n/a	n/a	23	n/a	73	n/a	
97	Basin 41*	Jefferson Ave/Washington Ave	Trench Drain	Steel	n/a	35	n/a	86	n/a	
98	Basin 41*	Washington Ave/Jefferson Ave	Inlet w/ 24" Storm Sewer	RCP	1.2	35	No	86	No	
99	39	Grants Canyon Arroyo/Washington Ave	4-9' x 7' CM Arch w/ Concrete Bottom Area Inlets and Storm Sewer from Sage St	CMP/Concrete	n/a	885	Yes	3,225	No	Some deterioration mostly at the upstream end, some of the approach slab is worn away, some corrosion in arches, concrete base in some cells degraded, channel bed, ~1.5' to 2 ' below outlet invert
100	97	Rio San Jose/Nimitz Dr	Bridge	Concrete	n/a	1,236	Yes	3,603	No	High potential for flow to be trapped behind levee and cross Nimitz
101	40*	Mt Taylor Dr/Mesa Blvd	12' x 1' Channel	Concrete	n/a	70	Yes	200	No	
102	16	Sakelares Blvd/George Hanosh Blvd	8-42" x 29" Arch	CMP	1.2	446	No	1,328	No	Upstream ends of several culverts need debris and vegetation removed
103	16*	George Hanosh Blvd/Sakelares Blvd	2-24"	CMP	1.0	446	No	1,328	No	
104	16*	George Hanosh Blvd/Redondo Ln	2-24"	CMP	2.0	446	No	1,328	No	
105	98	Rio San Jose/George Hanosh Blvd	3-72"	CMP	n/a	1,247	No	3,626	No	Southwest culvert badly rusted on along invert and side
106	99	Rio San Jose/McBride Rd	4-10' x 8' CBC	Concrete	n/a	1,495	Yes	4,541	No	
107	100	Rio San Jose/RR	Bridge	n/a	n/a	1,484	Yes	4,470	Yes	
108	5	McBride Rd/Michael St	Culvert	n/a	n/a	418	n/a	1,417	n/a	
109	5	McBride Rd/Glynn St	Culvert	n/a	n/a	418	n/a	1,417	n/a	
110	3	George Hanosh Blvd/Golf Course	2-48"	CMP	2.3	178	Yes	584	No	Culverts appear in relatively good shape
111	-	Ice Caves Rd/Rodeo Ground Rd	Culvert	n/a	n/a	n/a	n/a	n/a	n/a	

* Corresponding Analysis Point determined based on nearby location relative to drainage structure. Actual flow reaching drainage structure may be higher or lower than flowrate for analysis point depending on existing drainage characteristics.

** Flowrate for drainage structure estimated using weighted percentage of basin contributing to drainage structure location.

TABLE 3-1 cont.



N

0 2,000 4,000

DRAINAGE STRUCTURE INVENTORY KEY MAP

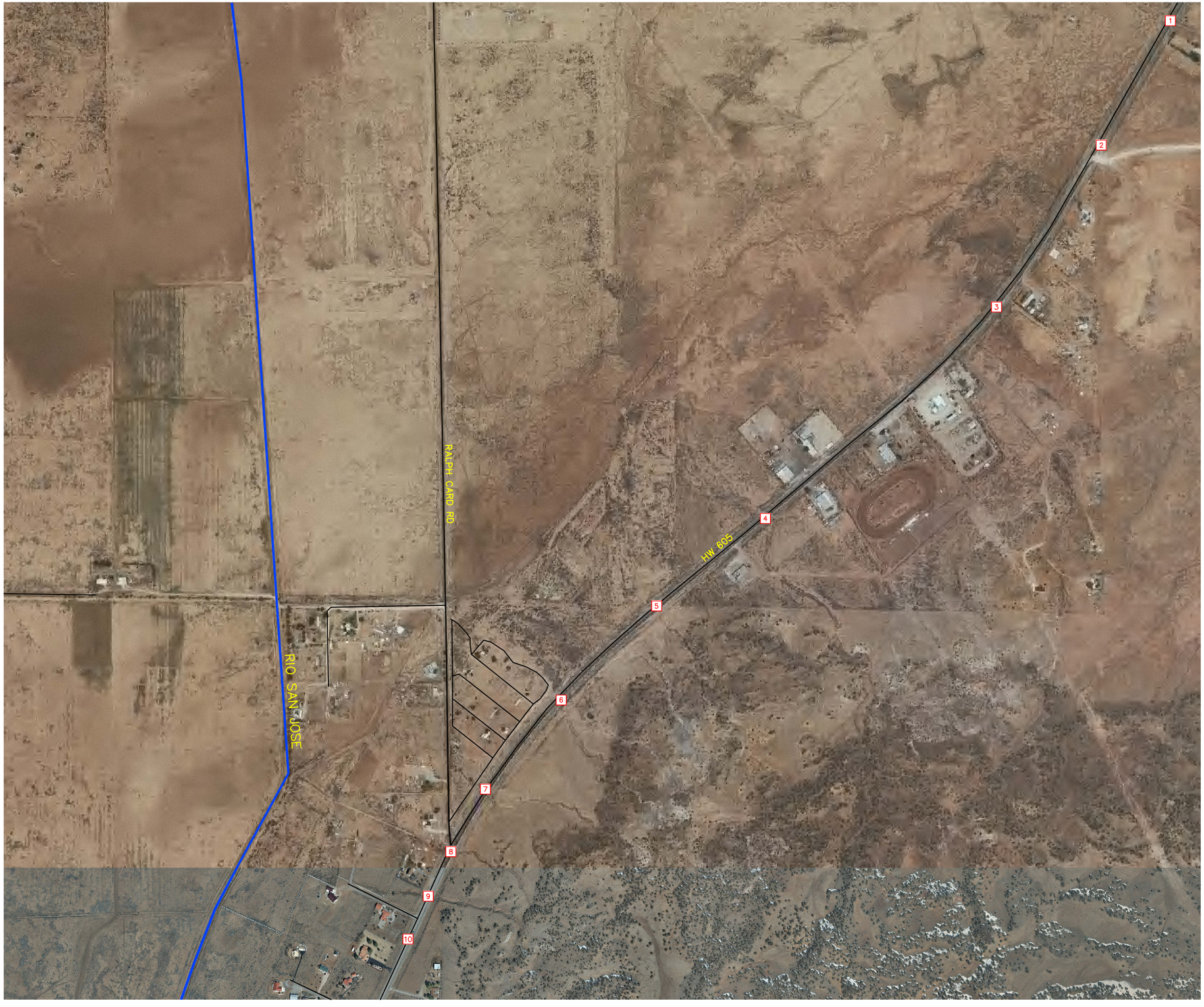
CITY OF GRANTS AND
VILLAGE OF MILAN, NM DMP

09/18/2010

FIGURE 3-1

WILSON & COMPANY

M:\IDS\10-600-033-00\CADD\EXHIBITS\Phase 1 Exhibits\Drainage Structures.dwg, 9/23/2010 8:41:20 AM





0 400 800

LEGEND

- 1 DRAINAGE STRUCTURE ID
- DRAINAGE CHANNEL
- ROADWAYS/STREETS

REFER TO FIGURES 2-7 THRU 2-13 FOR ANALYSIS POINTS AND TABLE 3-1 FOR DETAILED INFORMATION FOR EACH DRAINAGE STRUCTURE IDENTIFIED.

DRAINAGE STRUCTURE INVENTORY MAP 1

CITY OF GRANTS AND
VILLAGE OF MILAN, NM DMP

09/22/2010

FIGURE 3-2

WILSON & COMPANY

M:\DS\10-600\03-00\CAD\EXHIBITS\Phase 1 Exhibits\Drainage Structures.dwg, 9/29/2010 8:54:30 AM



N

0 400 800

LEGEND

- 1 DRAINAGE STRUCTURE ID
- DRAINAGE CHANNEL
- ROADWAYS/STREETS

REFER TO FIGURES 2-7 THRU 2-13 FOR ANALYSIS POINTS AND TABLE 3-1 FOR DETAILED INFORMATION FOR EACH DRAINAGE STRUCTURE IDENTIFIED.

DRAINAGE STRUCTURE INVENTORY MAP 2

CITY OF GRANTS AND
VILLAGE OF MILAN, NM DMP

09/22/2010

FIGURE 3-3

WILSON & COMPANY

M:\DGS\10-600-03-00\CAD\EXHIBITS\Phase 1 Exhibits\Drainage Structures.dwg, 9/29/2010 8:56:25 AM



N

0 400 800

LEGEND

- 1 DRAINAGE STRUCTURE ID
- DRAINAGE CHANNEL
- ROADWAYS/STREETS

REFER TO FIGURES 2-7 THRU 2-13 FOR ANALYSIS POINTS AND TABLE 3-1 FOR DETAILED INFORMATION FOR EACH DRAINAGE STRUCTURE IDENTIFIED.

DRAINAGE STRUCTURE INVENTORY MAP 3

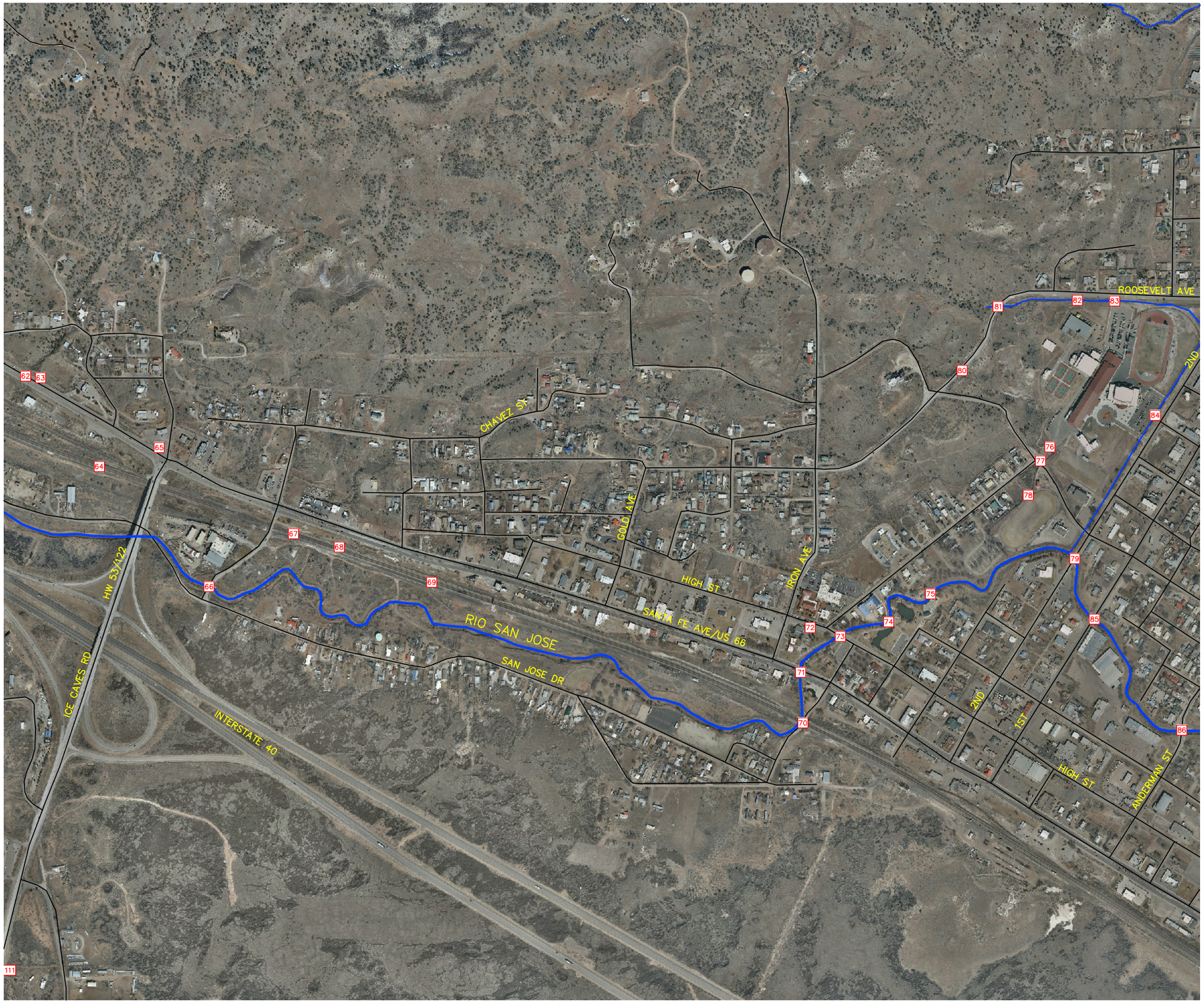
CITY OF GRANTS AND
VILLAGE OF MILAN, NM DMP

09/22/2010

FIGURE 3-4

WILSON & COMPANY

M:\DS\10-600-433-00\CADD\EXHIBITS\Phase 1 Exhibits\Drainage Structures.dwg, 9/29/2010 9:41:59 AM





0 400 800

LEGEND

- [1] DRAINAGE STRUCTURE ID
- DRAINAGE CHANNEL
- ROADWAYS/STREETS

REFER TO FIGURES 2–7 THRU 2–13 FOR ANALYSIS POINTS AND TABLE 3–1 FOR DETAILED INFORMATION FOR EACH DRAINAGE STRUCTURE IDENTIFIED.

DRAINAGE STRUCTURE INVENTORY MAP 4

CITY OF GRANTS AND
VILLAGE OF MILAN, NM DMP

09/22/2010

FIGURE 3-5

WILSON & COMPANY

M:\DSV\10-600-033-04\CAD\EXHIBITS\Phase 1 Exhibits\Drainage Structures.dwg, 9/29/2010 8:58:45 AM



N

0 400 800

LEGEND

- [1] DRAINAGE STRUCTURE ID
- DRAINAGE CHANNEL
- ROADWAYS/STREETS

REFER TO FIGURES 2-7 THRU 2-13 FOR ANALYSIS POINTS AND TABLE 3-1 FOR DETAILED INFORMATION FOR EACH DRAINAGE STRUCTURE IDENTIFIED.

DRAINAGE STRUCTURE INVENTORY MAP 5

CITY OF GRANTS AND
VILLAGE OF MILAN, NM DMP

09/22/2010

FIGURE 3-6

WILSON & COMPANY

M:\DS\10-600\033-000\CADD\EXHIBITS\Phase 1 Exhibits\Drainage Structures.dwg, 9/29/2010 9:46:06 AM





0 400 800

LEGEND

- 1 DRAINAGE STRUCTURE ID
- DRAINAGE CHANNEL
- ROADWAYS/STREETS

REFER TO FIGURES 2-7 THRU 2-13 FOR ANALYSIS POINTS AND TABLE 3-1 FOR DETAILED INFORMATION FOR EACH DRAINAGE STRUCTURE IDENTIFIED.

DRAINAGE STRUCTURE INVENTORY MAP 6

CITY OF GRANTS AND
VILLAGE OF MILAN, NM DMP

09/22/2010

FIGURE 3-7

WILSON & COMPANY

M:\DS\10-600\03-01\CAD\EXHIBITS\Phase 1 Exhibits\Drainage Structures.dwg, 9/29/2010 9:01:22 AM



N

0 400 800

LEGEND

1 DRAINAGE STRUCTURE ID

DRAINAGE CHANNEL

ROADWAYS/STREETS

REFER TO FIGURES 2-7 THRU 2-13 FOR ANALYSIS POINTS AND TABLE 3-1 FOR DETAILED INFORMATION FOR EACH DRAINAGE STRUCTURE IDENTIFIED.

DRAINAGE STRUCTURE INVENTORY MAP 7

CITY OF GRANTS AND
VILLAGE OF MILAN, NM DMP

09/22/2010

FIGURE 3-8

WILSON & COMPANY

M:\DS\10-600-03-01\CAD\EXHIBITS\Phase 1 Exhibits\Drainage Structures.dwg, 9/29/2010 9:02:32 AM



LEGEND

- 1 DRAINAGE STRUCTURE ID
- HEC–RAS CROSS SECTIONS
- HEC–RAS FLOWRATE
- GENERAL OVERFLOW LOCATION
- DRAINAGE CHANNEL
- 2' CONTOURS

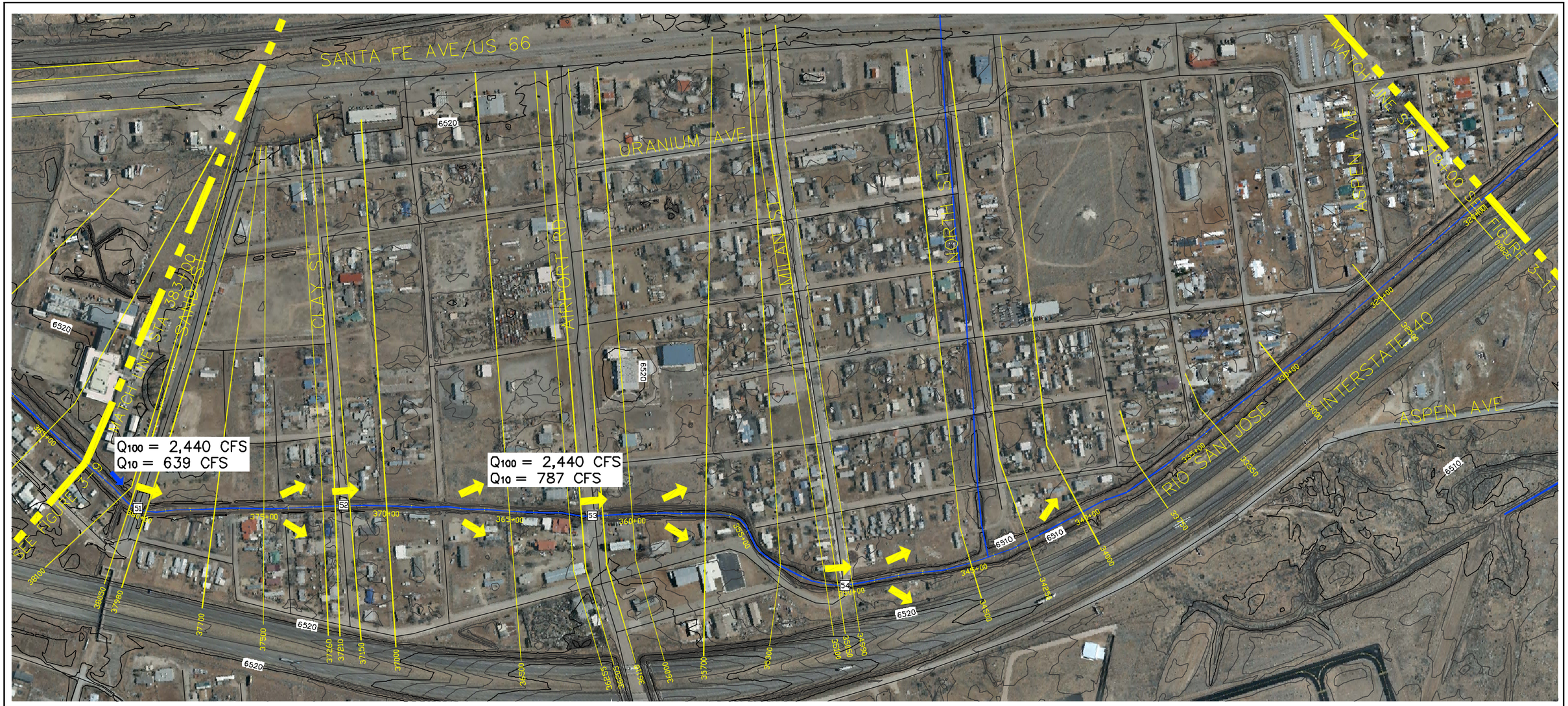
0 200 400

HEC-RAS SECTIONS
RIO SAN JOSE
STA 435+00 TO 383+00
CITY OF GRANTS AND VILLAGE OF MILAN, NM DMP

09/22/2010

FIGURE 3-9

WILSON & COMPANY



LEGEND

- 1 DRAINAGE STRUCTURE ID
- HEC–RAS CROSS SECTIONS
- HEC–RAS FLOWRATE
- GENERAL OVERFLOW LOCATION
- DRAINAGE CHANNEL
- 2' CONTOURS

0 200 400

HEC-RAS SECTIONS
RIO SAN JOSE
STA 383+00 TO 319+00

CITY OF GRANTS AND
VILLAGE OF MILAN, NM DMP
09/22/2010

FIGURE 3-10

WILSON & COMPANY



LEGEND

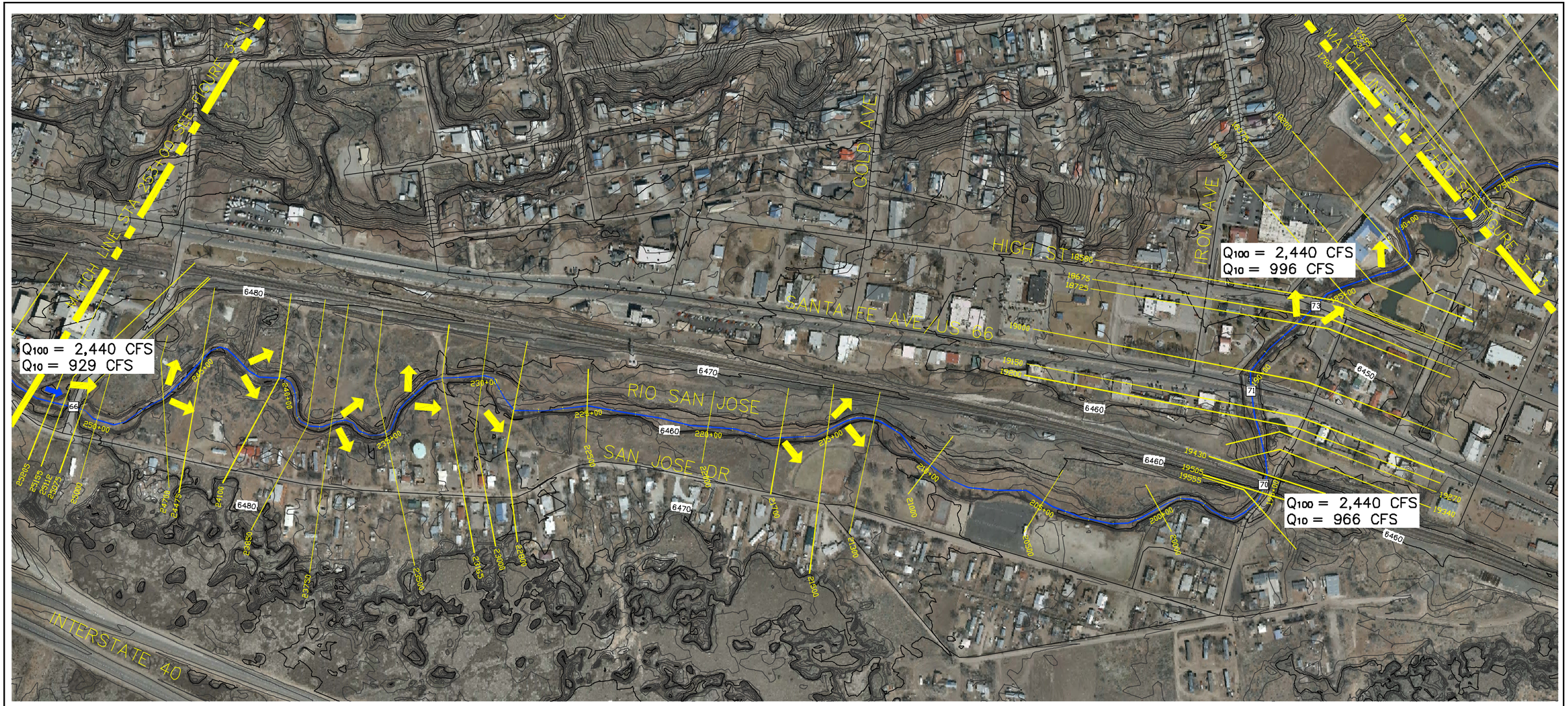
- 1 DRAINAGE STRUCTURE ID
- HEC–RAS CROSS SECTIONS
- HEC–RAS FLOWRATE
- GENERAL OVERFLOW LOCATION
- DRAINAGE CHANNEL
- 2' CONTOURS

0 200 400

HEC-RAS SECTIONS
RIO SAN JOSE
STA 319+00 TO 253+00
CITY OF GRANTS AND
VILLAGE OF MILAN, NM DMP
09/22/2010

FIGURE 3-11

WILSON & COMPANY



LEGEND

- 1 DRAINAGE STRUCTURE ID
- HEC–RAS CROSS SECTIONS
- HEC–RAS FLOWRATE
- GENERAL OVERFLOW LOCATION
- DRAINAGE CHANNEL
- 2' CONTOURS

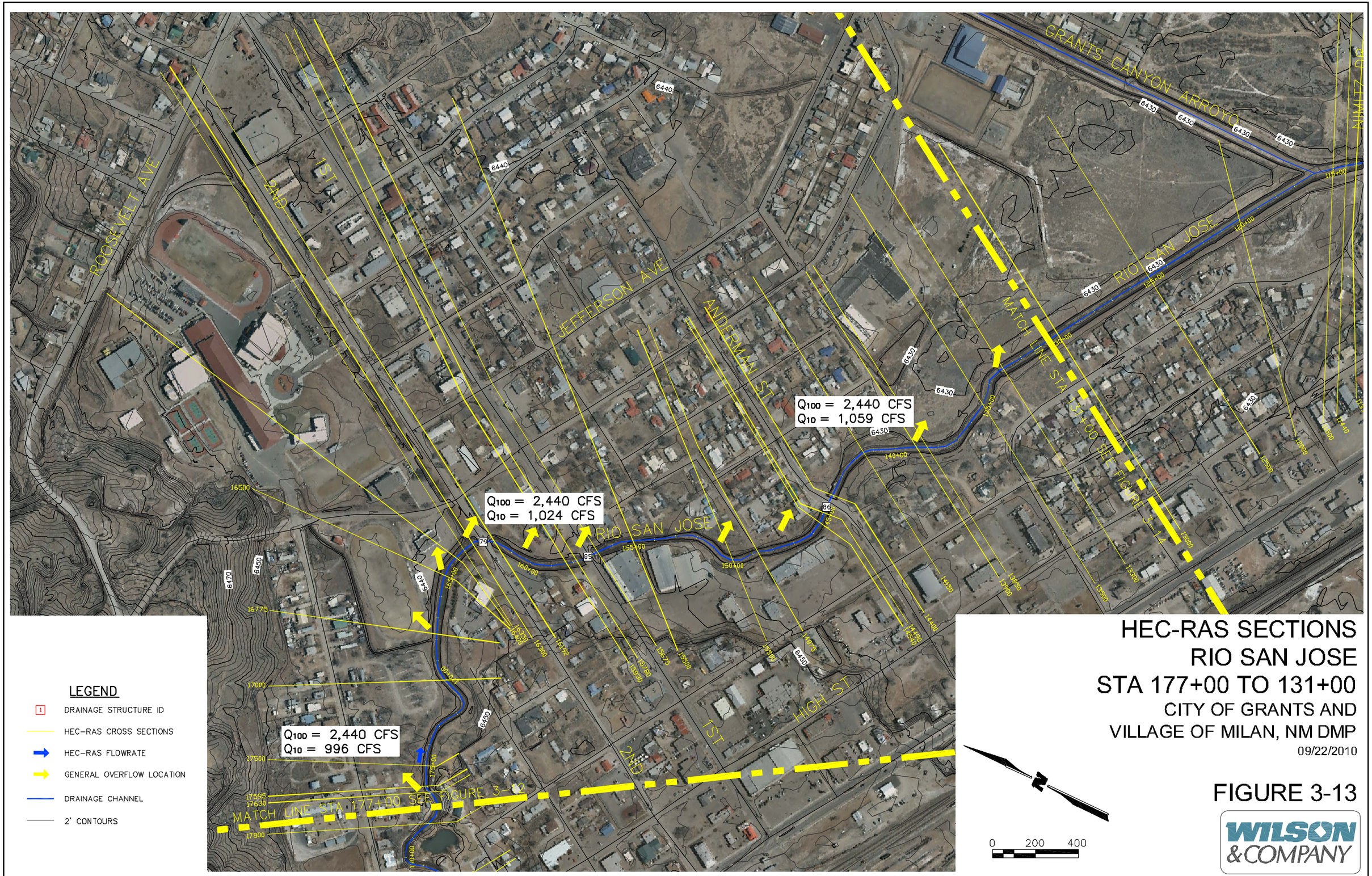
0 200 400

HEC-RAS SECTIONS
RIO SAN JOSE
STA 253+00 TO 177+00

CITY OF GRANTS AND
VILLAGE OF MILAN, NM DMP
09/22/2010

FIGURE 3-12

WILSON & COMPANY



HEC-RAS SECTIONS
RIO SAN JOSE
STA 177+00 TO 131+00
CITY OF GRANTS AND
VILLAGE OF MILAN, NM DMP
09/22/2010

FIGURE 3-13

WILSON & COMPANY



LEGEND

- 1 DRAINAGE STRUCTURE ID
- HEC–RAS CROSS SECTIONS
- HEC–RAS FLOWRATE
- GENERAL OVERFLOW LOCATION
- DRAINAGE CHANNEL
- 2' CONTOURS

0 200 400

HEC-RAS SECTIONS
RIO SAN JOSE
STA 131+00 TO 74+54

CITY OF GRANTS AND
VILLAGE OF MILAN, NM DMP
09/22/2010

FIGURE 3-14

WILSON & COMPANY



LEGEND

- 1 DRAINAGE STRUCTURE ID
- HEC–RAS CROSS SECTIONS
- HEC–RAS FLOWRATE
- GENERAL OVERFLOW LOCATION
- DRAINAGE CHANNEL
- 2' CONTOURS

0 200 400

HEC-RAS SECTIONS
RIO SAN JOSE
STA 74+54 TO 10+00

CITY OF GRANTS AND
VILLAGE OF MILAN, NM DMP
09/22/2010

FIGURE 3-15

WILSON & COMPANY

Profile Summary Table

HEC-RAS Plan: GRSJ River: Rio San Jose Reach: grants - milan

Reach	River Sta	Profile	Q Total	Q Left	Q Channel	Q Right	Min Ch El	W.S. Elev	Crit W.S.	Max Chl Dpth	E.G. Slope	Vel Left	Vel Chnl	Vel Right	Flow Area	Top Width	Froude # Chl
			(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(ft/s)	(sq ft)	(ft)	
grants - milan	2500.	100-YR	4470.00	4.72	1443.30	3021.98	6406.80	6413.64	6411.79	6.84	0.001502	0.60	4.29	2.29	1666.02	2182.45	0.33
grants - milan	2500.	100 YR (FEMA)	2440.00		953.29	1486.71	6406.80	6412.40	6411.19	5.60	0.001501		3.69	1.79	1090.95	1813.54	0.32
grants - milan	2500.	10-YR	1484.00		722.41	761.59	6406.80	6411.64	6410.00	4.83	0.001501		3.39	1.38	763.80	1111.35	0.31
grants - milan	3000.	100-YR	4470.00	0.26	754.89	3714.85	6407.88	6414.18	6411.48	6.30	0.000468	0.14	2.37	1.39	2984.02	1763.80	0.18
grants - milan	3000.	100 YR (FEMA)	2440.00		504.48	1935.52	6407.88	6412.91	6411.04	5.03	0.000469		2.06	1.10	2007.29	1428.85	0.17
grants - milan	3000.	10-YR	1484.00		385.32	1098.68	6407.88	6412.14	6410.73	4.26	0.000483		1.90	0.89	1441.88	1195.66	0.17
grants - milan	3500.	100-YR	4470.00		945.03	3524.97	6408.40	6414.45	6411.72	6.05	0.000734		2.89	1.81	2269.75	1658.08	0.23
grants - milan	3500.	100 YR (FEMA)	2440.00		584.64	1855.36	6408.40	6413.18	6411.08	4.78	0.000651		2.37	1.39	1581.38	1454.41	0.21
grants - milan	3500.	10-YR	1484.00		411.29	1072.71	6408.40	6412.41	6410.78	4.01	0.000593		2.04	1.10	1180.92	1119.56	0.19
grants - milan	4000.	100-YR	4470.00		1557.14	2912.86	6408.40	6414.99	6413.69	6.59	0.002274		5.02	2.50	1473.22	1348.69	0.40
grants - milan	4000.	100 YR (FEMA)	2440.00		1159.25	1280.75	6408.40	6413.68	6413.09	5.28	0.002930		4.99	2.02	866.32	1217.28	0.44
grants - milan	4000.	10-YR	1484.00		1006.43	477.57	6408.40	6412.85	6412.64	4.45	0.004159		5.40	1.53	499.43	1109.00	0.51
grants - milan	4250	100-YR	4470.00		3112.17	1357.83	6408.40	6415.57	6413.99	7.17	0.005820		8.88	3.73	715.01	1528.00	0.64
grants - milan	4250	100 YR (FEMA)	2440.00		1897.36	542.64	6408.40	6414.48	6412.52	6.08	0.004010		6.62	2.47	506.34	1270.07	0.52
grants - milan	4250	10-YR	1484.00		1170.12	313.88	6408.40	6413.77	6411.49	5.37	0.002369		4.74	2.07	398.20	1083.39	0.39
grants - milan	4500.	100-YR	4470.00		4470.00	0.00	6408.64	6416.57	6416.15	7.93	0.011453		12.29	0.13	363.74	1345.69	0.90
grants - milan	4500.	100 YR (FEMA)	2440.00		2440.00		6408.64	6415.35	6413.94	6.71	0.006424		8.41		290.14	1258.13	0.66
grants - milan	4500.	10-YR	1484.00		1484.00		6408.64	6414.32	6412.56	5.68	0.004392		6.37		233.08	854.59	0.54
grants - milan	4540	100-YR	4470.00	0.57	4469.43		6408.80	6418.21	6415.55	9.41	0.004840	0.44	8.48		528.15	399.82	0.60
grants - milan	4540	100 YR (FEMA)	2440.00		2440.00		6408.80	6415.97	6413.61	7.17	0.003539		6.76		361.12	101.96	0.50
grants - milan	4540	10-YR	1484.00		1484.00		6408.80	6414.68	6412.44	5.88	0.002701		5.27		281.83	59.43	0.43
grants - milan	4566 Santa Fe RR-Mb		Bridge														
grants - milan	4605	100-YR	4470.00		4470.00		6409.10	6420.08	6417.13	10.98	0.002965		7.88		567.39	650.00	0.49
grants - milan	4605	100 YR (FEMA)	2440.00		2440.00		6409.10	6415.95	6415.12	6.85	0.008830		8.88		274.79	636.74	0.77
grants - milan	4605	10-YR	1484.00		1484.00		6409.10	6414.68	6413.73	5.58	0.007836		7.50		197.96	271.47	0.70
grants - milan	4655	100-YR	4541.00	2682.77	1687.09	171.13	6408.98	6421.14	6416.18	12.16	0.000229	1.15	2.57	1.19	3139.95	778.21	0.14
grants - milan	4655	100 YR (FEMA)	2440.00	1015.55	1396.85	27.60	6408.98	6417.32	6413.97	8.34	0.000720	1.32	3.38	0.81	1219.84	595.05	0.23
grants - milan	4655	10-YR	1495.00	261.28	1233.67	0.04	6408.98	6415.59	6412.57	6.61	0.001395	0.98	4.01	0.17	574.67	462.31	0.31
grants - milan	5000.	100-YR	4541.00	2027.40	1758.94	754.66	6409.10	6421.22		12.12	0.000170	0.80	2.86	1.06	3872.80	777.26	0.16
grants - milan	5000.	100 YR (FEMA)	2440.00	680.69	1447.21	312.11	6409.10	6417.54		8.44	0.000505	0.86	3.69	1.32	1418.11	538.86	0.25
grants - milan	5000.	10-YR	1495.00	214.26	1129.91	150.83	6409.10	6415.97		6.87	0.000655	0.68	3.75	1.15	745.57	361.70	0.28
grants - milan	5500.	100-YR	4541.00	2736.57	1443.42	361.01	6409.78	6421.32		11.54	0.000119	0.78	2.34	0.72	4631.94	828.01	0.13
grants - milan	5500.	100 YR (FEMA)	2440.00	1002.71	1267.76	169.53	6409.78	6417.82		8.04	0.000356	0.74	3.15	1.02	1920.41	714.44	0.21
grants - milan	5500.	10-YR	1495.00	331.70	1088.59	74.72	6409.78	6416.31		6.53	0.000537	0.60	3.44	0.88	953.51	563.11	0.26
grants - milan	5950	100-YR	4541.00	2869.77	1372.23	299.00	6410.13	6421.38	6417.15	11.25	0.000126	0.93	2.36	0.68	4121.45	774.61	0.13
grants - milan	5950	100 YR (FEMA)	2440.00	1027.59	1262.82	149.59	6410.13	6417.99	6415.31	7.86	0.000417	0.90	3.33	1.06	1666.38	661.15	0.23
grants - milan	5950	10-YR	1495.00	235.63	1184.19	75.18	6410.13	6416.56	6413.61	6.43	0.000734	0.61	3.96	1.03	761.14	613.38	0.30
grants - milan	6100	100-YR	4541.00	612.58	3228.47	699.95	6410.10	6421.22	6417.05	11.12	0.000688	1.94	5.34	1.59	1359.91	753.38	0.31

HEC-RAS Plan: GRSJ River: Rio San Jose Reach: grants - milan (Continued)

Reach	River Sta	Profile	Q Total	Q Left	Q Channel	Q Right	Min Ch El	W.S. Elev	Crit W.S.	Max Chl Dpth	E.G. Slope	Vel Left	Vel Chnl	Vel Right	Flow Area	Top Width	Froude # Chl
			(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(ft/s)	(sq ft)	(ft)	
grants - milan	6100	100 YR (FEMA)	2440.00	87.27	2076.71	276.03	6410.10	6417.90	6414.72	7.80	0.001016	1.35	5.24	1.69	623.65	626.59	0.36
grants - milan	6100	10-YR	1495.00	14.73	1376.16	104.11	6410.10	6416.63	6413.42	6.53	0.000818	0.94	4.27	1.12	431.49	381.22	0.32
grants - milan	6500.	100-YR	4541.00	1731.28	2357.01	452.71	6410.20	6421.64	6417.63	11.44	0.000310	0.87	3.60	1.03	3077.12	790.67	0.21
grants - milan	6500.	100 YR (FEMA)	2440.00	231.55	1989.63	218.81	6410.20	6418.36	6414.88	8.16	0.000784	0.68	4.65	1.32	931.72	430.41	0.32
grants - milan	6500.	10-YR	1495.00	27.97	1410.90	56.13	6410.20	6416.96	6413.68	6.76	0.000773	0.39	4.16	0.79	481.31	256.50	0.31
grants - milan	7000.	100-YR	4541.00	2017.14	2394.17	129.68	6410.63	6421.77	6417.58	11.14	0.000402	1.23	3.92	1.10	2366.98	800.59	0.24
grants - milan	7000.	100 YR (FEMA)	2440.00	118.02	2310.37	11.61	6410.63	6418.69	6415.31	8.06	0.001200	0.62	5.70	0.79	611.73	544.78	0.39
grants - milan	7000.	10-YR	1495.00		1494.78	0.22	6410.63	6417.33	6414.11	6.70	0.000961		4.61	0.28	325.03	62.67	0.34
grants - milan	7135	100-YR	4541.00	3603.31	803.97	133.73	6411.46	6421.93	6418.67	10.47	0.000082	0.57	1.38	0.38	7219.37	2094.79	0.10
grants - milan	7135	100 YR (FEMA)	2440.00	1624.43	815.57		6411.46	6419.25	6418.15	7.79	0.000463	0.77	2.58		2418.46	1478.67	0.23
grants - milan	7135	10-YR	1495.00	279.88	1215.12		6411.46	6417.56	6417.56	6.10	0.003634	1.03	6.17		468.71	631.25	0.62
grants - milan	7174 McBride Road		Culvert														
grants - milan	7225	100-YR	4541.00	3639.58	897.90	3.52	6412.87	6421.98	6419.15	9.10	0.000093	0.58	1.55	0.16	6841.76	2180.00	0.11
grants - milan	7225	100 YR (FEMA)	2440.00	1707.22	732.78		6412.87	6420.15	6418.63	7.28	0.000207	0.57	1.83		3397.70	1782.43	0.16
grants - milan	7225	10-YR	1495.00	592.73	902.27		6412.87	6418.78	6417.64	5.91	0.000819	0.64	3.23		1200.34	1355.30	0.30
grants - milan	7275	100-YR	4541.00	3104.56	1436.44		6412.88	6421.98	6419.42	9.10	0.000320	1.07	3.01		3374.17	1591.20	0.21
grants - milan	7275	100 YR (FEMA)	2440.00	1326.75	1113.25		6412.88	6420.17	6418.69	7.29	0.000467	0.88	3.16		1865.07	1386.15	0.24
grants - milan	7275	10-YR	1495.00	437.02	1057.98		6412.88	6418.86	6417.03	5.98	0.000958	0.76	3.94		843.86	1001.89	0.33
grants - milan	7500.	100-YR	3626.00	2189.32	1436.69		6413.00	6422.11	6419.03	9.11	0.000202	0.96	2.57		2834.26	1057.88	0.17
grants - milan	7500.	100 YR (FEMA)	2440.00	1111.66	1328.34		6413.00	6420.33	6417.16	7.33	0.000369	0.88	3.08		1692.06	742.57	0.22
grants - milan	7500.	10-YR	1247.00	308.90	938.10		6413.00	6419.14	6415.69	6.14	0.000341	0.53	2.68		937.38	608.03	0.20
grants - milan	7750	100-YR	3626.00	2199.63	1426.37		6413.00	6422.17	6419.60	9.17	0.000232	0.95	2.70		2838.81	1105.42	0.18
grants - milan	7750	100 YR (FEMA)	2440.00	1035.49	1404.51		6413.00	6420.44	6417.51	7.44	0.000483	0.88	3.46		1582.90	884.67	0.25
grants - milan	7750	10-YR	1247.00	183.53	1063.47		6413.00	6419.21	6415.98	6.21	0.000529	0.48	3.27		711.32	702.59	0.26
grants - milan	8100	100-YR	3626.00	2196.50	1429.50		6413.03	6422.28	6420.25	9.25	0.000298	0.97	3.04		2733.71	1742.98	0.20
grants - milan	8100	100 YR (FEMA)	2440.00	896.73	1543.27		6413.03	6420.63	6417.87	7.60	0.000702	0.88	4.19		1389.46	1653.34	0.30
grants - milan	8100	10-YR	1247.00	63.03	1183.97		6413.03	6419.38	6416.25	6.35	0.000781	0.44	4.01		439.86	603.89	0.31
grants - milan	8475	100-YR	3626.00	2183.44	1442.56		6413.23	6422.39	6420.15	9.16	0.000212	0.81	2.53		3259.09	1696.38	0.17
grants - milan	8475	100 YR (FEMA)	2440.00	986.14	1453.87		6413.23	6420.92	6417.69	7.68	0.000423	0.73	3.22		1806.11	1389.07	0.23
grants - milan	8475	10-YR	1247.00	127.26	1119.74		6413.23	6419.72	6416.17	6.49	0.000482	0.41	3.09		674.06	977.24	0.24
grants - milan	8820	100-YR	3626.00	2175.23	1450.77		6413.98	6422.48	6421.23	8.50	0.000548	0.99	4.18		2534.36	1189.27	0.27
grants - milan	8820	100 YR (FEMA)	2440.00	696.68	1743.32		6413.98	6420.96	6419.65	6.98	0.001585	0.98	6.33		986.61	882.06	0.46
grants - milan	8820	10-YR	1247.00	83.83	1163.17		6413.98	6419.80	6417.50	5.82	0.001331	0.73	5.21		338.79	243.74	0.41
grants - milan	8860 George Hanosh		Culvert														
grants - milan	8910	100-YR	3603.00	2149.05	1453.95		6415.60	6422.50	6421.51	6.90	0.000885	1.21	3.97		2148.74	1152.15	0.33
grants - milan	8910	100 YR (FEMA)	2440.00	759.43	1680.57		6415.60	6421.21	6420.92	5.61	0.002170	1.20	6.14		906.94	823.17	0.51
grants - milan	8910	10-YR	1236.00	242.23	993.77		6415.60	6420.81	6418.68	5.21	0.000988	0.67	3.97		611.82	651.23	0.34

HEC-RAS Plan: GRSJ River: Rio San Jose Reach: grants - milan (Continued)

Reach	River Sta	Profile	Q Total	Q Left	Q Channel	Q Right	Min Ch El	W.S. Elev	Crit W.S.	Max Chl Dpth	E.G. Slope	Vel Left	Vel Chnl	Vel Right	Flow Area	Top Width	Froude # Chl
			(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(ft/s)	(sq ft)	(ft)	
grants - milan	8960	100-YR	3603.00	1466.39	2136.61		6415.30	6422.50	6420.89	7.20	0.000711	1.31	4.20		1625.36	1209.83	0.30
grants - milan	8960	100 YR (FEMA)	2440.00	682.21	1757.79		6415.30	6421.51	6419.22	6.21	0.000828	1.02	4.12		1097.76	845.53	0.32
grants - milan	8960	10-YR	1236.00	218.10	1017.91		6415.30	6420.95	6417.99	5.65	0.000394	0.52	2.67		803.47	633.01	0.22
grants - milan	9350	100-YR	3603.00	1459.48	2143.52		6416.00	6422.78	6421.82	6.78	0.001664	1.93	5.91		1118.48	1084.29	0.45
grants - milan	9350	100 YR (FEMA)	2440.00	684.72	1755.28		6416.00	6421.85	6421.29	5.85	0.001985	1.51	5.84		754.24	718.55	0.48
grants - milan	9350	10-YR	1236.00	156.55	1079.45		6416.00	6421.10	6419.32	5.10	0.001295	0.74	4.29		463.94	510.78	0.38
grants - milan	9500.	100-YR	3603.00	1470.85	2132.15		6416.60	6423.12	6423.12	6.52	0.003108	1.71	8.32		1114.52	1015.67	0.63
grants - milan	9500.	100 YR (FEMA)	2440.00	711.82	1728.18		6416.60	6422.68	6422.68	6.08	0.002640	1.27	7.33		796.72	908.45	0.57
grants - milan	9500.	10-YR	1236.00	2.09	1233.92		6416.60	6420.94	6420.25	4.34	0.004756	0.54	7.83		161.51	103.92	0.73
grants - milan	10000.	100-YR	3603.00	1478.98	2124.03		6417.65	6424.58	6424.54	6.93	0.002219	1.38	7.40		1358.58	1566.29	0.53
grants - milan	10000.	100 YR (FEMA)	2440.00	457.57	1982.43		6417.65	6423.92	6423.91	6.27	0.002780	1.01	7.76		708.86	1299.60	0.59
grants - milan	10000.	10-YR	1236.00	27.46	1208.54		6417.65	6422.89	6421.17	5.24	0.001993	0.71	5.83		245.83	484.31	0.49
grants - milan	10500.	100-YR	3603.00	1484.87	2118.13		6419.20	6426.16	6426.16	6.96	0.002707	1.67	8.33		1145.36	1454.23	0.59
grants - milan	10500.	100 YR (FEMA)	2440.00	631.95	1808.05		6419.20	6425.54	6425.54	6.34	0.002705	1.30	7.90		714.51	1287.81	0.59
grants - milan	10500.	10-YR	1236.00		1236.00		6419.20	6423.93	6422.76	4.73	0.003440		7.48		165.27	492.98	0.64
grants - milan	10750	100-YR	3603.00	1462.30	2140.70		6419.83	6426.98	6426.49	7.15	0.001685	1.56	6.27		1279.61	1439.08	0.46
grants - milan	10750	100 YR (FEMA)	2440.00	707.07	1732.93		6419.83	6426.44	6424.68	6.61	0.001464	1.12	5.59		942.13	1385.64	0.42
grants - milan	10750	10-YR	1236.00	0.89	1235.11		6419.83	6425.00	6423.02	5.16	0.001776	0.15	5.36		236.60	433.78	0.45
grants - milan	11000.	100-YR	3603.00	1469.28	2133.72		6420.49	6428.25	6428.25	7.76	0.002706	1.65	8.72		1136.85	1179.56	0.60
grants - milan	11000.	100 YR (FEMA)	2440.00	600.62	1839.38		6420.49	6427.52	6427.52	7.02	0.002836	1.28	8.44		688.07	816.05	0.60
grants - milan	11000.	10-YR	1236.00		1236.00		6420.49	6425.12	6424.48	4.63	0.005312		9.09		135.98	52.33	0.78
grants - milan	11290	100-YR	3603.00	1462.91	2140.09		6421.25	6429.99	6429.99	8.74	0.002563	1.49	8.93		1221.63	1436.61	0.58
grants - milan	11290	100 YR (FEMA)	2440.00	639.46	1800.55		6421.25	6429.34	6429.34	8.09	0.002392	1.13	8.25		785.00	1196.11	0.56
grants - milan	11290	10-YR	1236.00		1236.00		6421.25	6426.58	6425.82	5.33	0.005017		9.27		133.37	356.64	0.77
grants - milan	11337 Nimitz Drive		Bridge														
grants - milan	11390	100-YR	3570.00	1422.36	2147.64		6421.10	6431.84	6427.93	10.74	0.000608	1.22	4.37		1658.06	1832.55	0.28
grants - milan	11390	100 YR (FEMA)	2440.00	921.92	1518.08		6421.10	6431.66	6426.56	10.56	0.000330	0.85	3.17		1559.49	1826.41	0.21
grants - milan	11390	10-YR	1220.00	145.18	1074.82		6421.10	6430.05	6424.72	8.95	0.000281	0.40	2.80		743.49	1398.68	0.19
grants - milan	11440	100-YR	3570.00	1425.32	2144.68		6421.30	6431.91	6427.58	10.61	0.000415	1.01	3.84		1964.64	1854.65	0.24
grants - milan	11440	100 YR (FEMA)	2440.00	932.53	1507.47		6421.30	6431.70	6426.35	10.40	0.000223	0.73	2.77		1828.82	1826.61	0.17
grants - milan	11440	10-YR	1220.00	187.36	1032.64		6421.30	6430.10	6424.72	8.80	0.000195	0.41	2.36		892.55	1501.50	0.16
grants - milan	11500.	100-YR	3570.00	1426.32	2143.68	0.00	6421.49	6431.94	6427.58	10.45	0.000578	1.37	3.74	0.01	1616.50	1907.25	0.27
grants - milan	11500.	100 YR (FEMA)	2440.00	930.27	1509.73		6421.49	6431.71	6426.40	10.22	0.000297	0.96	2.74		1517.33	1865.94	0.19
grants - milan	11500.	10-YR	1220.00	228.67	991.33		6421.49	6430.12	6424.81	8.63	0.000178	0.48	2.26		913.54	1407.65	0.15
grants - milan	12000.	100-YR	2440.00	1007.24	1432.76		6421.17	6432.24	6426.40	11.07	0.000226	0.98	2.50		1606.50	1397.11	0.15
grants - milan	12000.	100 YR (FEMA)	2440.00	933.55	1506.45		6421.17	6431.87	6426.40	10.70	0.000288	1.02	2.75		1464.47	1381.58	0.17
grants - milan	12000.	10-YR	1059.00	235.89	823.11		6421.17	6430.24	6424.37	9.07	0.000168	0.55	1.87		870.55	1216.21	0.13
grants - milan	12500.	100-YR	2440.00	1515.64	924.36		6421.58	6432.37	6426.80	10.79	0.000129	0.62	1.82		2963.27	1991.00	0.11

HEC-RAS Plan: GRSJ River: Rio San Jose Reach: grants - milan (Continued)

Reach	River Sta	Profile	Q Total	Q Left	Q Channel	Q Right	Min Ch El	W.S. Elev	Crit W.S.	Max Chl Dpth	E.G. Slope	Vel Left	Vel Chnl	Vel Right	Flow Area	Top Width	Froude # Chl
			(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(ft/s)	(sq ft)	(ft)	
grants - milan	12500.	100 YR (FEMA)	2440.00	1416.30	1023.70		6421.58	6432.04	6426.80	10.46	0.000181	0.67	2.10		2614.04	1991.00	0.13
grants - milan	12500.	10-YR	1059.00	268.80	790.20		6421.58	6430.33	6424.71	8.75	0.000199	0.40	2.04		1055.84	1571.69	0.14
grants - milan	13000.	100-YR	2440.00	1167.11	1272.89		6421.75	6432.43	6426.47	10.68	0.000183	0.81	2.23		2015.36	1957.12	0.13
grants - milan	13000.	100 YR (FEMA)	2440.00	1084.66	1355.34		6421.75	6432.12	6426.47	10.37	0.000231	0.84	2.46		1838.32	1888.74	0.15
grants - milan	13000.	10-YR	1059.00	266.81	792.19		6421.75	6430.42	6424.60	8.67	0.000148	0.47	1.79		1005.36	819.73	0.12
grants - milan	13300	100-YR	2440.00	1123.44	1316.56		6421.90	6432.49	6427.35	10.59	0.000269	1.19	2.55		1461.70	1553.41	0.16
grants - milan	13300	100 YR (FEMA)	2440.00	1078.19	1361.81		6421.90	6432.20	6427.35	10.30	0.000321	1.24	2.74		1369.98	1501.40	0.18
grants - milan	13300	10-YR	1059.00	293.95	765.05		6421.90	6430.47	6425.28	8.57	0.000206	0.65	1.98		838.69	417.07	0.14
grants - milan	13500.	100-YR	2440.00	1125.16	1293.29	21.54	6422.43	6432.59	6427.56	10.16	0.000450	1.21	1.78	0.26	1743.03	1180.52	0.14
grants - milan	13500.	100 YR (FEMA)	2440.00	1081.36	1349.93	8.70	6422.43	6432.31	6427.56	9.88	0.000594	1.29	1.97	0.20	1568.34	1017.08	0.16
grants - milan	13500.	10-YR	1059.00	147.21	911.79		6422.43	6430.53	6425.63	8.10	0.000759	0.66	2.07		664.27	424.30	0.18
grants - milan	13850	100-YR	2440.00	368.87	2066.51	4.62	6422.45	6432.72	6427.66	10.27	0.001138	1.17	3.66	0.57	887.33	601.18	0.24
grants - milan	13850	100 YR (FEMA)	2440.00	276.29	2160.96	2.75	6422.45	6432.49	6427.66	10.04	0.001382	1.11	3.95	0.54	800.89	572.10	0.26
grants - milan	13850	10-YR	1059.00		1059.00		6422.45	6430.76	6425.67	8.31	0.000730		2.54		417.63	191.98	0.18
grants - milan	13900	100-YR	2440.00	747.63	1692.37		6422.59	6432.86	6427.79	10.27	0.001010	1.36	2.95		1125.93	824.82	0.22
grants - milan	13900	100 YR (FEMA)	2440.00	669.12	1770.88		6422.59	6432.66	6427.79	10.07	0.001230	1.40	3.19		1030.77	722.52	0.24
grants - milan	13900	10-YR	1059.00		1059.00		6422.59	6430.80	6425.82	8.21	0.000829		2.68		395.33	67.45	0.19
grants - milan	14150	100-YR	2440.00	55.74	2384.26		6422.81	6433.07	6428.99	10.26	0.001483	0.83	3.82		690.88	323.38	0.27
grants - milan	14150	100 YR (FEMA)	2440.00	44.80	2395.20		6422.81	6432.93	6428.99	10.12	0.001611	0.83	3.93		663.92	296.10	0.28
grants - milan	14150	10-YR	1059.00		1059.00		6422.81	6431.04	6427.55	8.22	0.000950		2.48		427.75	140.23	0.20
grants - milan	14400	100-YR	2440.00	6.55	2430.07	3.38	6423.30	6433.36		10.06	0.003350	0.55	6.11	0.44	417.21	157.47	0.39
grants - milan	14400	100 YR (FEMA)	2440.00	4.18	2434.77	1.06	6423.30	6433.25		9.95	0.003506	0.59	6.22	0.34	401.87	113.35	0.40
grants - milan	14400	10-YR	1024.00		1024.00		6423.30	6431.25		7.95	0.001388		3.49		293.37	46.73	0.25
grants - milan	14440 Anderman Street		Culvert														
grants - milan	14490	100-YR	2440.00	419.55	1999.85	20.60	6426.00	6434.68	6432.09	8.68	0.005380	0.83	5.83	0.61	884.21	1015.78	0.48
grants - milan	14490	100 YR (FEMA)	2440.00	394.61	2028.64	16.75	6426.00	6434.65	6432.11	8.65	0.005681	0.82	5.96	0.60	848.27	993.86	0.49
grants - milan	14490	10-YR	1024.00	0.50	1023.50		6426.00	6432.90	6429.69	6.90	0.002660	0.25	4.26		242.20	59.79	0.34
grants - milan	14540	100-YR	2440.00	576.65	1859.76	3.59	6425.96	6434.96		9.00	0.003496	0.81	5.43	0.39	1064.09	936.32	0.40
grants - milan	14540	100 YR (FEMA)	2440.00	577.99	1858.36	3.65	6425.96	6434.96		9.00	0.003487	0.81	5.42	0.39	1065.92	937.15	0.40
grants - milan	14540	10-YR	1024.00	0.34	1023.66		6425.96	6433.03		7.07	0.002857	0.24	4.32		238.62	58.62	0.35
grants - milan	14875	100-YR	2440.00	561.27	1824.12	54.61	6426.67	6435.92		9.25	0.002218	0.73	5.09	1.63	1159.66	871.89	0.35
grants - milan	14875	100 YR (FEMA)	2440.00	561.01	1824.42	54.57	6426.67	6435.92		9.25	0.002219	0.73	5.10	1.63	1159.25	871.81	0.35
grants - milan	14875	10-YR	1024.00	0.00	1024.00		6426.67	6433.84		7.17	0.001909	0.05	4.11		249.02	52.22	0.32
grants - milan	15000	100-YR	2440.00	321.74	1884.73	233.53	6426.69	6436.22		9.53	0.001634	0.47	4.37	1.92	1236.19	1147.05	0.31
grants - milan	15000	100 YR (FEMA)	2440.00	321.47	1885.05	233.48	6426.69	6436.22		9.53	0.001635	0.47	4.37	1.92	1235.63	1147.00	0.31
grants - milan	15000	10-YR	1024.00		1013.21	10.79	6426.69	6434.12		7.42	0.001026		3.26	0.81	323.86	77.57	0.24
grants - milan	15500	100-YR	2440.00	700.09	1739.91		6429.50	6438.24	6438.24	8.74	0.005798	0.88	7.14		1038.00	1241.09	0.55
grants - milan	15500	100 YR (FEMA)	2440.00	700.09	1739.91		6429.50	6438.24	6438.24	8.74	0.005798	0.88	7.14		1038.00	1241.09	0.55

HEC-RAS Plan: GRSJ River: Rio San Jose Reach: grants - milan (Continued)

Reach	River Sta	Profile	Q Total	Q Left	Q Channel	Q Right	Min Ch El	W.S. Elev	Crit W.S.	Max Chl Dpth	E.G. Slope	Vel Left	Vel Chnl	Vel Right	Flow Area	Top Width	Froude # Chl
			(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(ft/s)	(sq ft)	(ft)	
grants - milan	15500	10-YR	1024.00		1024.00		6429.50	6434.70	6434.70	5.20	0.022306		10.08		101.56	32.74	1.01
grants - milan	15675	100-YR	2440.00	1336.00	1104.00		6431.15	6439.43		8.28	0.001191	0.61	3.53		2491.68	1822.95	0.26
grants - milan	15675	100 YR (FEMA)	2440.00	1336.00	1104.00		6431.15	6439.43		8.28	0.001191	0.61	3.53		2491.68	1822.95	0.26
grants - milan	15675	10-YR	1024.00	1.15	1022.85		6431.15	6437.22		6.07	0.003323	0.18	5.00		210.91	117.03	0.41
grants - milan	15725 1st Street		Culvert														
grants - milan	15780	100-YR	2440.00	1812.90	627.10		6433.10	6439.51	6438.00	6.40	0.000696	0.62	2.39		3186.02	1990.38	0.19
grants - milan	15780	100 YR (FEMA)	2440.00	1812.90	627.10		6433.10	6439.51	6438.00	6.40	0.000696	0.62	2.39		3186.02	1990.38	0.19
grants - milan	15780	10-YR	1024.00	251.19	772.81		6433.10	6437.43	6436.90	4.33	0.004464	0.87	4.89		446.52	574.68	0.46
grants - milan	15830	100-YR	2440.00	1650.51	789.49		6433.12	6439.55		6.43	0.000935	0.63	2.84		2896.10	2099.71	0.22
grants - milan	15830	100 YR (FEMA)	2440.00	1650.51	789.49		6433.12	6439.55		6.43	0.000935	0.63	2.84		2896.10	2099.71	0.22
grants - milan	15830	10-YR	1024.00	44.28	979.72		6433.12	6437.57	6436.17	4.45	0.005463	0.51	5.60		261.65	430.70	0.52
grants - milan	16192	100-YR	2440.00	1426.83	1013.17		6432.76	6439.83		7.07	0.000901	0.62	2.65		2696.40	2068.27	0.22
grants - milan	16192	100 YR (FEMA)	2440.00	1426.83	1013.17		6432.76	6439.83		7.07	0.000901	0.62	2.65		2696.40	2068.27	0.22
grants - milan	16192	10-YR	1024.00	252.48	771.52		6432.76	6438.66		5.90	0.000975	0.41	2.63		913.54	1089.66	0.23
grants - milan	16245 2nd Street		Culvert														
grants - milan	16300	100-YR	2440.00	1229.76	1210.24		6434.40	6440.05	6440.05	5.65	0.005757	1.20	6.28		1219.36	1783.17	0.54
grants - milan	16300	100 YR (FEMA)	2440.00	1229.76	1210.24		6434.40	6440.05	6440.05	5.65	0.005757	1.20	6.28		1219.36	1783.17	0.54
grants - milan	16300	10-YR	1002.00	2.49	999.51		6434.40	6438.75	6437.85	4.35	0.009927	0.43	7.25		143.60	112.36	0.69
grants - milan	16350	100-YR	2440.00	992.07	1447.93		6434.42	6440.35		5.93	0.004461	1.53	5.92		891.18	1442.70	0.48
grants - milan	16350	100 YR (FEMA)	2440.00	992.07	1447.93		6434.42	6440.35		5.93	0.004461	1.53	5.92		891.18	1442.70	0.48
grants - milan	16350	10-YR	1002.00	183.74	818.26		6434.42	6439.64		5.22	0.002155	1.26	3.91		355.46	252.49	0.33
grants - milan	16400	100-YR	2440.00	439.63	2000.38		6434.42	6440.42	6440.01	6.00	0.009445	2.85	8.66		385.33	206.24	0.70
grants - milan	16400	100 YR (FEMA)	2440.00	439.63	2000.38		6434.42	6440.42	6440.01	6.00	0.009445	2.85	8.66		385.33	206.24	0.70
grants - milan	16400	10-YR	1002.00	94.83	907.17		6434.42	6439.74	6437.63	5.32	0.003004	1.30	4.57		271.37	148.36	0.39
grants - milan	16500.	100-YR	2440.00	800.07	1636.91	3.02	6434.35	6441.81		7.46	0.003071	1.74	4.54	0.35	830.65	566.25	0.37
grants - milan	16500.	100 YR (FEMA)	2440.00	800.07	1636.91	3.02	6434.35	6441.81		7.46	0.003071	1.74	4.54	0.35	830.65	566.25	0.37
grants - milan	16500.	10-YR	1002.00	47.89	954.11		6434.35	6440.10		5.75	0.002302	0.87	3.77		307.96	155.68	0.31
grants - milan	16775	100-YR	2440.00	587.33	1794.64	58.03	6434.20	6442.62		8.42	0.003185	1.26	5.95	1.05	823.30	711.72	0.39
grants - milan	16775	100 YR (FEMA)	2440.00	587.33	1794.64	58.03	6434.20	6442.62		8.42	0.003185	1.26	5.95	1.05	823.30	711.72	0.39
grants - milan	16775	10-YR	1002.00	24.54	975.47	2.00	6434.20	6440.73		6.53	0.002563	1.39	4.36	0.45	245.63	71.73	0.33
grants - milan	17000.	100-YR	2440.00	169.28	2163.60	107.12	6434.20	6443.37		9.17	0.003061	0.88	5.81	1.90	621.60	503.78	0.39
grants - milan	17000.	100 YR (FEMA)	2440.00	169.28	2163.60	107.12	6434.20	6443.37		9.17	0.003061	0.88	5.81	1.90	621.60	503.78	0.39
grants - milan	17000.	10-YR	996.00		996.00		6434.20	6441.31		7.11	0.001984		3.77		263.92	51.60	0.29
grants - milan	17500	100-YR	2440.00	286.08	2135.75	18.16	6435.40	6445.12		9.72	0.005258	1.02	7.36	1.16	585.17	597.87	0.50
grants - milan	17500	100 YR (FEMA)	2440.00	286.08	2135.75	18.16	6435.40	6445.12		9.72	0.005258	1.02	7.36	1.16	585.17	597.87	0.50
grants - milan	17500	10-YR	996.00	13.57	982.43		6435.40	6442.60		7.20	0.004567	1.05	5.35		196.61	58.35	0.44
grants - milan	17595	100-YR	2440.00	903.52	1536.48		6435.40	6446.02		10.62	0.003900	1.56	5.73		845.96	617.82	0.41

HEC-RAS Plan: GRSJ River: Rio San Jose Reach: grants - milan (Continued)

Reach	River Sta	Profile	Q Total	Q Left	Q Channel	Q Right	Min Ch El	W.S. Elev	Crit W.S.	Max Chl Dpth	E.G. Slope	Vel Left	Vel Chnl	Vel Right	Flow Area	Top Width	Froude # Chl
			(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(ft/s)	(sq ft)	(ft)	
grants - milan	17595	100 YR (FEMA)	2440.00	903.52	1536.48		6435.40	6446.02		10.62	0.003900	1.56	5.73		845.96	617.82	0.41
grants - milan	17595	10-YR	996.00	50.50	945.50		6435.40	6443.01		7.61	0.005552	1.81	6.03		184.73	58.07	0.46
grants - milan	17630	100-YR	2440.00	664.94	1775.06		6439.04	6446.10		7.06	0.007641	1.95	6.40		617.91	478.42	0.56
grants - milan	17630	100 YR (FEMA)	2440.00	664.94	1775.06		6439.04	6446.10		7.06	0.007641	1.95	6.40		617.91	478.42	0.56
grants - milan	17630	10-YR	996.00		996.00		6439.04	6443.66	6443.66	4.62	0.029378		8.29		120.14	56.41	1.00
grants - milan	17800	100-YR	2440.00	924.64	1515.36		6441.45	6447.19	6446.60	5.74	0.003408	1.95	4.52		808.67	662.83	0.39
grants - milan	17800	100 YR (FEMA)	2440.00	924.64	1515.36		6441.45	6447.19	6446.60	5.74	0.003408	1.95	4.52		808.67	662.83	0.39
grants - milan	17800	10-YR	996.00	27.73	968.27		6441.45	6445.98	6444.15	4.53	0.003840	1.00	4.00		270.05	154.94	0.39
grants - milan	18200	100-YR	2440.00	1462.26	960.49	17.25	6441.77	6448.47		6.70	0.003913	2.07	4.58	0.75	938.96	735.10	0.36
grants - milan	18200	100 YR (FEMA)	2440.00	1462.26	960.49	17.25	6441.77	6448.47		6.70	0.003913	2.07	4.58	0.75	938.96	735.10	0.36
grants - milan	18200	10-YR	996.00	375.27	620.73		6441.77	6447.41		5.64	0.003330	1.62	3.73		398.85	315.23	0.32
grants - milan	18375	100-YR	2440.00	1394.51	944.44	101.05	6441.77	6449.02		7.25	0.002175	1.80	4.29	1.11	1085.86	822.45	0.32
grants - milan	18375	100 YR (FEMA)	2440.00	1394.51	944.44	101.05	6441.77	6449.02		7.25	0.002175	1.80	4.29	1.11	1085.86	822.45	0.32
grants - milan	18375	10-YR	996.00	396.08	599.92		6441.77	6447.88		6.10	0.001801	1.38	3.41		462.20	419.37	0.28
grants - milan	18500.	100-YR	2440.00	512.33	1757.83	169.84	6441.77	6449.13		7.36	0.008756	2.48	8.18	2.05	504.18	752.21	0.62
grants - milan	18500.	100 YR (FEMA)	2440.00	512.33	1757.83	169.84	6441.77	6449.13		7.36	0.008756	2.48	8.18	2.05	504.18	752.21	0.62
grants - milan	18500.	10-YR	996.00	31.92	962.65	1.43	6441.77	6448.02		6.25	0.005715	0.92	5.66	0.64	207.22	324.22	0.48
grants - milan	18580	100-YR	2440.00	482.73	1582.27	375.00	6442.40	6450.10		7.70	0.001085	1.03	3.05	1.19	1303.78	1036.43	0.23
grants - milan	18580	100 YR (FEMA)	2440.00	482.73	1582.27	375.00	6442.40	6450.10		7.70	0.001085	1.03	3.05	1.19	1303.78	1036.43	0.23
grants - milan	18580	10-YR	996.00	34.59	928.10	33.31	6442.40	6448.62		6.22	0.001025	0.49	2.42	0.75	497.78	462.57	0.21
grants - milan	18634 High Street		Culvert														
grants - milan	18675	100-YR	2440.00	149.97	1173.39	1116.64	6443.09	6450.17	6448.77	7.08	0.001194	0.50	2.56	1.07	1796.54	1038.83	0.23
grants - milan	18675	100 YR (FEMA)	2440.00	149.97	1173.39	1116.64	6443.09	6450.17	6448.77	7.08	0.001194	0.50	2.56	1.07	1796.54	1038.83	0.23
grants - milan	18675	10-YR	984.00	17.50	665.07	301.43	6443.09	6449.10	6446.24	6.01	0.001050	0.37	1.98	0.62	870.13	718.86	0.20
grants - milan	18725	100-YR	2440.00	122.92	2309.92	7.16	6442.75	6449.55	6448.61	6.80	0.009930	1.50	8.74	1.10	352.78	762.70	0.67
grants - milan	18725	100 YR (FEMA)	2440.00	122.92	2309.92	7.16	6442.75	6449.55	6448.61	6.80	0.009930	1.50	8.74	1.10	352.78	762.70	0.67
grants - milan	18725	10-YR	984.00	18.37	965.35	0.28	6442.75	6449.04	6446.14	6.28	0.002430	0.53	4.04	0.29	274.71	589.95	0.32
grants - milan	19000.	100-YR	2440.00	0.36	2430.83	8.81	6443.64	6451.65	6448.19	8.01	0.002605	0.25	4.77	0.40	532.93	632.96	0.35
grants - milan	19000.	100 YR (FEMA)	2440.00	0.36	2430.83	8.81	6443.64	6451.65	6448.19	8.01	0.002605	0.25	4.77	0.40	532.93	632.96	0.35
grants - milan	19000.	10-YR	984.00		984.00		6443.64	6449.65	6446.29	6.01	0.001333		2.86		344.65	77.61	0.24
grants - milan	19076 Santa Fe Av-High		Bridge														
grants - milan	19150	100-YR	2440.00	45.16	2394.84		6444.00	6452.43	6448.37	8.43	0.001839	0.75	4.36		609.53	301.77	0.30
grants - milan	19150	100 YR (FEMA)	2440.00	45.16	2394.84		6444.00	6452.43	6448.37	8.43	0.001839	0.75	4.36		609.53	301.77	0.30
grants - milan	19150	10-YR	966.00		966.00		6444.00	6449.88	6446.50	5.88	0.001263		2.80		345.02	76.75	0.23
grants - milan	19200	100-YR	2440.00	136.96	2303.04		6443.89	6452.47	6449.07	8.58	0.002761	1.35	5.22		543.10	559.98	0.37
grants - milan	19200	100 YR (FEMA)	2440.00	136.96	2303.04		6443.89	6452.47	6449.07	8.58	0.002761	1.35	5.22		543.10	559.98	0.37
grants - milan	19200	10-YR	966.00	2.35	963.65		6443.89	6449.91	6446.97	6.02	0.001985	0.39	3.53		278.91	77.65	0.29

HEC-RAS Plan: GRSJ River: Rio San Jose Reach: grants - milan (Continued)

Reach	River Sta	Profile	Q Total	Q Left	Q Channel	Q Right	Min Ch El	W.S. Elev	Crit W.S.	Max Chl Dpth	E.G. Slope	Vel Left	Vel Chnl	Vel Right	Flow Area	Top Width	Froude # Chl
			(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(ft/s)	(sq ft)	(ft)	
grants - milan	19270	100-YR	2440.00	165.59	2274.41		6444.08	6452.46	6450.34	8.37	0.005870	2.62	7.44		369.06	572.78	0.52
grants - milan	19270	100 YR (FEMA)	2440.00	165.59	2274.41		6444.08	6452.46	6450.34	8.37	0.005870	2.62	7.44		369.06	572.78	0.52
grants - milan	19270	10-YR	966.00	0.37	965.63		6444.08	6449.97	6447.77	5.89	0.004445	0.50	5.07		191.36	48.94	0.43
grants - milan	19340	100-YR	2440.00	192.16	2212.16	35.68	6443.64	6452.84	6450.62	9.20	0.006566	3.45	7.82	2.66	351.77	714.03	0.51
grants - milan	19340	100 YR (FEMA)	2440.00	192.16	2212.16	35.68	6443.64	6452.84	6450.62	9.20	0.006566	3.45	7.82	2.66	351.77	714.03	0.51
grants - milan	19340	10-YR	966.00	9.61	956.39		6443.64	6450.28	6447.77	6.64	0.004848	1.44	5.17		191.66	551.84	0.41
grants - milan	19430	100-YR	2440.00		2440.00		6443.28	6453.78		10.50	0.001592		4.04		603.75	74.11	0.25
grants - milan	19430	100 YR (FEMA)	2440.00		2440.00		6443.28	6453.78		10.50	0.001592		4.04		603.75	74.11	0.25
grants - milan	19430	10-YR	966.00		966.00		6443.28	6450.80		7.52	0.001006		2.52		383.75	72.21	0.19
grants - milan	19464 Santa Fe RR-5th		Bridge														
grants - milan	19505	100-YR	2440.00		2440.00		6442.68	6453.85	6447.80	11.17	0.001669		3.73		654.72	100.28	0.26
grants - milan	19505	100 YR (FEMA)	2440.00		2440.00		6442.68	6453.85	6447.80	11.17	0.001669		3.73		654.72	100.28	0.26
grants - milan	19505	10-YR	966.00		966.00		6442.68	6450.81	6445.85	8.13	0.000822		2.41		400.76	68.45	0.18
grants - milan	19555	100-YR	2440.00	43.88	2337.99	58.13	6444.08	6453.91	6449.02	9.82	0.000722	0.72	3.75	0.86	751.17	451.89	0.24
grants - milan	19555	100 YR (FEMA)	2440.00	43.88	2337.99	58.13	6444.08	6453.91	6449.02	9.82	0.000722	0.72	3.75	0.86	751.17	451.89	0.24
grants - milan	19555	10-YR	942.00	0.00	942.00		6444.08	6450.84	6447.12	6.76	0.000640	0.07	2.55		369.20	141.52	0.21
grants - milan	20000.	100-YR	2440.00		2440.00		6446.40	6454.04	6454.04	7.63	0.016734		10.64		229.42	66.18	1.01
grants - milan	20000.	100 YR (FEMA)	2440.00		2440.00		6446.40	6454.04	6454.04	7.63	0.016734		10.64		229.42	66.18	1.01
grants - milan	20000.	10-YR	942.00		942.00		6446.40	6450.84	6450.84	4.44	0.017631		9.74		96.71	32.84	1.00
grants - milan	20500.	100-YR	2440.00	35.18	2404.82		6451.00	6457.80		6.80	0.002030	1.17	4.86		524.68	128.76	0.38
grants - milan	20500.	100 YR (FEMA)	2440.00	35.18	2404.82		6451.00	6457.80		6.80	0.002030	1.17	4.86		524.68	128.76	0.38
grants - milan	20500.	10-YR	942.00		942.00		6451.00	6455.06		4.06	0.002790		3.87		243.29	86.26	0.41
grants - milan	21000.	100-YR	2440.00	0.05	2390.62	49.33	6452.63	6459.10		6.47	0.004051	0.36	5.74	2.17	439.52	129.43	0.52
grants - milan	21000.	100 YR (FEMA)	2440.00	0.05	2390.62	49.33	6452.63	6459.10		6.47	0.004051	0.36	5.74	2.17	439.52	129.43	0.52
grants - milan	21000.	10-YR	942.00		941.72	0.28	6452.63	6456.95		4.32	0.006020		4.77	0.70	198.01	94.91	0.57
grants - milan	21300	100-YR	2440.00	158.64	1650.71	630.65	6454.10	6462.91	6462.91	8.81	0.005285	2.47	8.29	1.93	590.65	455.48	0.59
grants - milan	21300	100 YR (FEMA)	2440.00	158.64	1650.71	630.65	6454.10	6462.91	6462.91	8.81	0.005285	2.47	8.29	1.93	590.65	455.48	0.59
grants - milan	21300	10-YR	942.00		942.00		6454.10	6459.08	6459.08	4.98	0.018079		10.74		87.67	24.76	1.01
grants - milan	21500.	100-YR	2440.00	133.28	1708.16	598.56	6455.24	6463.95		8.71	0.001202	1.12	4.24	1.00	1120.84	697.35	0.30
grants - milan	21500.	100 YR (FEMA)	2440.00	133.28	1708.16	598.56	6455.24	6463.95		8.71	0.001202	1.12	4.24	1.00	1120.84	697.35	0.30
grants - milan	21500.	10-YR	942.00	0.25	941.75		6455.24	6461.48		6.24	0.001308	0.25	3.66		258.55	61.44	0.30
grants - milan	21700	100-YR	2440.00	44.14	2361.80	34.06	6455.13	6464.15		9.02	0.000932	0.92	3.81	0.45	743.59	323.53	0.27
grants - milan	21700	100 YR (FEMA)	2440.00	44.14	2361.80	34.06	6455.13	6464.15		9.02	0.000932	0.92	3.81	0.45	743.59	323.53	0.27
grants - milan	21700	10-YR	942.00		942.00		6455.13	6461.78		6.65	0.000605		2.40		392.59	90.79	0.20
grants - milan	22000.	100-YR	2440.00		2440.00		6455.59	6464.40		8.81	0.001790		5.06		482.31	80.05	0.36
grants - milan	22000.	100 YR (FEMA)	2440.00		2440.00		6455.59	6464.40		8.81	0.001790		5.06		482.31	80.05	0.36
grants - milan	22000.	10-YR	942.00		942.00		6455.59	6461.97		6.38	0.001104		3.15		298.98	71.07	0.27
grants - milan	22500.	100-YR	2440.00		2440.00		6457.50	6465.45		7.95	0.004001		6.88		354.54	67.75	0.53

HEC-RAS Plan: GRSJ River: Rio San Jose Reach: grants - milan (Continued)

Reach	River Sta	Profile	Q Total	Q Left	Q Channel	Q Right	Min Ch El	W.S. Elev	Crit W.S.	Max Chl Dpth	E.G. Slope	Vel Left	Vel Chnl	Vel Right	Flow Area	Top Width	Froude # Chl
			(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(ft/s)	(sq ft)	(ft)	
grants - milan	22500.	100 YR (FEMA)	2440.00		2440.00		6457.50	6465.45		7.95	0.004001		6.88		354.54	67.75	0.53
grants - milan	22500.	10-YR	942.00		942.00		6457.50	6462.77		5.27	0.004349		5.12		183.95	59.50	0.51
grants - milan	22800	100-YR	2440.00		2440.00		6461.70	6466.95		5.25	0.003903		5.39		452.94	126.06	0.50
grants - milan	22800	100 YR (FEMA)	2440.00		2440.00		6461.70	6466.95		5.25	0.003903		5.39		452.94	126.06	0.50
grants - milan	22800	10-YR	942.00		942.00		6461.70	6464.51		2.81	0.008339		5.38		175.14	86.56	0.67
grants - milan	23000	100-YR	2440.00	133.88	1616.61	689.51	6463.54	6471.01	6471.01	7.47	0.005711	1.76	7.33	1.53	747.81	702.27	0.61
grants - milan	23000	100 YR (FEMA)	2440.00	133.88	1616.61	689.51	6463.54	6471.01	6471.01	7.47	0.005711	1.76	7.33	1.53	747.81	702.27	0.61
grants - milan	23000	10-YR	942.00		942.00		6463.54	6468.29	6468.29	4.75	0.018064		9.25		101.83	38.41	1.00
grants - milan	23165	100-YR	2440.00	725.63	770.19	944.18	6466.94	6472.07		5.13	0.002915	2.24	5.57	1.21	1240.62	843.94	0.46
grants - milan	23165	100 YR (FEMA)	2440.00	725.63	770.19	944.18	6466.94	6472.07		5.13	0.002915	2.24	5.57	1.21	1240.62	843.94	0.46
grants - milan	23165	10-YR	942.00	201.67	530.59	209.74	6466.94	6470.73		3.79	0.004316	1.72	5.40	1.64	343.19	282.57	0.52
grants - milan	23500.	100-YR	2440.00	1112.95	835.17	491.88	6468.00	6473.09		5.09	0.003853	1.97	5.08	1.12	1168.54	997.37	0.49
grants - milan	23500.	100 YR (FEMA)	2440.00	1112.95	835.17	491.88	6468.00	6473.09		5.09	0.003853	1.97	5.08	1.12	1168.54	997.37	0.49
grants - milan	23500.	10-YR	942.00	270.55	616.49	54.96	6468.00	6472.18		4.18	0.004905	1.46	5.05	0.72	384.14	582.24	0.53
grants - milan	23750	100-YR	2440.00	964.37	1466.87	8.75	6468.10	6474.00	6473.83	5.90	0.006145	2.17	6.99	1.09	661.66	824.19	0.63
grants - milan	23750	100 YR (FEMA)	2440.00	964.37	1466.87	8.75	6468.10	6474.00	6473.83	5.90	0.006145	2.17	6.99	1.09	661.66	824.19	0.63
grants - milan	23750	10-YR	942.00	183.33	758.67		6468.10	6473.13	6472.06	5.03	0.003374	1.17	4.63		320.65	333.15	0.45
grants - milan	23850	100-YR	2440.00	1031.32	1271.29	137.39	6468.36	6474.65		6.29	0.004605	1.99	6.55	2.43	768.22	541.76	0.54
grants - milan	23850	100 YR (FEMA)	2440.00	1031.32	1271.29	137.39	6468.36	6474.65		6.29	0.004605	1.99	6.55	2.43	768.22	541.76	0.54
grants - milan	23850	10-YR	942.00	79.83	846.80	15.37	6468.36	6473.37		5.01	0.004948	1.27	5.97	1.29	216.71	196.34	0.55
grants - milan	24100	100-YR	2440.00	502.25	1148.80	788.94	6470.33	6475.71		5.38	0.003856	1.85	5.63	2.29	820.35	548.34	0.50
grants - milan	24100	100 YR (FEMA)	2440.00	502.25	1148.80	788.94	6470.33	6475.71		5.38	0.003856	1.85	5.63	2.29	820.35	548.34	0.50
grants - milan	24100	10-YR	942.00	67.23	703.74	171.03	6470.33	6474.65		4.32	0.003485	1.08	4.65	1.43	332.94	322.46	0.46
grants - milan	24475	100-YR	2440.00	539.11	1667.68	233.21	6470.10	6476.55		6.45	0.001236	1.36	3.58	0.88	1126.92	676.17	0.29
grants - milan	24475	100 YR (FEMA)	2440.00	539.11	1667.68	233.21	6470.10	6476.55		6.45	0.001236	1.36	3.58	0.88	1126.92	676.17	0.29
grants - milan	24475	10-YR	929.00	80.96	845.71	2.33	6470.10	6475.36		5.26	0.000767	0.58	2.43	0.24	496.64	358.82	0.22
grants - milan	24700	100-YR	2440.00	543.49	1687.68	208.83	6469.39	6476.79		7.40	0.002514	1.89	5.63	1.31	747.66	424.44	0.42
grants - milan	24700	100 YR (FEMA)	2440.00	543.49	1687.68	208.83	6469.39	6476.79		7.40	0.002514	1.89	5.63	1.31	747.66	424.44	0.42
grants - milan	24700	10-YR	929.00	66.54	861.39	1.07	6469.39	6475.52		6.13	0.001543	0.86	3.74	0.36	310.11	211.43	0.32
grants - milan	25000.	100-YR	2440.00	4.45	2435.55		6471.16	6477.53	6475.95	6.36	0.005152	0.62	7.37		337.77	290.22	0.60
grants - milan	25000.	100 YR (FEMA)	2440.00	4.45	2435.55		6471.16	6477.53	6475.95	6.36	0.005152	0.62	7.37		337.77	290.22	0.60
grants - milan	25000.	10-YR	929.00		929.00		6471.16	6476.03	6473.96	4.87	0.002106		4.01		231.67	62.41	0.37
grants - milan	25075	100-YR	2440.00	67.30	2325.64	47.06	6470.17	6478.04	6474.80	7.87	0.002469	2.02	6.37	1.87	423.41	192.49	0.41
grants - milan	25075	100 YR (FEMA)	2440.00	67.30	2325.64	47.06	6470.17	6478.04	6474.80	7.87	0.002469	2.02	6.37	1.87	423.41	192.49	0.41
grants - milan	25075	10-YR	929.00	5.86	921.45	1.69	6470.17	6476.22	6472.71	6.05	0.000980	0.72	3.34	0.48	287.82	66.22	0.25
grants - milan	25112 El Morro		Culvert														
grants - milan	25155	100-YR	2440.00	438.34	1181.95	819.71	6470.33	6479.73	6475.78	9.40	0.001188	0.95	5.25	2.62	998.58	553.07	0.32
grants - milan	25155	100 YR (FEMA)	2440.00	438.34	1181.95	819.71	6470.33	6479.73	6475.78	9.40	0.001188	0.95	5.25	2.62	998.58	553.07	0.32

HEC-RAS Plan: GRSJ River: Rio San Jose Reach: grants - milan (Continued)

Reach	River Sta	Profile	Q Total	Q Left	Q Channel	Q Right	Min Ch El	W.S. Elev	Crit W.S.	Max Chl Dpth	E.G. Slope	Vel Left	Vel Chnl	Vel Right	Flow Area	Top Width	Froude # Chl
			(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(ft/s)	(sq ft)	(ft)	
grants - milan	25155	10-YR	929.00	21.49	559.64	347.86	6470.33	6476.76	6473.92	6.43	0.001118	1.37	3.82	2.20	320.45	71.93	0.29
grants - milan	25205	100-YR	2440.00	57.98	2346.86	35.15	6472.10	6479.26		7.16	0.005883	1.59	8.53	1.75	331.76	254.84	0.64
grants - milan	25205	100 YR (FEMA)	2440.00	57.98	2346.86	35.15	6472.10	6479.26		7.16	0.005883	1.59	8.53	1.75	331.76	254.84	0.64
grants - milan	25205	10-YR	929.00		929.00		6472.10	6476.56		4.46	0.005847		6.30		147.35	42.48	0.60
grants - milan	25500.	100-YR	2440.00	160.95	2181.47	97.59	6472.70	6481.06	6479.04	8.36	0.003402	1.54	6.69	1.99	479.55	458.06	0.49
grants - milan	25500.	100 YR (FEMA)	2440.00	160.95	2181.47	97.59	6472.70	6481.06	6479.04	8.36	0.003402	1.54	6.69	1.99	479.55	458.06	0.49
grants - milan	25500.	10-YR	929.00		929.00		6472.70	6478.10	6476.26	5.40	0.003827		5.50		168.97	42.83	0.49
grants - milan	25725	100-YR	2440.00	933.25	1476.76	29.99	6475.22	6482.08		6.85	0.001409	1.37	3.99	1.21	1076.10	430.06	0.32
grants - milan	25725	100 YR (FEMA)	2440.00	933.25	1476.76	29.99	6475.22	6482.08		6.85	0.001409	1.37	3.99	1.21	1076.10	430.06	0.32
grants - milan	25725	10-YR	929.00		928.98	0.02	6475.22	6479.25		4.03	0.007402		5.60	0.41	165.89	70.85	0.64
grants - milan	25765	100-YR	2440.00	1144.07	1241.48	54.45	6476.90	6482.18		5.28	0.001557	1.74	3.77	1.47	1022.89	414.86	0.32
grants - milan	25765	100 YR (FEMA)	2440.00	1144.07	1241.48	54.45	6476.90	6482.18		5.28	0.001557	1.74	3.77	1.47	1022.89	414.86	0.32
grants - milan	25765	10-YR	929.00		928.38	0.62	6476.90	6479.44	6479.43	2.54	0.020156		7.53	1.21	123.87	74.53	1.01
grants - milan	25800	100-YR	2440.00	1481.08	924.04	34.88	6476.04	6482.25		6.21	0.001329	1.77	4.03	1.40	1091.81	406.11	0.31
grants - milan	25800	100 YR (FEMA)	2440.00	1481.08	924.04	34.88	6476.04	6482.25		6.21	0.001329	1.77	4.03	1.40	1091.81	406.11	0.31
grants - milan	25800	10-YR	929.00	206.22	713.70	9.08	6476.04	6480.34		4.30	0.003688	1.13	4.94	1.55	332.97	369.76	0.48
grants - milan	26000.	100-YR	2440.00	1819.91	620.09		6475.20	6482.65		7.45	0.001466	1.80	3.66		1180.10	476.63	0.30
grants - milan	26000.	100 YR (FEMA)	2440.00	1819.91	620.09		6475.20	6482.65		7.45	0.001466	1.80	3.66		1180.10	476.63	0.30
grants - milan	26000.	10-YR	887.00	448.30	438.70		6475.20	6481.17		5.97	0.002023	1.20	3.74		491.73	418.25	0.35
grants - milan	26500.	100-YR	2440.00	1319.61	1076.53	43.86	6476.47	6483.32		6.85	0.001909	1.59	4.52	1.21	1104.57	622.92	0.36
grants - milan	26500.	100 YR (FEMA)	2440.00	1319.61	1076.53	43.86	6476.47	6483.32		6.85	0.001909	1.59	4.52	1.21	1104.57	622.92	0.36
grants - milan	26500.	10-YR	887.00	270.46	614.91	1.63	6476.47	6481.94		5.47	0.001538	1.46	3.52	0.52	362.83	166.97	0.31
grants - milan	27000.	100-YR	2440.00	848.68	1511.33	80.00	6478.18	6485.17	6485.17	6.99	0.007131	2.25	8.56	2.68	583.60	412.48	0.69
grants - milan	27000.	100 YR (FEMA)	2440.00	848.68	1511.33	80.00	6478.18	6485.17	6485.17	6.99	0.007131	2.25	8.56	2.68	583.60	412.48	0.69
grants - milan	27000.	10-YR	887.00	9.19	877.71	0.10	6478.18	6483.01	6483.01	4.83	0.014269	1.22	8.90	0.53	106.32	63.58	0.91
grants - milan	27500.	100-YR	2440.00	1462.74	728.02	249.23	6481.02	6487.54		6.52	0.001973	1.80	4.23	1.59	1140.49	530.37	0.36
grants - milan	27500.	100 YR (FEMA)	2440.00	1462.74	728.02	249.23	6481.02	6487.54		6.52	0.001973	1.80	4.23	1.59	1140.49	530.37	0.36
grants - milan	27500.	10-YR	887.00	452.29	411.41	23.30	6481.02	6486.19		5.17	0.001784	1.26	3.40	0.61	517.19	394.44	0.33
grants - milan	28000.	100-YR	2440.00	1748.29	649.59	42.12	6481.25	6488.29		7.04	0.001026	1.55	2.96	0.84	1397.12	556.39	0.24
grants - milan	28000.	100 YR (FEMA)	2440.00	1748.29	649.59	42.12	6481.25	6488.29		7.04	0.001026	1.55	2.96	0.84	1397.12	556.39	0.24
grants - milan	28000.	10-YR	887.00	516.64	368.29	2.07	6481.25	6486.85		5.60	0.000877	1.06	2.33	0.38	651.94	389.79	0.21
grants - milan	28300	100-YR	2440.00	751.11	1640.84	48.06	6483.45	6488.63	6486.27	5.76	0.001784	1.93	3.55	0.98	901.00	509.74	0.31
grants - milan	28300	100 YR (FEMA)	2440.00	751.11	1640.84	48.06	6483.45	6488.63	6486.27	5.76	0.001784	1.93	3.55	0.98	901.00	509.74	0.31
grants - milan	28300	10-YR	863.00	220.00	642.63	0.36	6483.45	6487.13	6484.99	4.26	0.001071	1.37	2.16	0.25	460.27	397.33	0.23
grants - milan	28500.	100-YR	2440.00	753.01	1546.39	140.61	6482.16	6488.96	6487.60	6.80	0.005247	3.58	6.33	1.81	532.70	336.06	0.53
grants - milan	28500.	100 YR (FEMA)	2440.00	753.01	1546.39	140.61	6482.16	6488.96	6487.60	6.80	0.005247	3.58	6.33	1.81	532.70	336.06	0.53
grants - milan	28500.	10-YR	863.00	247.77	613.87	1.37	6482.16	6487.36	6485.88	5.20	0.003094	2.41	3.85	0.43	265.40	228.67	0.38
grants - milan	29000.	100-YR	2440.00	1147.34	916.15	376.51	6487.00	6492.48	6491.90	5.48	0.010691	4.02	7.40	3.55	515.15	323.86	0.72

HEC-RAS Plan: GRSJ River: Rio San Jose Reach: grants - milan (Continued)

Reach	River Sta	Profile	Q Total	Q Left	Q Channel	Q Right	Min Ch El	W.S. Elev	Crit W.S.	Max Chl Dpth	E.G. Slope	Vel Left	Vel Chnl	Vel Right	Flow Area	Top Width	Froude # Chl
			(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(ft/s)	(sq ft)	(ft)	
grants - milan	29000.	100 YR (FEMA)	2440.00	1147.34	916.15	376.51	6487.00	6492.48	6491.90	5.48	0.010691	4.02	7.40	3.55	515.15	323.86	0.72
grants - milan	29000.	10-YR	778.00	406.55	343.72	27.73	6487.00	6490.35	6490.35	3.35	0.025724	6.41	6.92	2.08	126.40	146.05	0.98
grants - milan	29500.	100-YR	2440.00	755.04	810.73	874.23	6492.17	6497.20	6496.84	5.03	0.007751	4.42	6.25	2.19	699.95	796.86	0.61
grants - milan	29500.	100 YR (FEMA)	2440.00	755.04	810.73	874.23	6492.17	6497.20	6496.84	5.03	0.007751	4.42	6.25	2.19	699.95	796.86	0.61
grants - milan	29500.	10-YR	778.00	293.21	414.01	70.78	6492.17	6496.16	6495.61	3.99	0.005687	2.84	4.58	1.03	262.32	572.76	0.50
grants - milan	29700	100-YR	2440.00	837.00	450.50	1152.50	6491.98	6498.22		6.24	0.002273	1.65	3.75	1.58	1357.66	849.99	0.33
grants - milan	29700	100 YR (FEMA)	2440.00	837.00	450.50	1152.50	6491.98	6498.22		6.24	0.002273	1.65	3.75	1.58	1357.66	849.99	0.33
grants - milan	29700	10-YR	778.00	265.78	315.56	196.66	6491.98	6497.04		5.06	0.002610	1.50	3.59	0.92	478.26	552.97	0.34
grants - milan	30000.	100-YR	2440.00	65.02	731.77	1643.22	6494.80	6499.36		5.36	0.013696	2.88	8.03	3.39	598.78	436.65	0.79
grants - milan	30000.	100 YR (FEMA)	2440.00	65.02	731.77	1643.22	6494.80	6499.36		5.36	0.013696	2.88	8.03	3.39	598.78	436.65	0.79
grants - milan	30000.	10-YR	778.00	2.02	429.09	346.89	6494.80	6498.36		4.36	0.014571	1.01	6.78	2.26	218.74	281.05	0.78
grants - milan	30400	100-YR	2440.00	1141.78	823.74	474.48	6495.88	6502.25		6.37	0.004800	4.14	6.34	2.71	580.41	197.79	0.51
grants - milan	30400	100 YR (FEMA)	2440.00	1141.78	823.74	474.48	6495.88	6502.25		6.37	0.004800	4.14	6.34	2.71	580.41	197.79	0.51
grants - milan	30400	10-YR	778.00	346.25	343.43	88.32	6495.88	6500.71		4.83	0.002736	2.26	3.85	1.37	306.54	159.74	0.36
grants - milan	30500.	100-YR	2440.00	400.77	1350.96	688.27	6495.67	6502.44		6.77	0.011195	5.68	9.82	3.16	426.09	216.47	0.77
grants - milan	30500.	100 YR (FEMA)	2440.00	400.77	1350.96	688.27	6495.67	6502.44		6.77	0.011195	5.68	9.82	3.16	426.09	216.47	0.77
grants - milan	30500.	10-YR	778.00	114.05	558.91	105.04	6495.67	6500.86		5.19	0.005969	3.13	5.88	1.89	187.01	101.33	0.54
grants - milan	31000.	100-YR	2440.00		2440.00		6500.72	6506.71		5.98	0.006835		8.13		300.25	67.49	0.68
grants - milan	31000.	100 YR (FEMA)	2440.00		2440.00		6500.72	6506.71		5.98	0.006835		8.13		300.25	67.49	0.68
grants - milan	31000.	10-YR	778.00		778.00		6500.72	6504.12	6503.46	3.40	0.007365		5.63		138.27	58.03	0.64
grants - milan	31500.	100-YR	2440.00		2440.00		6503.00	6509.44		6.44	0.003182		6.14		397.67	74.93	0.47
grants - milan	31500.	100 YR (FEMA)	2440.00		2440.00		6503.00	6509.44		6.44	0.003182		6.14		397.67	74.93	0.47
grants - milan	31500.	10-YR	778.00		778.00		6503.00	6506.64		3.64	0.003048		3.99		194.96	69.95	0.42
grants - milan	32000.	100-YR	2440.00		2440.00		6504.00	6510.90		6.90	0.002281		5.54		440.52	75.79	0.40
grants - milan	32000.	100 YR (FEMA)	2440.00		2440.00		6504.00	6510.90		6.90	0.002281		5.54		440.52	75.79	0.40
grants - milan	32000.	10-YR	778.00		778.00		6504.00	6507.88		3.88	0.001855		3.48		223.83	67.92	0.34
grants - milan	32500.	100-YR	2440.00		2440.00		6505.16	6512.12		6.96	0.002638		5.57		437.96	85.23	0.43
grants - milan	32500.	100 YR (FEMA)	2440.00		2440.00		6505.16	6512.12		6.96	0.002638		5.57		437.96	85.23	0.43
grants - milan	32500.	10-YR	787.00		787.00		6505.16	6508.95		3.79	0.002698		3.93		200.07	67.42	0.40
grants - milan	33000.	100-YR	2440.00		2435.44	4.56	6505.60	6513.28		7.67	0.001691		4.94	0.39	504.79	138.68	0.35
grants - milan	33000.	100 YR (FEMA)	2440.00		2435.44	4.56	6505.60	6513.28		7.67	0.001691		4.94	0.39	504.79	138.68	0.35
grants - milan	33000.	10-YR	787.00		787.00		6505.60	6509.98		4.38	0.001393		3.20		246.31	68.50	0.30
grants - milan	33350	100-YR	2440.00	5.00	2282.85	152.15	6506.08	6513.88		7.80	0.001020	0.55	4.07	1.34	683.33	162.55	0.28
grants - milan	33350	100 YR (FEMA)	2440.00	5.00	2282.85	152.15	6506.08	6513.88		7.80	0.001020	0.55	4.07	1.34	683.33	162.55	0.28
grants - milan	33350	10-YR	787.00		787.00		6506.08	6510.46		4.38	0.001163		2.87		273.89	78.65	0.27
grants - milan	33750	100-YR	2440.00	8.95	2374.90	56.14	6505.75	6514.30		8.55	0.001184	0.37	4.18	1.13	642.30	226.38	0.30
grants - milan	33750	100 YR (FEMA)	2440.00	8.95	2374.90	56.14	6505.75	6514.30		8.55	0.001184	0.37	4.18	1.13	642.30	226.38	0.30
grants - milan	33750	10-YR	787.00		787.00		6505.75	6510.92		5.17	0.001126		2.91		270.90	74.58	0.27

HEC-RAS Plan: GRSJ River: Rio San Jose Reach: grants - milan (Continued)

Reach	River Sta	Profile	Q Total	Q Left	Q Channel	Q Right	Min Ch El	W.S. Elev	Crit W.S.	Max Chl Dpth	E.G. Slope	Vel Left	Vel Chnl	Vel Right	Flow Area	Top Width	Froude # Chl
			(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(ft/s)	(sq ft)	(ft)	
grants - milan	34000.	100-YR	2440.00	130.92	2135.48	173.60	6507.33	6514.90	6510.99	7.57	0.000861	0.36	3.54	1.28	1100.76	1071.97	0.25
grants - milan	34000.	100 YR (FEMA)	2440.00	130.92	2135.48	173.60	6507.33	6514.90	6510.99	7.57	0.000861	0.36	3.54	1.28	1100.76	1071.97	0.25
grants - milan	34000.	10-YR	787.00		787.00		6507.33	6511.48	6509.15	4.15	0.001073		2.79		281.69	79.20	0.26
grants - milan	34250	100-YR	2440.00	736.19	1554.66	149.16	6506.57	6515.15	6510.97	8.58	0.000410	0.47	2.68	0.97	2286.23	1547.76	0.18
grants - milan	34250	100 YR (FEMA)	2440.00	736.19	1554.66	149.16	6506.57	6515.15	6510.97	8.58	0.000410	0.47	2.68	0.97	2286.23	1547.76	0.18
grants - milan	34250	10-YR	787.00	5.03	778.19	3.78	6506.57	6511.73	6508.93	5.16	0.000854	0.22	2.62	0.48	328.21	160.56	0.24
grants - milan	34500.	100-YR	2440.00	1078.02	1256.31	105.67	6506.37	6515.27		8.90	0.000712	0.70	3.24	0.93	2042.62	936.56	0.23
grants - milan	34500.	100 YR (FEMA)	2440.00	1078.02	1256.31	105.67	6506.37	6515.27		8.90	0.000712	0.70	3.24	0.93	2042.62	936.56	0.23
grants - milan	34500.	10-YR	639.00	6.41	632.59		6506.37	6511.95		5.58	0.001295	0.23	3.24		222.77	144.88	0.29
grants - milan	34990	100-YR	2440.00	550.11	1651.94	237.95	6507.90	6515.82		7.92	0.003418	0.69	5.77	1.54	1239.00	1415.97	0.43
grants - milan	34990	100 YR (FEMA)	2440.00	550.11	1651.94	237.95	6507.90	6515.82		7.92	0.003418	0.69	5.77	1.54	1239.00	1415.97	0.43
grants - milan	34990	10-YR	639.00		639.00		6507.90	6512.80		4.90	0.003061		4.24		150.69	39.15	0.38
grants - milan	35000 Milan Street		Bridge														
grants - milan	35050	100-YR	2440.00	1032.26	1228.50	179.24	6507.73	6516.19	6515.66	8.46	0.001787	0.63	4.40	1.28	2052.08	1969.97	0.32
grants - milan	35050	100 YR (FEMA)	2440.00	1032.26	1228.50	179.24	6507.73	6516.19	6515.66	8.46	0.001787	0.63	4.40	1.28	2052.08	1969.97	0.32
grants - milan	35050	10-YR	639.00		639.00		6507.73	6513.02	6511.05	5.29	0.003859		4.65		137.35	37.92	0.43
grants - milan	35100	100-YR	2440.00	948.81	1356.96	134.23	6508.42	6516.27		7.85	0.002371	0.62	4.92	1.20	1909.85	2079.51	0.36
grants - milan	35100	100 YR (FEMA)	2440.00	948.81	1356.96	134.23	6508.42	6516.27		7.85	0.002371	0.62	4.92	1.20	1909.85	2079.51	0.36
grants - milan	35100	10-YR	639.00		639.00		6508.42	6513.22		4.80	0.004059		4.64		137.75	40.00	0.44
grants - milan	35300	100-YR	2440.00	887.40	1022.76	529.84	6508.44	6516.72		8.28	0.001478	0.54	3.99	1.16	2369.04	2134.59	0.29
grants - milan	35300	100 YR (FEMA)	2440.00	887.40	1022.76	529.84	6508.44	6516.72		8.28	0.001478	0.54	3.99	1.16	2369.04	2134.59	0.29
grants - milan	35300	10-YR	639.00	0.06	638.14	0.80	6508.44	6514.04		5.60	0.004071	0.11	4.58	0.29	142.65	86.49	0.44
grants - milan	35700	100-YR	2440.00	889.35	982.18	568.47	6508.60	6517.20		8.60	0.001111	0.52	3.55	0.96	2578.06	2006.18	0.25
grants - milan	35700	100 YR (FEMA)	2440.00	889.35	982.18	568.47	6508.60	6517.20		8.60	0.001111	0.52	3.55	0.96	2578.06	2006.18	0.25
grants - milan	35700	10-YR	639.00		600.04	38.96	6508.60	6515.08		6.48	0.001285		3.18	0.47	271.11	205.98	0.25
grants - milan	36000.	100-YR	2440.00	885.58	1544.29	10.14	6509.69	6517.67		7.98	0.003615	1.04	5.89	0.50	1132.54	1052.62	0.44
grants - milan	36000.	100 YR (FEMA)	2440.00	885.58	1544.29	10.14	6509.69	6517.67		7.98	0.003615	1.04	5.89	0.50	1132.54	1052.62	0.44
grants - milan	36000.	10-YR	639.00	0.01	638.99		6509.69	6515.51		5.82	0.002124	0.07	3.79		168.61	43.79	0.32
grants - milan	36118	100-YR	2440.00	1538.76	895.98	5.26	6510.12	6518.23		8.11	0.001473	0.76	3.61	0.33	2295.93	1790.72	0.27
grants - milan	36118	100 YR (FEMA)	2440.00	1538.76	895.98	5.26	6510.12	6518.23		8.11	0.001473	0.76	3.61	0.33	2295.93	1790.72	0.27
grants - milan	36118	10-YR	639.00		639.00		6510.12	6515.76		5.64	0.002651		4.18		152.91	32.97	0.34
grants - milan	36158 Airport Street		Culvert														
grants - milan	36205	100-YR	2440.00	1587.23	821.59	31.18	6509.90	6518.25	6517.41	8.34	0.001927	0.86	3.39	0.46	2147.43	1696.15	0.26
grants - milan	36205	100 YR (FEMA)	2440.00	1587.23	821.59	31.18	6509.90	6518.25	6517.41	8.34	0.001927	0.86	3.39	0.46	2147.43	1696.15	0.26
grants - milan	36205	10-YR	639.00		639.00		6509.90	6515.91	6513.22	6.01	0.004123		4.34		147.24	33.17	0.36
grants - milan	36255	100-YR	2440.00	1192.16	1173.25	74.59	6509.90	6518.29		8.39	0.003547	0.98	4.88	0.61	1582.78	1780.69	0.36
grants - milan	36255	100 YR (FEMA)	2440.00	1192.16	1173.25	74.59	6509.90	6518.29		8.39	0.003547	0.98	4.88	0.61	1582.78	1780.69	0.36
grants - milan	36255	10-YR	639.00	0.03	638.97		6509.90	6516.14		6.24	0.004244	0.21	4.23		151.22	39.83	0.37

HEC-RAS Plan: GRSJ River: Rio San Jose Reach: grants - milan (Continued)

Reach	River Sta	Profile	Q Total	Q Left	Q Channel	Q Right	Min Ch El	W.S. Elev	Crit W.S.	Max Chl Dpth	E.G. Slope	Vel Left	Vel Chnl	Vel Right	Flow Area	Top Width	Froude # Chl
			(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(ft/s)	(sq ft)	(ft)	
grants - milan	36500.	100-YR	2440.00	994.26	634.69	811.06	6511.19	6518.85		7.66	0.000833	0.60	2.43	0.70	3078.13	2019.59	0.18
grants - milan	36500.	100 YR (FEMA)	2440.00	994.26	634.69	811.06	6511.19	6518.85		7.66	0.000833	0.60	2.43	0.70	3078.13	2019.59	0.18
grants - milan	36500.	10-YR	639.00	17.48	512.89	108.63	6511.19	6516.99		5.80	0.001825	0.36	2.87	0.48	455.12	541.93	0.25
grants - milan	37000.	100-YR	2440.00	1361.98	580.97	497.06	6512.19	6519.28		7.09	0.000875	0.73	2.60	0.65	2852.72	2077.06	0.21
grants - milan	37000.	100 YR (FEMA)	2440.00	1361.98	580.97	497.06	6512.19	6519.28		7.09	0.000875	0.73	2.60	0.65	2852.72	2077.06	0.21
grants - milan	37000.	10-YR	639.00	79.81	529.63	29.56	6512.19	6517.90		5.71	0.001933	0.69	3.33	0.44	341.25	423.45	0.31
grants - milan	37150	100-YR	2440.00	1114.49	579.50	746.01	6512.40	6519.44	6518.73	7.03	0.001307	0.68	2.83	0.89	2679.72	2057.84	0.25
grants - milan	37150	100 YR (FEMA)	2440.00	1114.49	579.50	746.01	6512.40	6519.44	6518.73	7.03	0.001307	0.68	2.83	0.89	2679.72	2057.84	0.25
grants - milan	37150	10-YR	639.00	49.37	473.23	116.39	6512.40	6518.20	6515.81	5.80	0.001678	0.31	3.21	0.47	550.69	1077.83	0.29
grants - milan	37180 Clay Street		Bridge														
grants - milan	37210	100-YR	2440.00	1156.96	629.38	653.65	6512.15	6519.56	6518.86	7.40	0.001240	0.68	3.12	0.76	2762.84	2000.67	0.25
grants - milan	37210	100 YR (FEMA)	2440.00	1156.96	629.38	653.65	6512.15	6519.56	6518.86	7.40	0.001240	0.68	3.12	0.76	2762.84	2000.67	0.25
grants - milan	37210	10-YR	639.00	67.90	442.94	128.17	6512.15	6518.41	6515.97	6.26	0.001311	0.30	2.86	0.42	688.77	1231.30	0.25
grants - milan	37260	100-YR	2440.00	1338.41	571.41	530.19	6512.16	6519.62		7.46	0.001125	0.70	2.94	0.69	2878.58	1982.79	0.24
grants - milan	37260	100 YR (FEMA)	2440.00	1338.41	571.41	530.19	6512.16	6519.62		7.46	0.001125	0.70	2.94	0.69	2878.58	1982.79	0.24
grants - milan	37260	10-YR	639.00	122.25	435.51	81.24	6512.16	6518.48		6.32	0.001419	0.34	2.94	0.35	738.11	1524.34	0.26
grants - milan	37500.	100-YR	2440.00	1275.93	751.58	412.49	6513.32	6519.91		6.59	0.001888	0.82	3.66	0.76	2301.68	1853.75	0.31
grants - milan	37500.	100 YR (FEMA)	2440.00	1275.93	751.58	412.49	6513.32	6519.91		6.59	0.001888	0.82	3.66	0.76	2301.68	1853.75	0.31
grants - milan	37500.	10-YR	639.00	111.56	494.36	33.08	6513.32	6518.83		5.50	0.001767	0.39	3.17	0.31	544.99	1180.95	0.29
grants - milan	37700	100-YR	2440.00	1503.02	613.62	323.36	6514.10	6520.18		6.08	0.001504	0.92	3.54	0.69	2281.81	1805.78	0.31
grants - milan	37700	100 YR (FEMA)	2440.00	1503.02	613.62	323.36	6514.10	6520.18		6.08	0.001504	0.92	3.54	0.69	2281.81	1805.78	0.31
grants - milan	37700	10-YR	639.00	194.10	394.01	50.89	6514.10	6519.14		5.04	0.001333	0.51	3.00	0.37	647.86	1148.88	0.28
grants - milan	37980	100-YR	2440.00	1809.83	410.05	220.12	6514.08	6520.42		6.34	0.000792	0.80	2.32	0.53	2841.11	1779.00	0.22
grants - milan	37980	100 YR (FEMA)	2440.00	1809.83	410.05	220.12	6514.08	6520.42		6.34	0.000792	0.80	2.32	0.53	2841.11	1779.00	0.22
grants - milan	37980	10-YR	639.00	339.52	250.48	48.99	6514.08	6519.40		5.32	0.000583	0.41	1.91	0.31	1121.25	1546.17	0.19
grants - milan	38000 Sand Street		Bridge														
grants - milan	38050	100-YR	2440.00	1424.18	647.28	368.55	6514.80	6520.86	6520.13	6.06	0.001076	0.99	3.04	1.01	2013.69	1452.83	0.27
grants - milan	38050	100 YR (FEMA)	2440.00	1424.18	647.28	368.55	6514.80	6520.86	6520.13	6.06	0.001076	0.99	3.04	1.01	2013.69	1452.83	0.27
grants - milan	38050	10-YR	559.00	110.32	423.74	24.94	6514.80	6519.70	6517.66	4.90	0.001220	0.42	2.74	0.44	476.39	1083.00	0.27
grants - milan	38100	100-YR	2440.00	408.10	1421.64	610.27	6515.14	6520.77		5.63	0.004601	1.51	5.36	1.73	888.16	1392.40	0.53
grants - milan	38100	100 YR (FEMA)	2440.00	408.10	1421.64	610.27	6515.14	6520.77		5.63	0.004601	1.51	5.36	1.73	888.16	1392.40	0.53
grants - milan	38100	10-YR	559.00	12.41	533.17	13.42	6515.14	6519.74		4.60	0.001861	0.45	2.94	0.59	231.52	617.56	0.33
grants - milan	38500.	100-YR	2440.00	487.30	1161.65	791.05	6515.33	6521.90		6.56	0.001656	1.05	4.02	0.82	1723.93	1610.64	0.33
grants - milan	38500.	100 YR (FEMA)	2440.00	487.30	1161.65	791.05	6515.33	6521.90		6.56	0.001656	1.05	4.02	0.82	1723.93	1610.64	0.33
grants - milan	38500.	10-YR	559.00	21.11	526.16	11.74	6515.33	6520.32		4.99	0.001093	0.45	2.72	0.17	307.56	581.45	0.26
grants - milan	39000.	100-YR	2440.00	1060.74	640.13	739.13	6515.61	6522.37		6.76	0.000419	0.73	2.14	0.56	3055.72	1551.94	0.17
grants - milan	39000.	100 YR (FEMA)	2440.00	1060.74	640.13	739.13	6515.61	6522.37		6.76	0.000419	0.73	2.14	0.56	3055.72	1551.94	0.17

HEC-RAS Plan: GRSJ River: Rio San Jose Reach: grants - milan (Continued)

Reach	River Sta	Profile	Q Total	Q Left	Q Channel	Q Right	Min Ch El	W.S. Elev	Crit W.S.	Max Chl Dpth	E.G. Slope	Vel Left	Vel Chnl	Vel Right	Flow Area	Top Width	Froude # Chl
			(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(ft/s)	(sq ft)	(ft)	
grants - milan	39000.	10-YR	559.00	34.78	395.55	128.66	6515.61	6520.73		5.12	0.000473	0.22	1.93	0.35	731.24	1136.69	0.17
grants - milan	39500.	100-YR	2440.00	460.73	1061.62	917.65	6515.64	6522.63		6.99	0.001290	1.05	3.72	0.73	1979.47	1550.07	0.30
grants - milan	39500.	100 YR (FEMA)	2440.00	460.73	1061.62	917.65	6515.64	6522.63		6.99	0.001290	1.05	3.72	0.73	1979.47	1550.07	0.30
grants - milan	39500.	10-YR	559.00	0.72	534.63	23.65	6515.64	6521.00		5.36	0.000962	0.20	2.74	0.26	291.20	411.05	0.25
grants - milan	40000.	100-YR	2440.00	0.30	971.51	1468.18	6516.51	6523.21		6.70	0.001543	0.13	4.42	0.83	1988.69	1113.32	0.37
grants - milan	40000.	100 YR (FEMA)	2440.00	0.30	971.51	1468.18	6516.51	6523.21		6.70	0.001543	0.13	4.42	0.83	1988.69	1113.32	0.37
grants - milan	40000.	10-YR	559.00		504.55	54.45	6516.51	6521.52		5.01	0.001399		3.51	0.26	352.49	697.08	0.33
grants - milan	40250	100-YR	2440.00		1204.55	1235.45	6516.57	6523.58		7.01	0.002112		5.30	0.83	1717.01	949.96	0.43
grants - milan	40250	100 YR (FEMA)	2440.00		1204.55	1235.45	6516.57	6523.58		7.01	0.002112		5.30	0.83	1717.01	949.96	0.43
grants - milan	40250	10-YR	559.00		539.95	19.05	6516.57	6521.85		5.28	0.001372		3.60	0.19	250.30	451.67	0.33
grants - milan	40500	100-YR	2440.00		1332.58	1107.42	6517.60	6524.07	6523.30	6.47	0.001785		4.92	0.79	1667.74	1003.78	0.40
grants - milan	40500	100 YR (FEMA)	2440.00		1332.58	1107.42	6517.60	6524.07	6523.30	6.47	0.001785		4.92	0.79	1667.74	1003.78	0.40
grants - milan	40500	10-YR	559.00		523.53	35.47	6517.60	6522.21	6520.01	4.61	0.001024		3.05	0.24	320.24	516.21	0.29
grants - milan	40800	100-YR	2440.00		2440.00		6517.90	6524.99	6524.99	7.09	0.011783		12.31		198.23	173.02	1.00
grants - milan	40800	100 YR (FEMA)	2440.00		2440.00		6517.90	6524.99	6524.99	7.09	0.011783		12.31		198.23	173.02	1.00
grants - milan	40800	10-YR	559.00		559.00		6517.90	6522.54		4.64	0.003467		5.25		106.43	43.71	0.51
grants - milan	40950	100-YR	2440.00	888.44	1551.56		6519.28	6527.66	6522.64	8.38	0.000301	0.49	1.95		2620.11	2800.73	0.16
grants - milan	40950	100 YR (FEMA)	2440.00	888.44	1551.56		6519.28	6527.66	6522.64	8.38	0.000301	0.49	1.95		2620.11	2800.73	0.16
grants - milan	40950	10-YR	559.00		559.00		6519.28	6523.09	6520.65	3.81	0.000420		1.90		294.67	90.10	0.18
grants - milan	41025 Santa Fe Av-Hrz		Culvert														
grants - milan	41100	100-YR	2440.00	1550.74	372.36	516.90	6519.72	6528.10	6523.83	8.38	0.000011	0.20	0.49	0.18	11441.88	4151.62	0.03
grants - milan	41100	100 YR (FEMA)	2440.00	1550.74	372.36	516.90	6519.72	6528.10	6523.83	8.38	0.000011	0.20	0.49	0.18	11441.88	4151.62	0.03
grants - milan	41100	10-YR	559.00	9.73	549.27		6519.72	6523.20	6521.24	3.47	0.000672	0.25	2.20		287.95	311.59	0.23
grants - milan	41150	100-YR	2440.00	1736.51	167.54	535.95	6519.70	6528.10		8.40	0.000004	0.16	0.28	0.13	15488.82	3216.06	0.02
grants - milan	41150	100 YR (FEMA)	2440.00	1736.51	167.54	535.95	6519.70	6528.10		8.40	0.000004	0.16	0.28	0.13	15488.82	3216.06	0.02
grants - milan	41150	10-YR	559.00	451.62	105.11	2.27	6519.70	6523.28		3.58	0.000062	0.24	0.60	0.07	2074.61	1853.49	0.07
grants - milan	41190	100-YR	2440.00		2440.00		6520.10	6527.90	6524.35	7.80	0.001078		4.31		565.50	1941.24	0.32
grants - milan	41190	100 YR (FEMA)	2440.00		2440.00		6520.10	6527.90	6524.35	7.80	0.001078		4.31		565.50	1941.24	0.32
grants - milan	41190	10-YR	559.00		559.00		6520.10	6523.15	6522.07	3.05	0.002576		3.60		155.40	71.48	0.43
grants - milan	41220 Santa Fe RR-Hrz		Bridge														
grants - milan	41250	100-YR	2440.00	1217.38	1222.62		6520.20	6528.46	6524.64	8.26	0.000190	0.62	1.86		2615.35	1112.02	0.14
grants - milan	41250	100 YR (FEMA)	2440.00	1217.38	1222.62		6520.20	6528.46	6524.64	8.26	0.000190	0.62	1.86		2615.35	1112.02	0.14
grants - milan	41250	10-YR	559.00		559.00		6520.20	6524.05	6522.23	3.85	0.001138		2.72		205.42	77.85	0.30
grants - milan	41300	100-YR	2440.00	189.04	2174.69	76.27	6520.00	6528.38	6525.06	8.38	0.000820	0.60	3.73	1.30	957.64	373.64	0.28
grants - milan	41300	100 YR (FEMA)	2440.00	189.04	2174.69	76.27	6520.00	6528.38	6525.06	8.38	0.000820	0.60	3.73	1.30	957.64	373.64	0.28
grants - milan	41300	10-YR	559.00		559.00		6520.00	6524.10	6522.93	4.10	0.002221		3.21		174.11	83.85	0.39
grants - milan	41500	100-YR	2440.00	322.74	1671.00	446.26	6520.54	6528.51		7.97	0.001586	0.90	5.36	2.54	845.44	342.38	0.39

HEC-RAS Plan: GRSJ River: Rio San Jose Reach: grants - milan (Continued)

Reach	River Sta	Profile	Q Total	Q Left	Q Channel	Q Right	Min Ch El	W.S. Elev	Crit W.S.	Max Chl Dpth	E.G. Slope	Vel Left	Vel Chnl	Vel Right	Flow Area	Top Width	Froude # Chl
			(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(ft/s)	(sq ft)	(ft)	
grants - milan	41500	100 YR (FEMA)	2440.00	322.74	1671.00	446.26	6520.54	6528.51		7.97	0.001586	0.90	5.36	2.54	845.44	342.38	0.39
grants - milan	41500	10-YR	559.00	0.00	539.59	19.41	6520.54	6524.50		3.96	0.003137	0.10	4.66	1.15	132.71	66.82	0.49
grants - milan	41900	100-YR	2440.00	122.00	1456.18	861.82	6521.70	6529.21	6527.15	7.51	0.001954	0.73	5.50	2.81	738.08	431.60	0.42
grants - milan	41900	100 YR (FEMA)	2440.00	122.00	1456.18	861.82	6521.70	6529.21	6527.15	7.51	0.001954	0.73	5.50	2.81	738.08	431.60	0.42
grants - milan	41900	10-YR	559.00		469.77	89.23	6521.70	6525.74	6524.71	4.04	0.002695		4.36	1.45	169.10	141.76	0.45
grants - milan	42000.	100-YR	2440.00	218.01	1510.45	711.53	6522.00	6529.52	6527.38	7.52	0.002141	0.86	4.52	2.68	852.87	459.52	0.42
grants - milan	42000.	100 YR (FEMA)	2440.00	218.01	1510.45	711.53	6522.00	6529.52	6527.38	7.52	0.002141	0.86	4.52	2.68	852.87	459.52	0.42
grants - milan	42000.	10-YR	559.00		525.49	33.51	6522.00	6526.02	6524.42	4.02	0.001902		3.80	0.96	173.18	134.04	0.38
grants - milan	42375	100-YR	2440.00		2255.48	184.52	6522.54	6530.26	6528.69	7.72	0.004115		7.04	2.27	401.66	161.08	0.60
grants - milan	42375	100 YR (FEMA)	2440.00		2255.48	184.52	6522.54	6530.26	6528.69	7.72	0.004115		7.04	2.27	401.66	161.08	0.60
grants - milan	42375	10-YR	559.00		559.00		6522.54	6526.79	6525.42	4.25	0.002604		4.30		129.88	45.22	0.45
grants - milan	42382 Hwy 605		Bridge														
grants - milan	42470	100-YR	2440.00	839.58	1333.34	267.08	6522.00	6532.75	6528.34	10.75	0.000275	0.76	2.89	0.83	1880.33	524.73	0.17
grants - milan	42470	100 YR (FEMA)	2440.00	839.58	1333.34	267.08	6522.00	6532.75	6528.34	10.75	0.000275	0.76	2.89	0.83	1880.33	524.73	0.17
grants - milan	42470	10-YR	559.00	21.97	537.03		6522.00	6527.52	6524.94	5.52	0.000917	0.49	2.95		226.96	117.91	0.27
grants - milan	42520	100-YR	2440.00	1195.11	693.13	551.76	6521.39	6532.81		11.42	0.000133	0.63	1.90	0.86	2900.16	639.92	0.12
grants - milan	42520	100 YR (FEMA)	2440.00	1195.11	693.13	551.76	6521.39	6532.81		11.42	0.000133	0.63	1.90	0.86	2900.16	639.92	0.12
grants - milan	42520	10-YR	559.00	44.42	423.76	90.82	6521.39	6527.59		6.20	0.000872	0.50	2.98	0.95	326.78	272.33	0.26
grants - milan	42700	100-YR	2440.00	1432.85	539.27	467.88	6521.70	6532.84		11.14	0.000079	0.53	1.41	0.69	3778.93	770.83	0.09
grants - milan	42700	100 YR (FEMA)	2440.00	1432.85	539.27	467.88	6521.70	6532.84		11.14	0.000079	0.53	1.41	0.69	3778.93	770.83	0.09
grants - milan	42700	10-YR	559.00	114.18	336.28	108.54	6521.70	6527.77		6.07	0.000574	0.53	2.35	0.84	489.24	339.03	0.21
grants - milan	43000	100-YR	2440.00	1763.16	355.44	321.40	6522.44	6532.87	6528.41	10.43	0.000046	0.56	1.02	0.58	4044.34	860.08	0.07
grants - milan	43000	100 YR (FEMA)	2440.00	1763.16	355.44	321.40	6522.44	6532.87	6528.41	10.43	0.000046	0.56	1.02	0.58	4044.34	860.08	0.07
grants - milan	43000	10-YR	559.00	76.38	319.80	162.82	6522.44	6527.96	6526.10	5.52	0.000731	0.52	2.53	1.17	413.84	396.43	0.24
grants - milan	43500	100-YR	2440.00	1605.04	358.67	476.30	6522.95	6532.89		9.94	0.000035	0.48	0.90	0.46	4763.55	994.69	0.06
grants - milan	43500	100 YR (FEMA)	2440.00	1605.04	358.67	476.30	6522.95	6532.89		9.94	0.000035	0.48	0.90	0.46	4763.55	994.69	0.06
grants - milan	43500	10-YR	559.00	133.45	347.86	77.70	6522.95	6528.28		5.33	0.000537	0.51	2.22	0.56	557.82	635.48	0.21

Bridge Summary Table

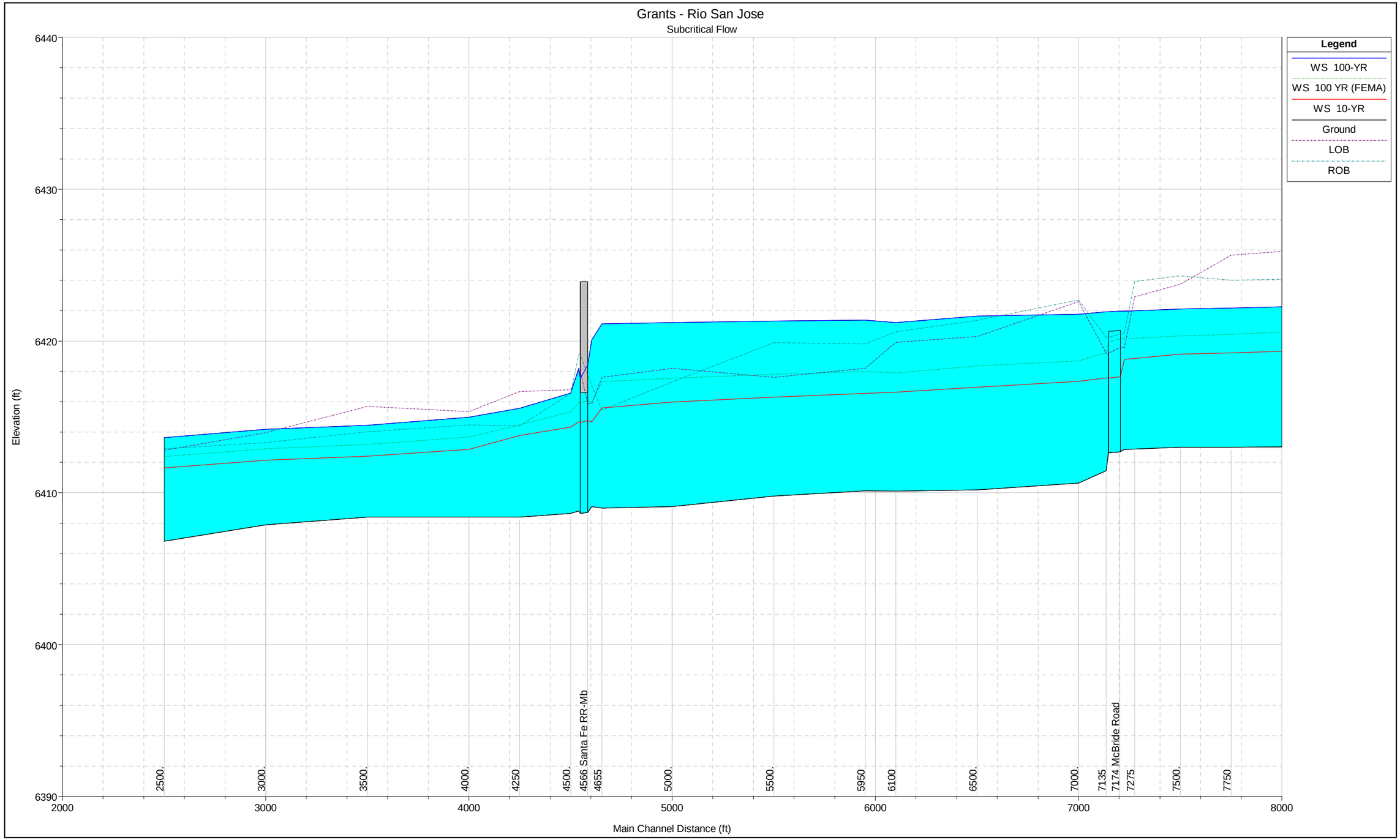
HEC-RAS Plan: GRSJ River: Rio San Jose Reach: grants - milan

Reach	River Sta	Profile	Q Total	E.G. US.	W.S. US.	Q Bridge	BR Open Area	BR Open Vel
			(cfs)	(ft)	(ft)	(cfs)	(sq ft)	(ft/s)
grants - milan	4566 Santa Fe RR-Mb	100-YR	4470.00	6421.05	6420.08	4470.00	364.15	12.28
grants - milan	4566 Santa Fe RR-Mb	100 YR (FEMA)	2440.00	6417.17	6415.95	2440.00	364.15	7.41
grants - milan	4566 Santa Fe RR-Mb	10-YR	1484.00	6415.55	6414.68	1484.00	364.15	6.12
grants - milan	11337 Nimitz Drive	100-YR	3570.00	6432.03	6431.84	2913.63	161.05	10.78
grants - milan	11337 Nimitz Drive	100 YR (FEMA)	2440.00	6431.76	6431.66	1531.92	161.05	9.51
grants - milan	11337 Nimitz Drive	10-YR	1220.00	6430.16	6430.05	1143.85	161.05	11.15
grants - milan	19076 Santa Fe Av-High	100-YR	2440.00	6452.72	6452.43	2440.00	563.63	4.35
grants - milan	19076 Santa Fe Av-High	100 YR (FEMA)	2440.00	6452.72	6452.43	2440.00	563.63	4.35
grants - milan	19076 Santa Fe Av-High	10-YR	966.00	6450.00	6449.88	966.00	563.63	2.47
grants - milan	19464 Santa Fe RR-5th	100-YR	2440.00	6454.06	6453.85	2440.00	604.03	4.15
grants - milan	19464 Santa Fe RR-5th	100 YR (FEMA)	2440.00	6454.06	6453.85	2440.00	604.03	4.15
grants - milan	19464 Santa Fe RR-5th	10-YR	966.00	6450.91	6450.81	966.00	604.03	2.57
grants - milan	35000 Milan Street	100-YR	2440.00	6516.35	6516.19	362.12	156.63	2.31
grants - milan	35000 Milan Street	100 YR (FEMA)	2440.00	6516.35	6516.19	362.12	156.63	2.31
grants - milan	35000 Milan Street	10-YR	639.00	6513.35	6513.02	639.00	156.63	5.39
grants - milan	37180 Clay Street	100-YR	2440.00	6519.60	6519.56	734.64	169.93	4.57
grants - milan	37180 Clay Street	100 YR (FEMA)	2440.00	6519.60	6519.56	734.64	169.93	4.57
grants - milan	37180 Clay Street	10-YR	639.00	6518.50	6518.41	511.36	169.93	4.15
grants - milan	38000 Sand Street	100-YR	2440.00	6520.91	6520.86	445.56	98.48	4.52
grants - milan	38000 Sand Street	100 YR (FEMA)	2440.00	6520.91	6520.86	445.56	98.48	4.52
grants - milan	38000 Sand Street	10-YR	559.00	6519.79	6519.70	540.74	98.48	6.15
grants - milan	41220 Santa Fe RR-Hrz	100-YR	2440.00	6528.49	6528.46	2440.00	478.46	6.00
grants - milan	41220 Santa Fe RR-Hrz	100 YR (FEMA)	2440.00	6528.49	6528.46	2440.00	478.46	6.00
grants - milan	41220 Santa Fe RR-Hrz	10-YR	559.00	6524.17	6524.05	559.00	478.46	6.67
grants - milan	42382 Hwy 605	100-YR	2440.00	6532.82	6532.75	2066.27	324.23	10.03
grants - milan	42382 Hwy 605	100 YR (FEMA)	2440.00	6532.82	6532.75	2066.27	324.23	10.03
grants - milan	42382 Hwy 605	10-YR	559.00	6527.65	6527.52	559.00	324.23	6.28

Culvert Summary Table

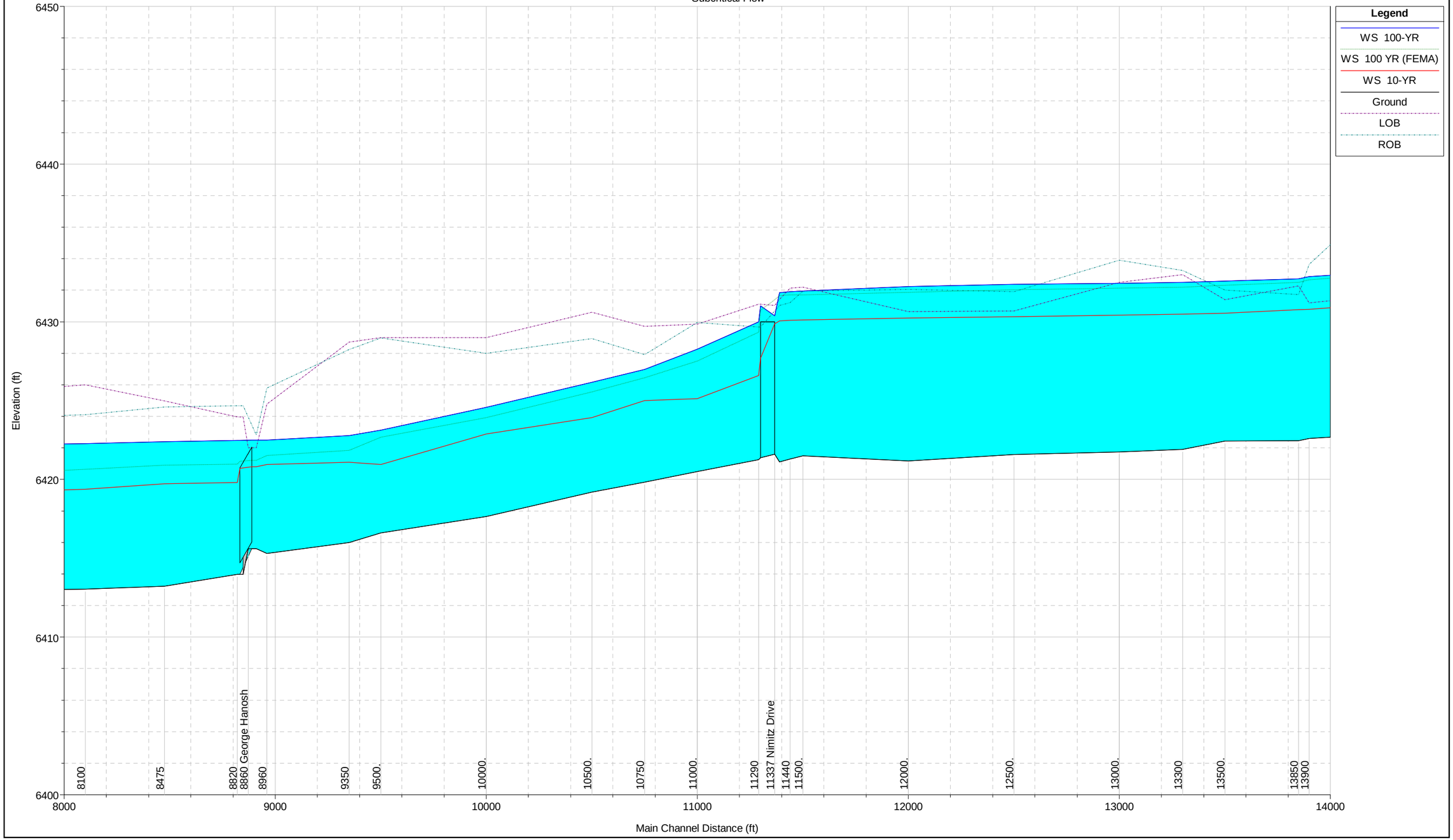
HEC-RAS Plan: GRSJ River: Rio San Jose Reach: grants - milan

Reach	River Sta	Profile	Q Total	E.G. US.	E.G. DS	W.S. US.	W.S. DS	Delta WS	Q Weir	Min El Weir Flow	Weir Max Depth	Wr Top Wdth	Q Culv Group	Culv Inv El Up	Culv Inv El Dn	Culv Vel US	Culv Vel DS
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(ft)	(ft)	(ft)	(cfs)	(ft)	(ft)	(ft/s)	(ft/s)
grants - milan	7174 McBride Road McBride Rd	100-YR	4541.00	6421.99	6421.94	6421.98	6421.93	0.05	1633.87	6419.21	2.74	1709.18	2907.13	6412.70	6412.63	9.08	9.08
grants - milan	7174 McBride Road McBride Rd	100 YR (FEMA)	2440.00	6420.17	6419.29	6420.15	6419.25	0.90	760.77	6419.21	0.97	828.42	1679.23	6412.70	6412.63	6.38	6.34
grants - milan	7174 McBride Road McBride Rd	10-YR	1495.00	6418.88	6418.05	6418.78	6417.56	1.22		6419.21			1495.00	6412.70	6412.63	7.57	7.58
grants - milan	8860 George Hanosh G. Hanosh	100-YR	3603.00	6422.62	6422.60	6422.50	6422.48	0.02	3489.00	6420.01	2.63	976.06	114.00	6416.04	6414.72	1.34	1.34
grants - milan	8860 George Hanosh G. Hanosh	100 YR (FEMA)	2440.00	6421.63	6421.41	6421.21	6420.96	0.25	2031.98	6420.01	1.63	765.91	408.02	6416.04	6414.72	5.29	4.81
grants - milan	8860 George Hanosh G. Hanosh	10-YR	1236.00	6421.01	6420.20	6420.81	6419.80	1.00	774.52	6420.01	1.01	509.61	461.48	6416.04	6414.72	9.40	11.67
grants - milan	14440 Anderman Street Anderman St	100-YR	2440.00	6435.12	6433.94	6434.68	6433.36	1.32	1451.33	6433.12	2.10	1261.37	988.67	6426.22	6425.23	7.66	7.66
grants - milan	14440 Anderman Street Anderman St	100 YR (FEMA)	2440.00	6435.11	6433.85	6434.65	6433.25	1.40	1422.57	6433.12	2.09	1237.21	1017.43	6426.22	6425.23	7.89	7.89
grants - milan	14440 Anderman Street Anderman St	10-YR	1024.00	6433.18	6431.44	6432.90	6431.25	1.65	1.26	6433.12	0.15	21.11	1022.74	6426.22	6425.23	8.48	7.96
grants - milan	15725 1st Street 1st St	100-YR	2440.00	6439.53	6439.52	6439.51	6439.43	0.07	2373.15	6436.95	3.06	1855.21	66.85	6432.92	6431.60	0.75	0.75
grants - milan	15725 1st Street 1st St	100 YR (FEMA)	2440.00	6439.53	6439.52	6439.51	6439.43	0.07	2373.15	6436.95	3.06	1855.21	66.85	6432.92	6431.60	0.75	0.75
grants - milan	15725 1st Street 1st St	10-YR	1024.00	6437.72	6437.61	6437.43	6437.22	0.21	810.38	6436.95	1.25	500.24	213.62	6432.92	6431.60	2.74	2.39
grants - milan	16245 2nd Street 2nd St	100-YR	2440.00	6440.05	6439.88	6440.05	6439.83	0.22	2231.01	6438.56	1.50	1709.22	208.99	6434.62	6433.32	2.55	2.55
grants - milan	16245 2nd Street 2nd St	100 YR (FEMA)	2440.00	6440.05	6439.88	6440.05	6439.83	0.22	2231.01	6438.56	1.50	1709.22	208.99	6434.62	6433.32	2.55	2.55
grants - milan	16245 2nd Street 2nd St	10-YR	1002.00	6439.56	6438.75	6438.75	6438.66	0.09	598.89	6438.56	1.03	1132.82	403.11	6434.62	6433.32	5.82	4.94
grants - milan	18634 High Street High St	100-YR	2440.00	6450.22	6450.20	6450.17	6450.10	0.07	2300.12	6447.81	2.44	992.68	139.88	6443.10	6442.80	1.30	1.30
grants - milan	18634 High Street High St	100 YR (FEMA)	2440.00	6450.22	6450.20	6450.17	6450.10	0.07	2300.12	6447.81	2.44	992.68	139.88	6443.10	6442.80	1.30	1.30
grants - milan	18634 High Street High St	10-YR	984.00	6449.15	6448.70	6449.10	6448.62	0.48	541.39	6447.81	1.34	391.44	442.61	6443.10	6442.80	4.10	4.10
grants - milan	25112 El Morro El Morrow	100-YR	2440.00	6479.98	6478.65	6479.73	6478.04	1.69	384.57	6478.49	1.50	200.82	2055.43	6470.60	6470.30	8.99	8.85
grants - milan	25112 El Morro El Morrow	100 YR (FEMA)	2440.00	6479.98	6478.65	6479.73	6478.04	1.69	384.57	6478.49	1.50	200.82	2055.43	6470.60	6470.30	8.99	8.85
grants - milan	25112 El Morro El Morrow	10-YR	929.00	6476.93	6476.39	6476.76	6476.22	0.55		6478.49			929.00	6470.60	6470.30	5.45	5.23
grants - milan	36158 Airport Street Airport St	100-YR	2440.00	6518.32	6518.31	6518.25	6518.23	0.02	2292.46	6515.91	2.54	1698.60	147.55	6509.50	6509.50	1.01	1.01
grants - milan	36158 Airport Street Airport St	100 YR (FEMA)	2440.00	6518.32	6518.31	6518.25	6518.23	0.02	2292.46	6515.91	2.54	1698.60	147.55	6509.50	6509.50	1.01	1.01
grants - milan	36158 Airport Street Airport St	10-YR	639.00	6516.20	6516.03	6515.91	6515.76	0.15	86.29	6515.91	0.43	160.35	552.71	6509.50	6509.50	3.78	3.78
grants - milan	41025 Santa Fe Av-Hrz US 66 (Horz)	100-YR	2440.00	6528.10	6527.70	6528.10	6527.66	0.44	1005.72	6526.59	1.53	936.77	1434.28	6520.15	6519.69	3.66	3.66
grants - milan	41025 Santa Fe Av-Hrz US 66 (Horz)	100 YR (FEMA)	2440.00	6528.10	6527.70	6528.10	6527.66	0.44	1005.72	6526.59	1.53	936.77	1434.28	6520.15	6519.69	3.66	3.66
grants - milan	41025 Santa Fe Av-Hrz US 66 (Horz)	10-YR	559.00	6523.27	6523.15	6523.20	6523.09	0.10		6526.59			559.00	6520.15	6519.69	2.41	2.12


Grants - Rio San Jose
Subcritical Flow
Legend
WS 100-YR
WS 100 YR (FEMA)
WS 10-YR
Ground
LOB
ROB
Elevation (ft)
6440
6430
6420
6410
6400
6390
2000
3000
4000
5000
6000
7000
8000
Main Channel Distance (ft)
2500.
3000.
3500.
4000.
4250
4500.
4566 Santa Fe RR-Mb
4655
5000.
5500.
5950
6100
6500.
7000.
7135
7174 McBride Road
7275
7500.
7750

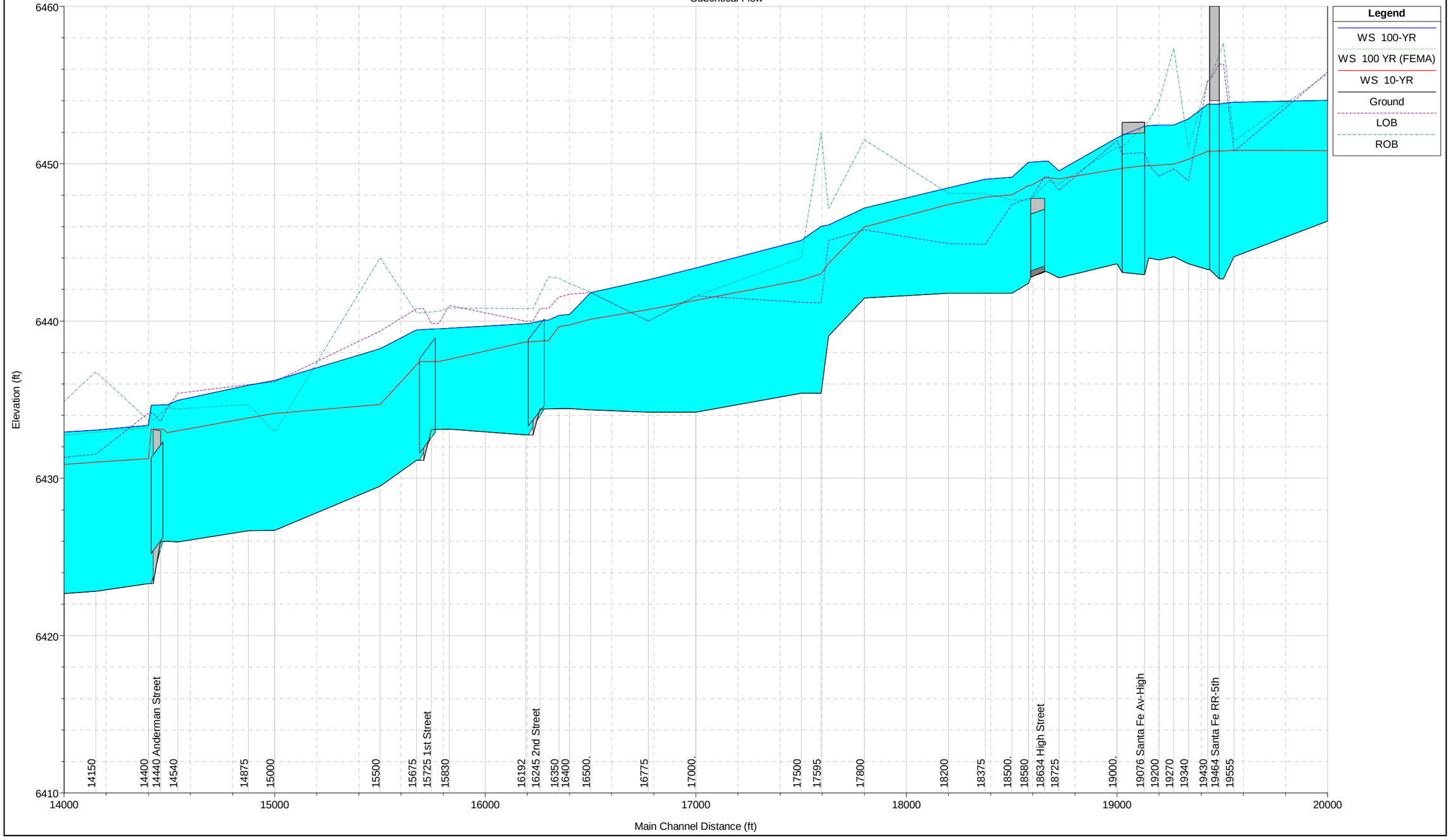
Grants - Rio San Jose

Subcritical Flow



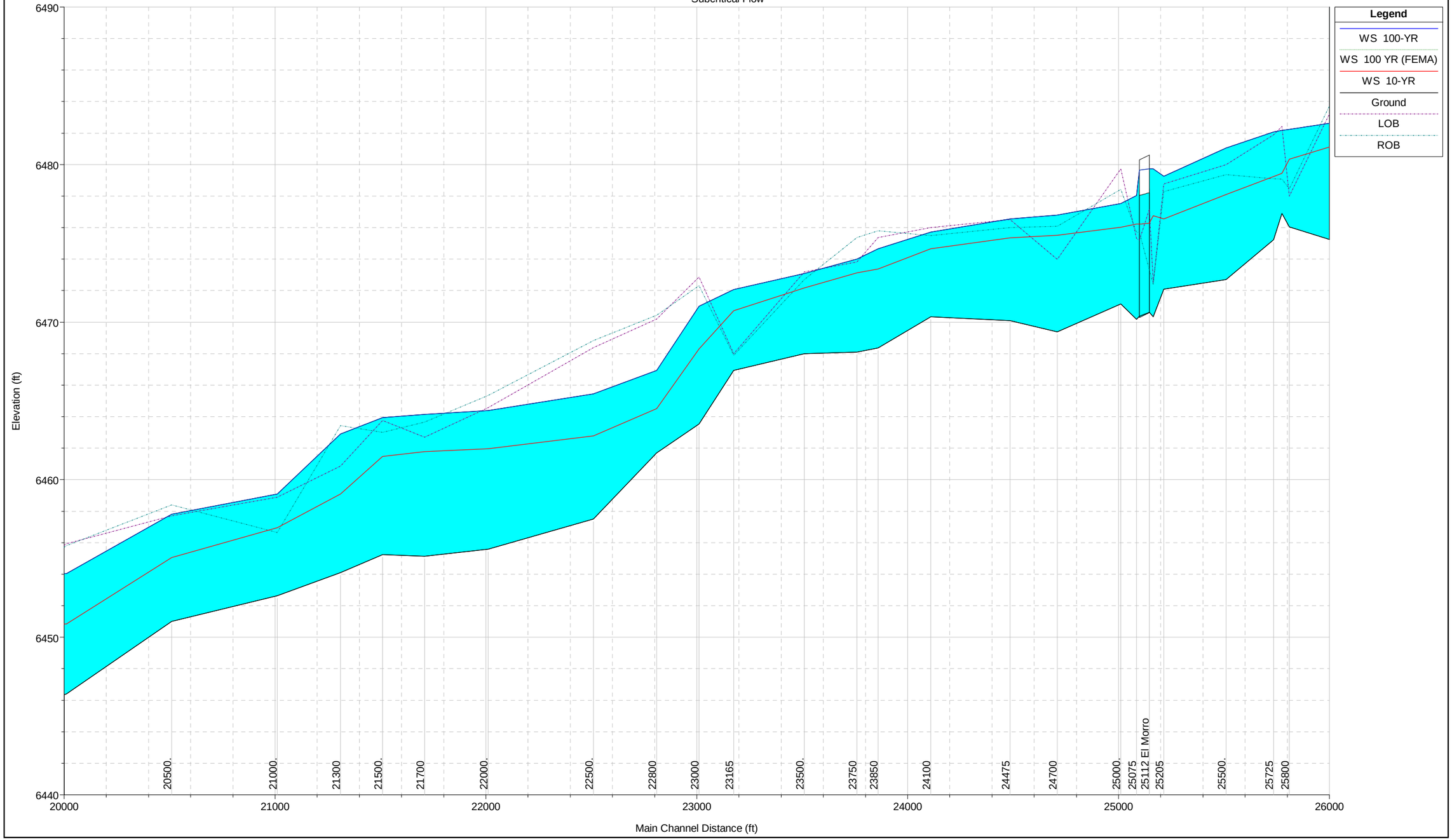
Grants - Rio San Jose

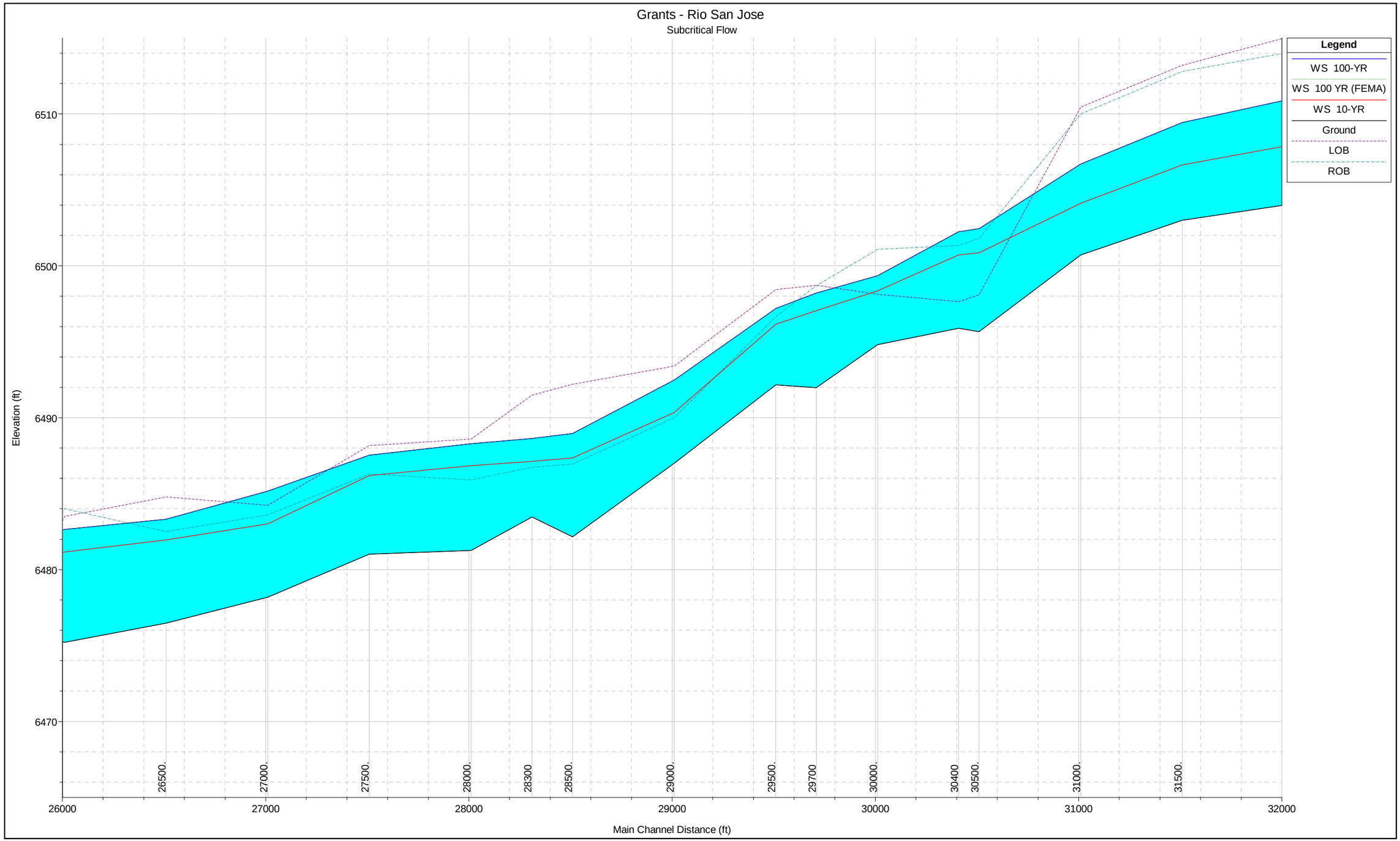
Subcritical Flow



Grants - Rio San Jose

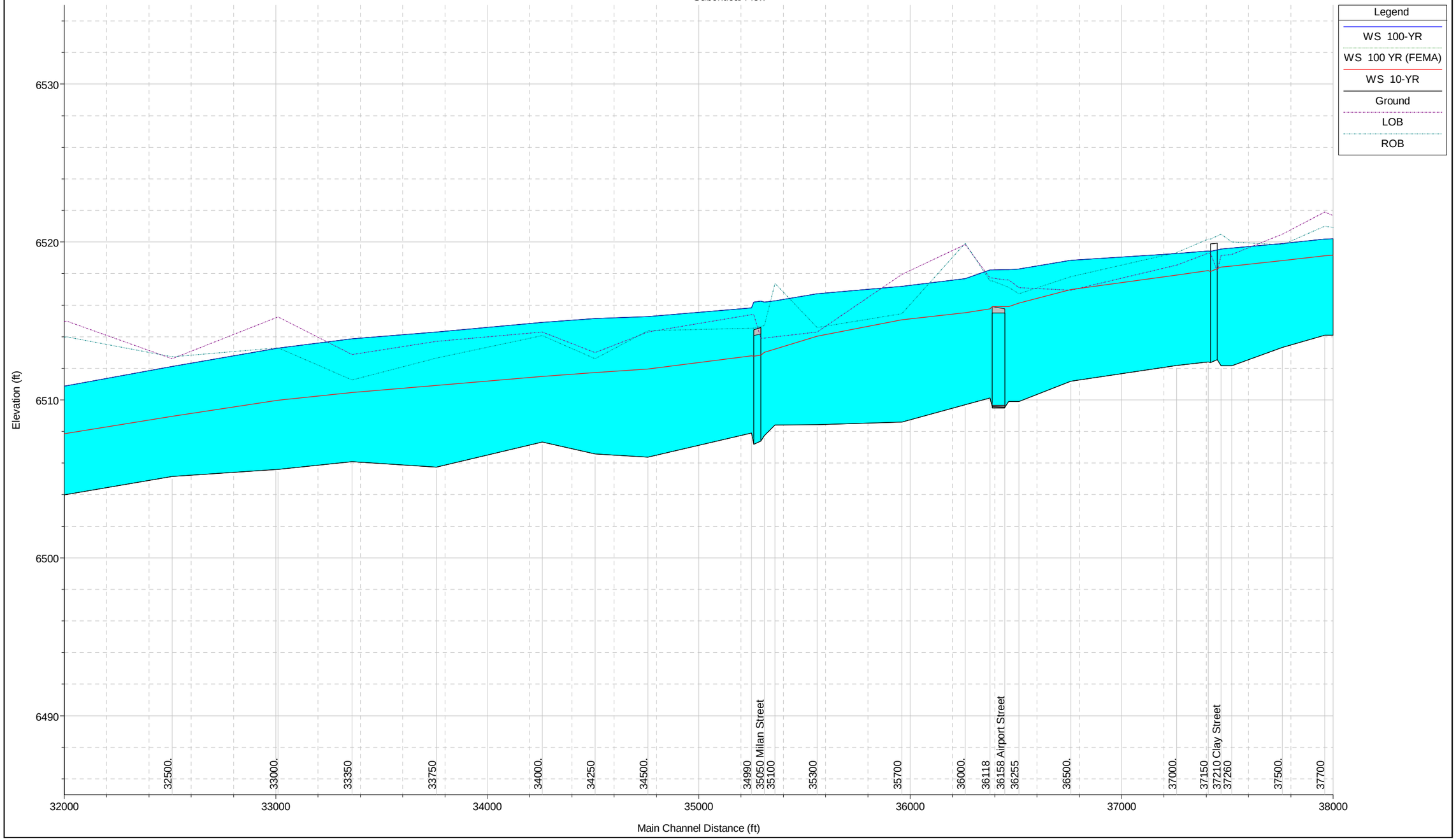
Subcritical Flow

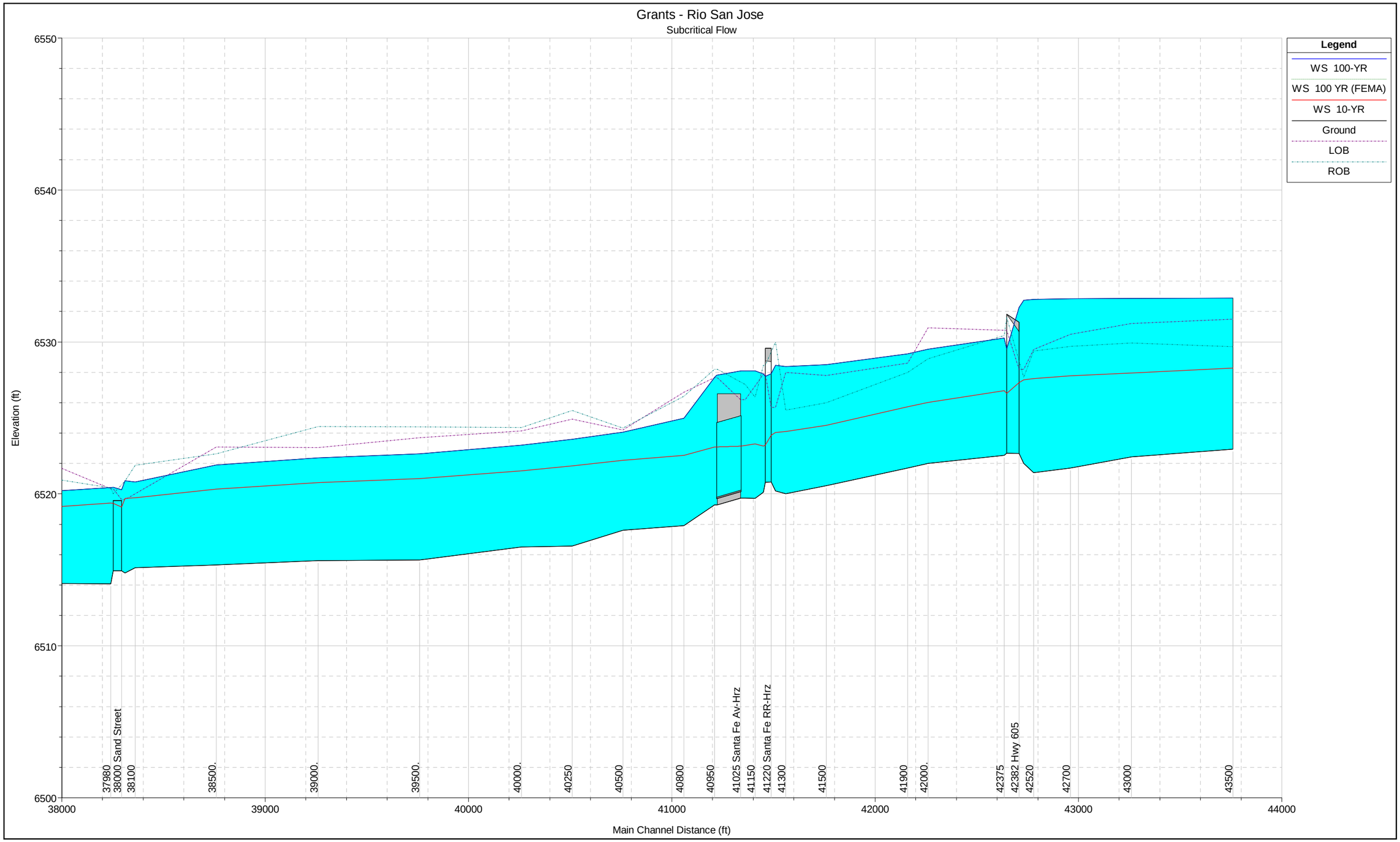


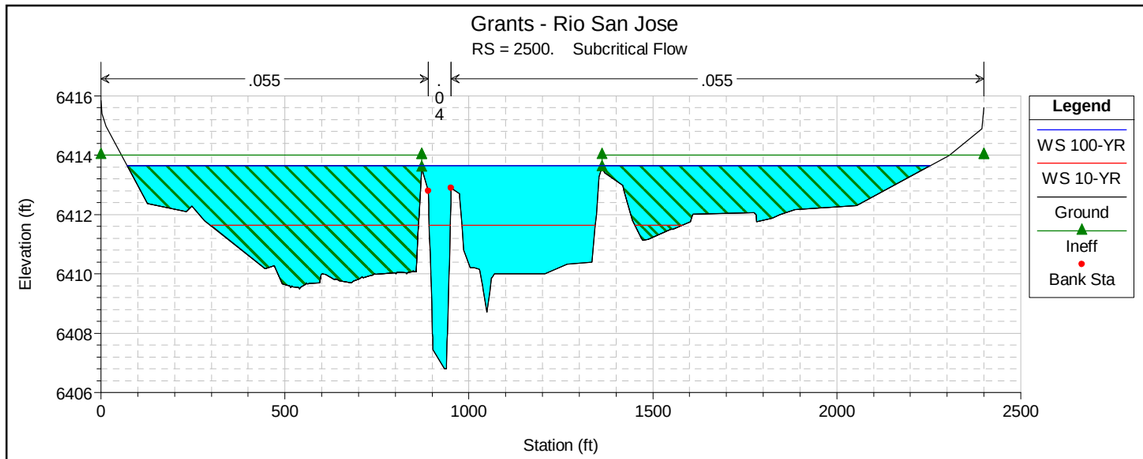

Grants - Rio San Jose
Subcritical Flow
Legend
WS 100-YR
WS 100 YR (FEMA)
WS 10-YR
Ground
LOB
ROB
Elevation (ft)
6510
6500
6490
6480
6470
26500.
27000.
27500.
28000.
28300
28500.
29000.
29500.
29700
30000.
30400
30500.
31000.
31500.
26000
27000
28000
29000
30000
31000
32000
Main Channel Distance (ft)

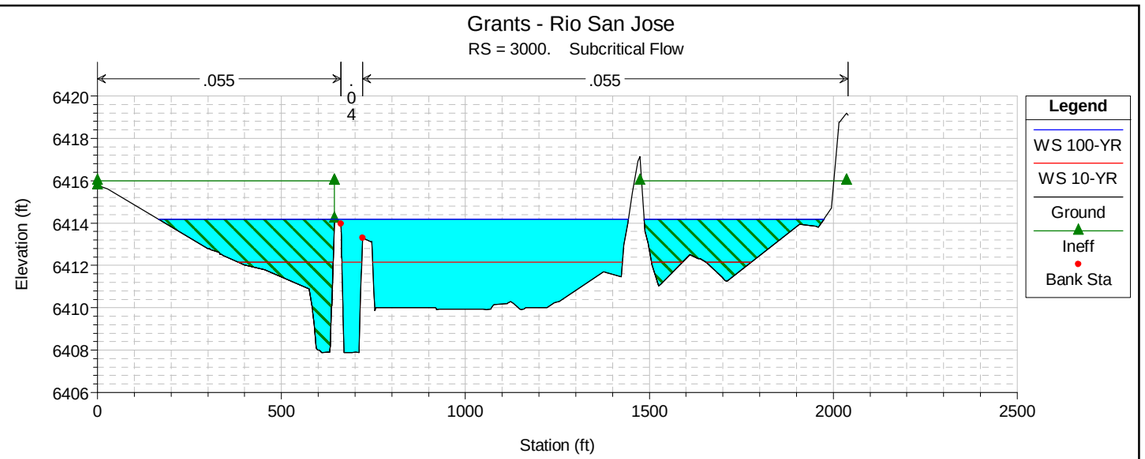
Grants - Rio San Jose

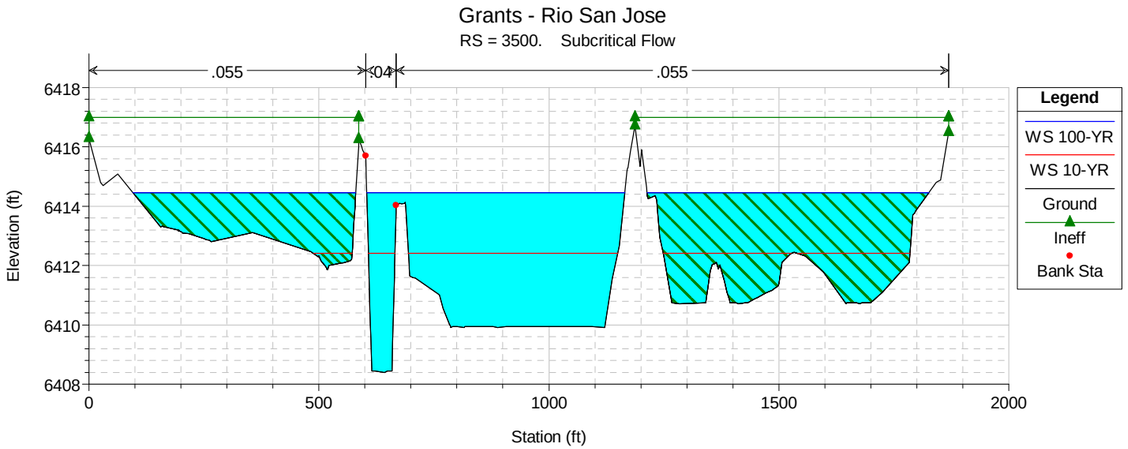
Subcritical Flow

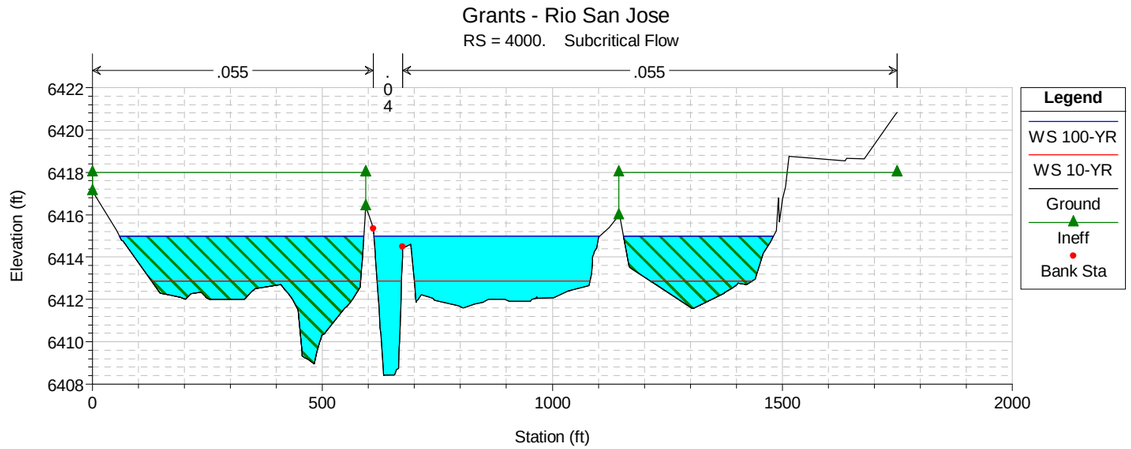


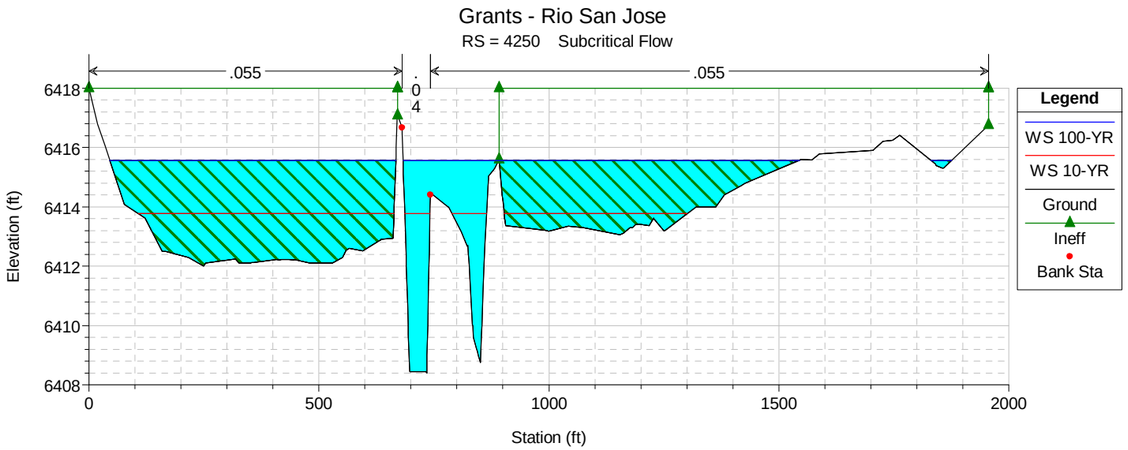

Grants - Rio San Jose
Subcritical Flow
Legend
WS 100-YR
WS 100 YR (FEMA)
WS 10-YR
Ground
LOB
ROB
Elevation (ft)
6550
6540
6530
6520
6510
6500
38000
39000
40000
41000
42000
43000
44000
Main Channel Distance (ft)
37980
38000 Sand Street
38100
38500.
39000.
39500.
40000.
40250
40500
40800
40950
41025 Santa Fe Av-Hrz
41150
41220 Santa Fe RR-Hrz
41300
41500
41900
42000.
42375
42382 Hwy 605
42520
42700
43000
43500

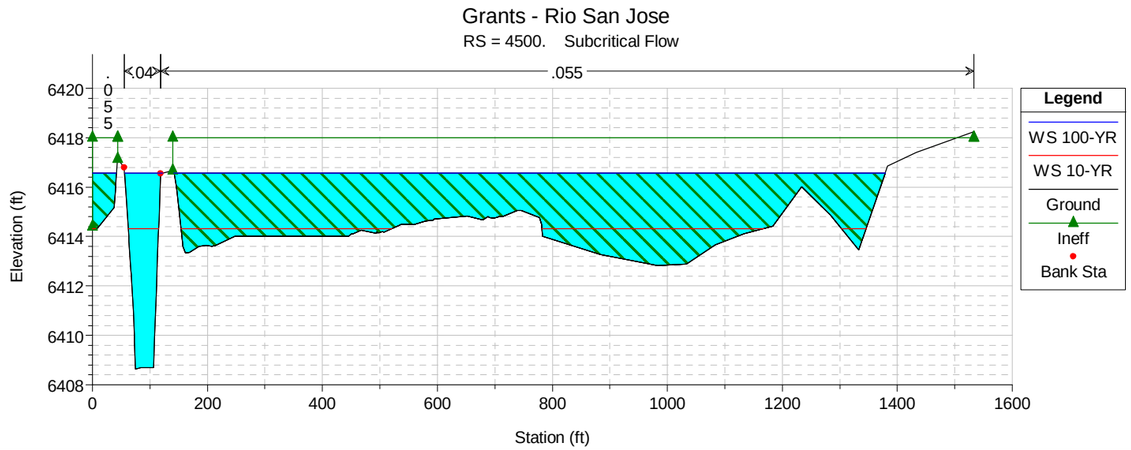

Grants - Rio San Jose
RS = 2500. Subcritical Flow
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

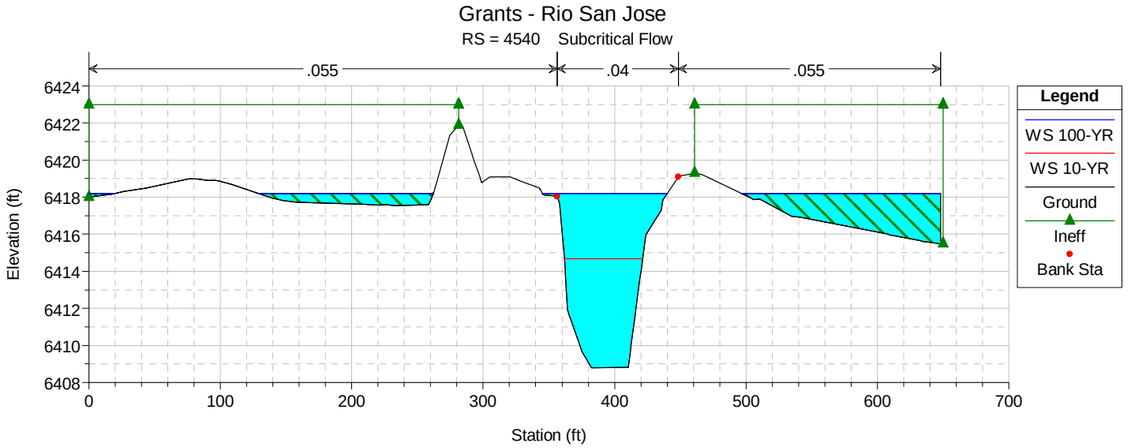

Grants - Rio San Jose
RS = 3000. Subcritical Flow
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

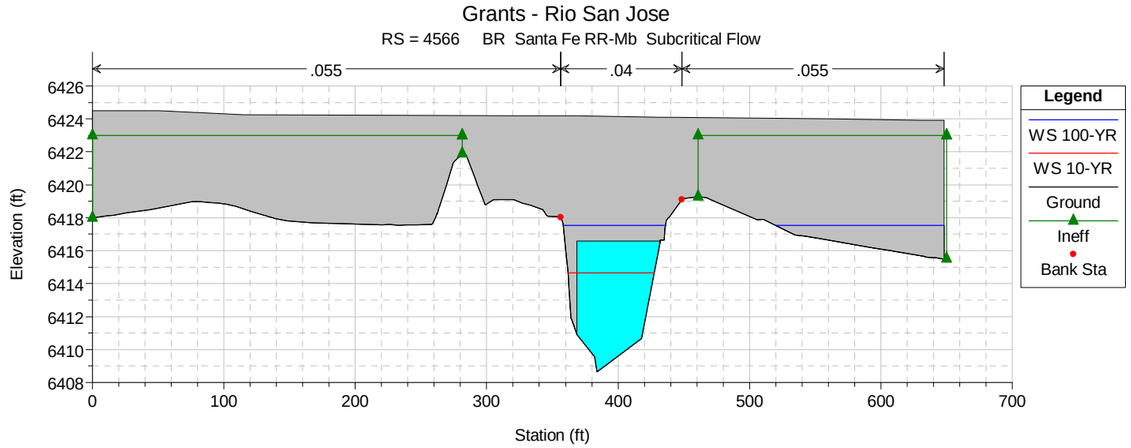

Grants - Rio San Jose
RS = 3500. Subcritical Flow
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

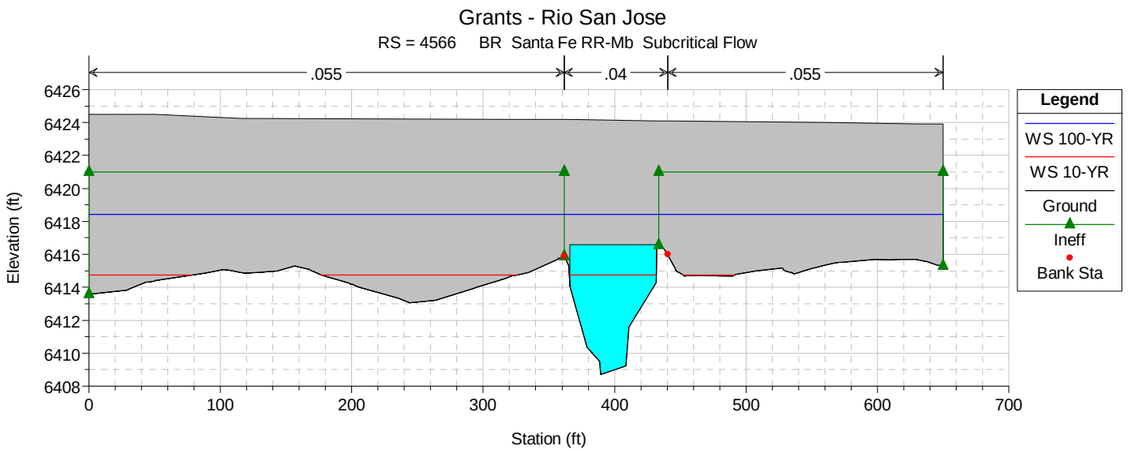

Grants - Rio San Jose
RS = 4000. Subcritical Flow
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

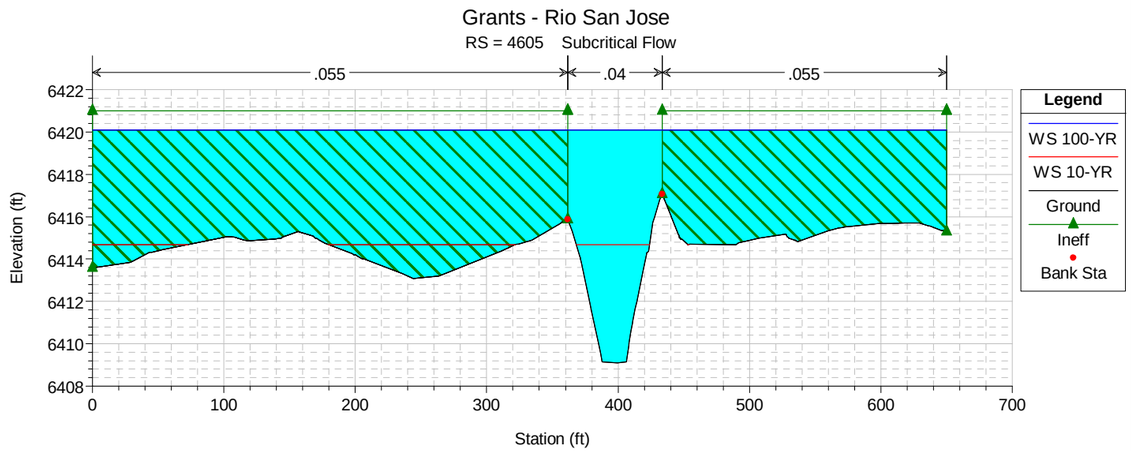

Grants - Rio San Jose
RS = 4250 Subcritical Flow
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

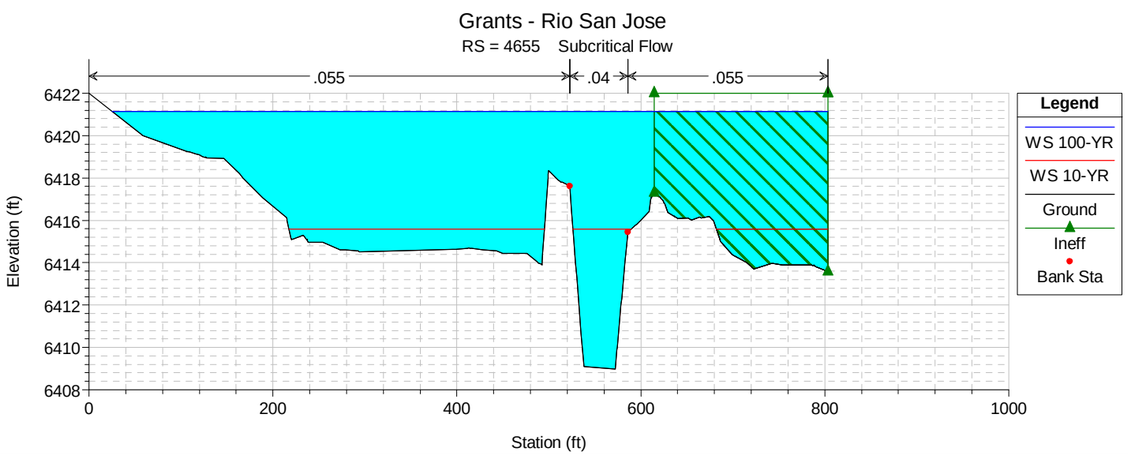

Grants - Rio San Jose
RS = 4500. Subcritical Flow
.055
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

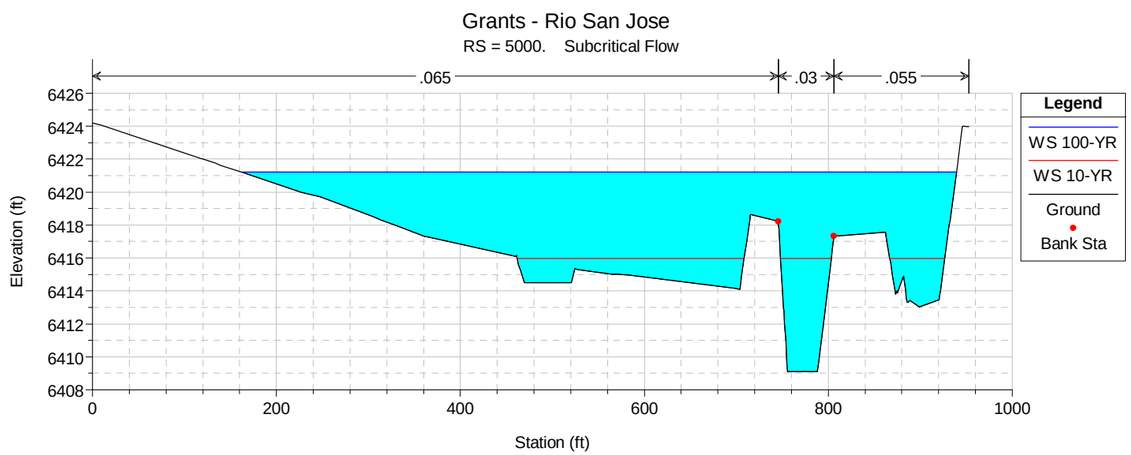

Grants - Rio San Jose
RS = 4540 Subcritical Flow
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

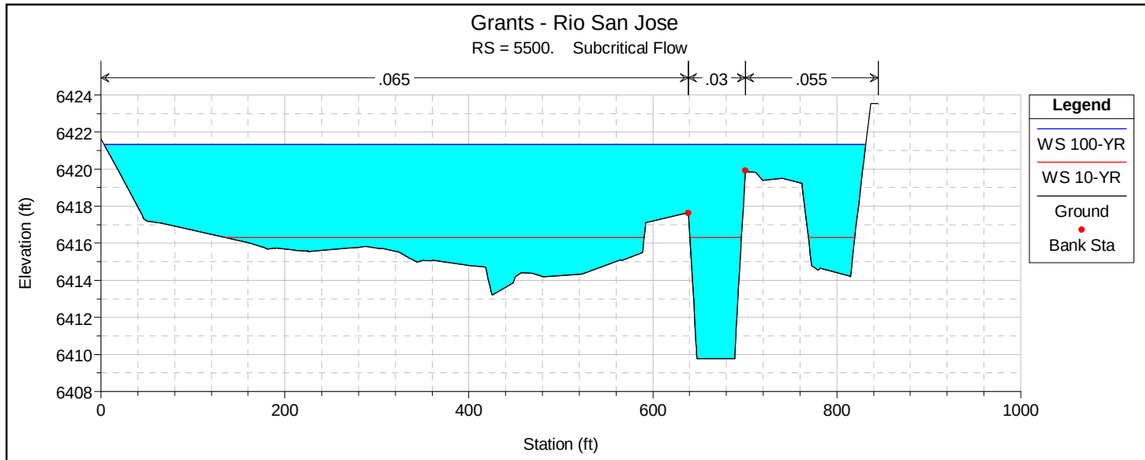

Grants - Rio San Jose
RS = 4566 BR Santa Fe RR-Mb Subcritical Flow
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

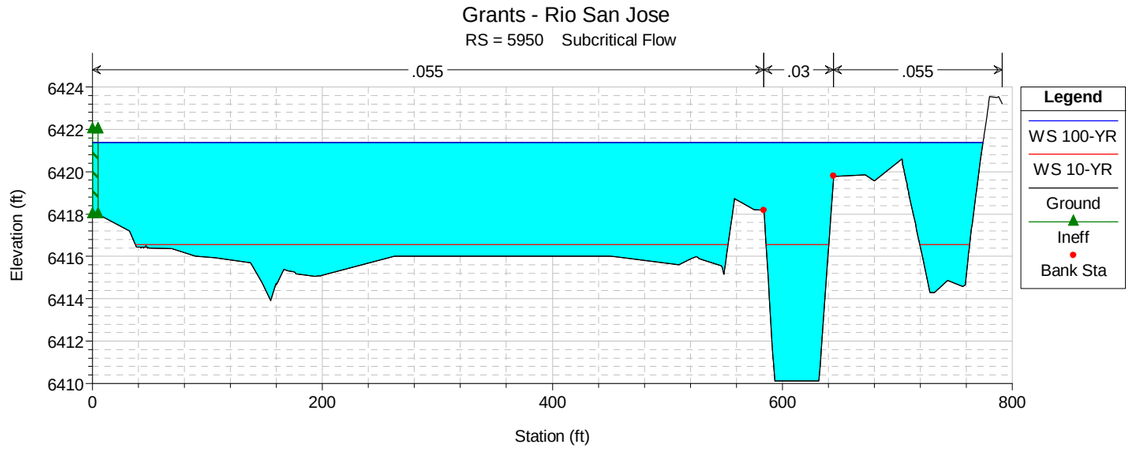

Grants - Rio San Jose
RS = 4566 BR Santa Fe RR-Mb Subcritical Flow
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

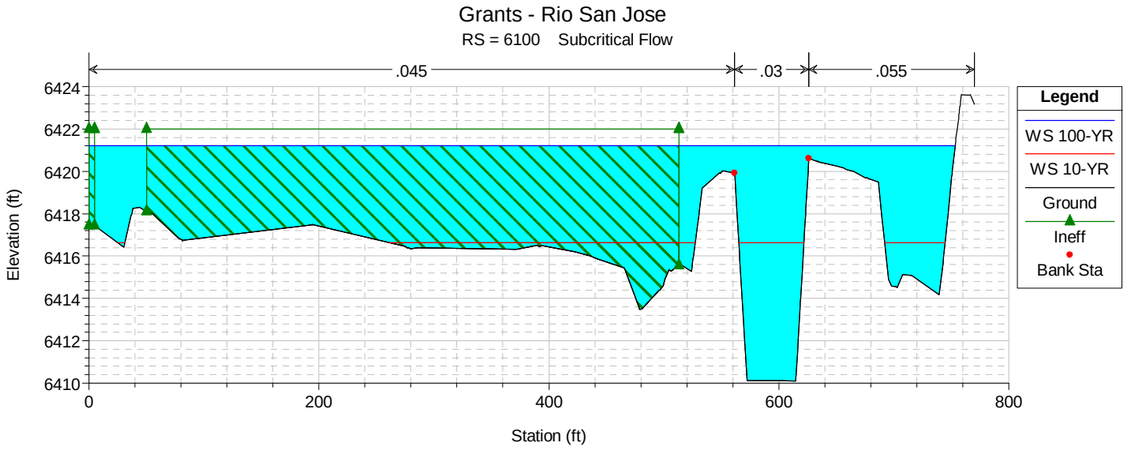

Grants - Rio San Jose
RS = 4605 Subcritical Flow
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

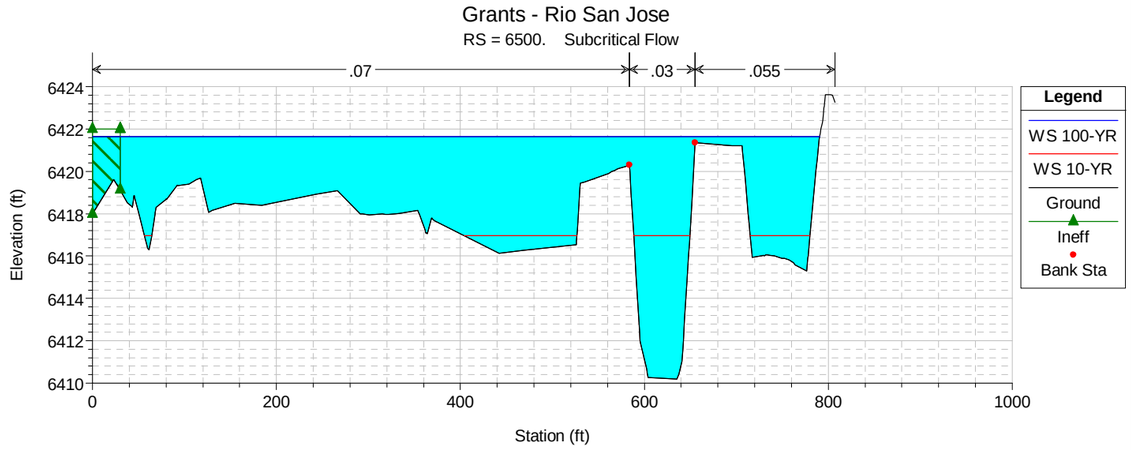

Grants - Rio San Jose
RS = 4655 Subcritical Flow
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

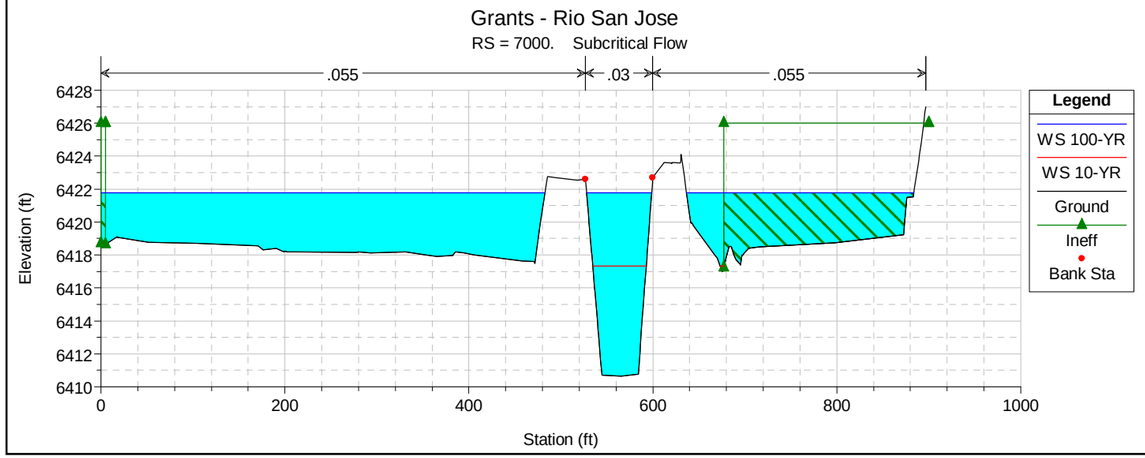

Grants - Rio San Jose
RS = 5000. Subcritical Flow
.065
.03
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

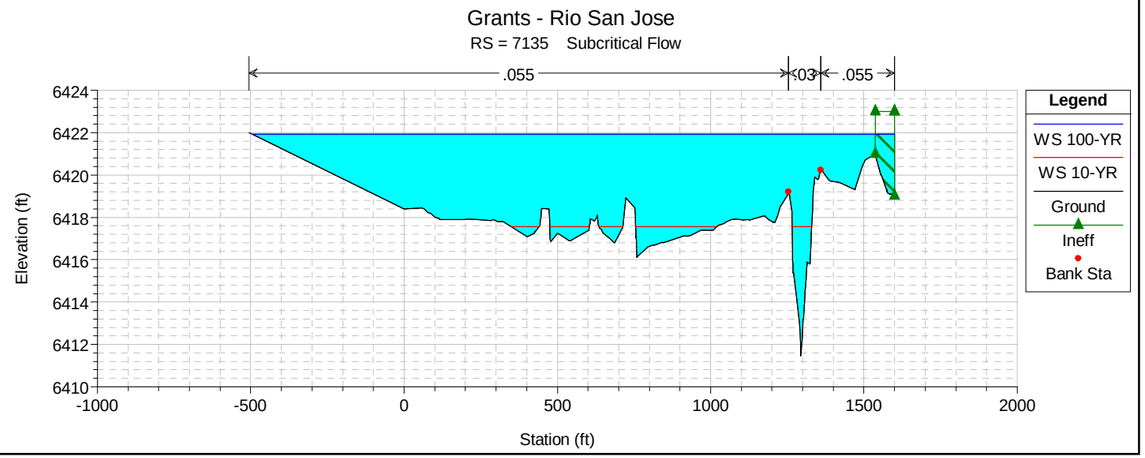

Grants - Rio San Jose
RS = 5500. Subcritical Flow
.065
.03
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

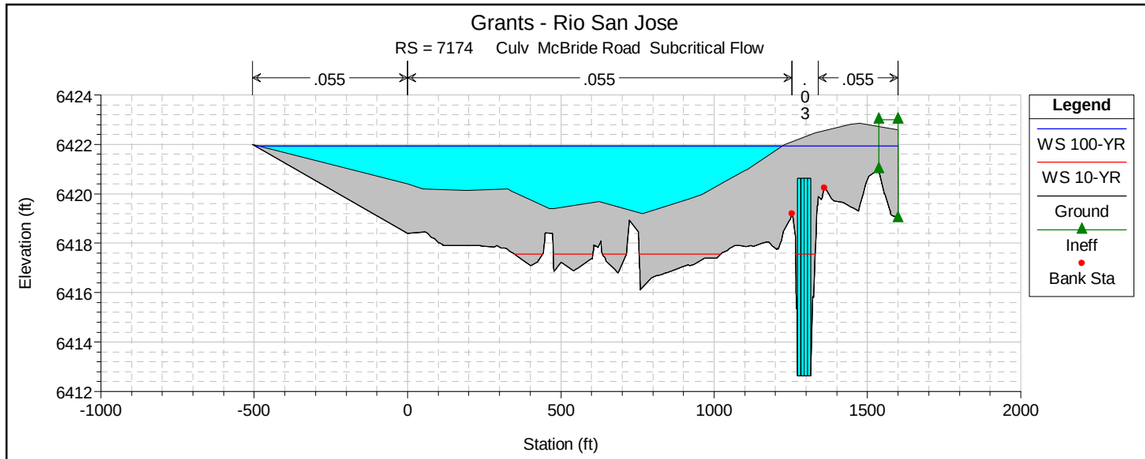

Grants - Rio San Jose
RS = 5950 Subcritical Flow
.055
.03
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

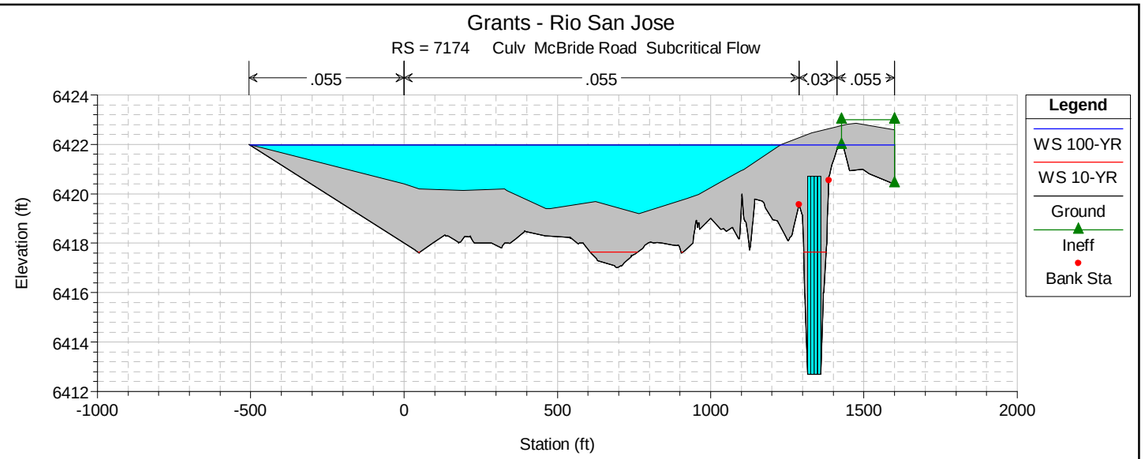

Grants - Rio San Jose
RS = 6100 Subcritical Flow
.045
.03
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

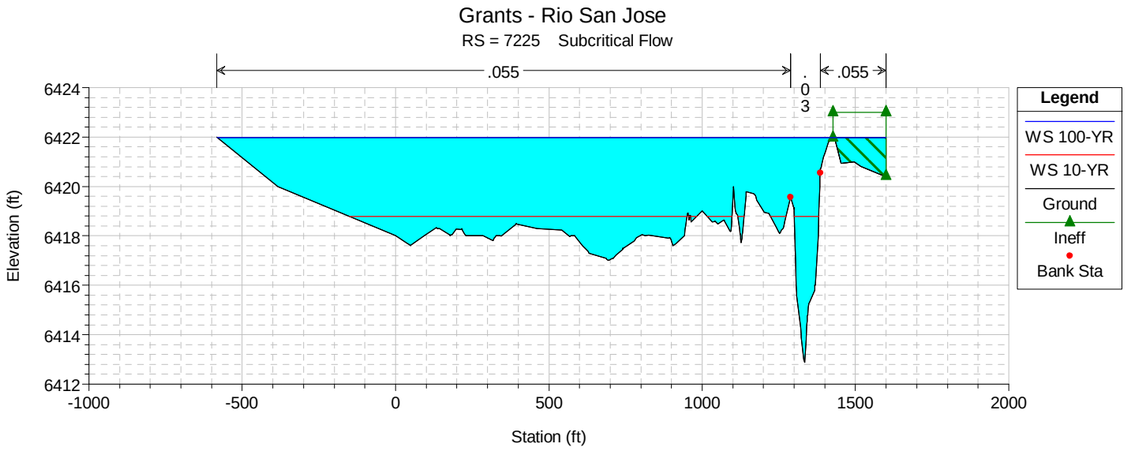

Grants - Rio San Jose
RS = 6500. Subcritical Flow
.07
.03
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

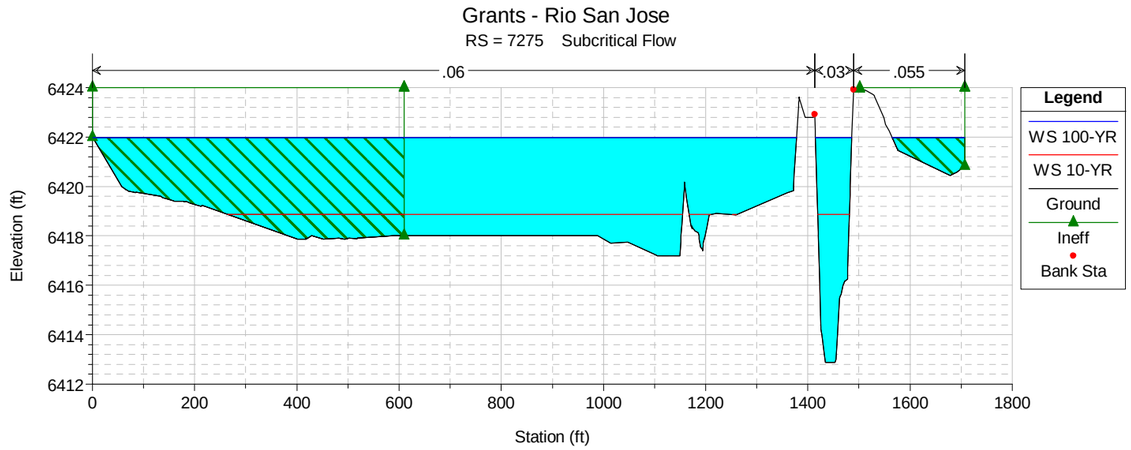

Grants - Rio San Jose
RS = 7000. Subcritical Flow
.055
.03
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

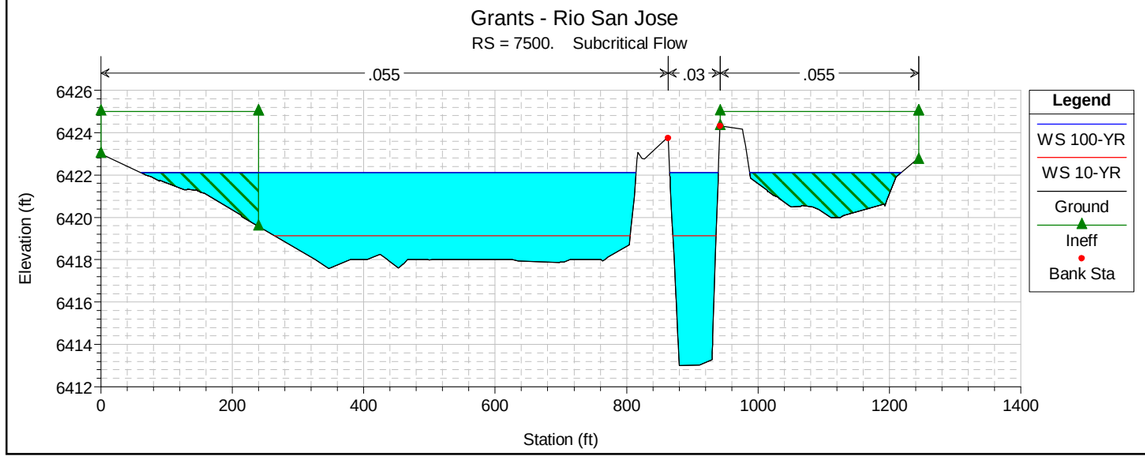

Grants - Rio San Jose
RS = 7135 Subcritical Flow
.055
.03
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

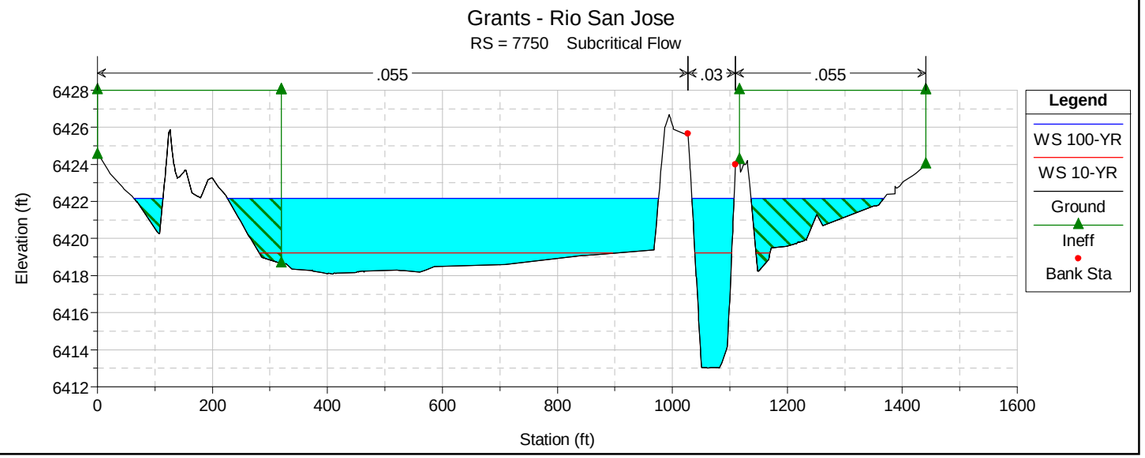

Grants - Rio San Jose
RS = 7174 Culv McBride Road Subcritical Flow
.055
.055
.03
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

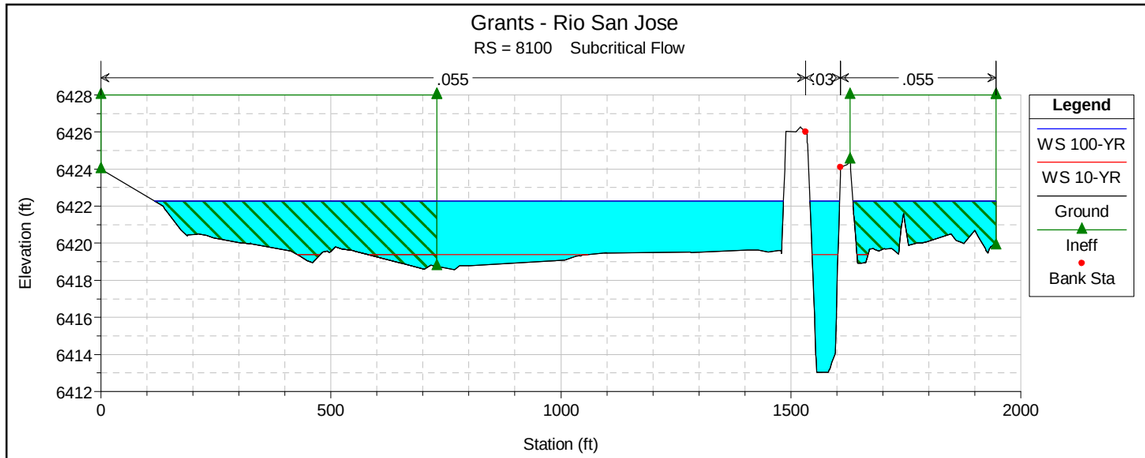

Grants - Rio San Jose
RS = 7174 Culv McBride Road Subcritical Flow
.055
.055
.03
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

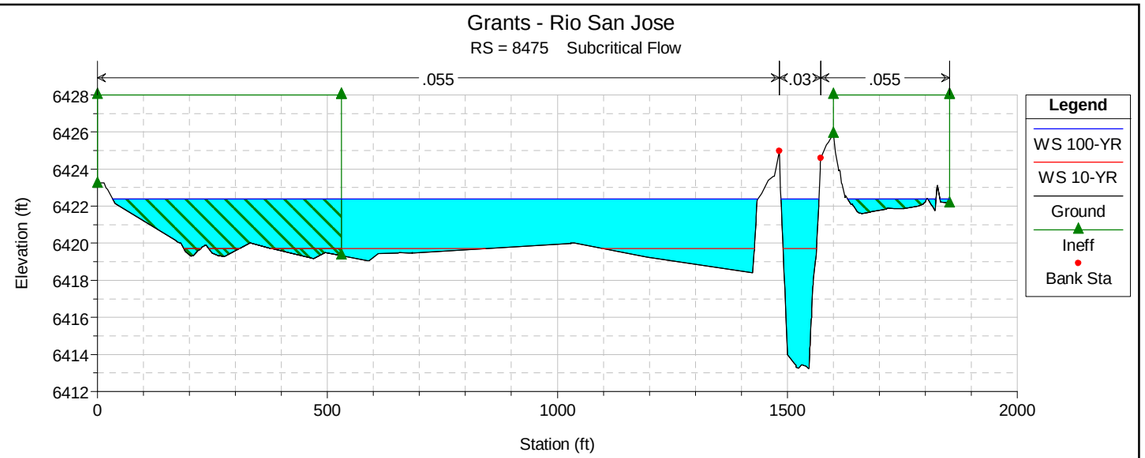

Grants - Rio San Jose
RS = 7225 Subcritical Flow
.055
.03
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

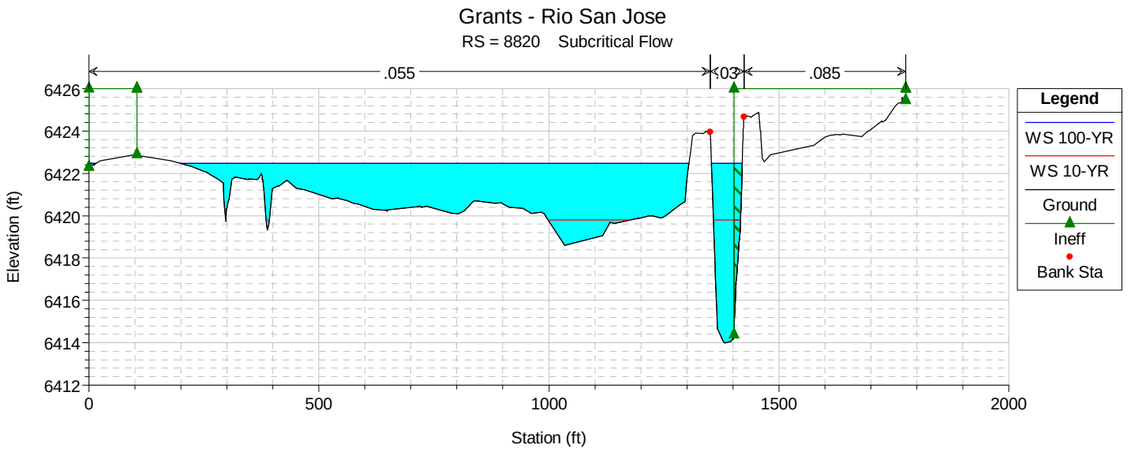

Grants - Rio San Jose
RS = 7275 Subcritical Flow
.06
.03
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

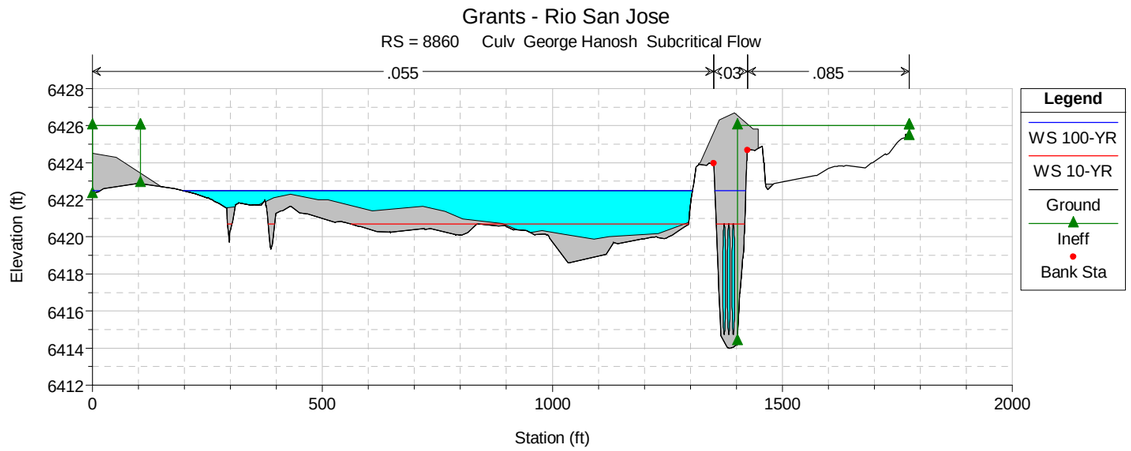

Grants - Rio San Jose
RS = 7500. Subcritical Flow
.055
.03
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

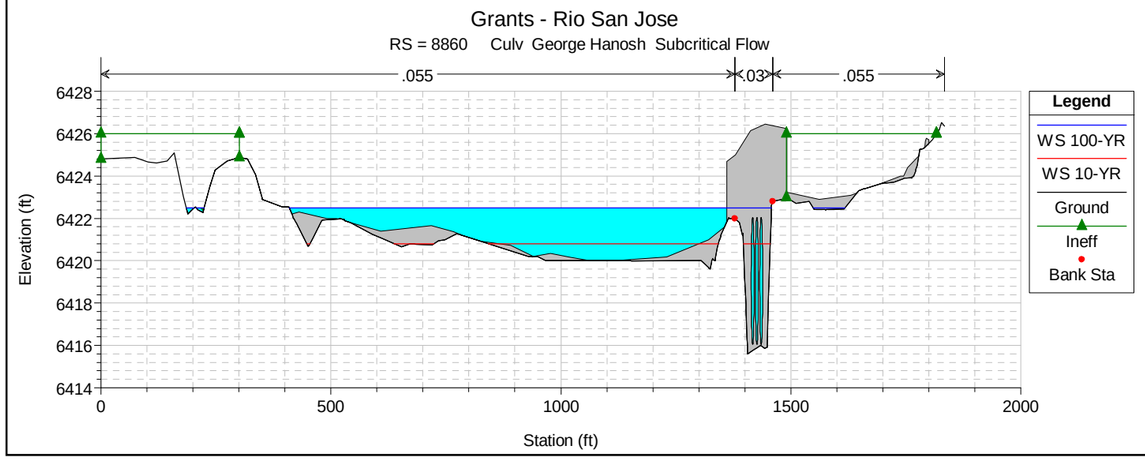

Grants - Rio San Jose
RS = 7750 Subcritical Flow
.055
.03
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

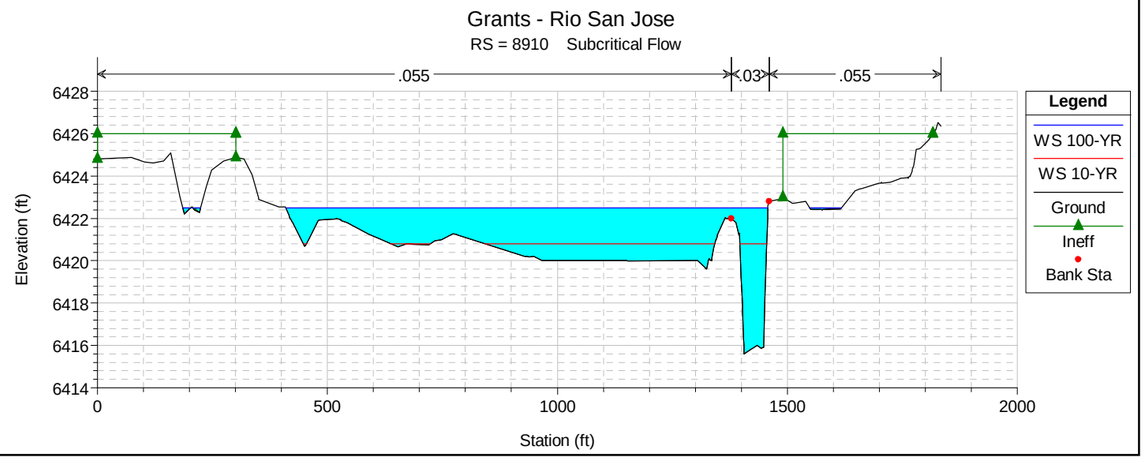

Grants - Rio San Jose
RS = 8100 Subcritical Flow
.055
.03
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

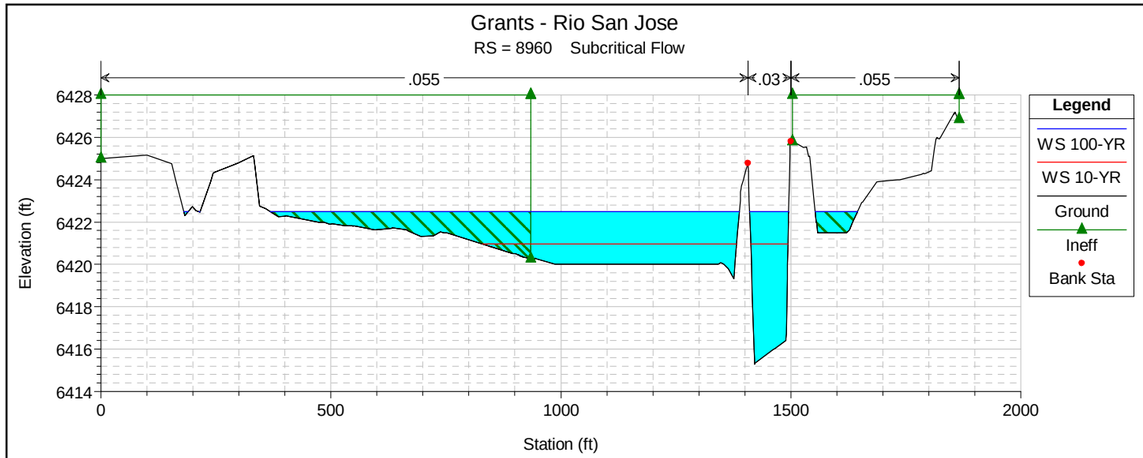

Grants - Rio San Jose
RS = 8475 Subcritical Flow
.055
.03
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

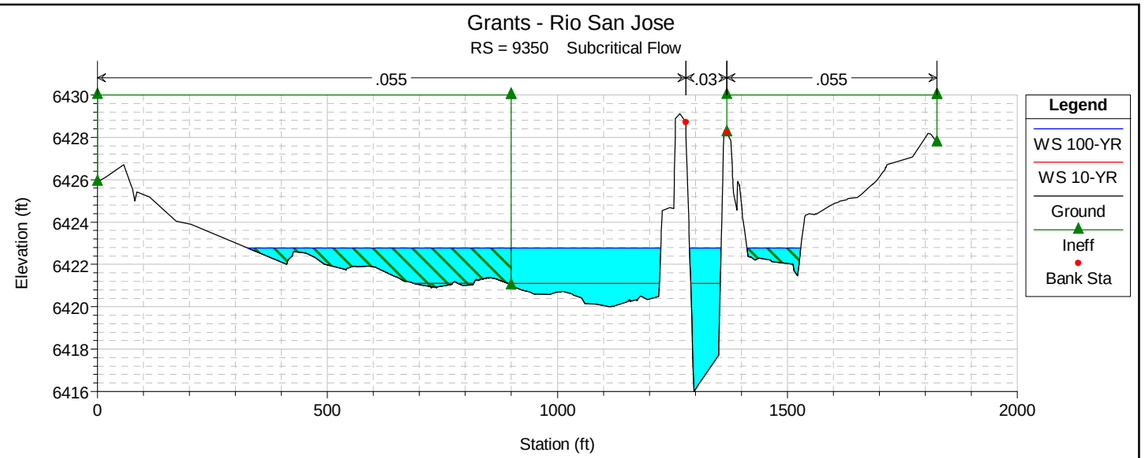

Grants - Rio San Jose
RS = 8820 Subcritical Flow
.055
.03
.085
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

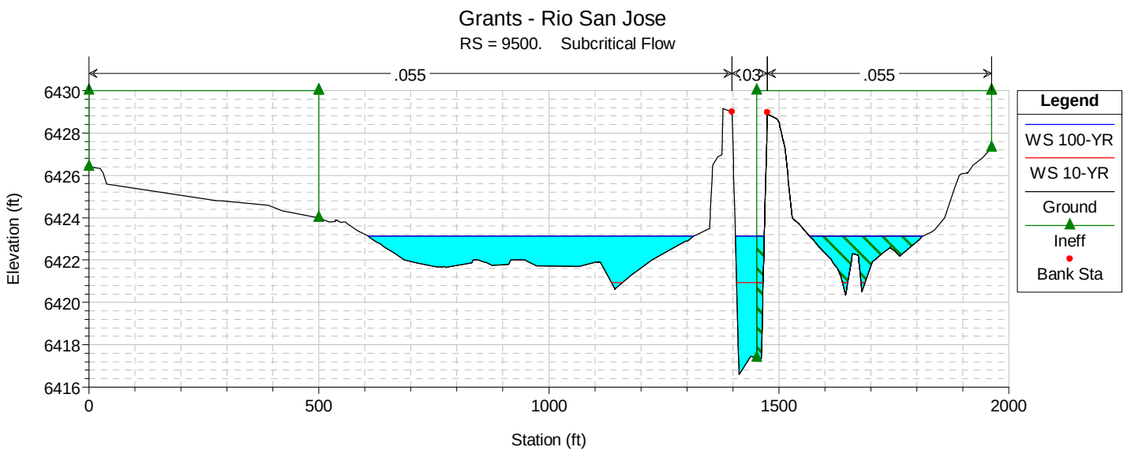

Grants - Rio San Jose
RS = 8860 Culv George Hanosh Subcritical Flow
.055
.03
.085
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

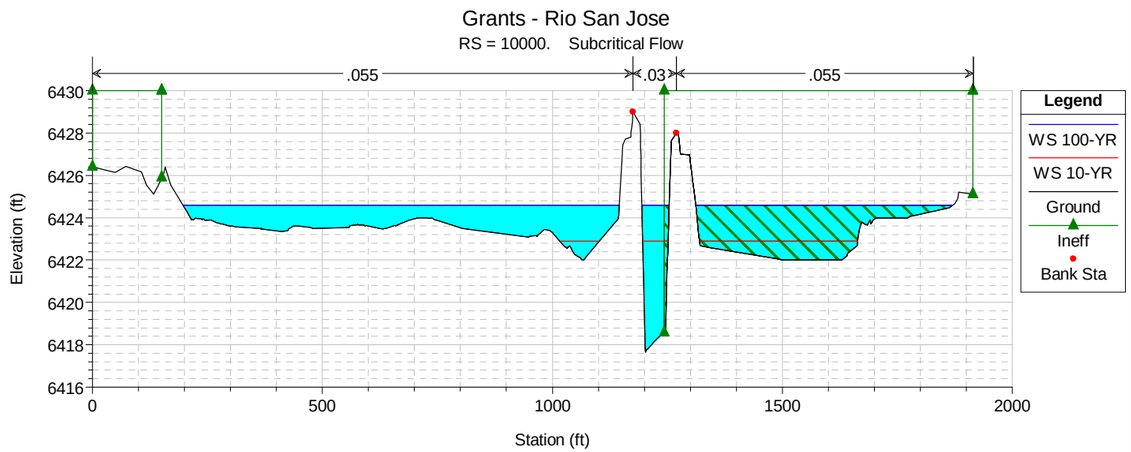

Grants - Rio San Jose
RS = 8860 Culv George Hanosh Subcritical Flow
.055
.03
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

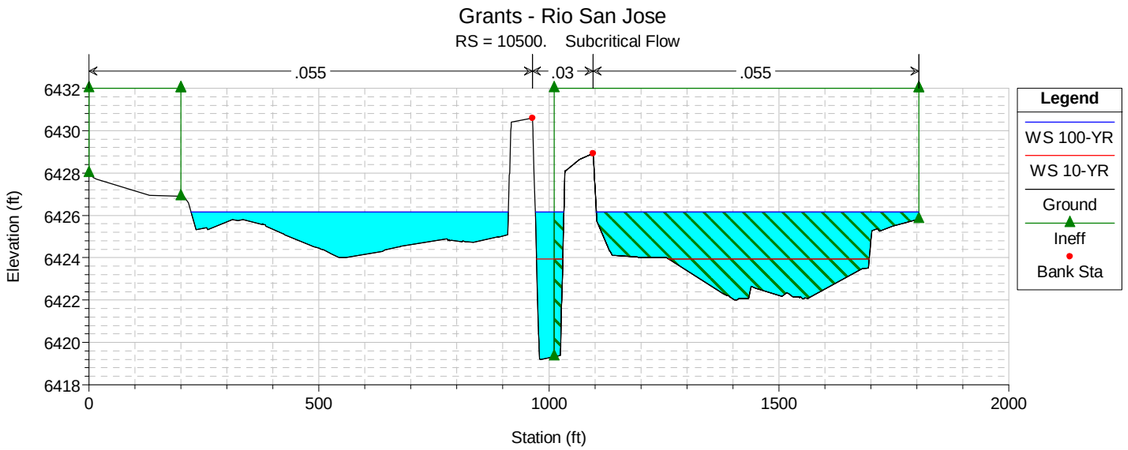

Grants - Rio San Jose
RS = 8910 Subcritical Flow
.055
.03
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

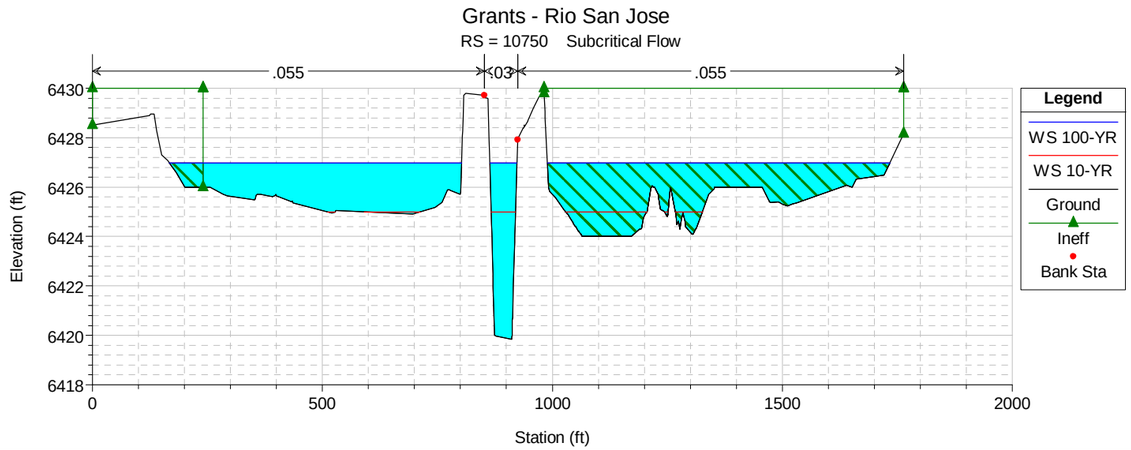

Grants - Rio San Jose
RS = 8960 Subcritical Flow
.055
.03
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

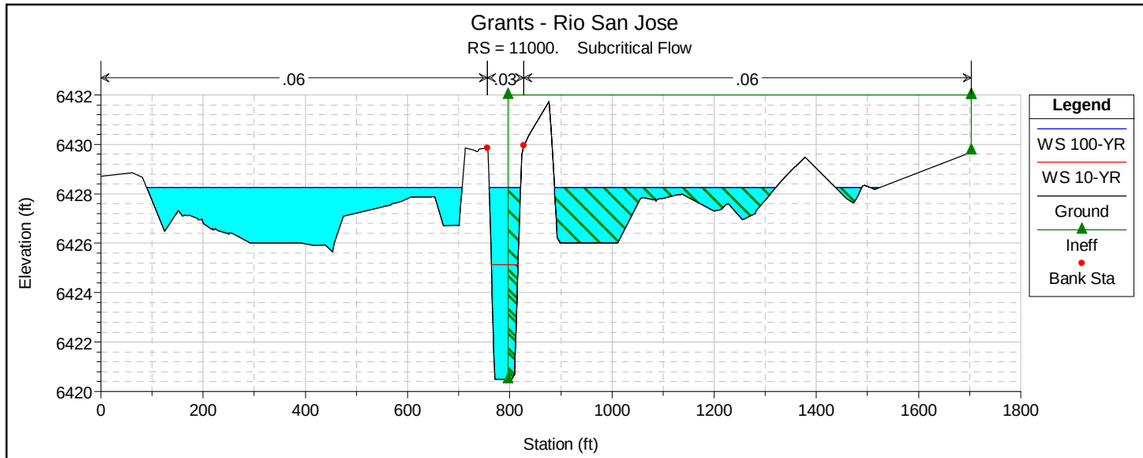

Grants - Rio San Jose
RS = 9350 Subcritical Flow
.055
.03
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

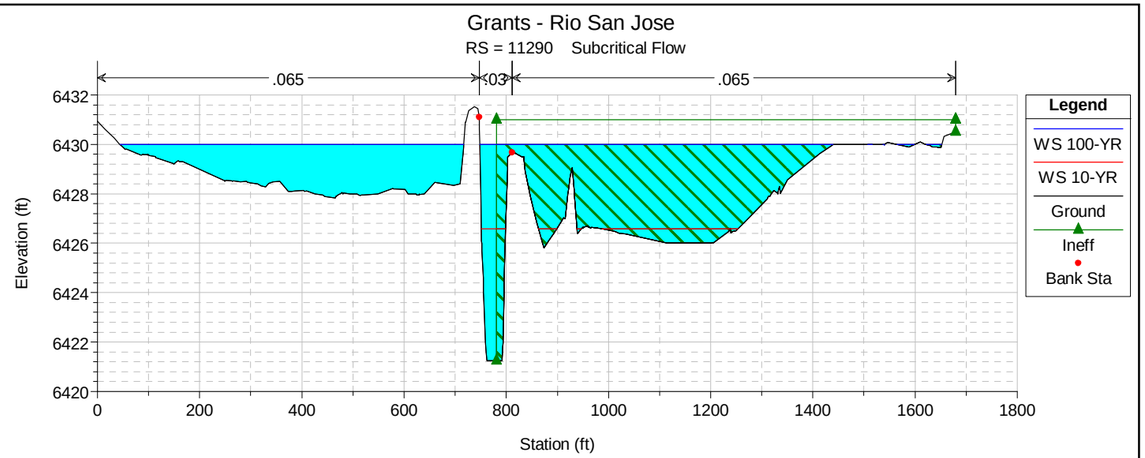

Grants - Rio San Jose
RS = 9500. Subcritical Flow
.055
.03
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

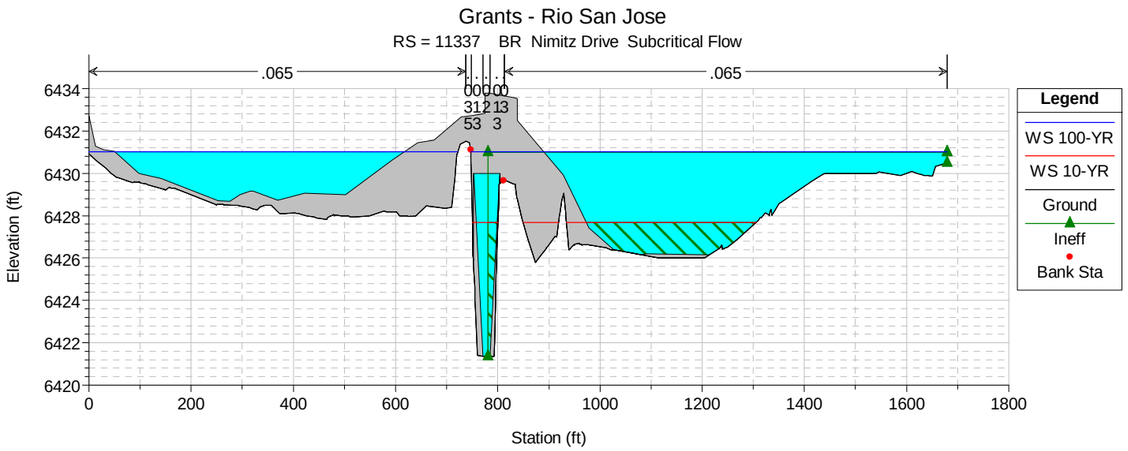

Grants - Rio San Jose
RS = 10000. Subcritical Flow
.055
.03
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

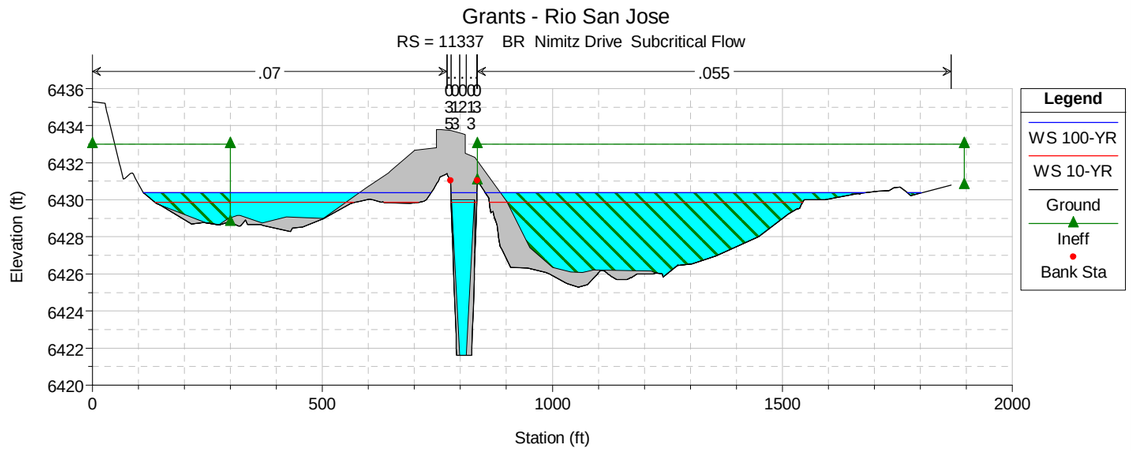

Grants - Rio San Jose
RS = 10500. Subcritical Flow
.055
.03
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

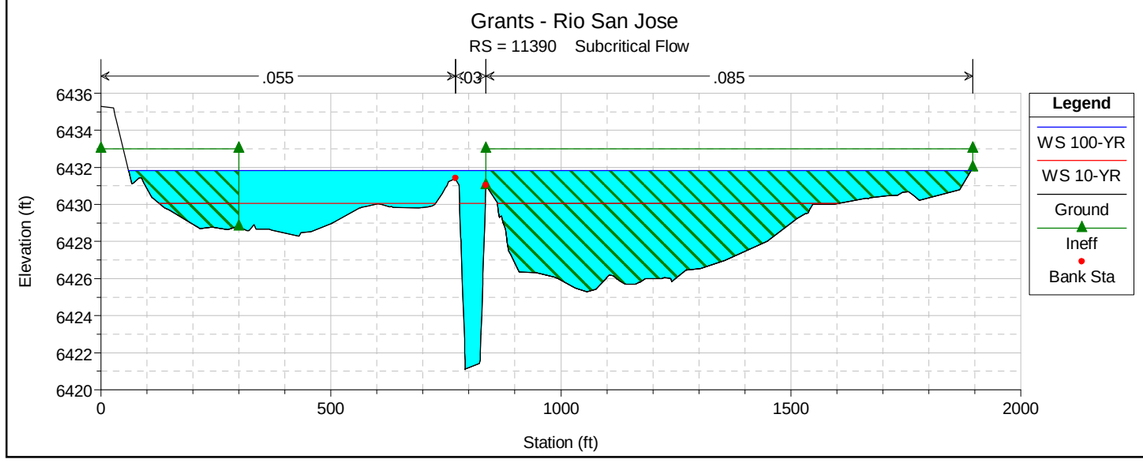

Grants - Rio San Jose
RS = 10750 Subcritical Flow
.055
.03
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

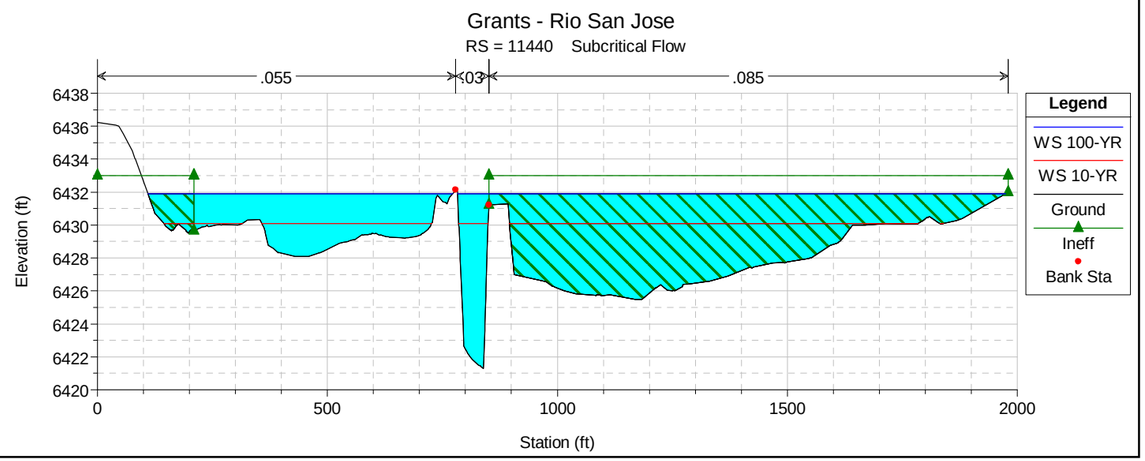

Grants - Rio San Jose
RS = 11000. Subcritical Flow
.06
.03
.06
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

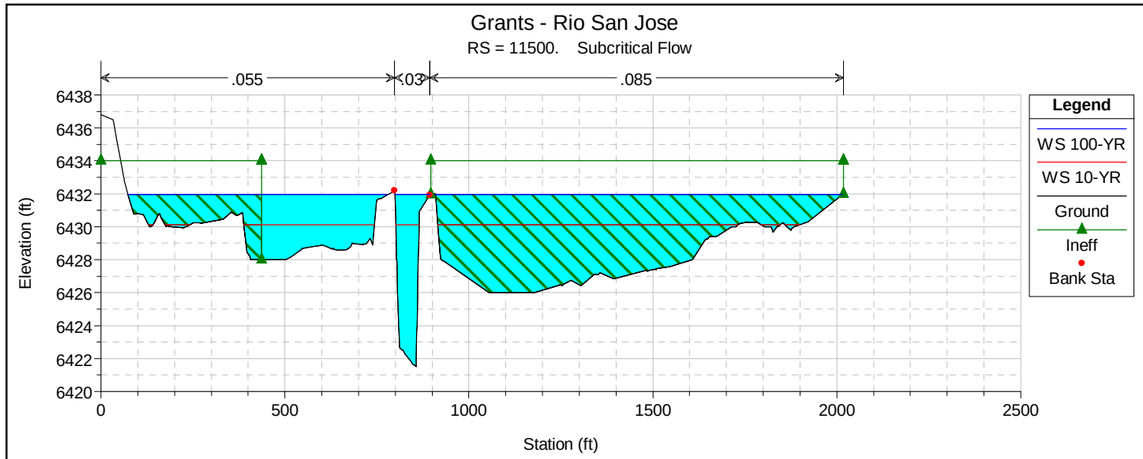

Grants - Rio San Jose
RS = 11290 Subcritical Flow
.065
.03
.065
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

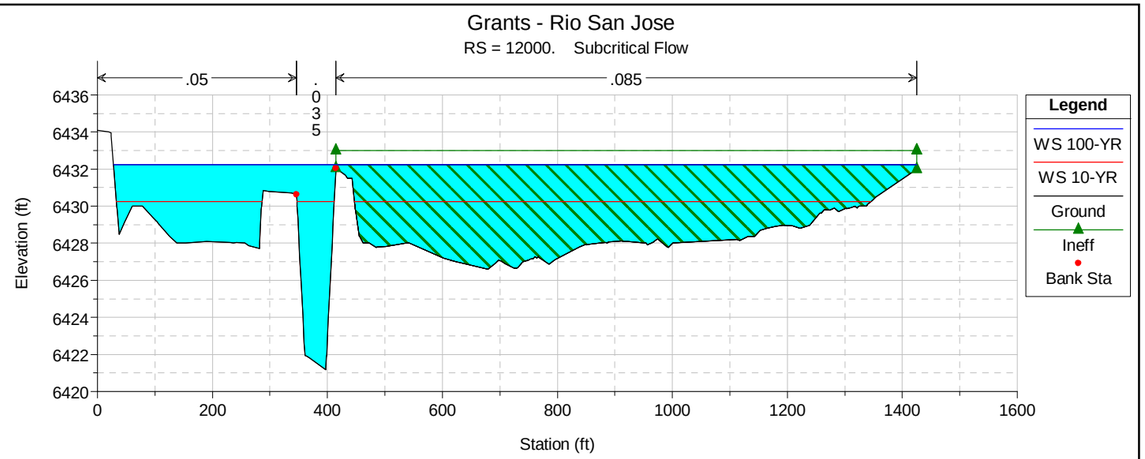

Grants - Rio San Jose
RS = 11337 BR Nimitz Drive Subcritical Flow
.065
.065
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

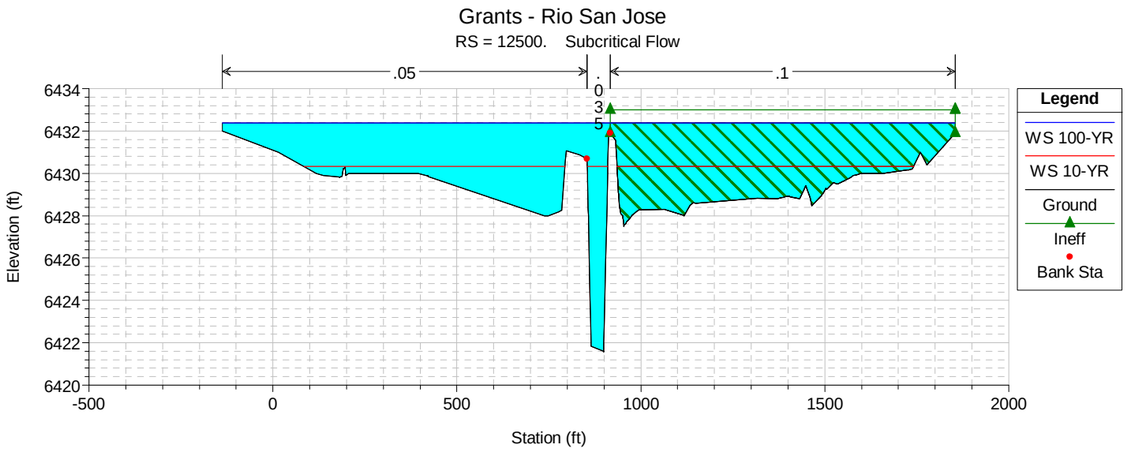

Grants - Rio San Jose
RS = 11337 BR Nimitz Drive Subcritical Flow
.07
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

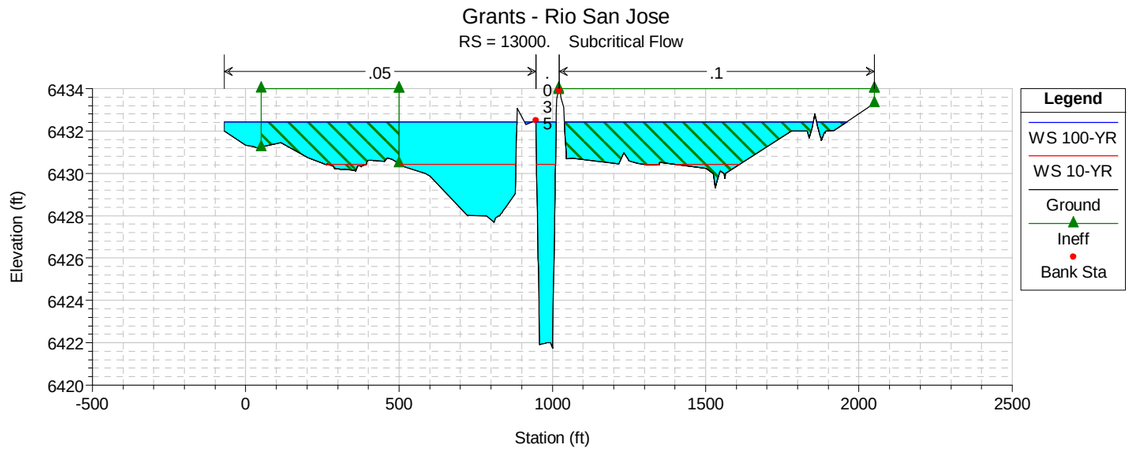

Grants - Rio San Jose
RS = 11390 Subcritical Flow
.055
.03
.085
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

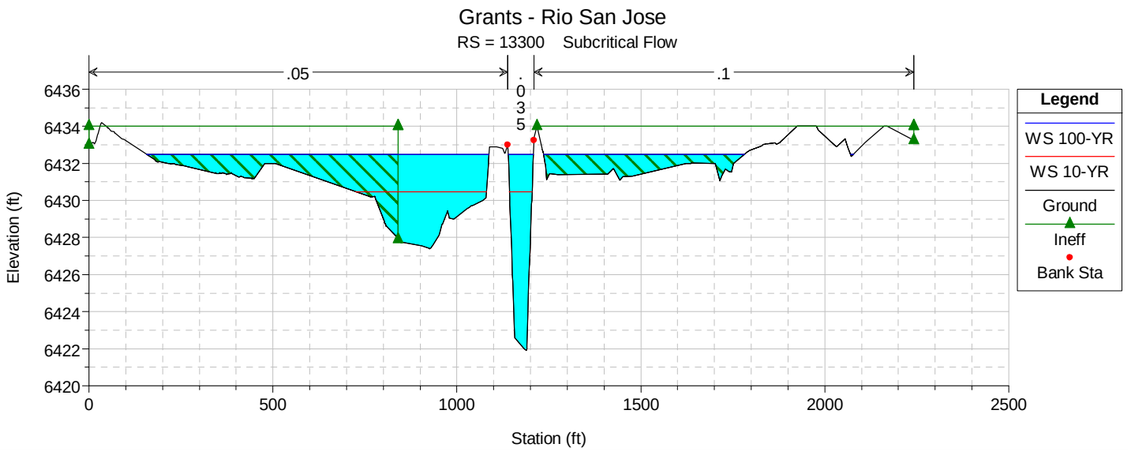

Grants - Rio San Jose
RS = 11440 Subcritical Flow
.055
.03
.085
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

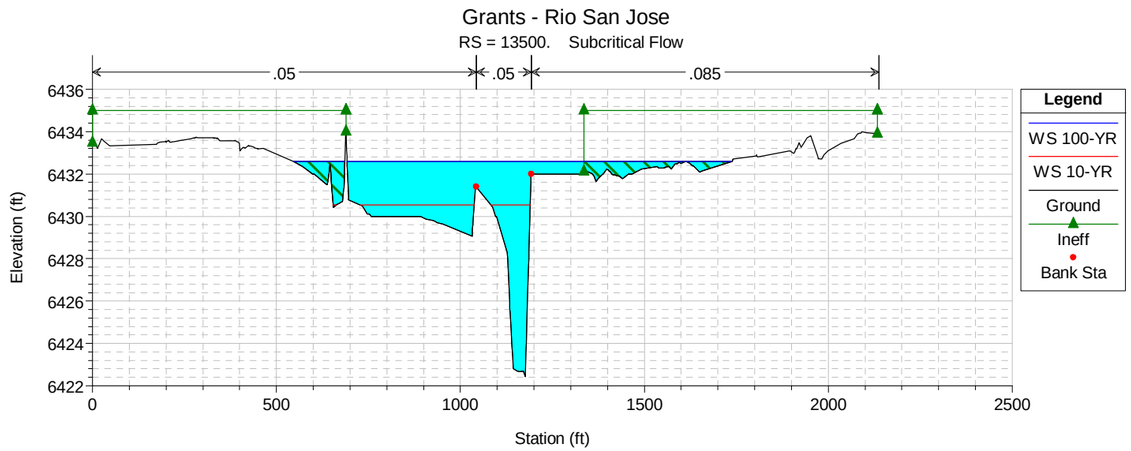

Grants - Rio San Jose
RS = 11500. Subcritical Flow
.055
.03
.085
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

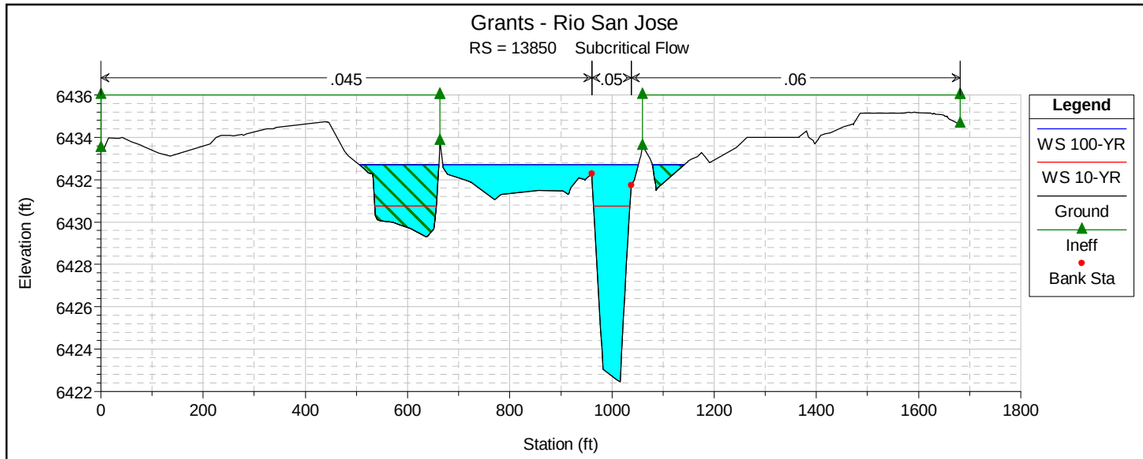

Grants - Rio San Jose
RS = 12000. Subcritical Flow
.05
.035
.085
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

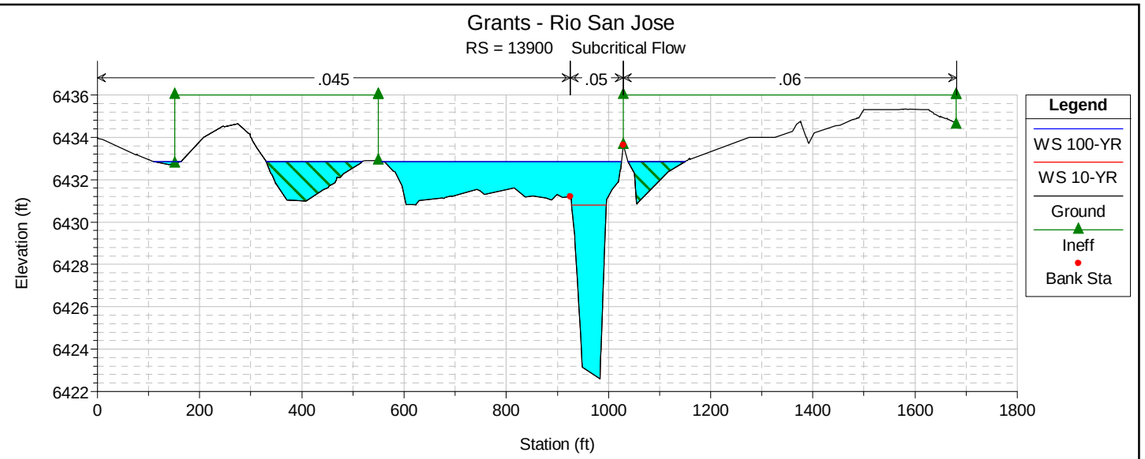

Grants - Rio San Jose
RS = 12500. Subcritical Flow
.05
.035
.1
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

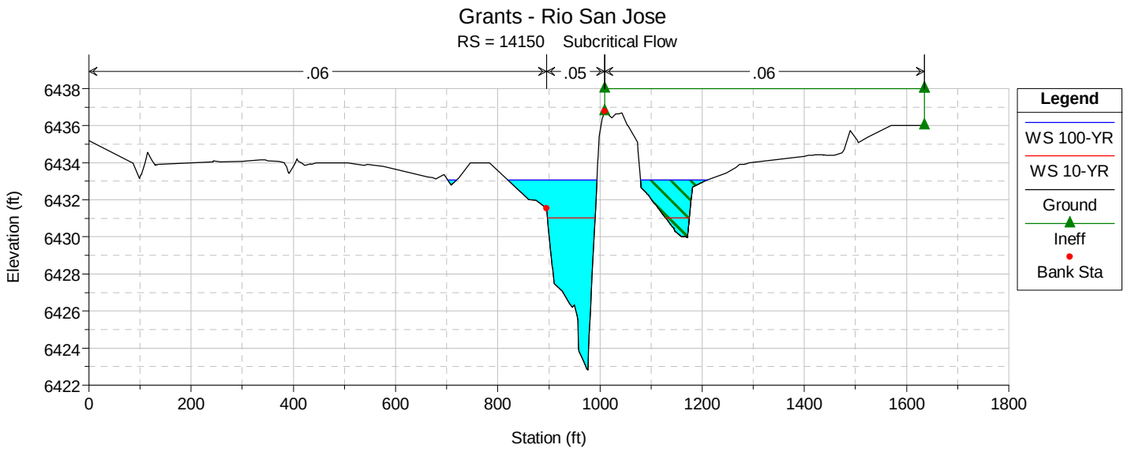

Grants - Rio San Jose
RS = 13000. Subcritical Flow
.05
.035
.1
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

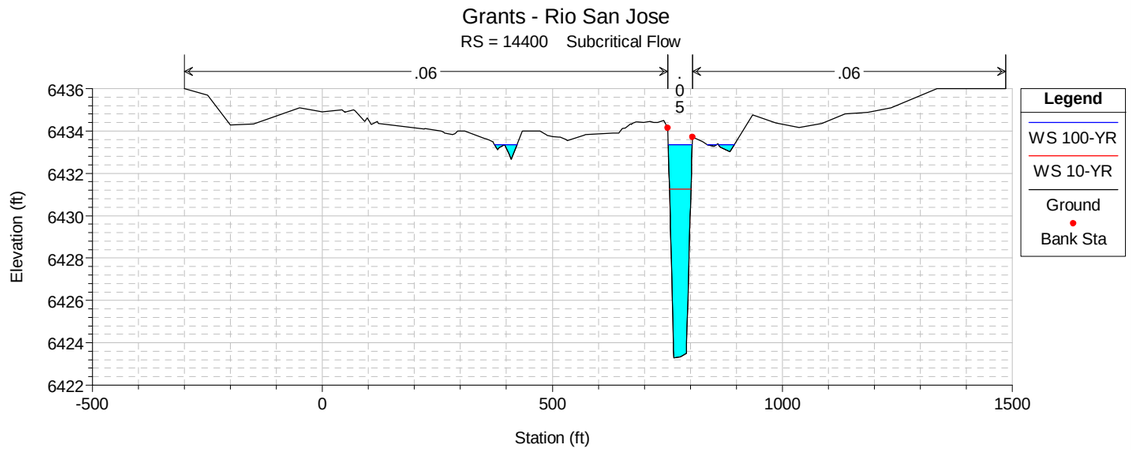

Grants - Rio San Jose
RS = 13300 Subcritical Flow
.05
.035
.1
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

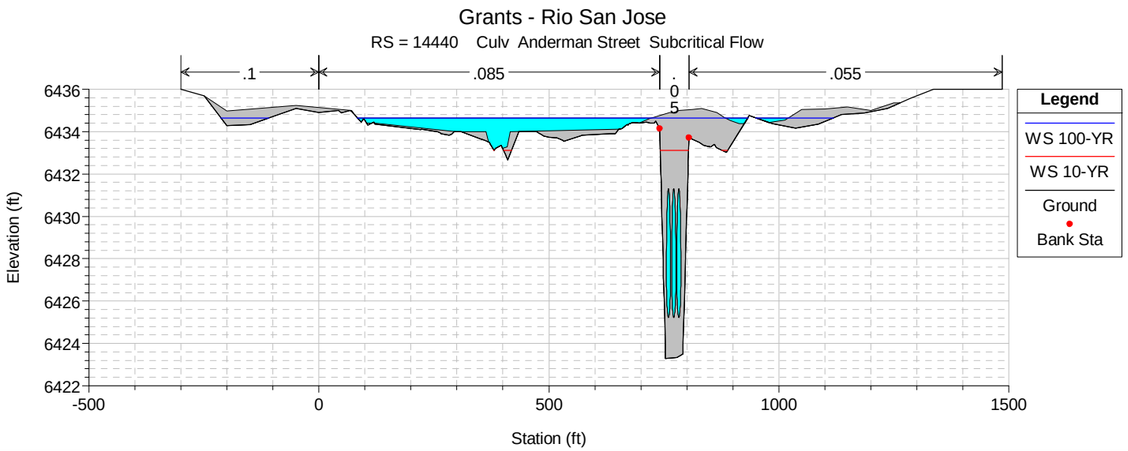

Grants - Rio San Jose
RS = 13500. Subcritical Flow
.05
.05
.085
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

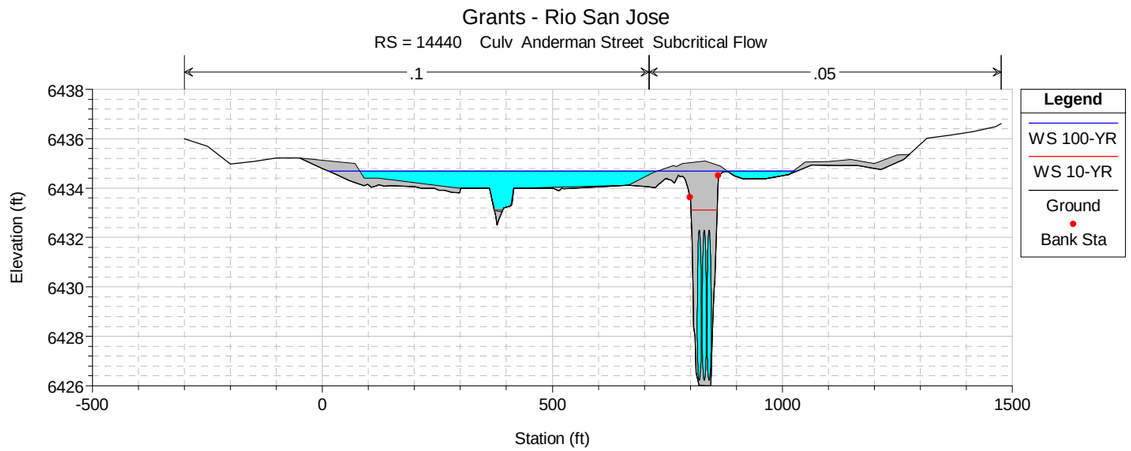

Grants - Rio San Jose
RS = 13850 Subcritical Flow
.045
.05
.06
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

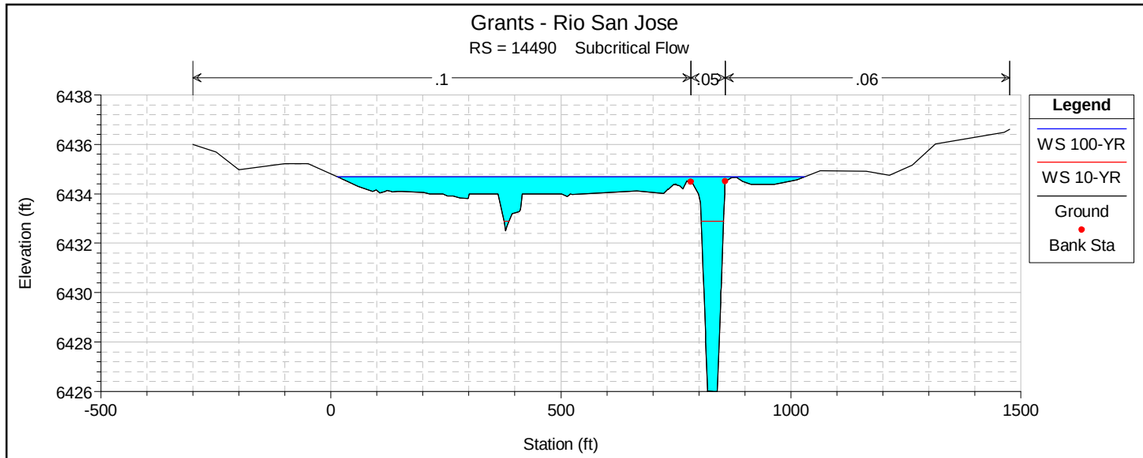

Grants - Rio San Jose
RS = 13900 Subcritical Flow
.045
.05
.06
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

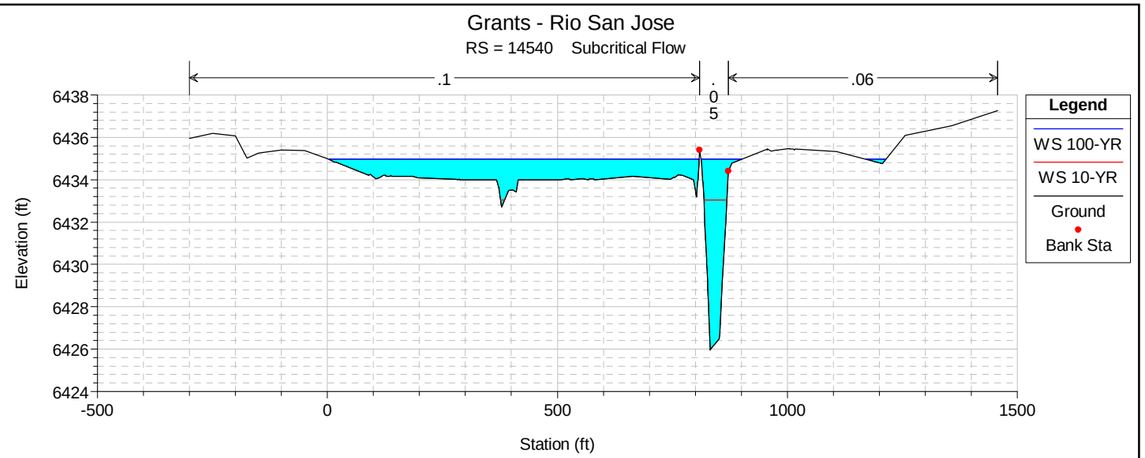

Grants - Rio San Jose
RS = 14150 Subcritical Flow
.06
.05
.06
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

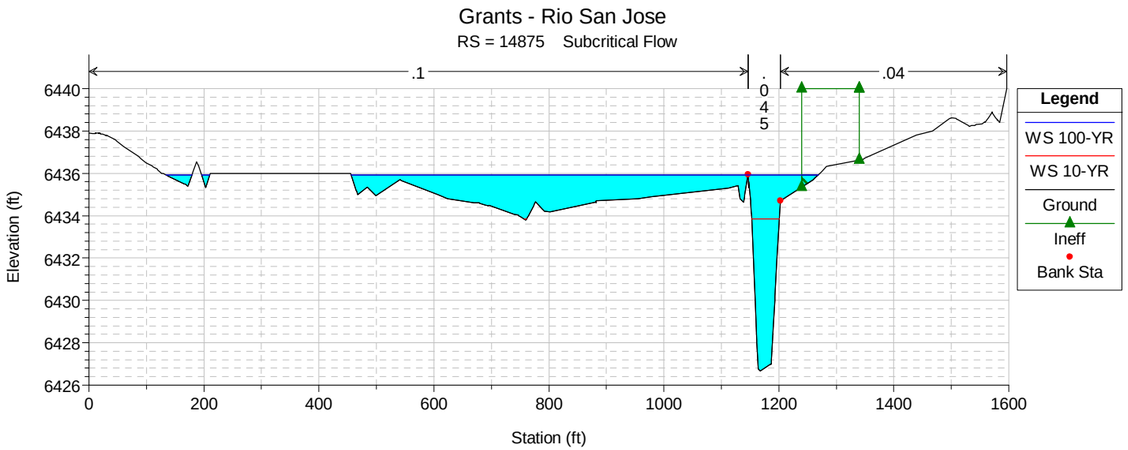

Grants - Rio San Jose
RS = 14400 Subcritical Flow
.06
.05
.06
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

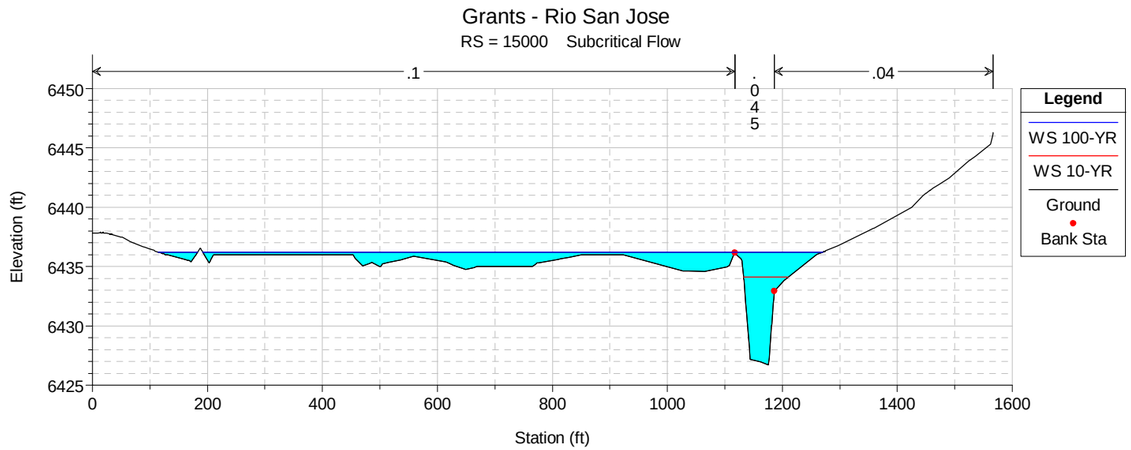

Grants - Rio San Jose
RS = 14440 Culv Anderman Street Subcritical Flow
.1
.085
.05
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

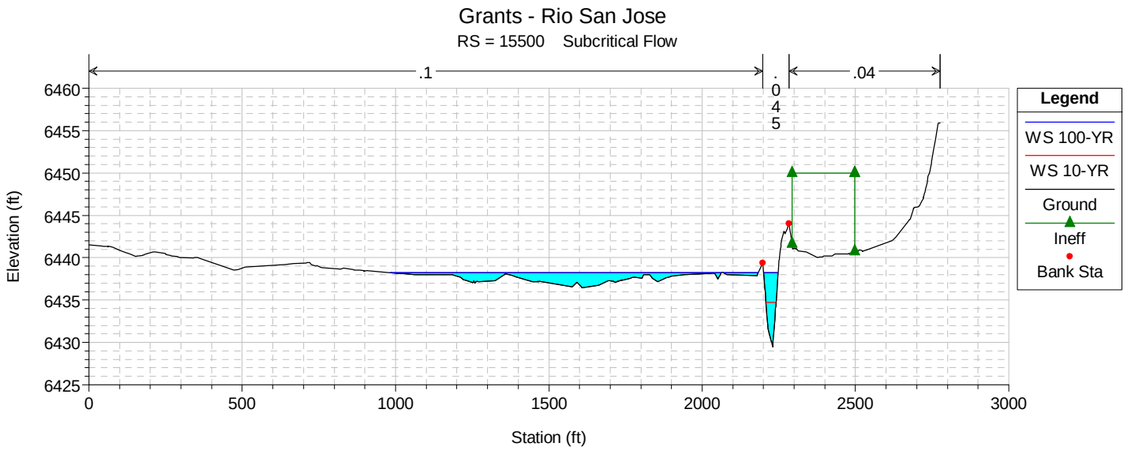

Grants - Rio San Jose
RS = 14440 Culv Anderman Street Subcritical Flow
.1
.05
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

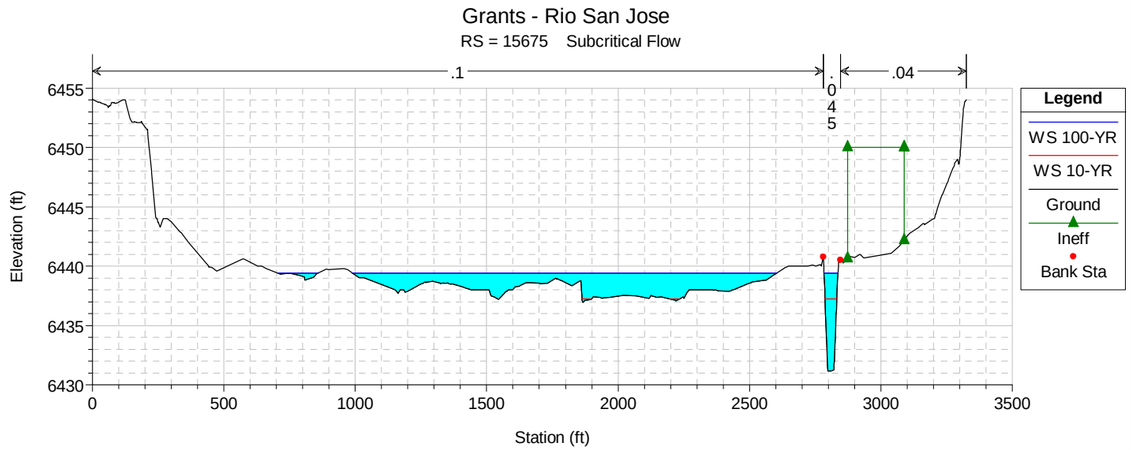

Grants - Rio San Jose
RS = 14490 Subcritical Flow
.1
.05
.06
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

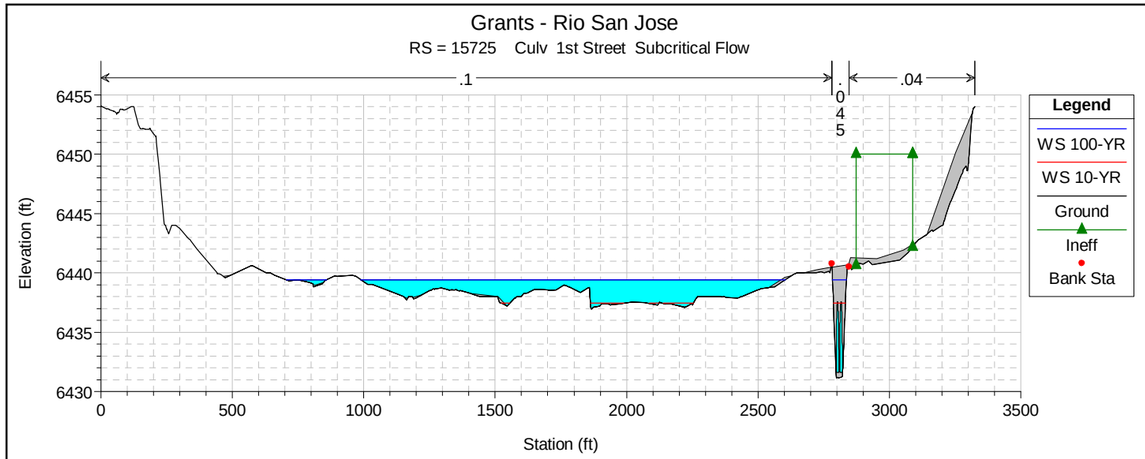

Grants - Rio San Jose
RS = 14540 Subcritical Flow
.1
.05
.06
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

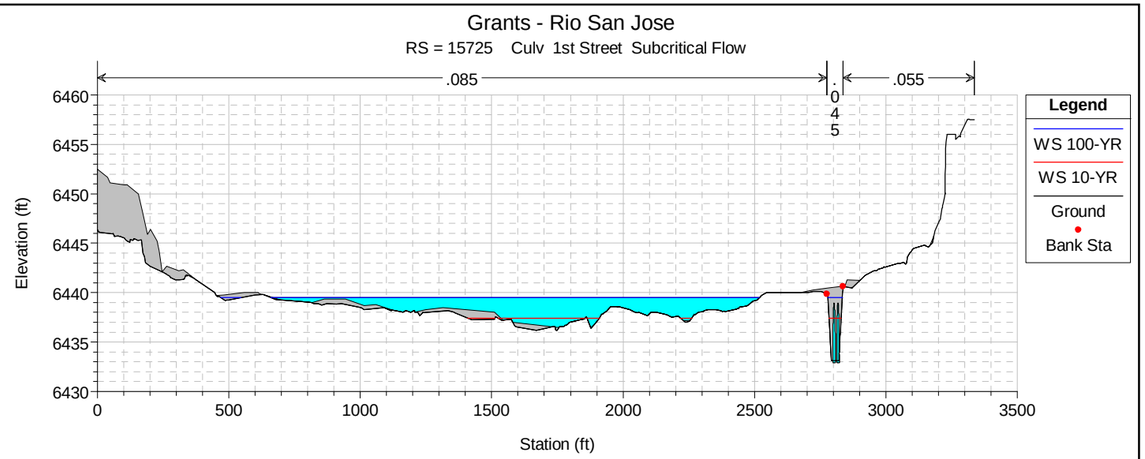

Grants - Rio San Jose
RS = 14875 Subcritical Flow
.1
.045
.04
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

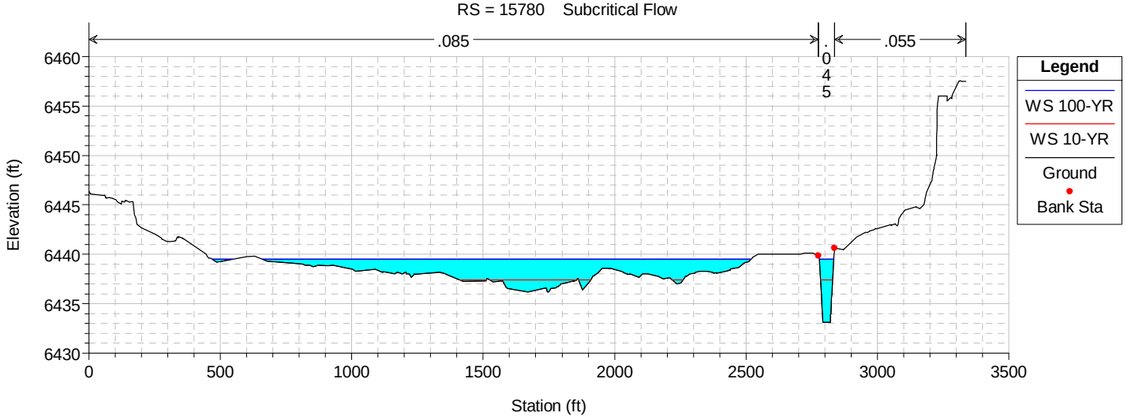

Grants - Rio San Jose
RS = 15000 Subcritical Flow
.1
.045
.04
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

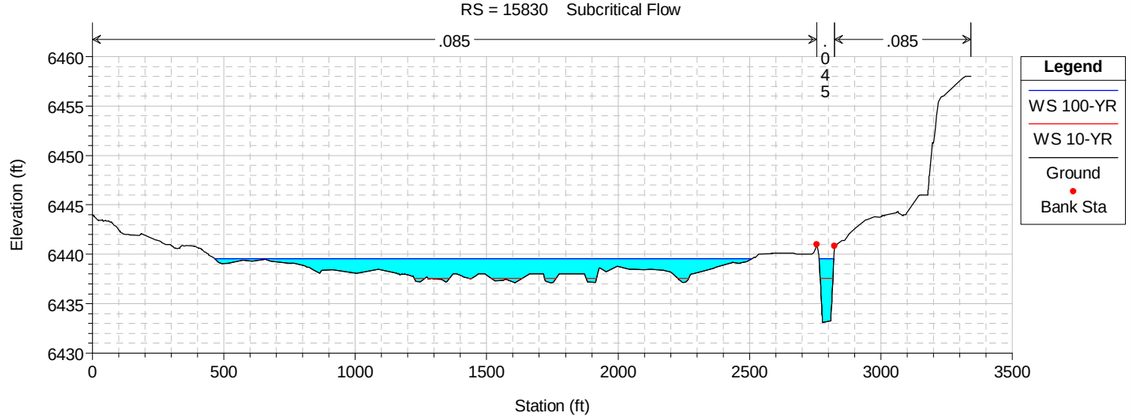

Grants - Rio San Jose
RS = 15500 Subcritical Flow
.1
.045
.04
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

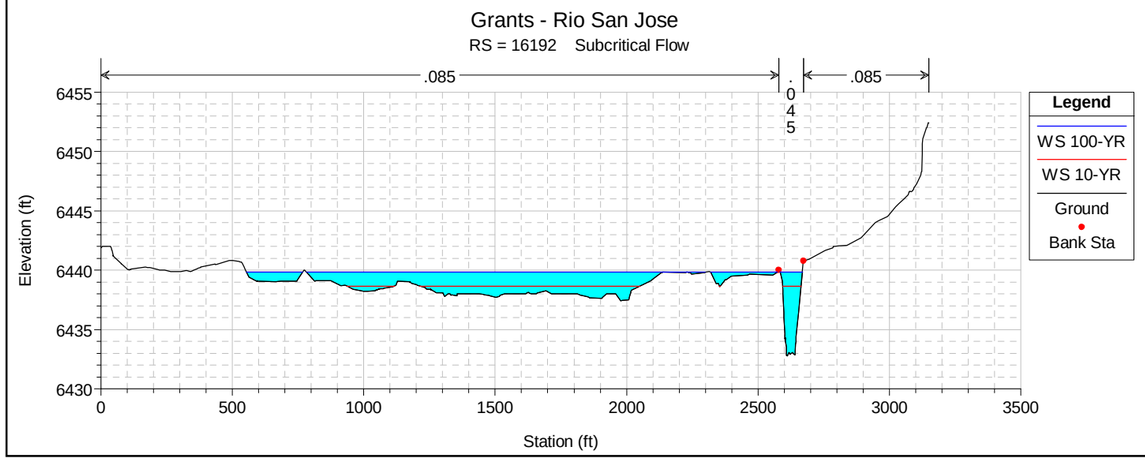

Grants - Rio San Jose
RS = 15675 Subcritical Flow
.1
.045
.04
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

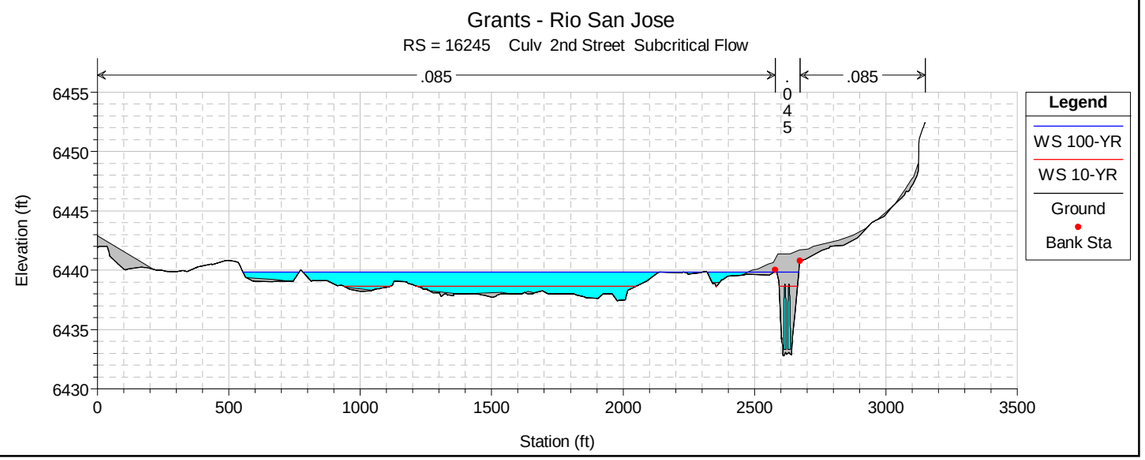

Grants - Rio San Jose
RS = 15725 Culv 1st Street Subcritical Flow
.1
.04
.045
Elevation (ft)
6455
6450
6445
6440
6435
6430
0
500
1000
1500
2000
2500
3000
3500
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

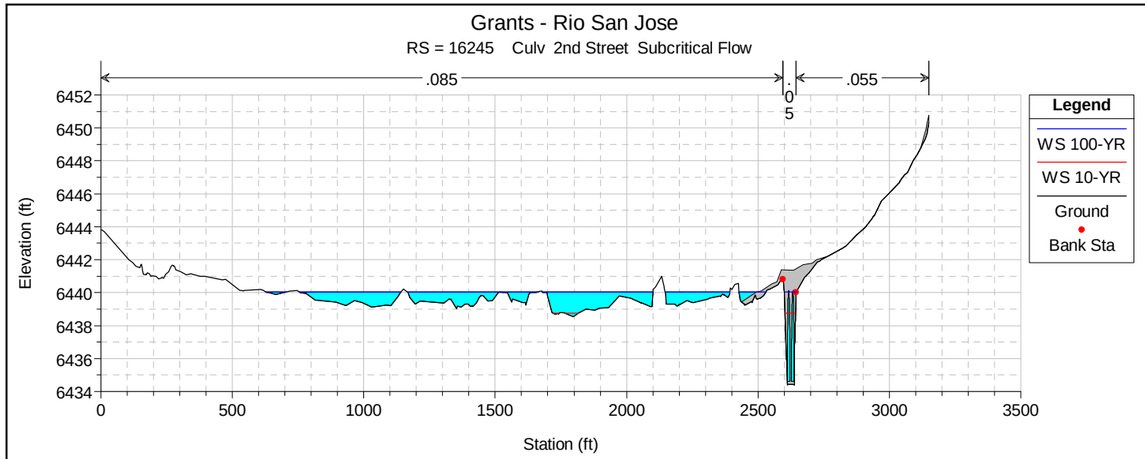

Grants - Rio San Jose
RS = 15725 Culv 1st Street Subcritical Flow
.085
.055
.045
Elevation (ft)
6460
6455
6450
6445
6440
6435
6430
0
500
1000
1500
2000
2500
3000
3500
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

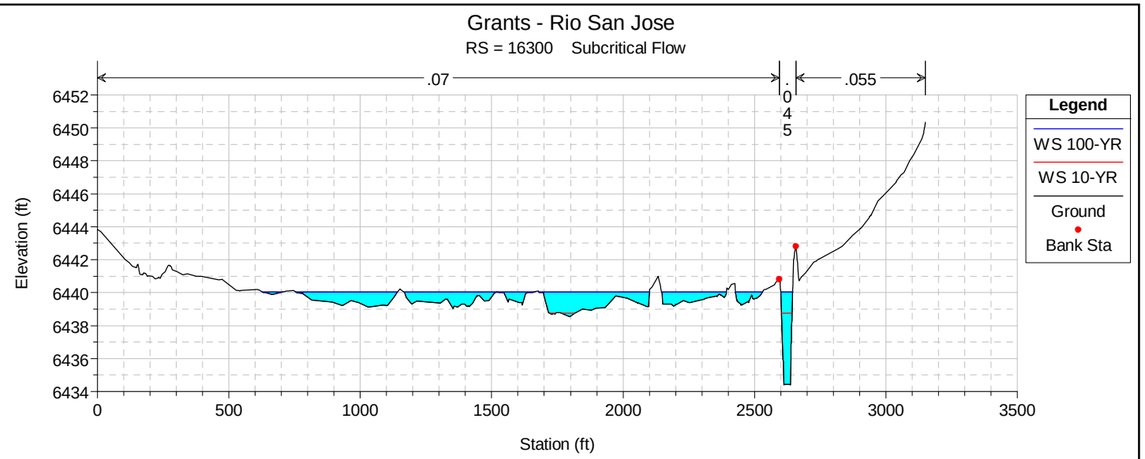

Grants - Rio San Jose
RS = 15780 Subcritical Flow
.085
.055
.045
Elevation (ft)
6460
6455
6450
6445
6440
6435
6430
0
500
1000
1500
2000
2500
3000
3500
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

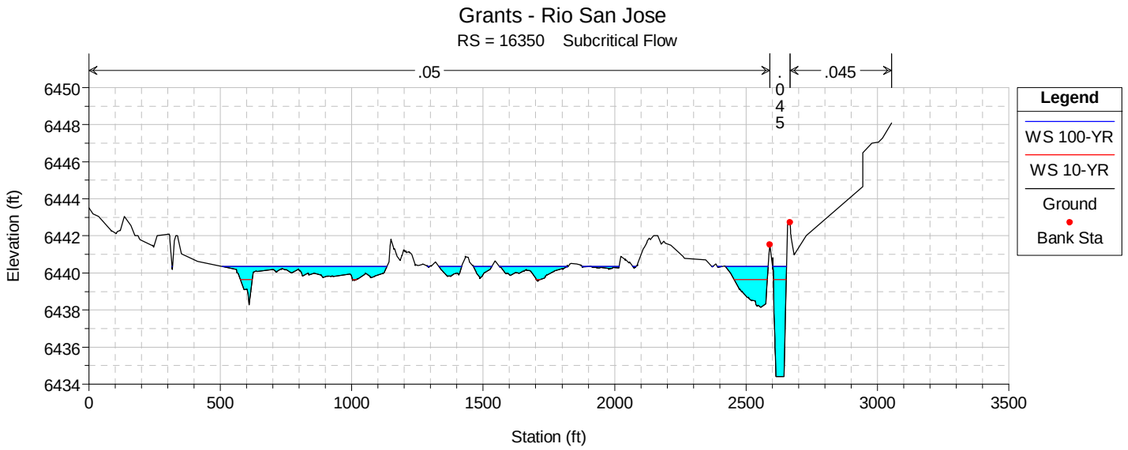

Grants - Rio San Jose
RS = 15830 Subcritical Flow
.085
.085
.045
Elevation (ft)
6460
6455
6450
6445
6440
6435
6430
0
500
1000
1500
2000
2500
3000
3500
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

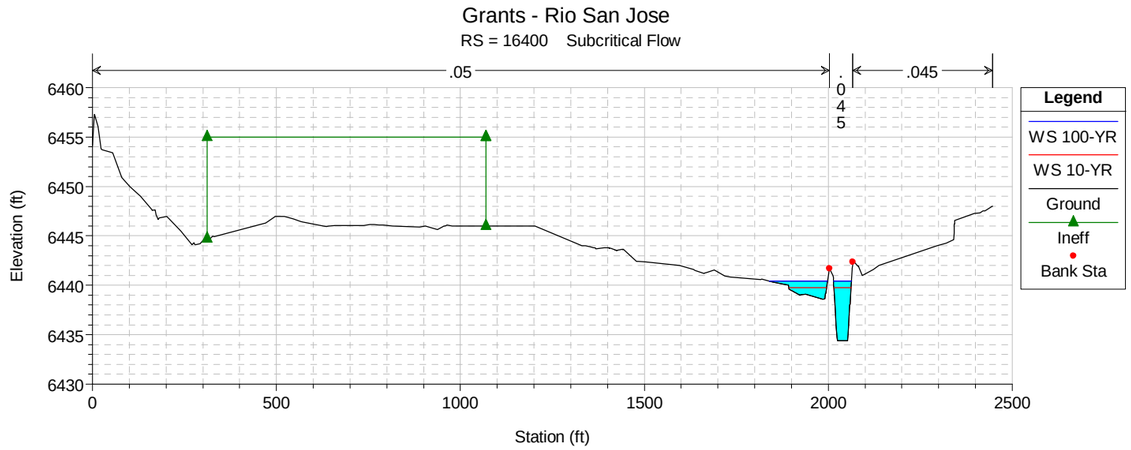

Grants - Rio San Jose
RS = 16192 Subcritical Flow
.085
.085
.045
Elevation (ft)
6455
6450
6445
6440
6435
6430
0
500
1000
1500
2000
2500
3000
3500
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

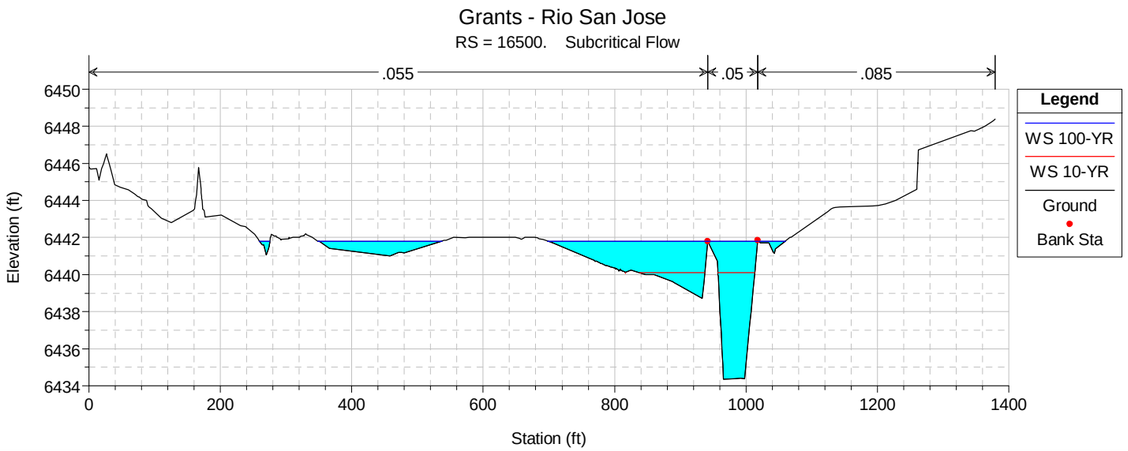

Grants - Rio San Jose
RS = 16245 Culv 2nd Street Subcritical Flow
.085
.085
.045
Elevation (ft)
6455
6450
6445
6440
6435
6430
0
500
1000
1500
2000
2500
3000
3500
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

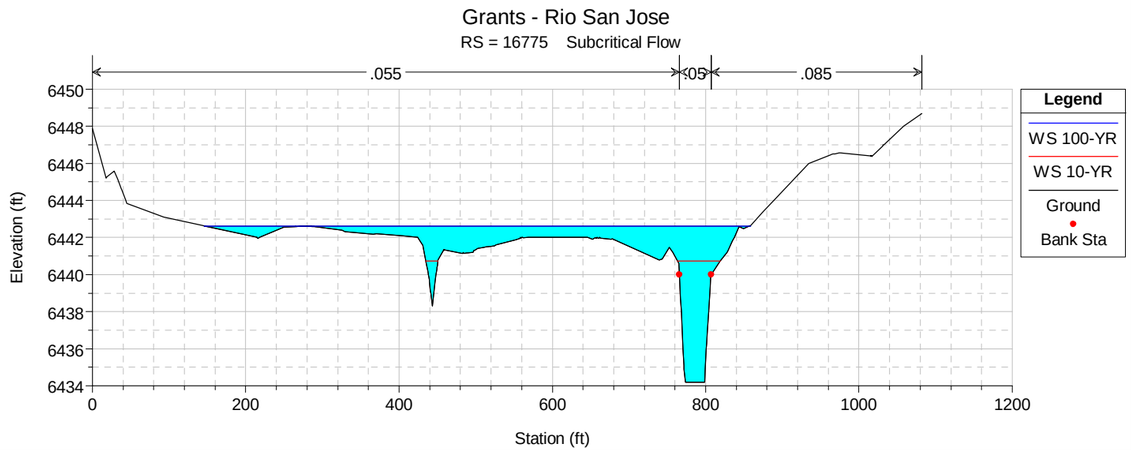

Grants - Rio San Jose
RS = 16245 Culv 2nd Street Subcritical Flow
.085
.055
.05
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

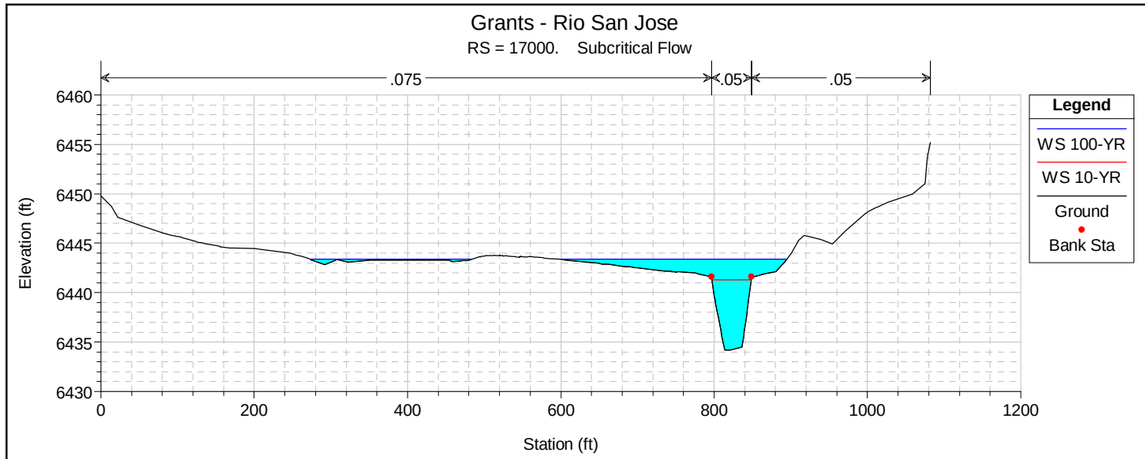

Grants - Rio San Jose
RS = 16300 Subcritical Flow
.07
.055
.045
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

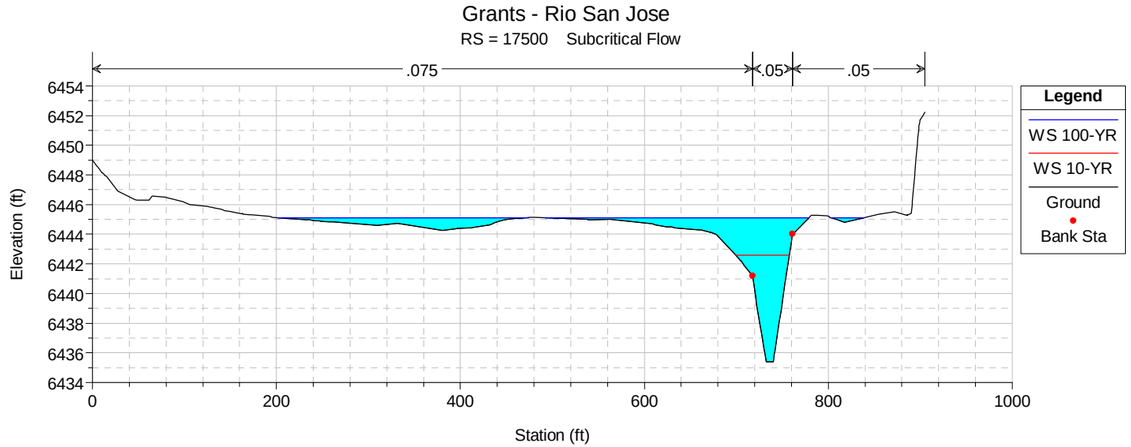

Grants - Rio San Jose
RS = 16350 Subcritical Flow
.05
.045
.045
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

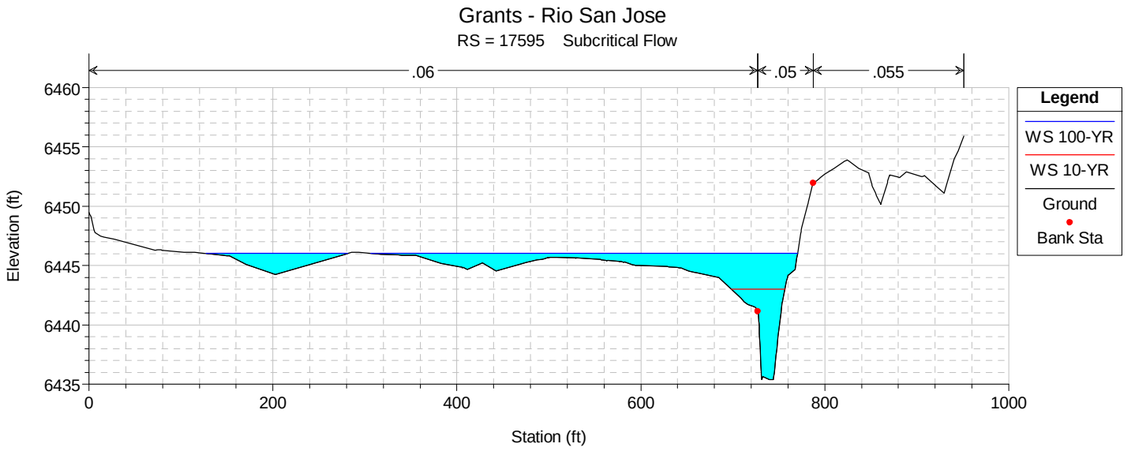

Grants - Rio San Jose
RS = 16400 Subcritical Flow
.05
.045
.045
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

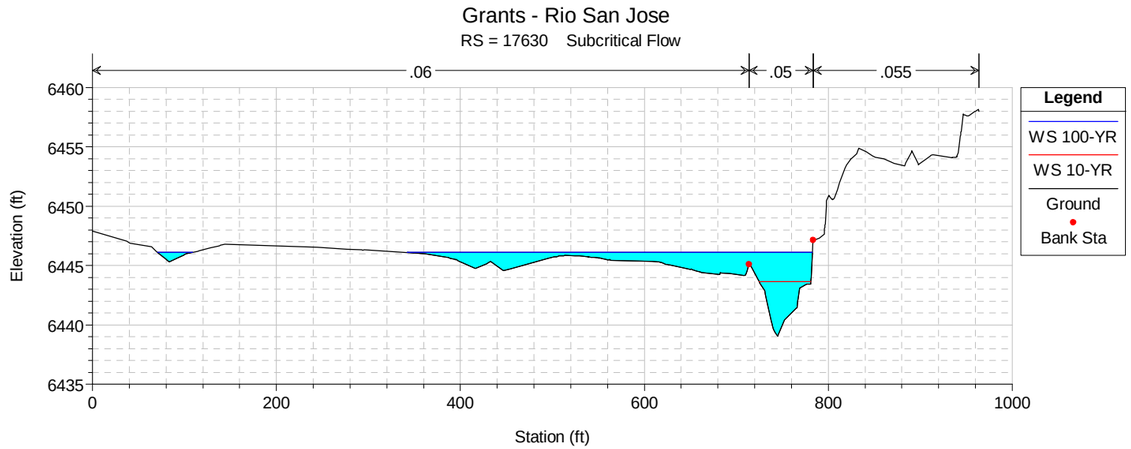

Grants - Rio San Jose
RS = 16500. Subcritical Flow
.055
.05
.085
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

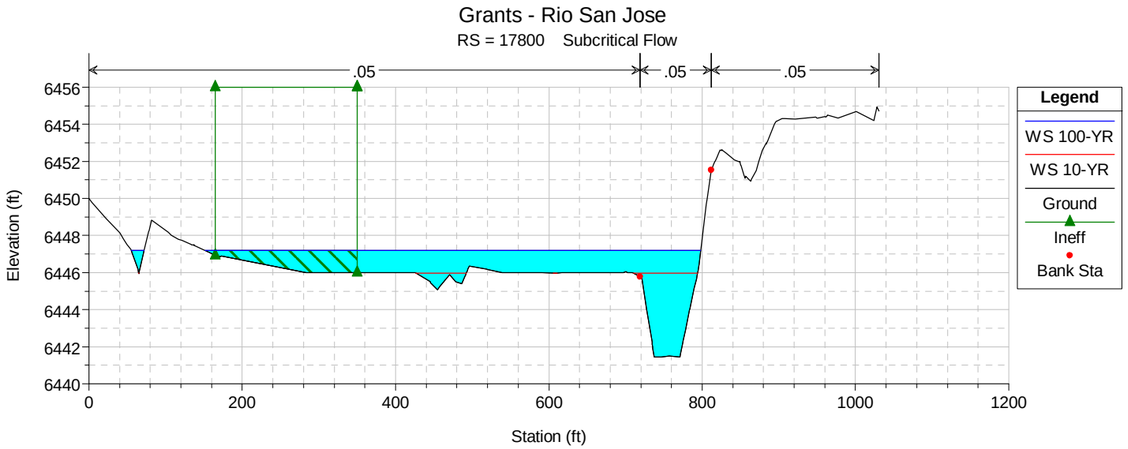

Grants - Rio San Jose
RS = 16775 Subcritical Flow
.055
.05
.085
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

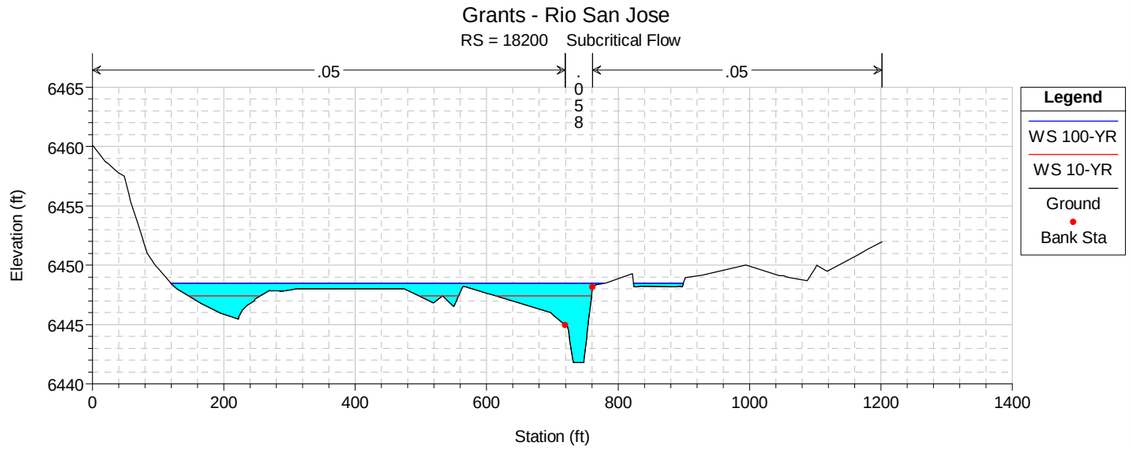

Grants - Rio San Jose
RS = 17000. Subcritical Flow
.075
.05
.05
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

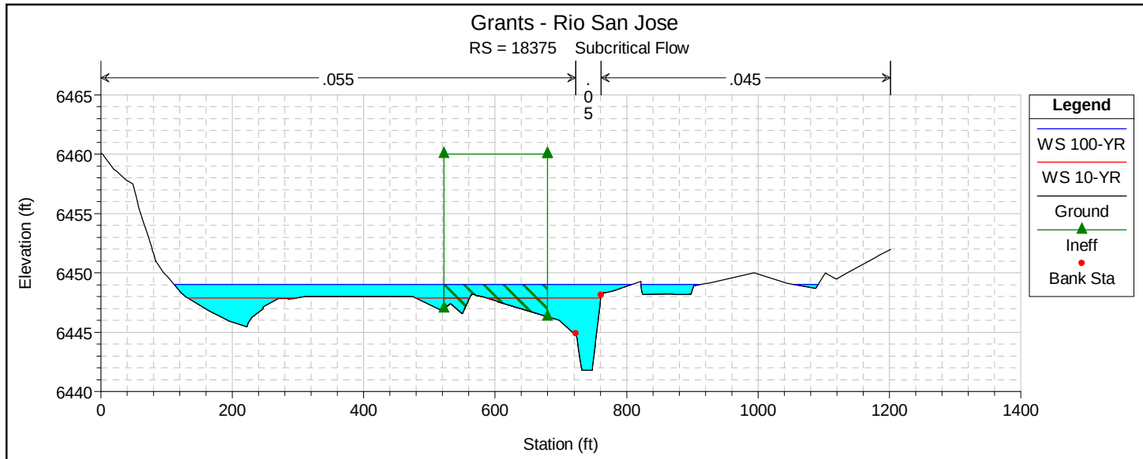

Grants - Rio San Jose
RS = 17500 Subcritical Flow
.075
.05
.05
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

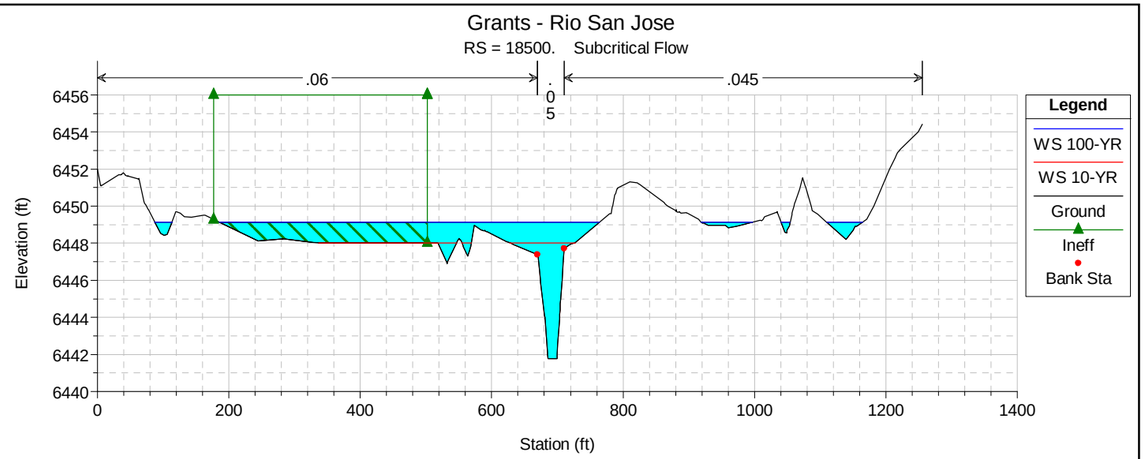

Grants - Rio San Jose
RS = 17595 Subcritical Flow
.06
.05
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

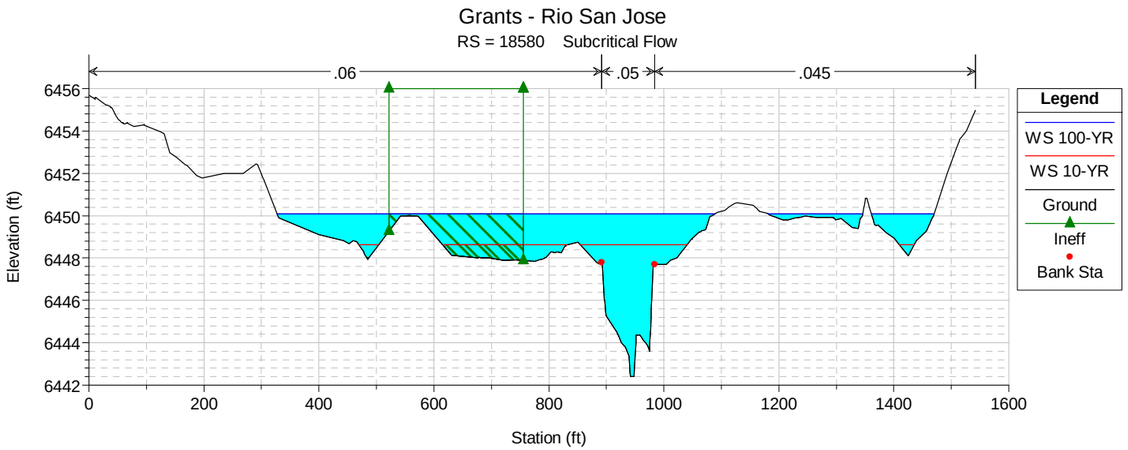

Grants - Rio San Jose
RS = 17630 Subcritical Flow
.06
.05
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

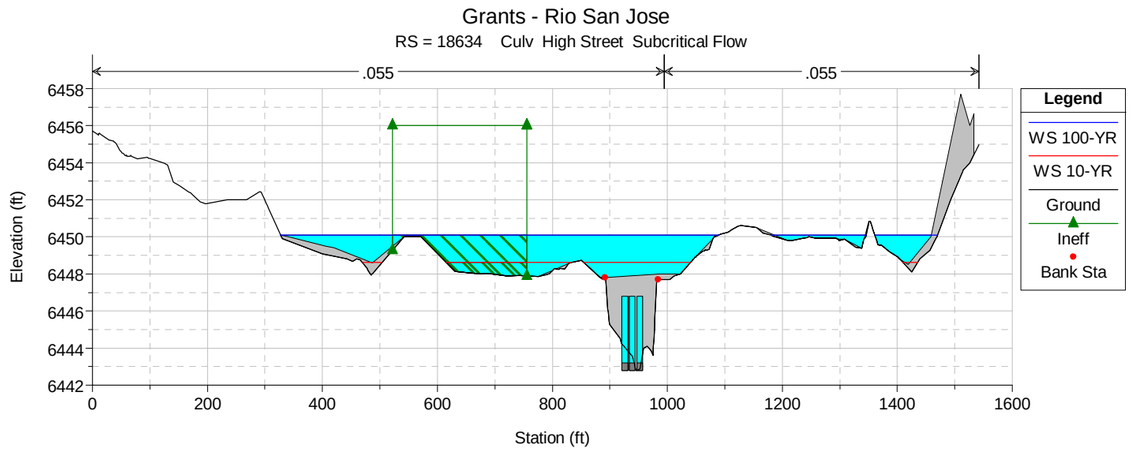

Grants - Rio San Jose
RS = 17800 Subcritical Flow
.05
.05
.05
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

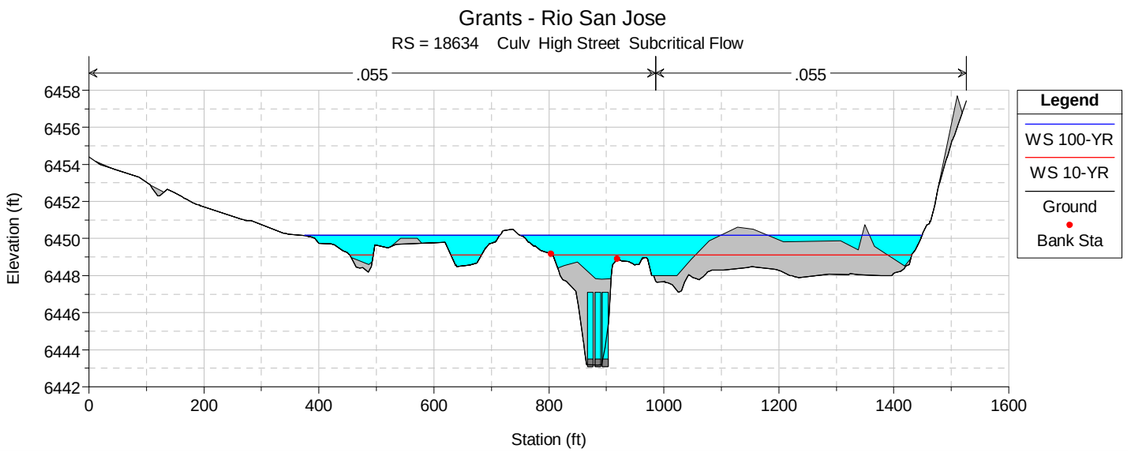

Grants - Rio San Jose
RS = 18200 Subcritical Flow
.05
.058
.05
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

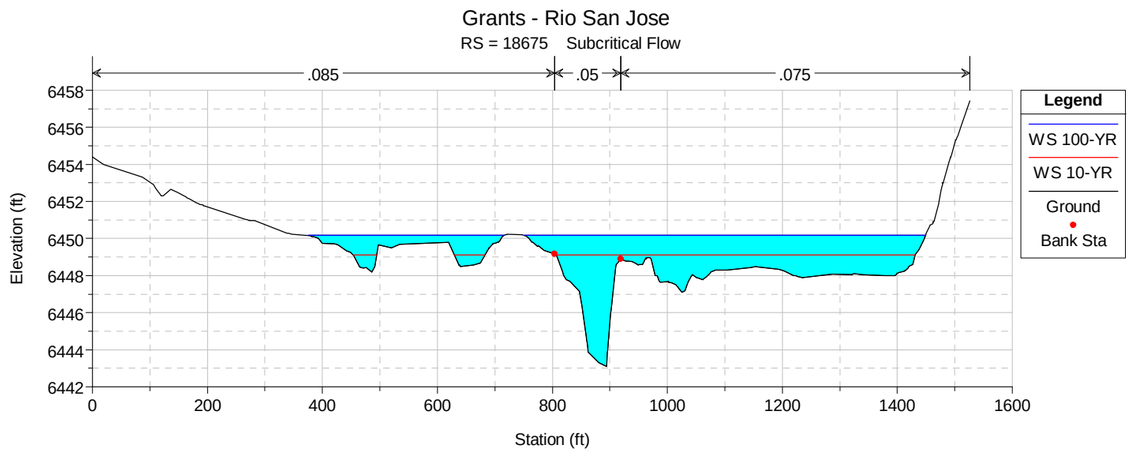

Grants - Rio San Jose
RS = 18375 Subcritical Flow
.055
.05
.045
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

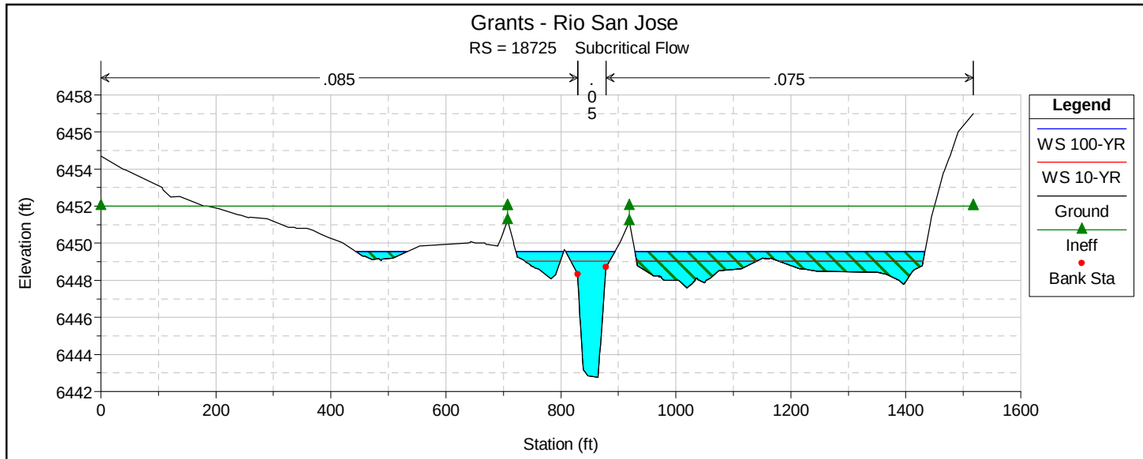

Grants - Rio San Jose
RS = 18500. Subcritical Flow
.06
.05
.045
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

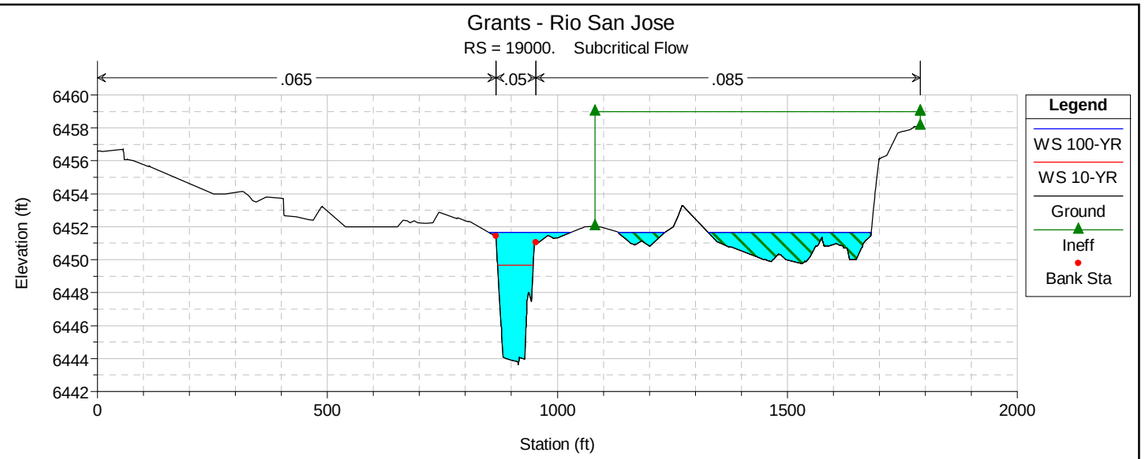

Grants - Rio San Jose
RS = 18580 Subcritical Flow
.06
.05
.045
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

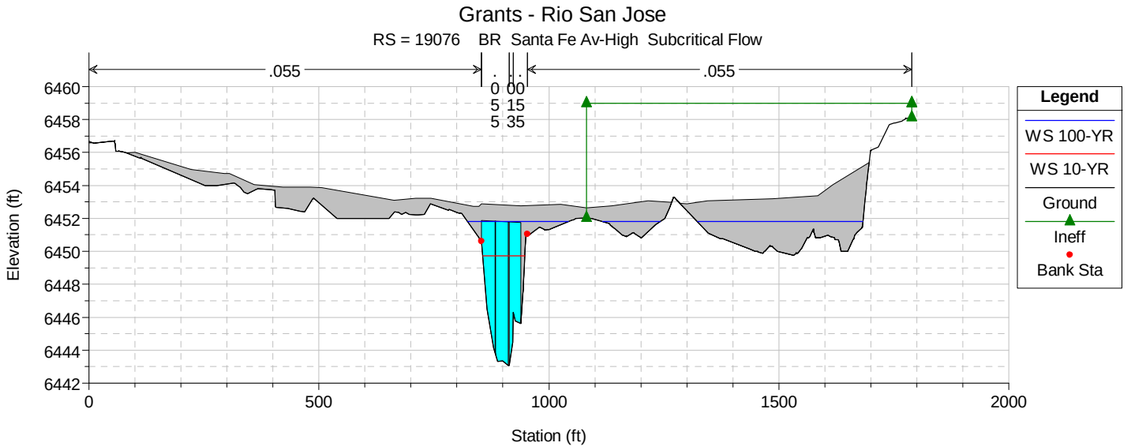

Grants - Rio San Jose
RS = 18634 Culv High Street Subcritical Flow
.055
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

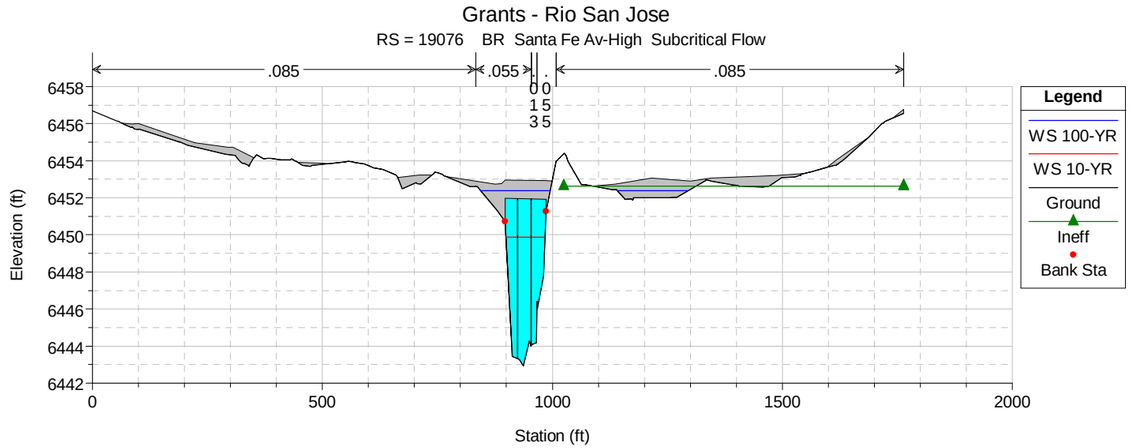

Grants - Rio San Jose
RS = 18634 Culv High Street Subcritical Flow
.055
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

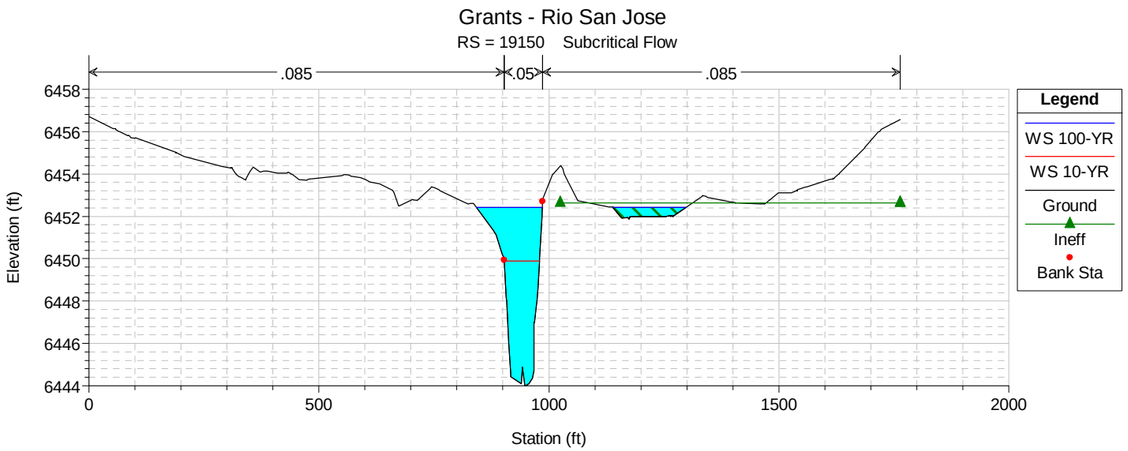

Grants - Rio San Jose
RS = 18675 Subcritical Flow
.085
.05
.075
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

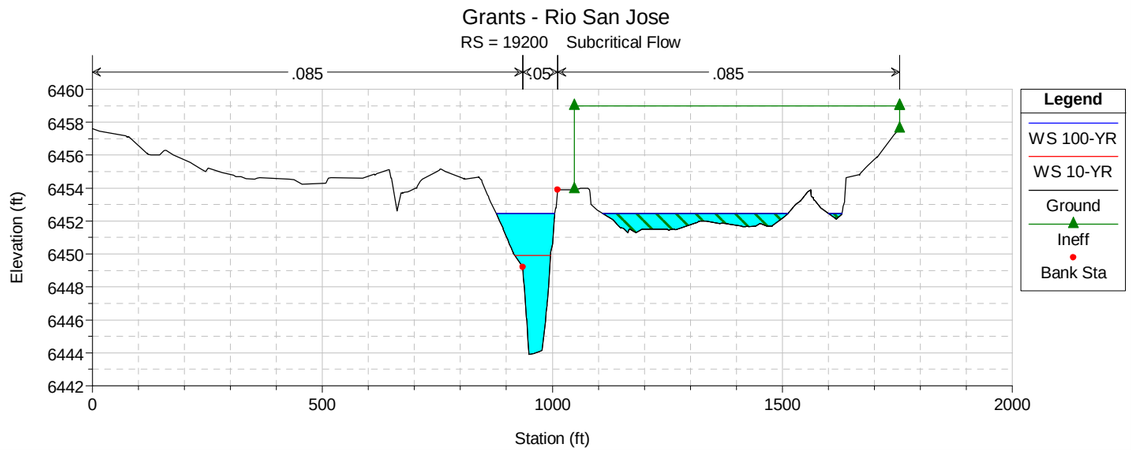

Grants - Rio San Jose
RS = 18725 Subcritical Flow
.085
.05
.075
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

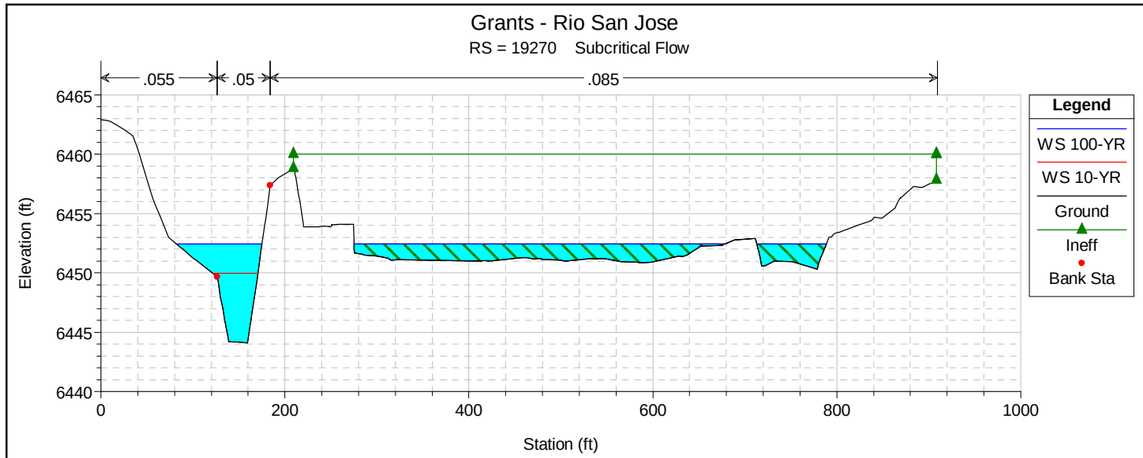

Grants - Rio San Jose
RS = 19000. Subcritical Flow
.065
.05
.085
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

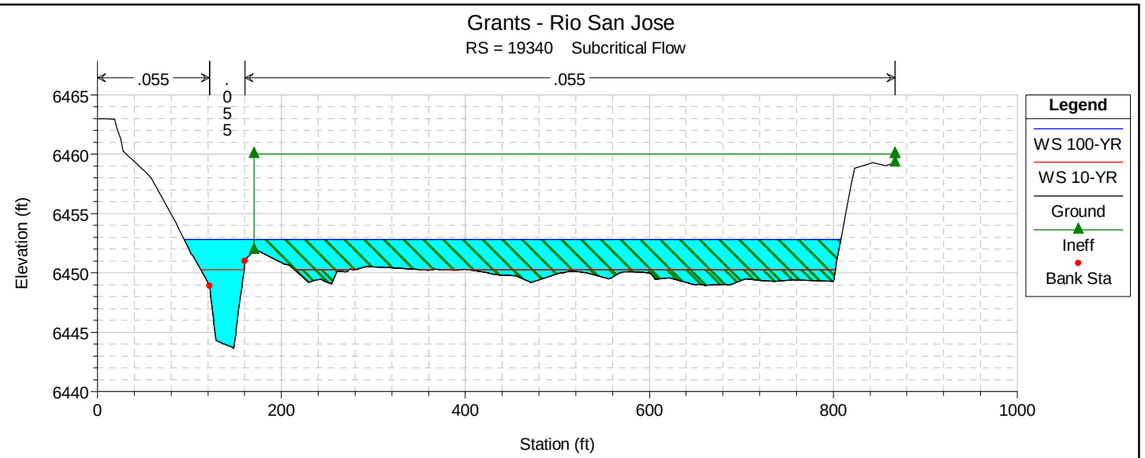

Grants - Rio San Jose
RS = 19076 BR Santa Fe Av-High Subcritical Flow
.055
.055
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

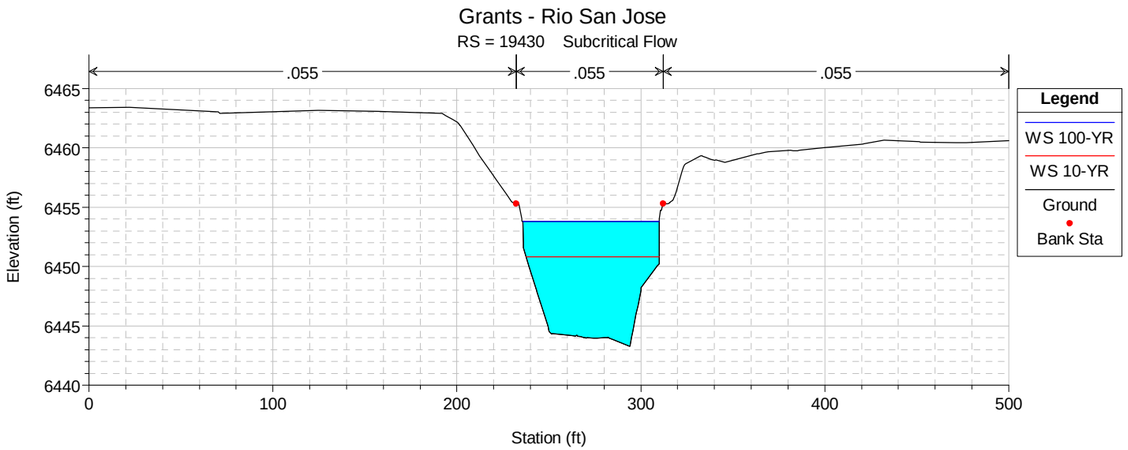

Grants - Rio San Jose
RS = 19076 BR Santa Fe Av-High Subcritical Flow
.085
.055
.085
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

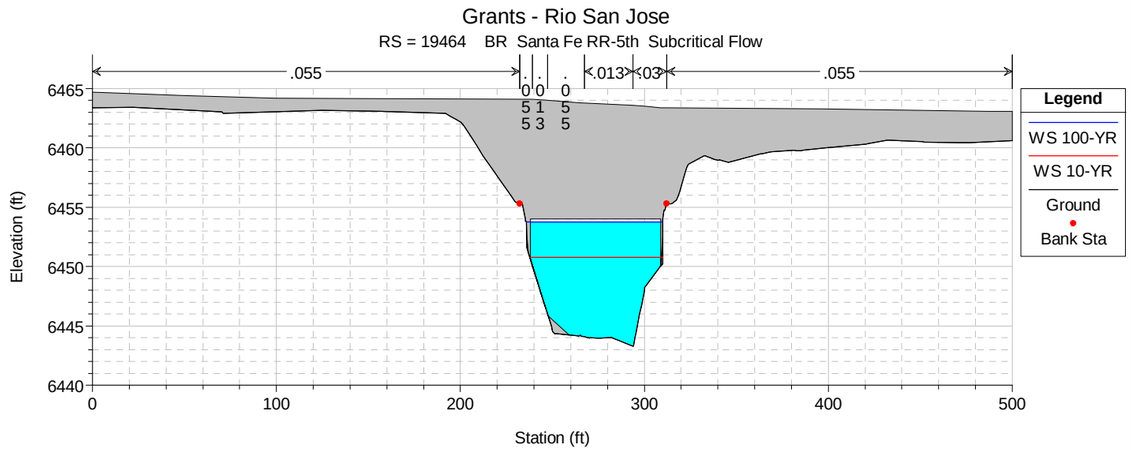

Grants - Rio San Jose
RS = 19150 Subcritical Flow
.085
.05
.085
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

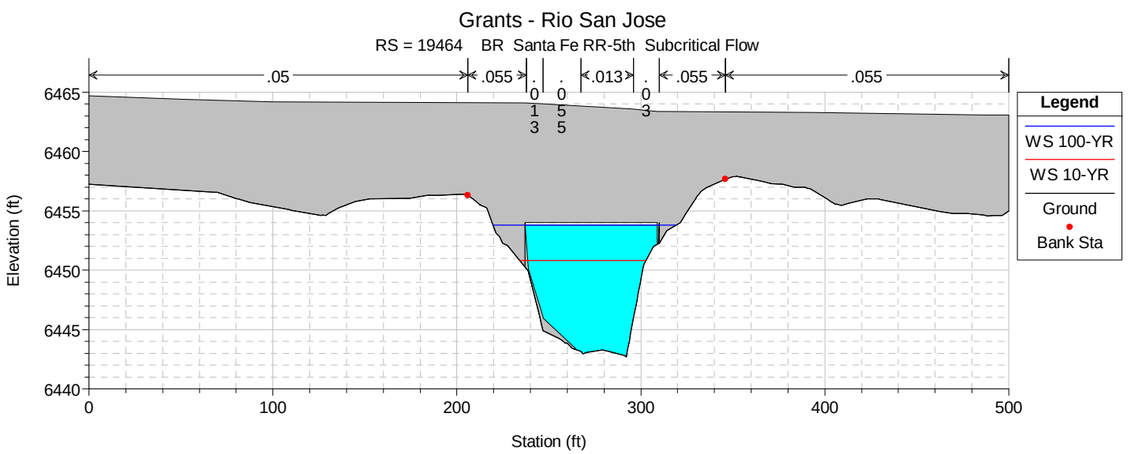

Grants - Rio San Jose
RS = 19200 Subcritical Flow
.085
.05
.085
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

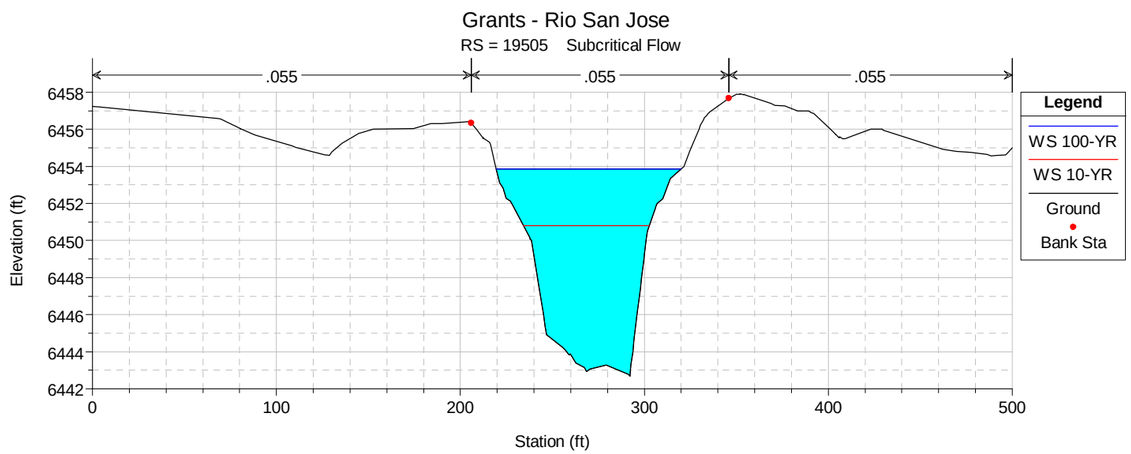

Grants - Rio San Jose
RS = 19270 Subcritical Flow
.055
.05
.085
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

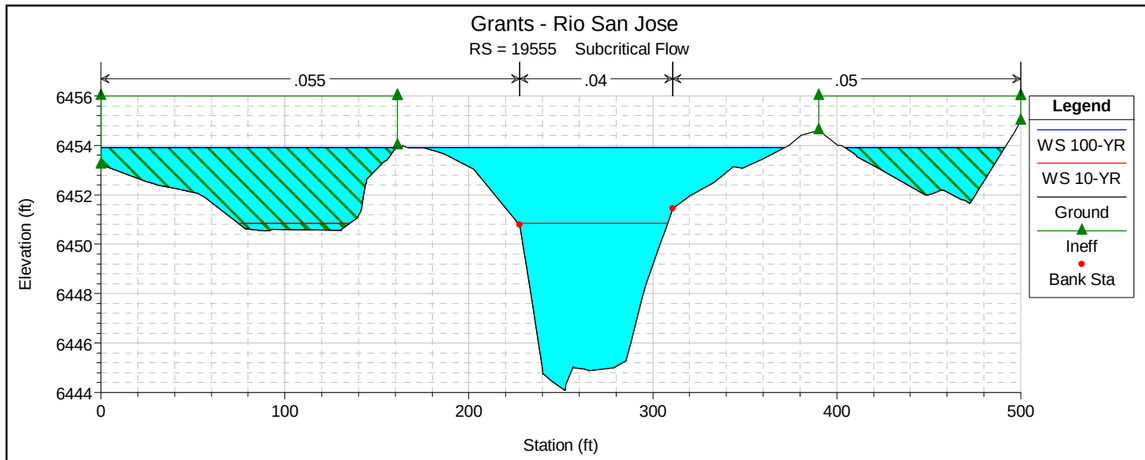

Grants - Rio San Jose
RS = 19340 Subcritical Flow
.055
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

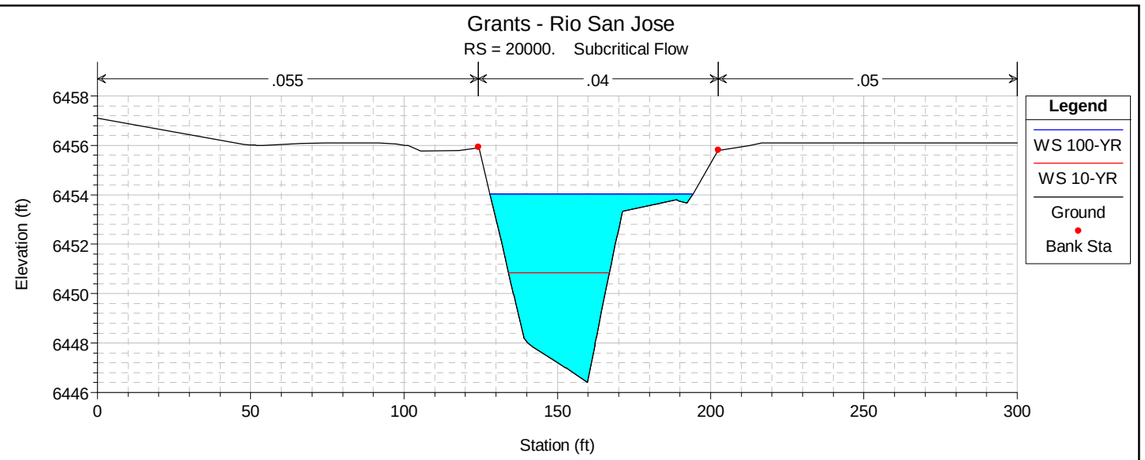

Grants - Rio San Jose
RS = 19430 Subcritical Flow
.055
.055
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

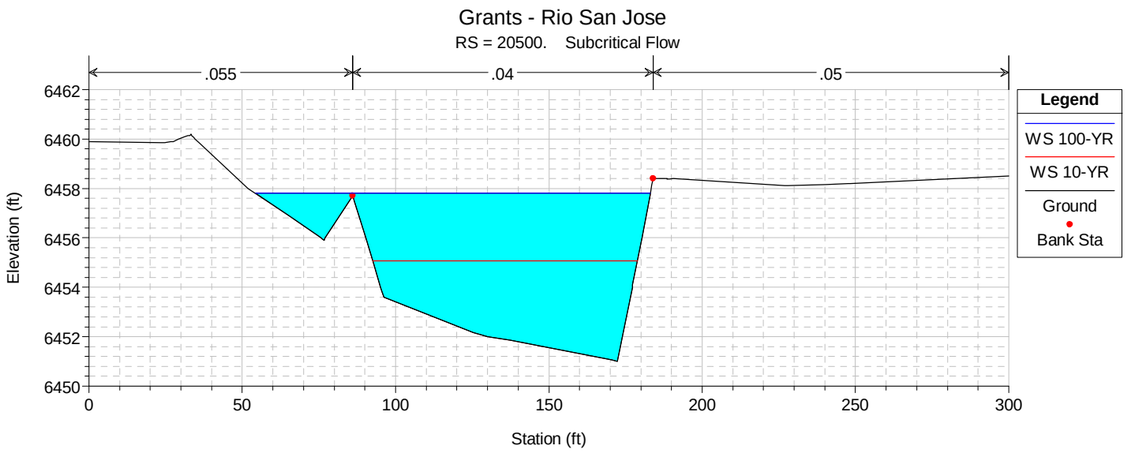

Grants - Rio San Jose
RS = 19464 BR Santa Fe RR-5th Subcritical Flow
.055
.055
.013
.03
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

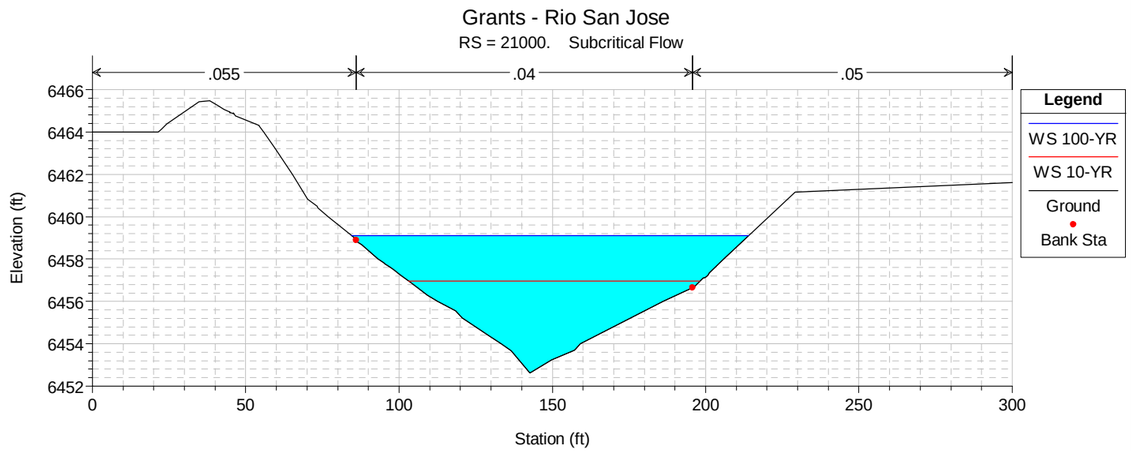

Grants - Rio San Jose
RS = 19464 BR Santa Fe RR-5th Subcritical Flow
.05
.055
.055
.013
.055
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

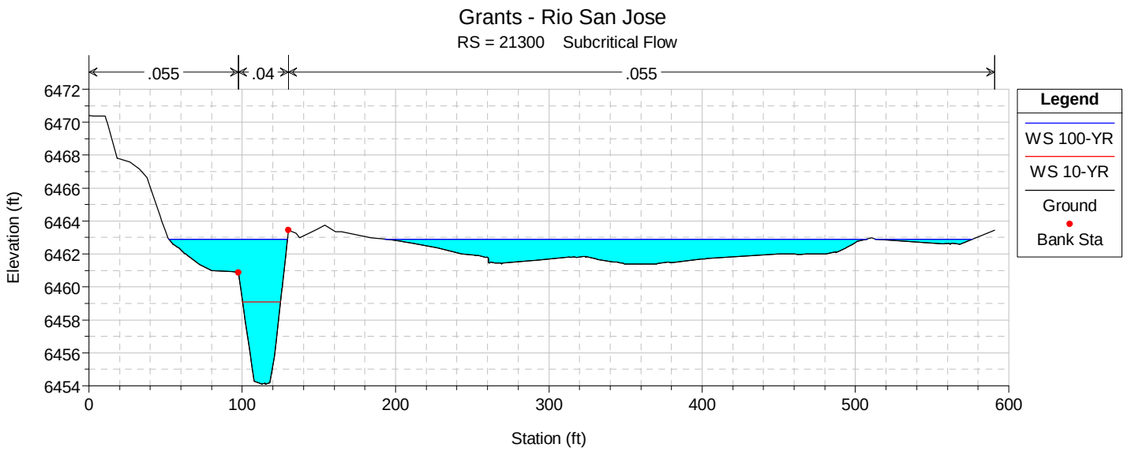

Grants - Rio San Jose
RS = 19505 Subcritical Flow
.055
.055
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

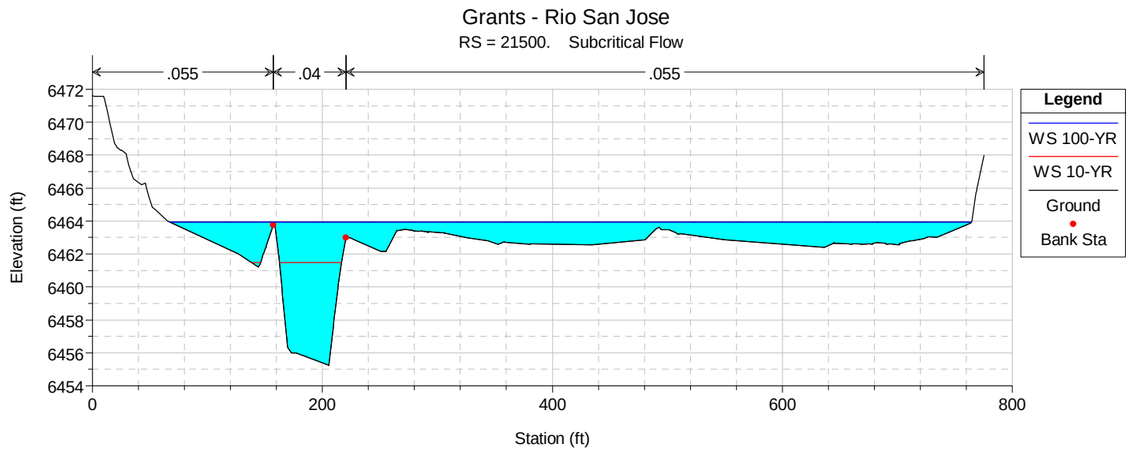

Grants - Rio San Jose
RS = 19555 Subcritical Flow
.055
.04
.05
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

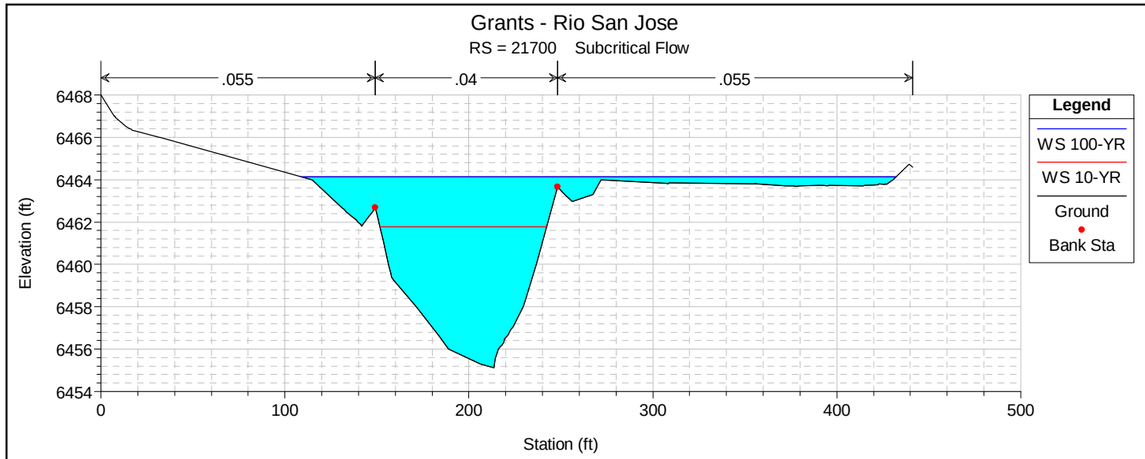

Grants - Rio San Jose
RS = 20000. Subcritical Flow
.055
.04
.05
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

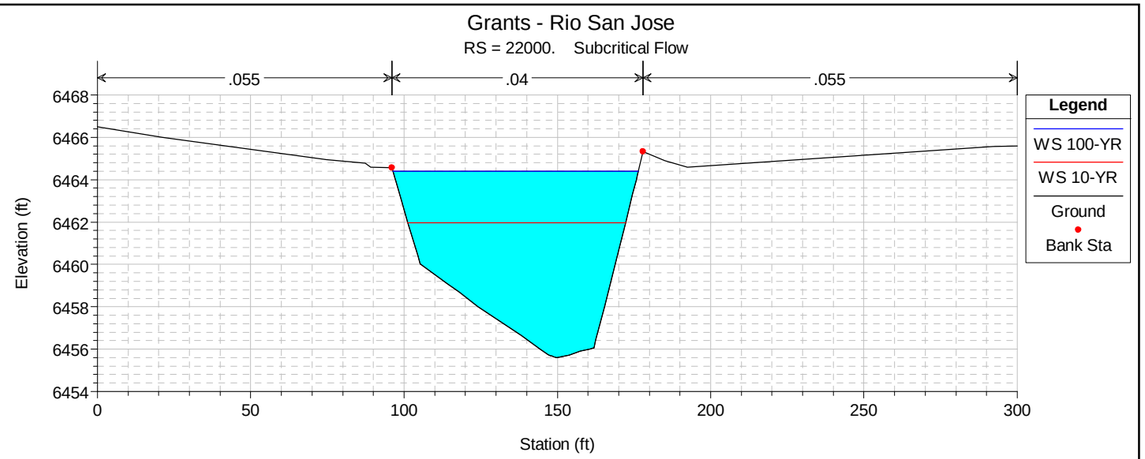

Grants - Rio San Jose
RS = 20500. Subcritical Flow
.055
.04
.05
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

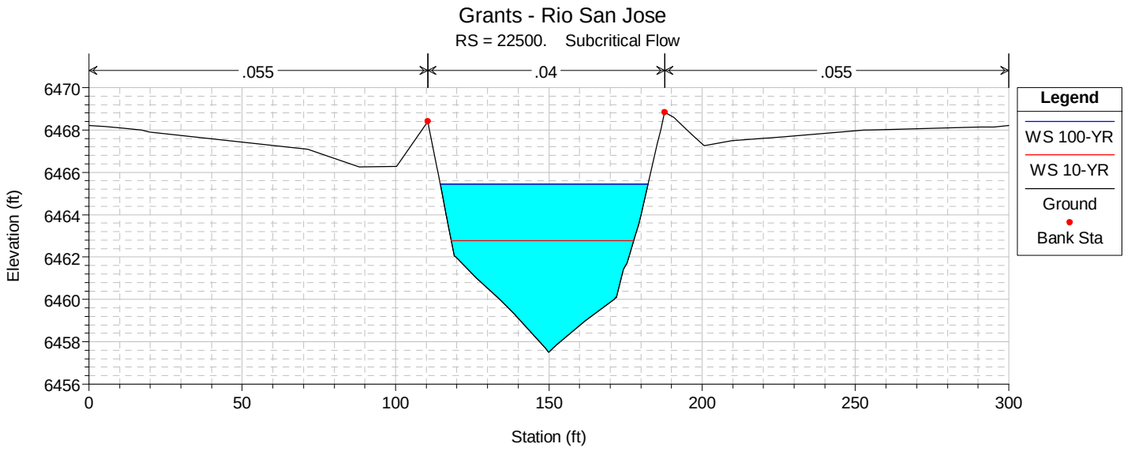

Grants - Rio San Jose
RS = 21000. Subcritical Flow
.055
.04
.05
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

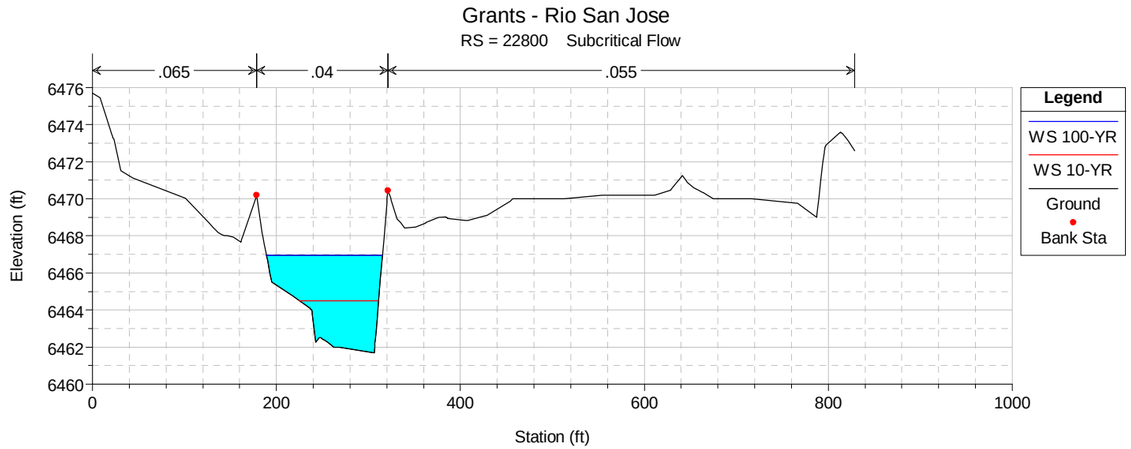

Grants - Rio San Jose
RS = 21300 Subcritical Flow
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

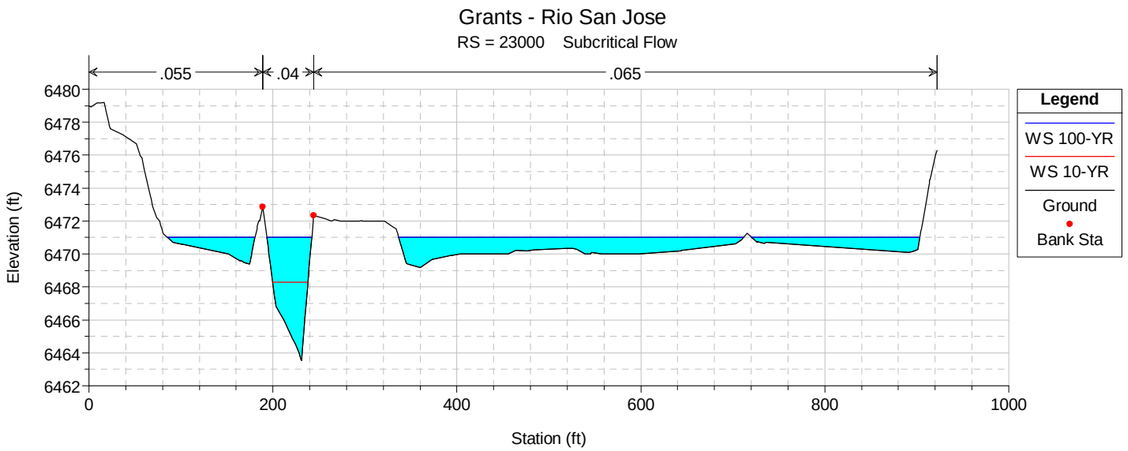

Grants - Rio San Jose
RS = 21500. Subcritical Flow
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

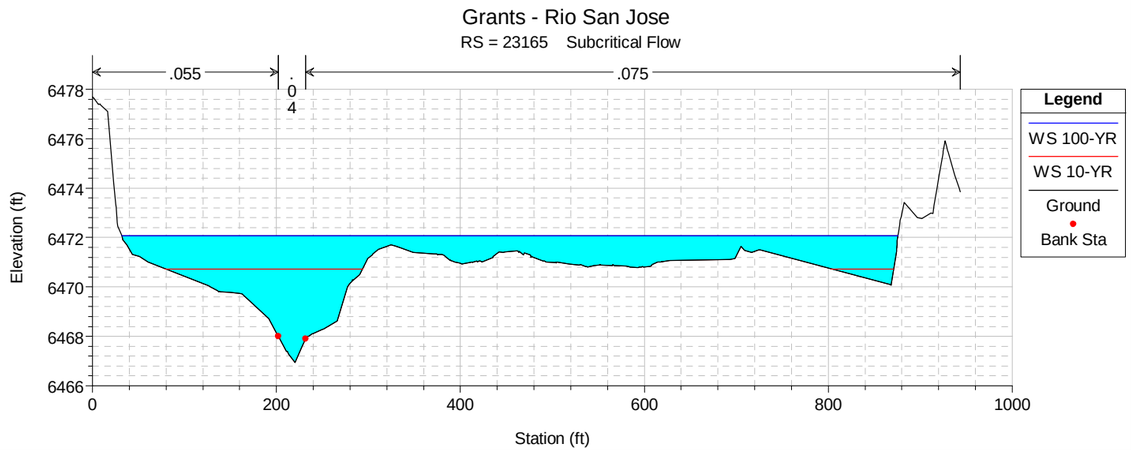

Grants - Rio San Jose
RS = 21700 Subcritical Flow
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

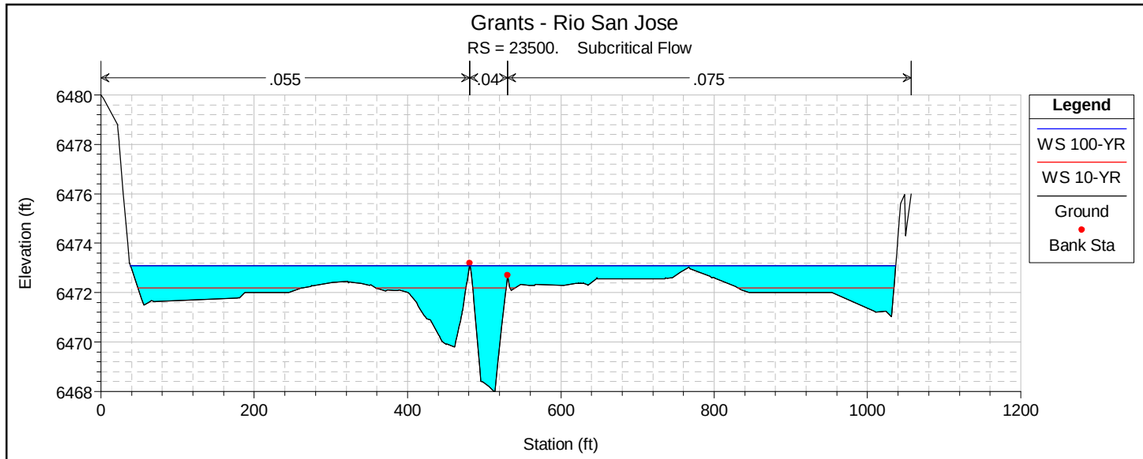

Grants - Rio San Jose
RS = 22000. Subcritical Flow
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

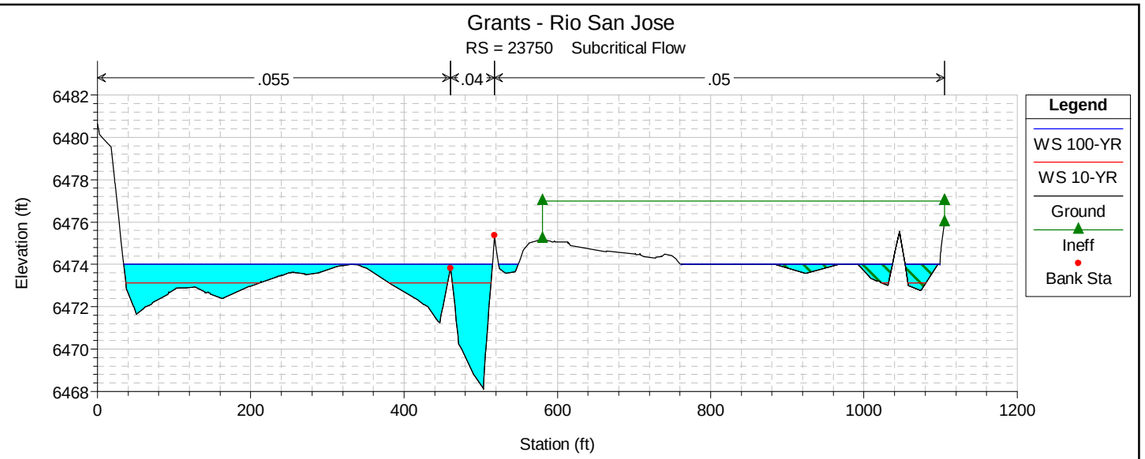

Grants - Rio San Jose
RS = 22500. Subcritical Flow
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

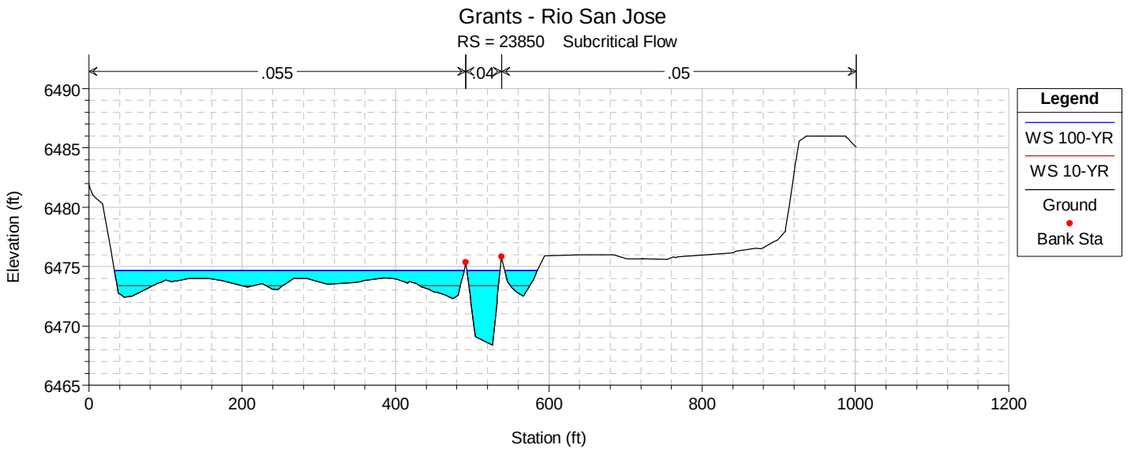

Grants - Rio San Jose
RS = 22800 Subcritical Flow
.065
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

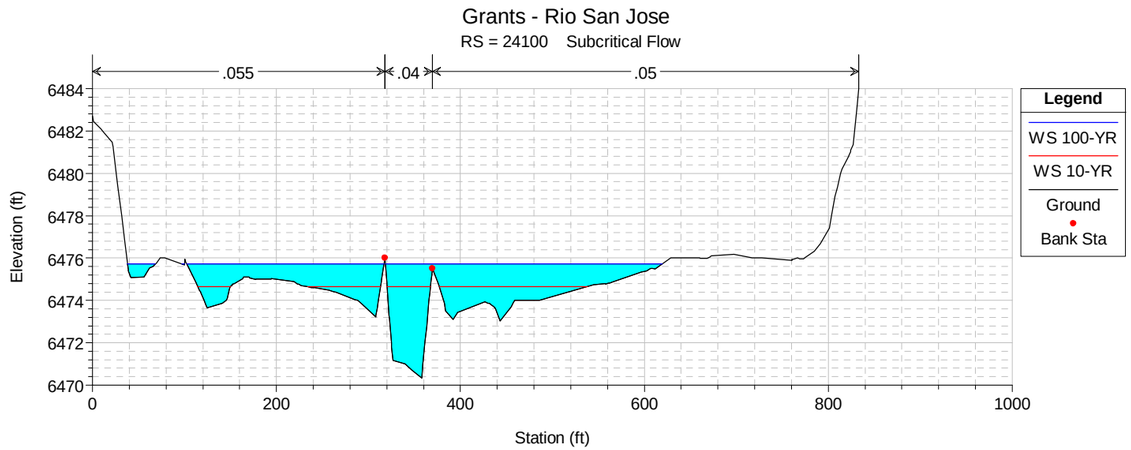

Grants - Rio San Jose
RS = 23000 Subcritical Flow
.055
.04
.065
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

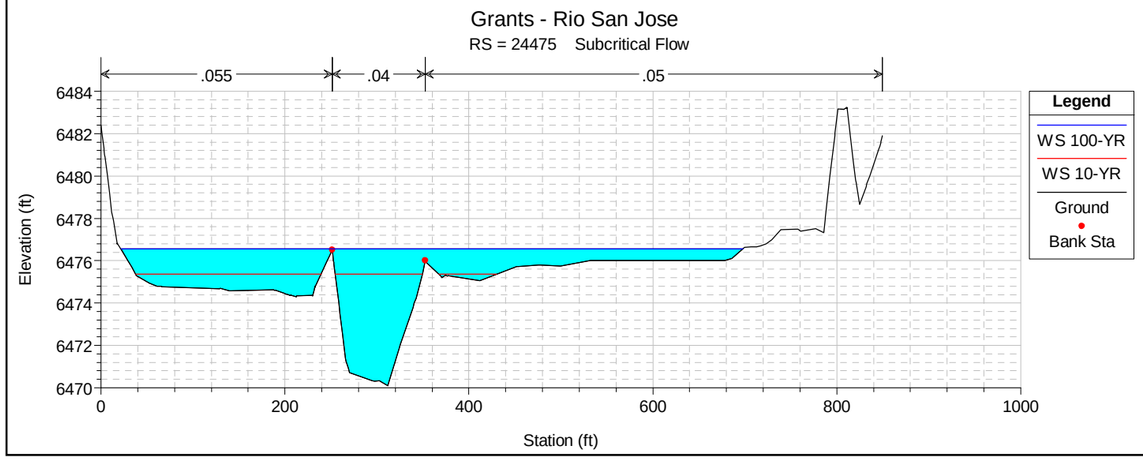

Grants - Rio San Jose
RS = 23165 Subcritical Flow
.055
.04
.075
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

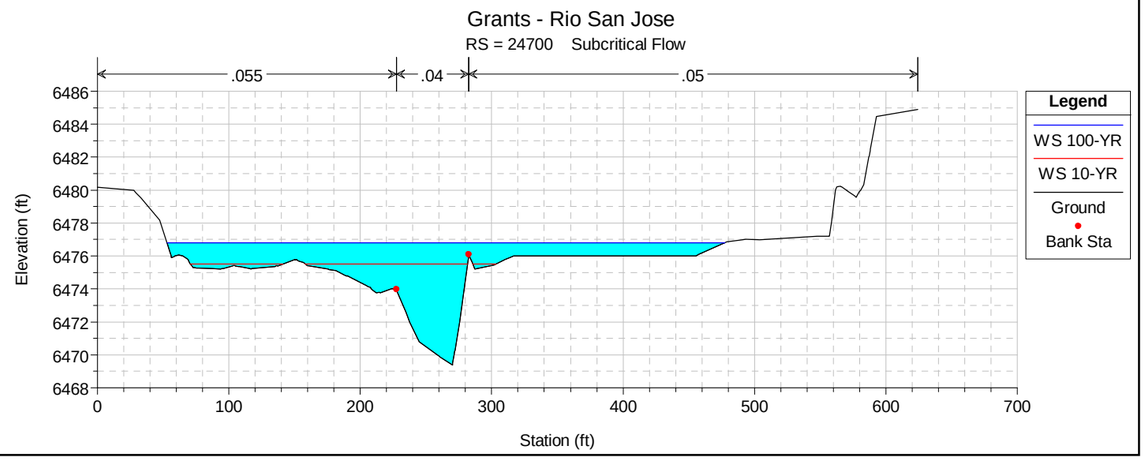

Grants - Rio San Jose
RS = 23500. Subcritical Flow
.055
.04
.075
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

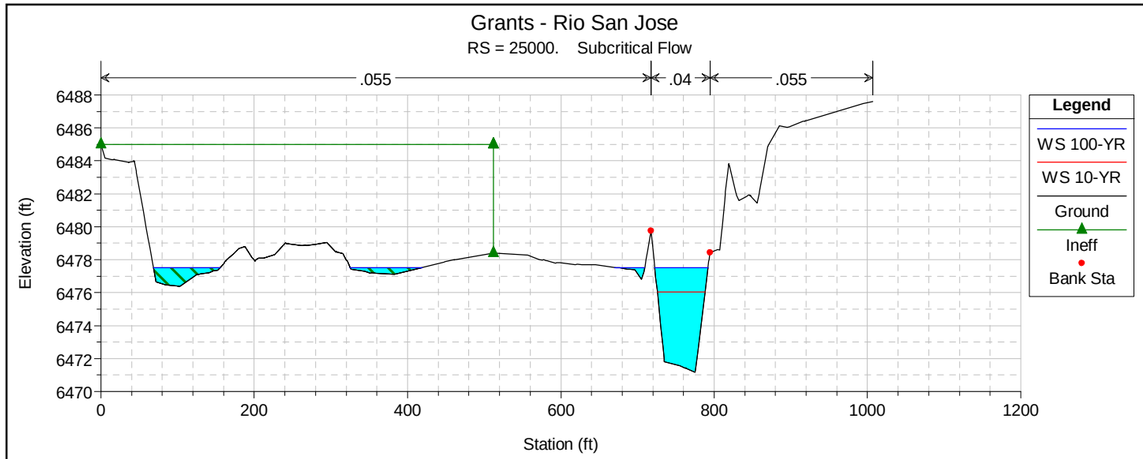

Grants - Rio San Jose
RS = 23750 Subcritical Flow
.055
.04
.05
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

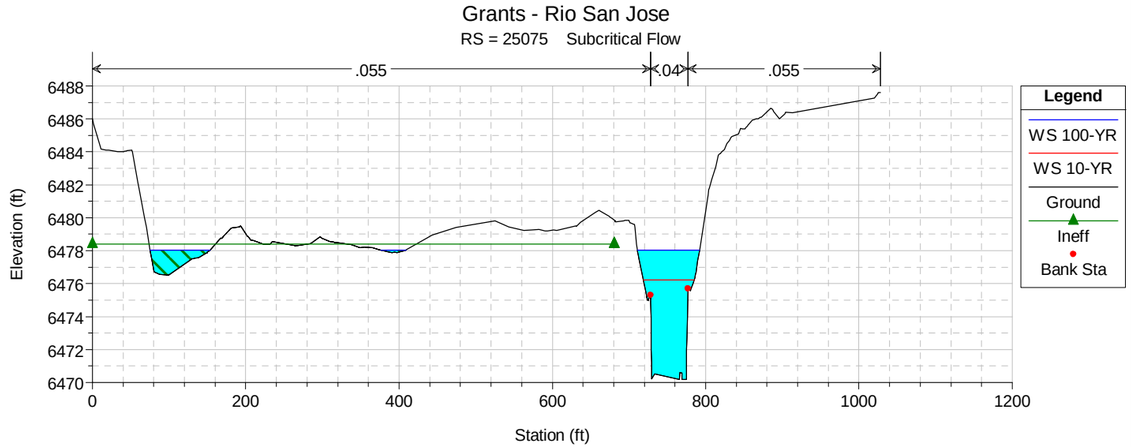

Grants - Rio San Jose
RS = 23850 Subcritical Flow
.055
.04
.05
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

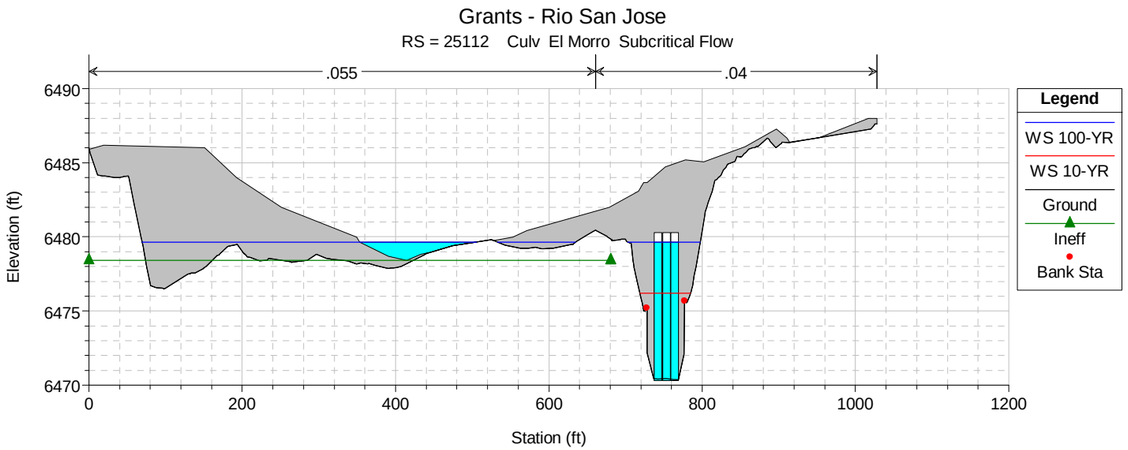

Grants - Rio San Jose
RS = 24100 Subcritical Flow
.055
.04
.05
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

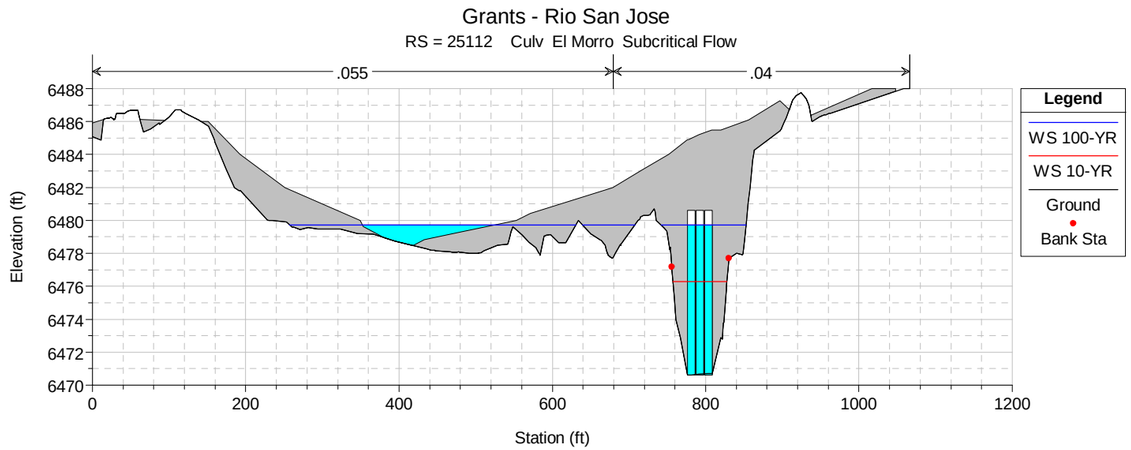

Grants - Rio San Jose
RS = 24475 Subcritical Flow
.055
.04
.05
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

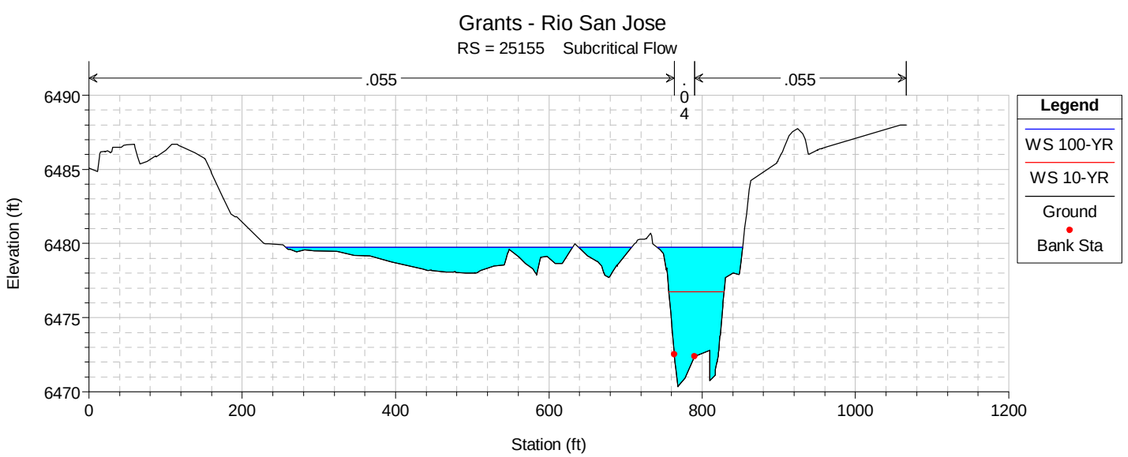

Grants - Rio San Jose
RS = 24700 Subcritical Flow
.055
.04
.05
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

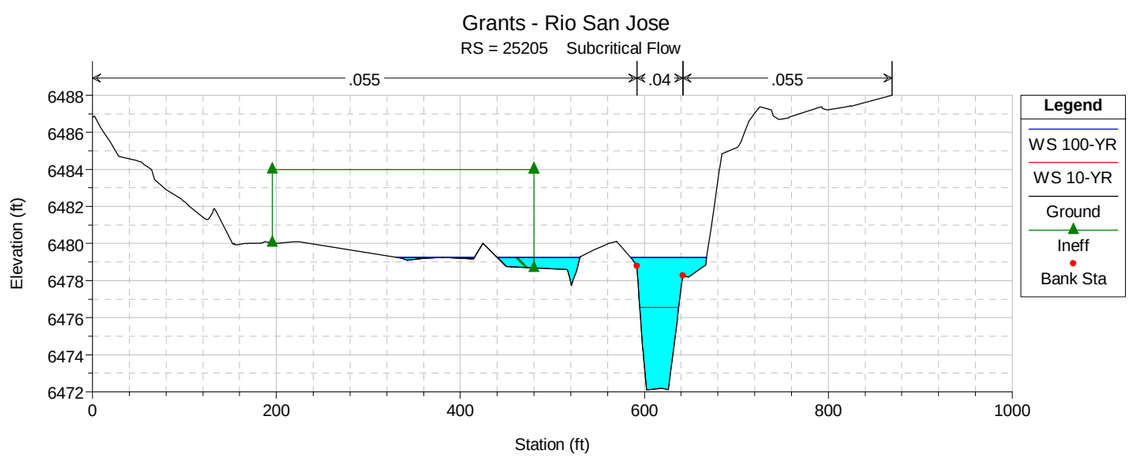

Grants - Rio San Jose
RS = 25000. Subcritical Flow
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

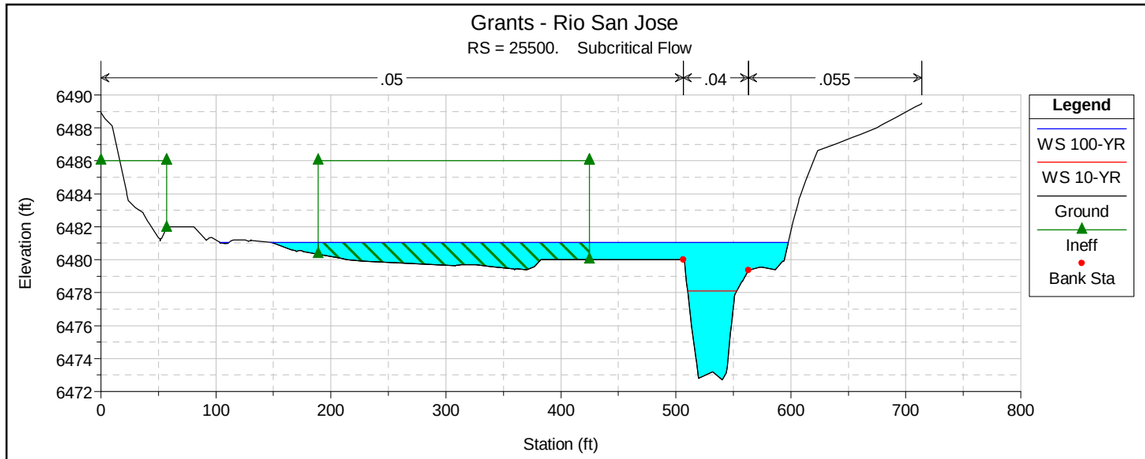

Grants - Rio San Jose
RS = 25075 Subcritical Flow
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

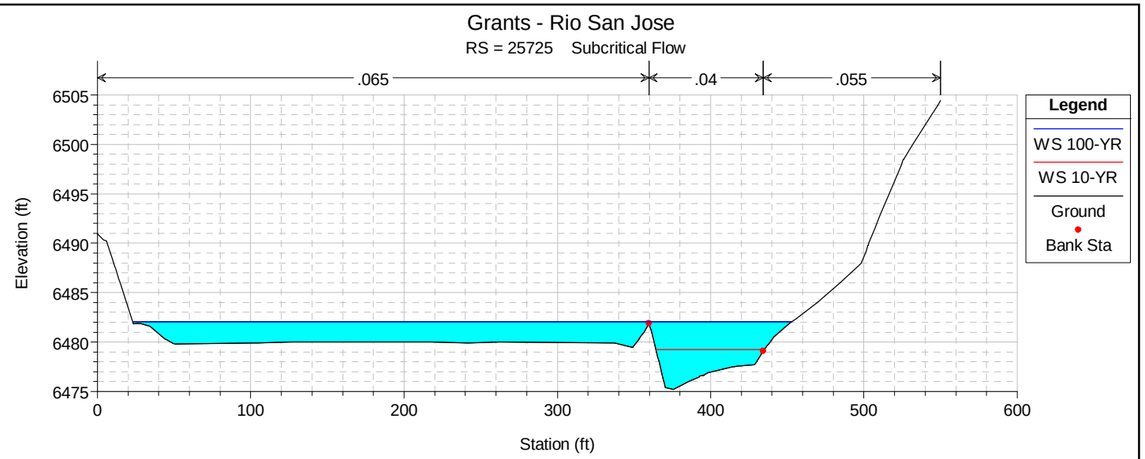

Grants - Rio San Jose
RS = 25112 Culv El Morro Subcritical Flow
.055
.04
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

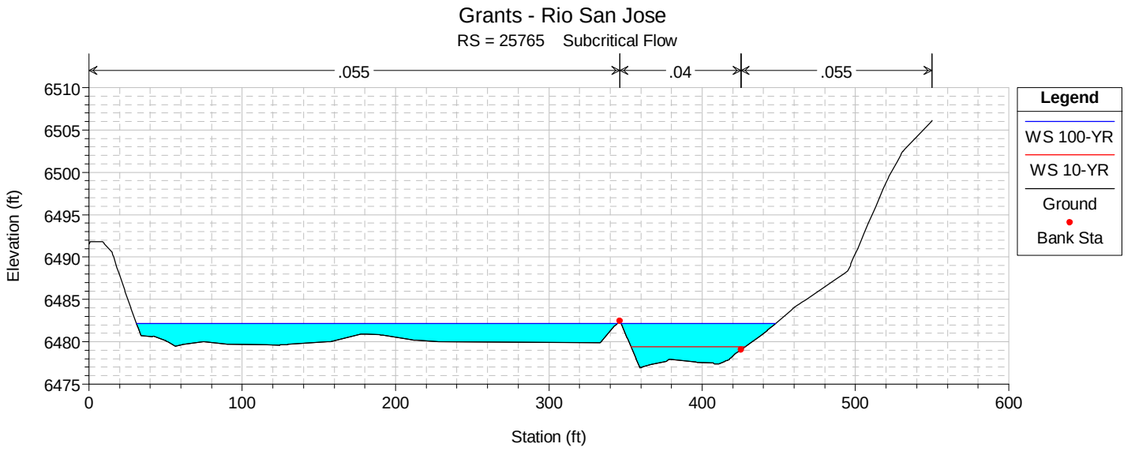

Grants - Rio San Jose
RS = 25112 Culv El Morro Subcritical Flow
.055
.04
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

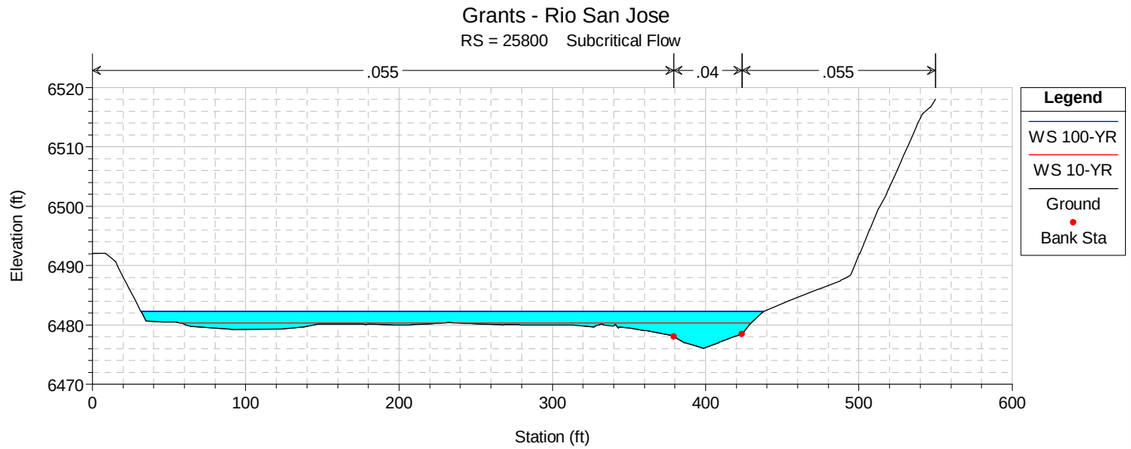

Grants - Rio San Jose
RS = 25155 Subcritical Flow
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

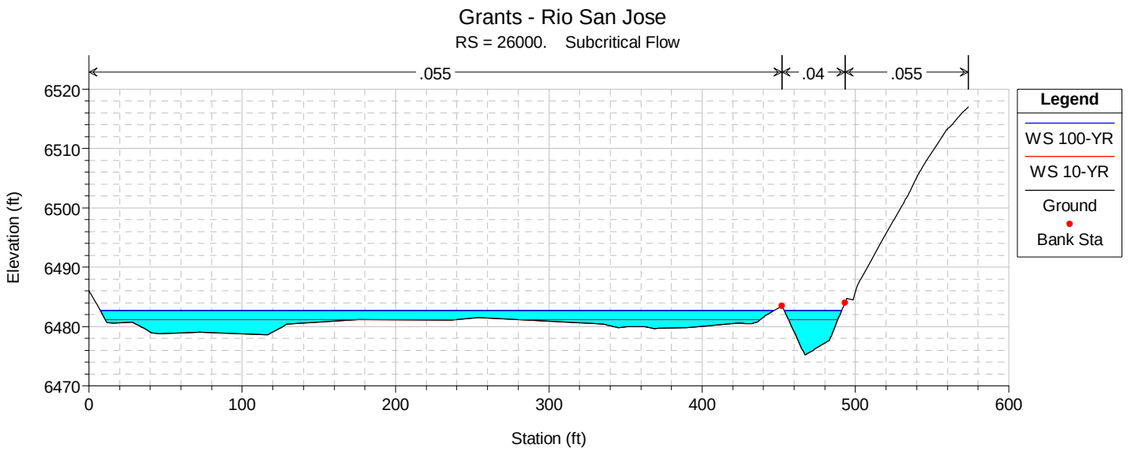

Grants - Rio San Jose
RS = 25205 Subcritical Flow
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

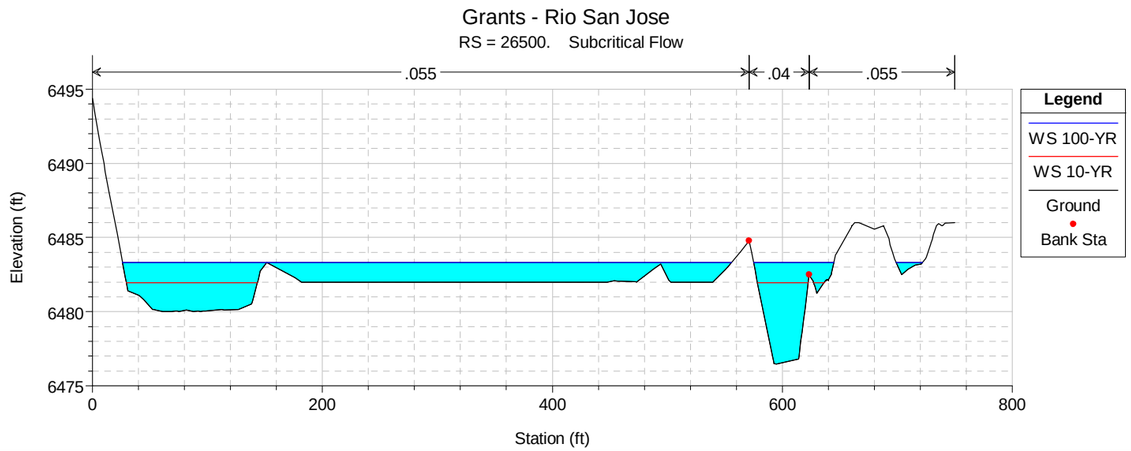

Grants - Rio San Jose
RS = 25500. Subcritical Flow
.05
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

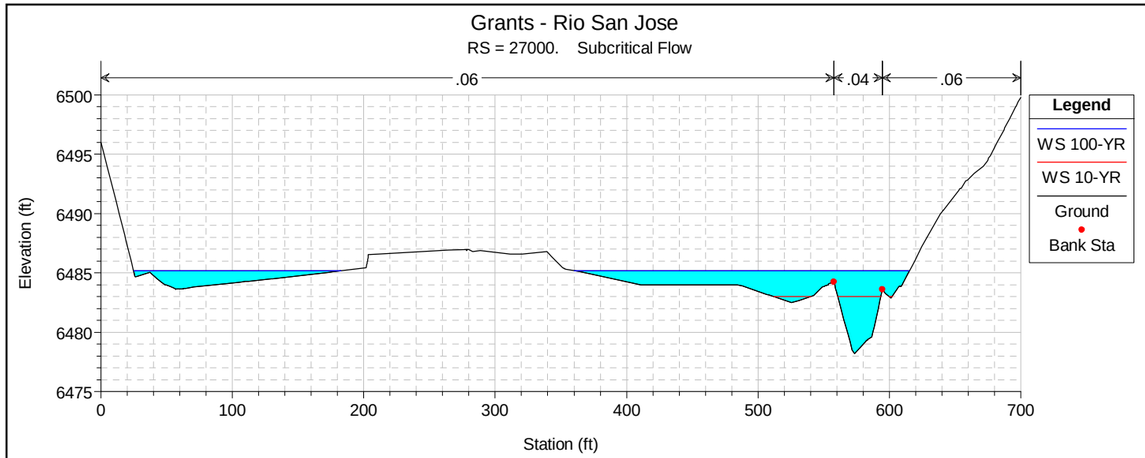

Grants - Rio San Jose
RS = 25725 Subcritical Flow
.065
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

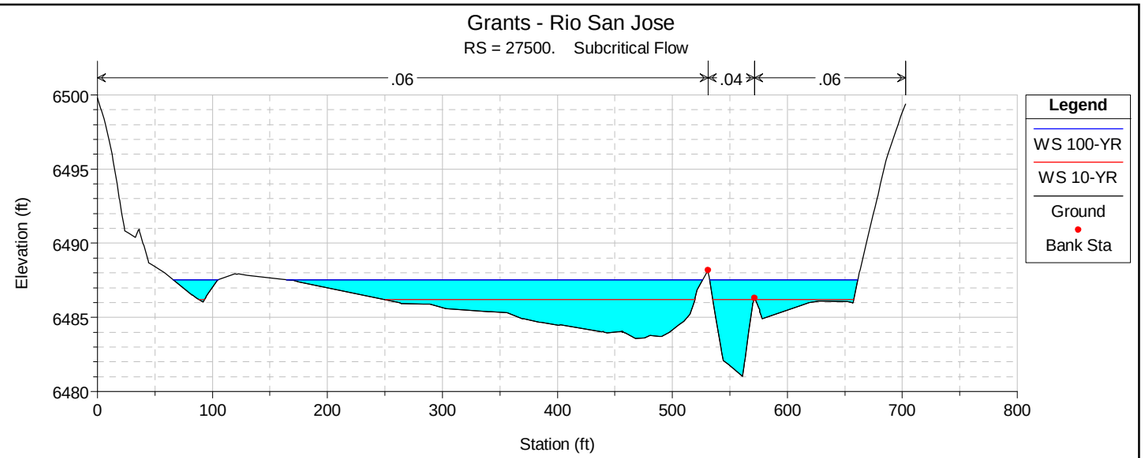

Grants - Rio San Jose
RS = 25765 Subcritical Flow
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

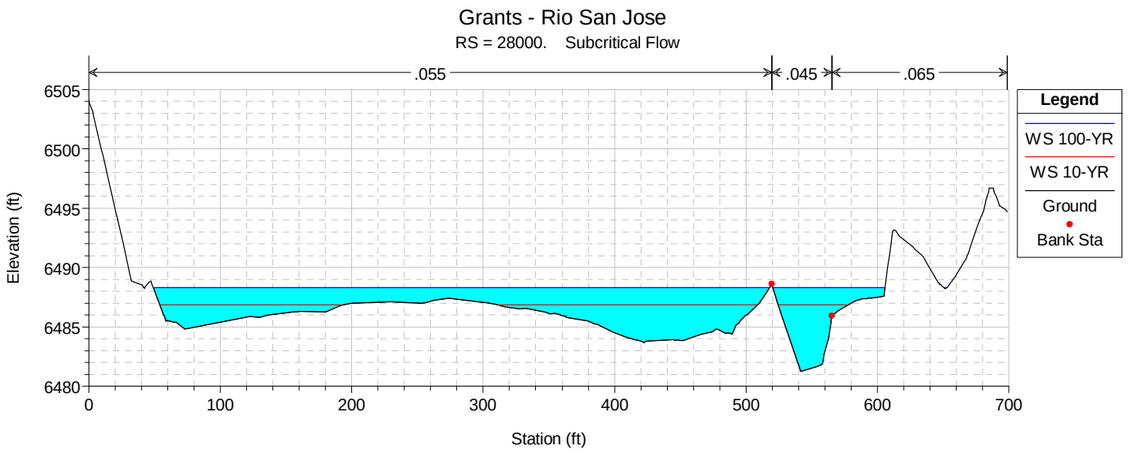

Grants - Rio San Jose
RS = 25800 Subcritical Flow
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

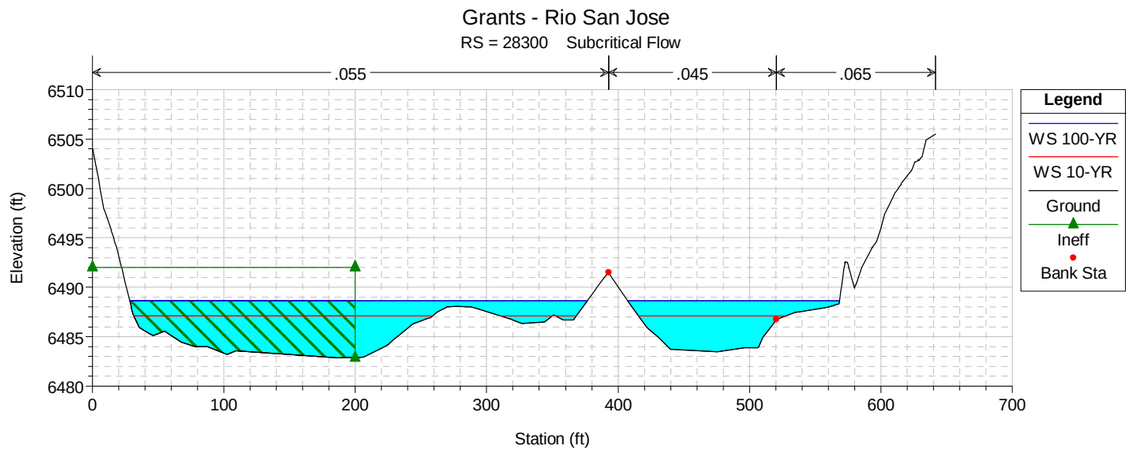

Grants - Rio San Jose
RS = 26000. Subcritical Flow
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

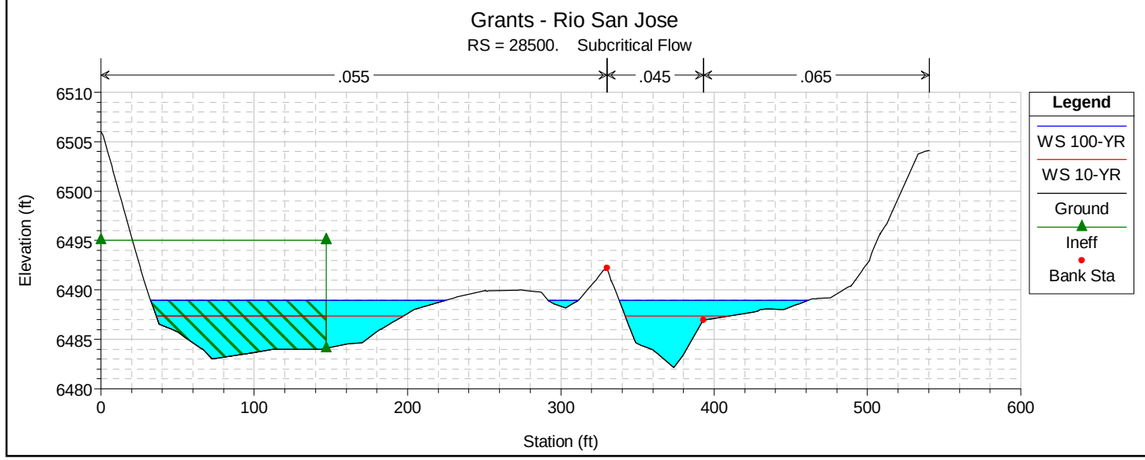

Grants - Rio San Jose
RS = 26500. Subcritical Flow
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

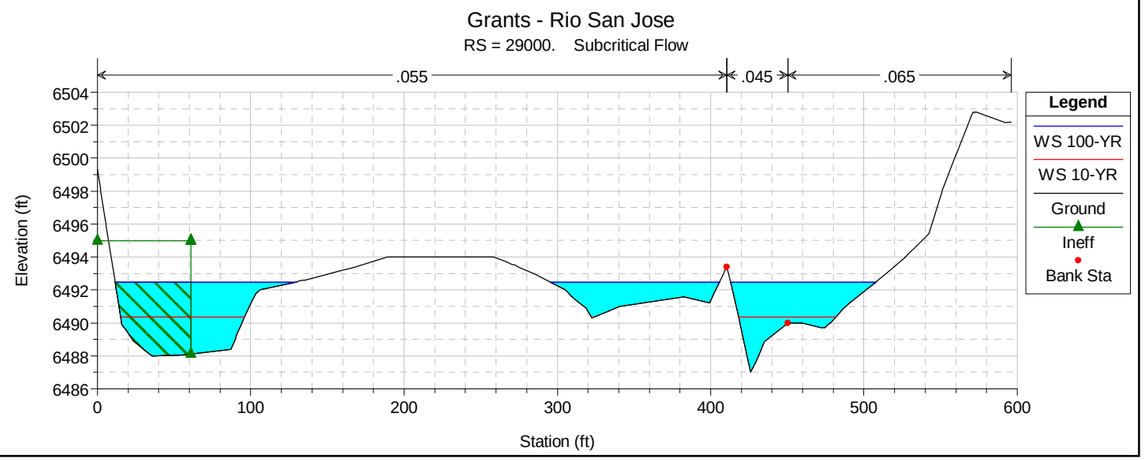

Grants - Rio San Jose
RS = 27000. Subcritical Flow
.06
.04
.06
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

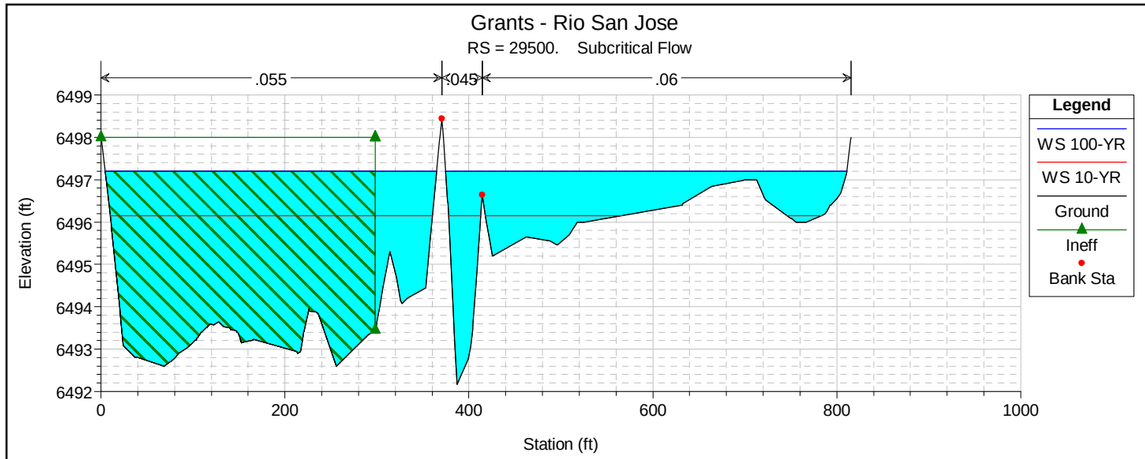

Grants - Rio San Jose
RS = 27500. Subcritical Flow
.06
.04
.06
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

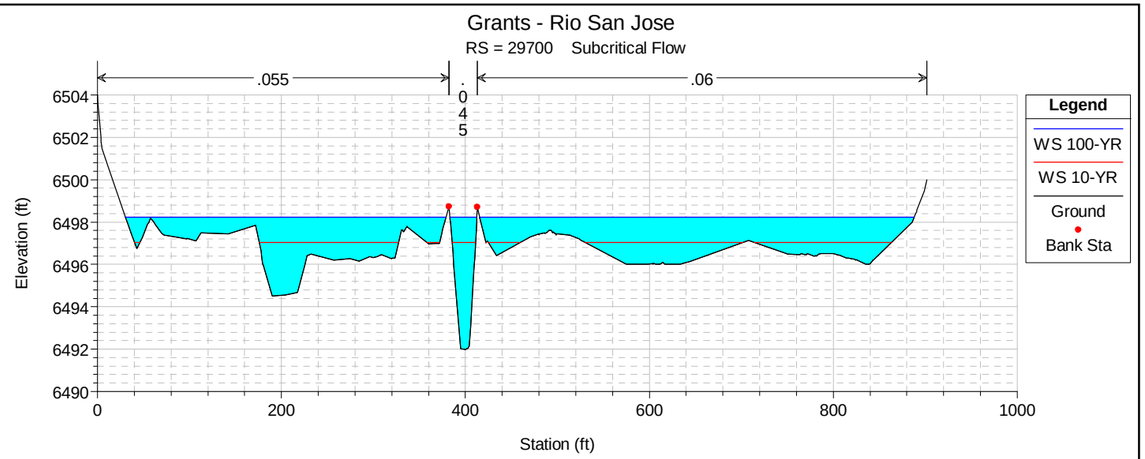

Grants - Rio San Jose
RS = 28000. Subcritical Flow
.055
.045
.065
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

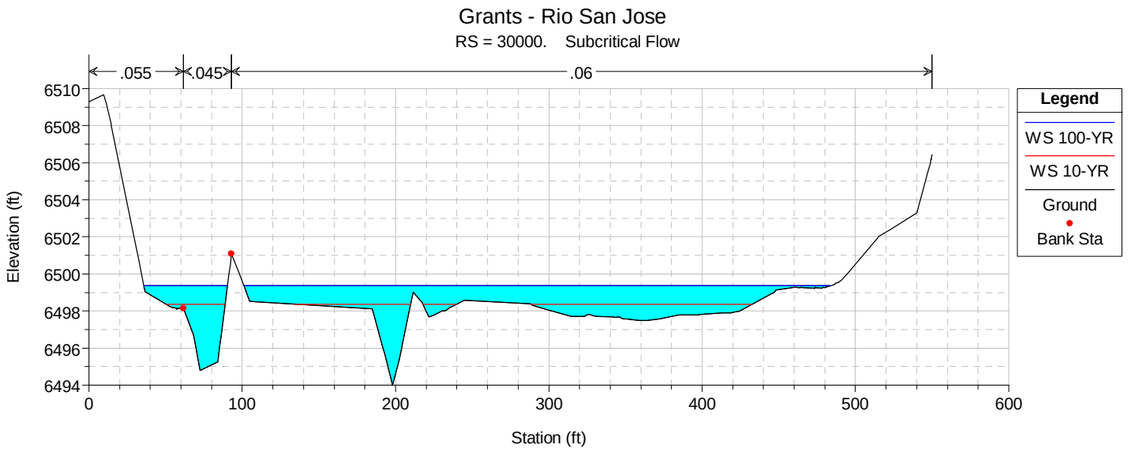

Grants - Rio San Jose
RS = 28300 Subcritical Flow
.055
.045
.065
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

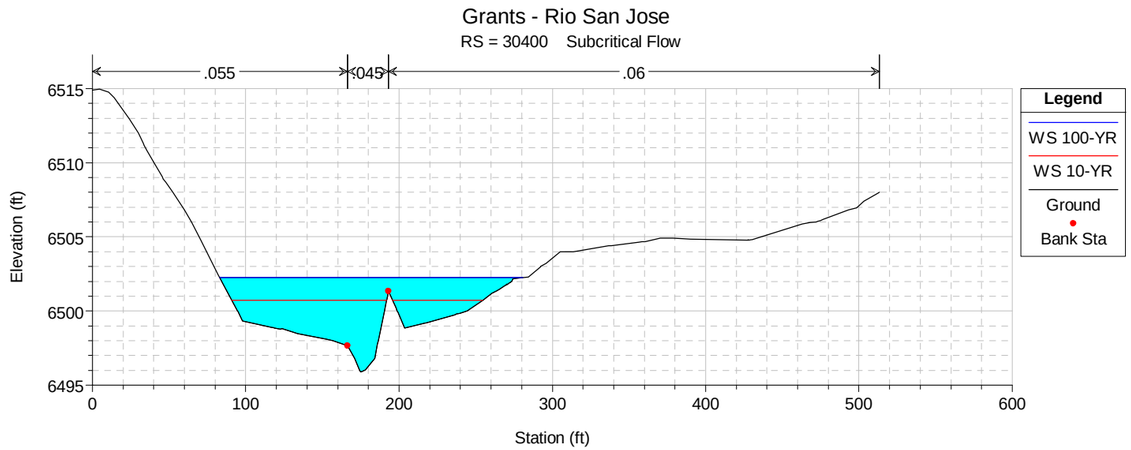

Grants - Rio San Jose
RS = 28500. Subcritical Flow
.055
.045
.065
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

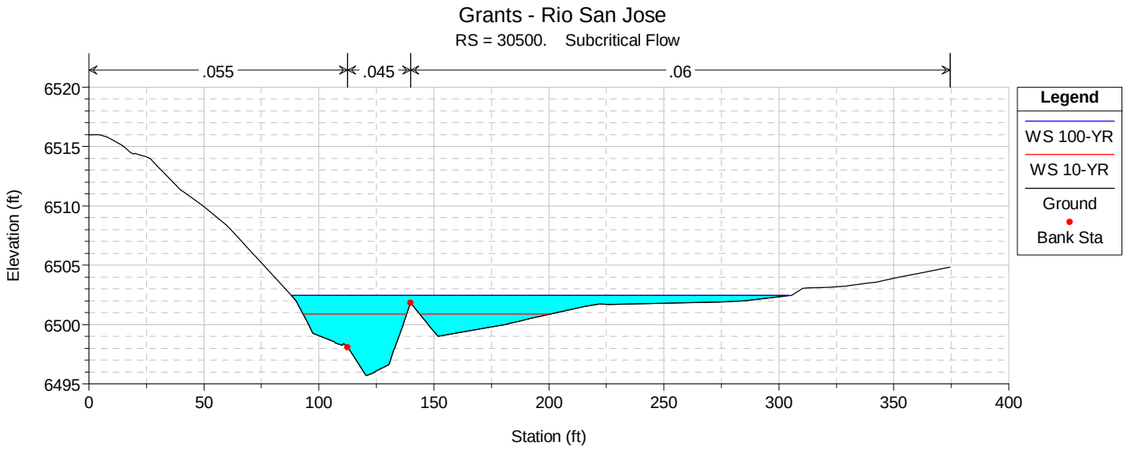

Grants - Rio San Jose
RS = 29000. Subcritical Flow
.055
.045
.065
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

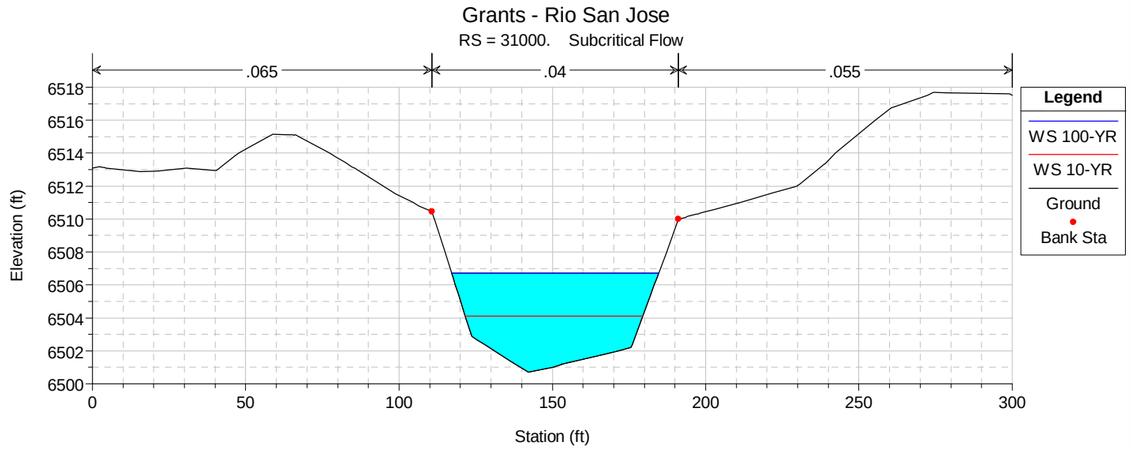

Grants - Rio San Jose
RS = 29500. Subcritical Flow
.055
.045
.06
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

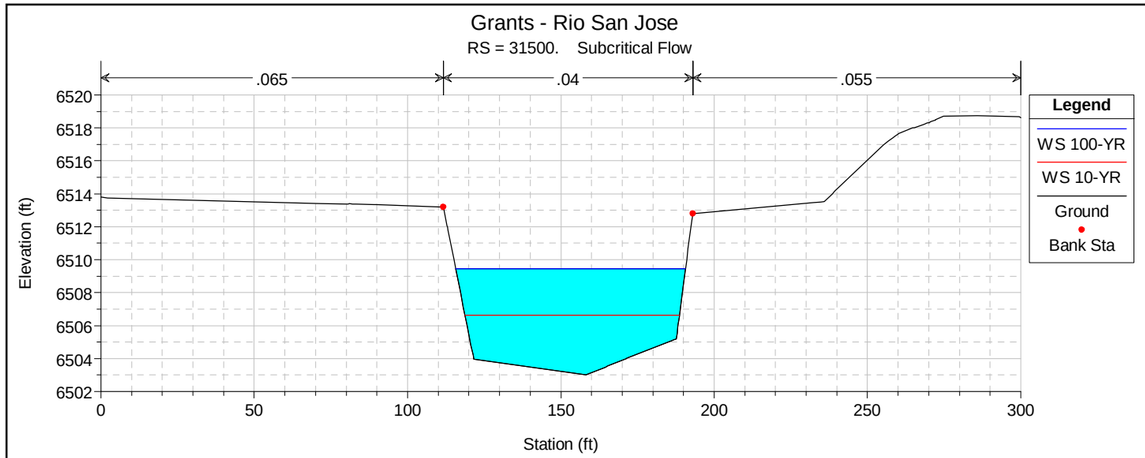

Grants - Rio San Jose
RS = 29700 Subcritical Flow
.055
.045
.06
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

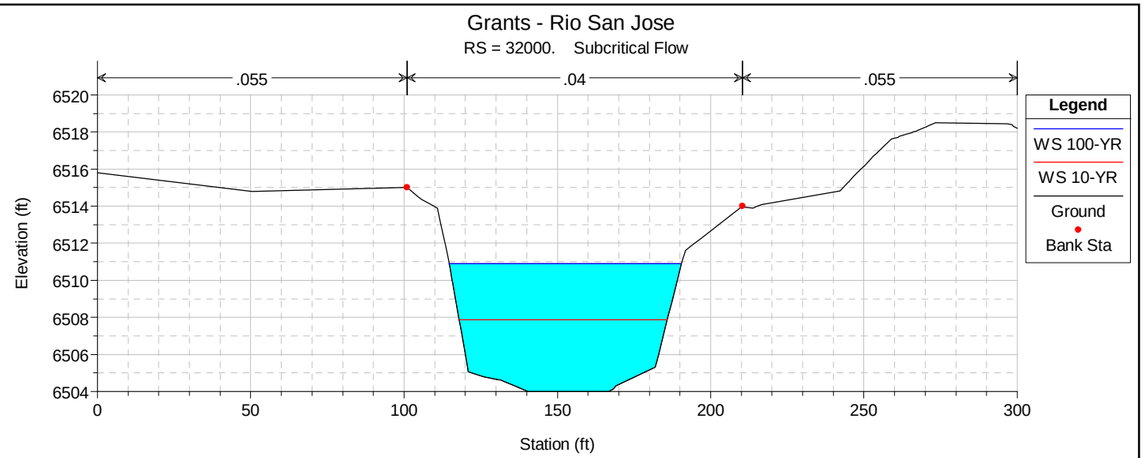

Grants - Rio San Jose
RS = 30000. Subcritical Flow
.055
.045
.06
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

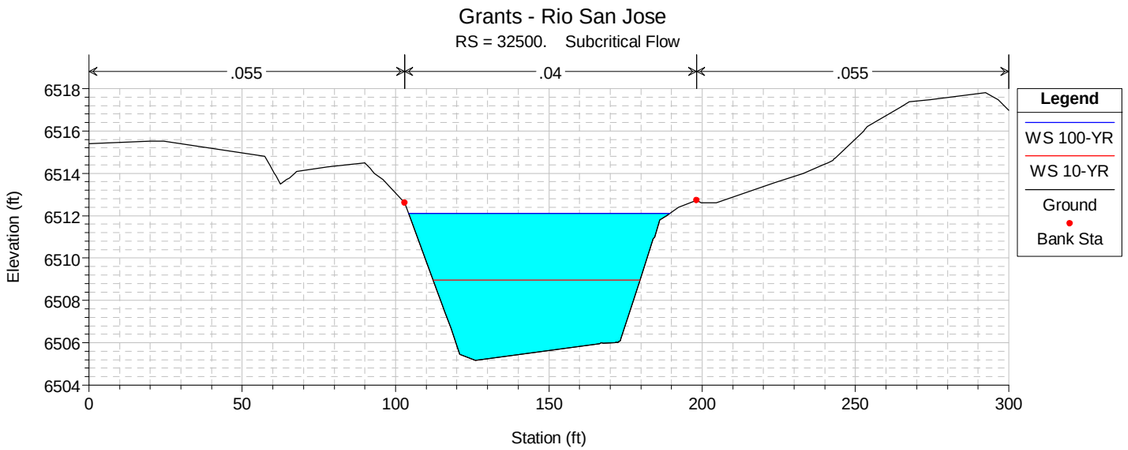

Grants - Rio San Jose
RS = 30400 Subcritical Flow
.055
.045
.06
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

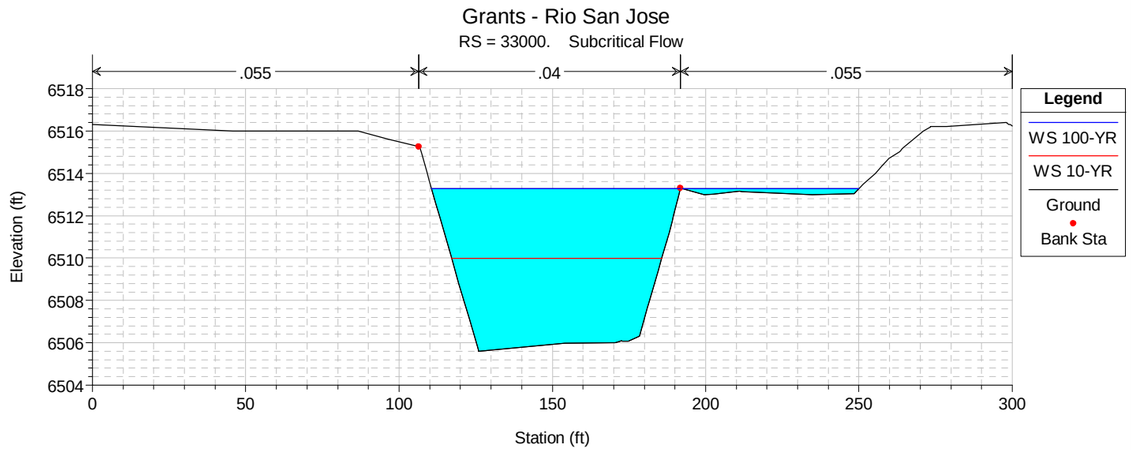

Grants - Rio San Jose
RS = 30500. Subcritical Flow
.055
.045
.06
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

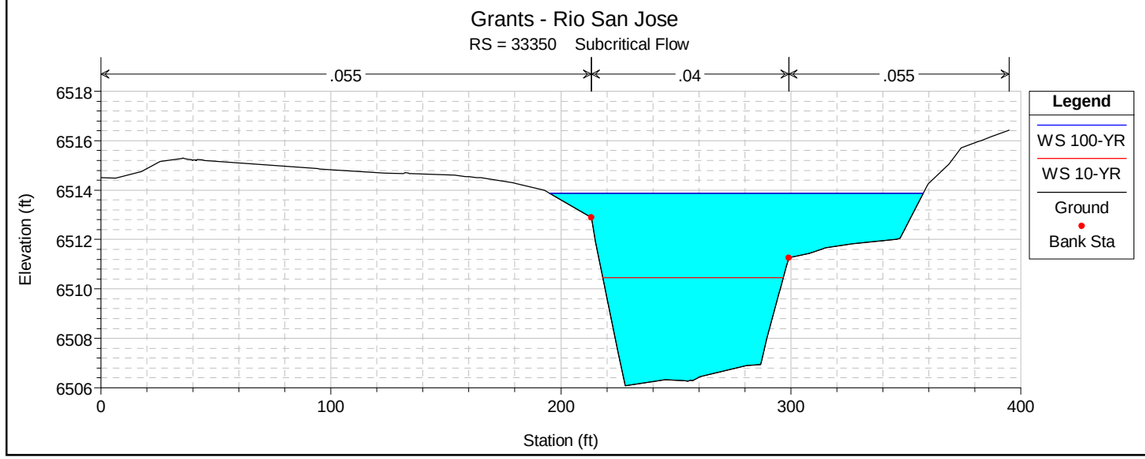

Grants - Rio San Jose
RS = 31000. Subcritical Flow
.065
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

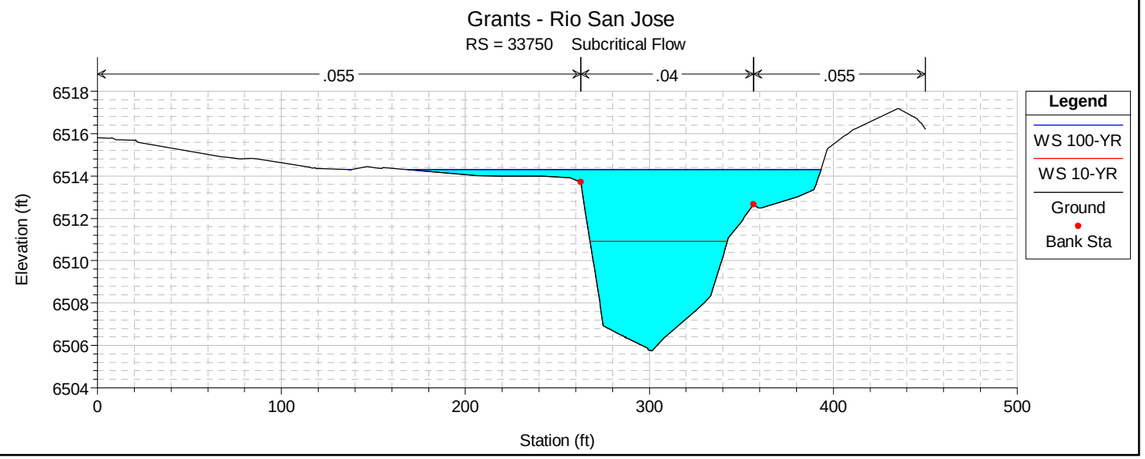

Grants - Rio San Jose
RS = 31500. Subcritical Flow
.065
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

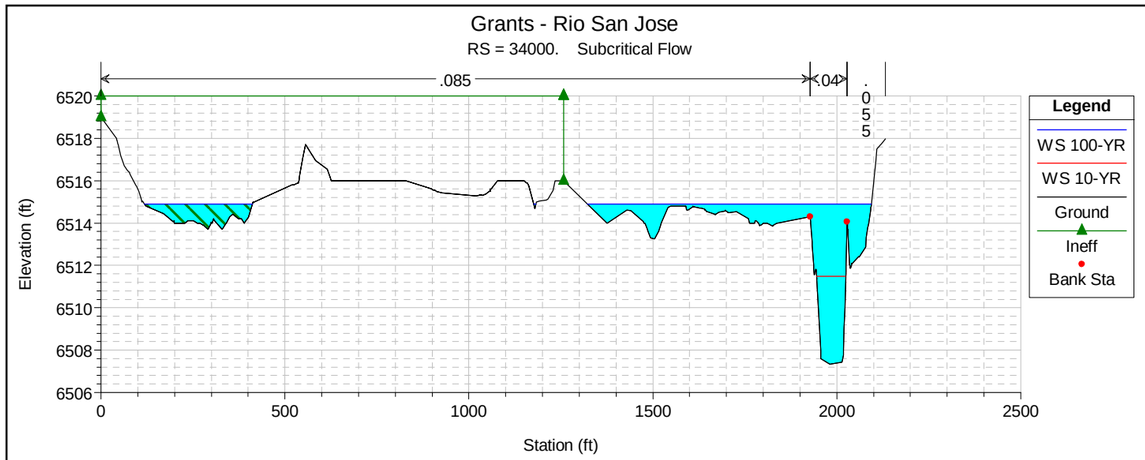

Grants - Rio San Jose
RS = 32000. Subcritical Flow
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

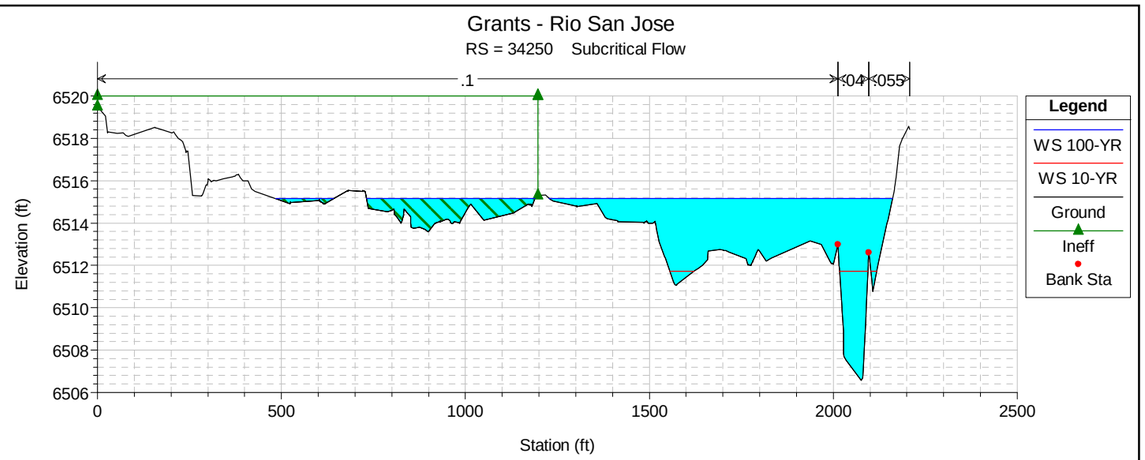

Grants - Rio San Jose
RS = 32500. Subcritical Flow
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

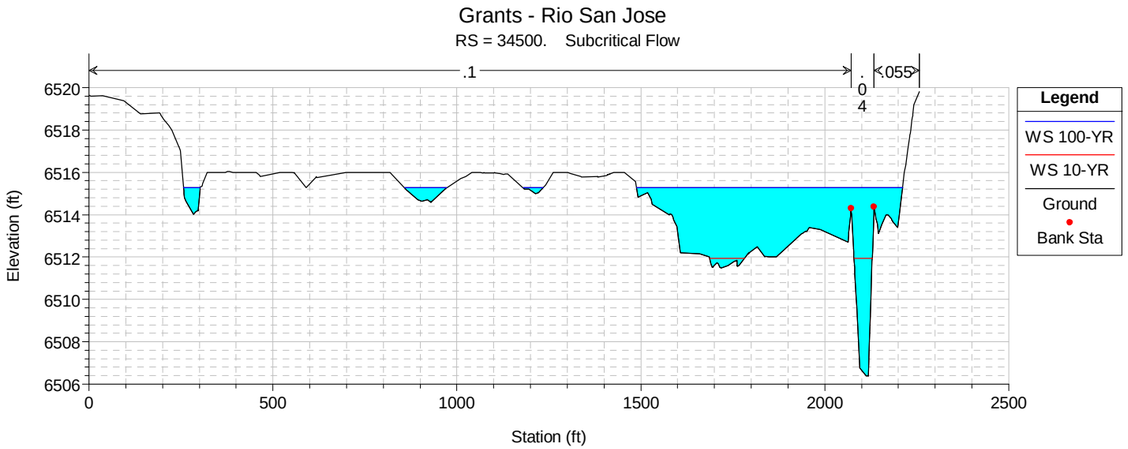

Grants - Rio San Jose
RS = 33000. Subcritical Flow
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

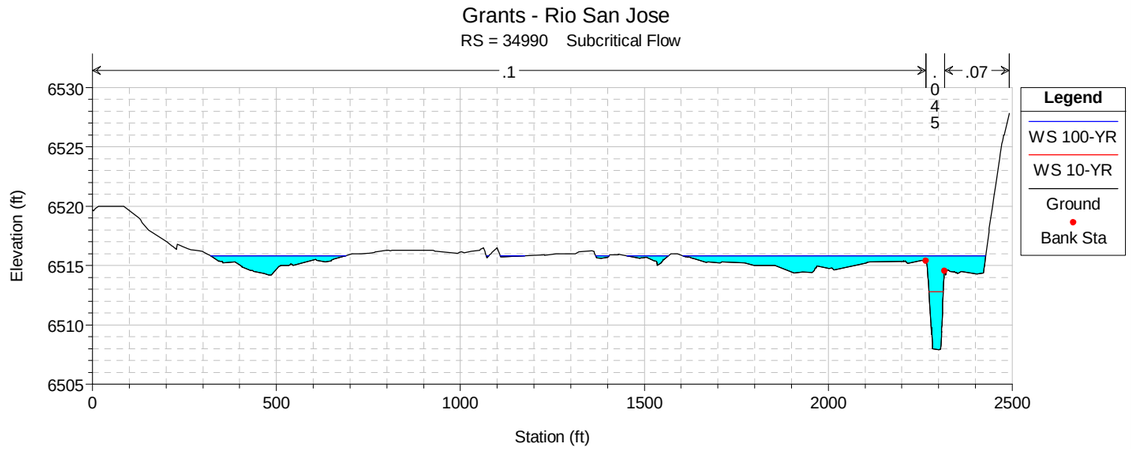

Grants - Rio San Jose
RS = 33350 Subcritical Flow
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

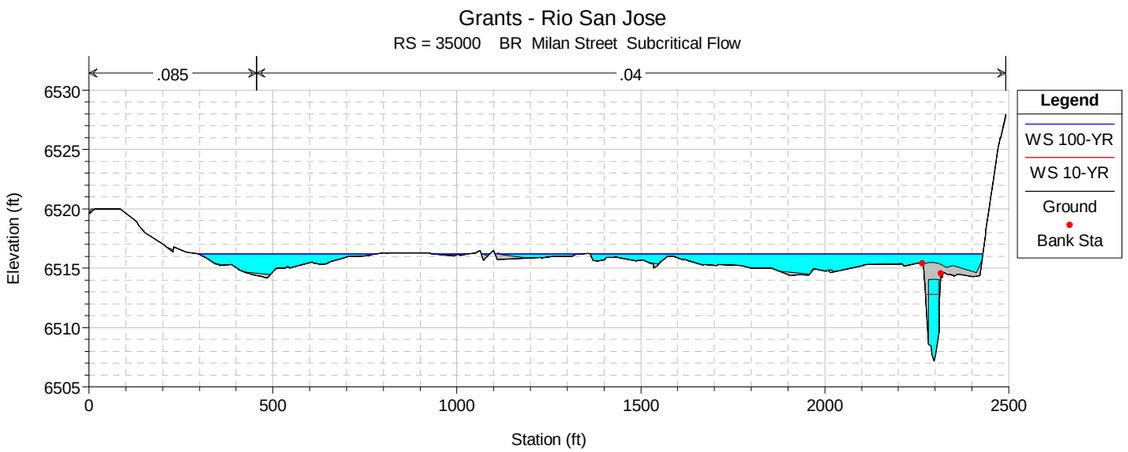

Grants - Rio San Jose
RS = 33750 Subcritical Flow
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

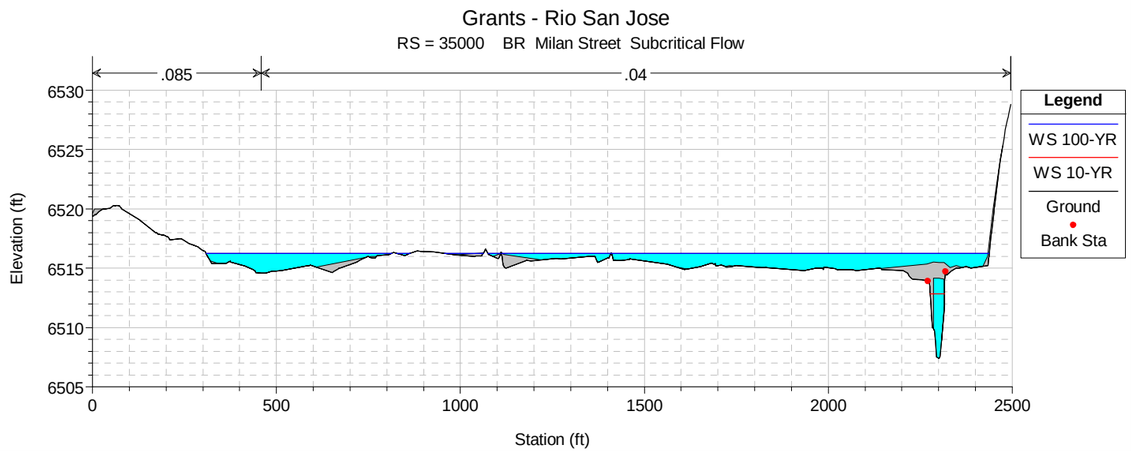

Grants - Rio San Jose
RS = 34000. Subcritical Flow
.085
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

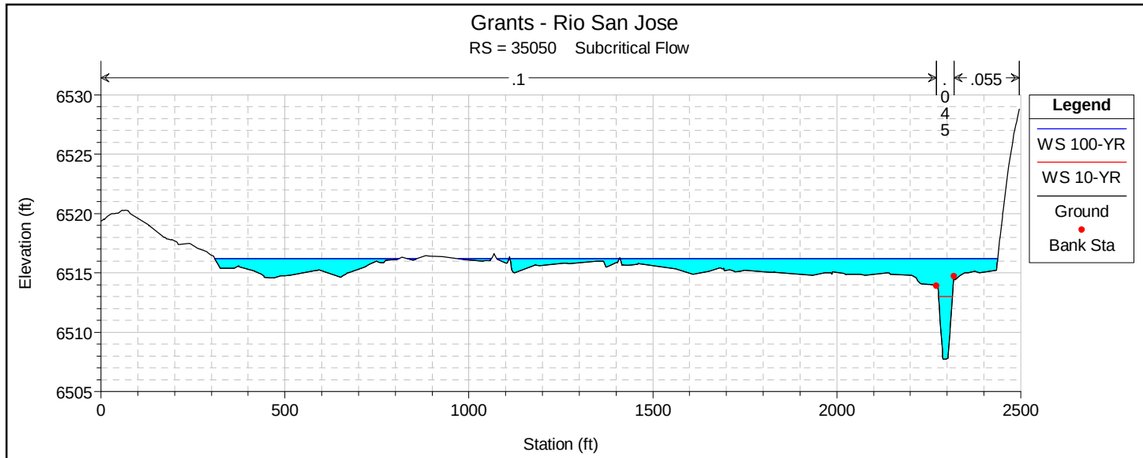

Grants - Rio San Jose
RS = 34250 Subcritical Flow
.1
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

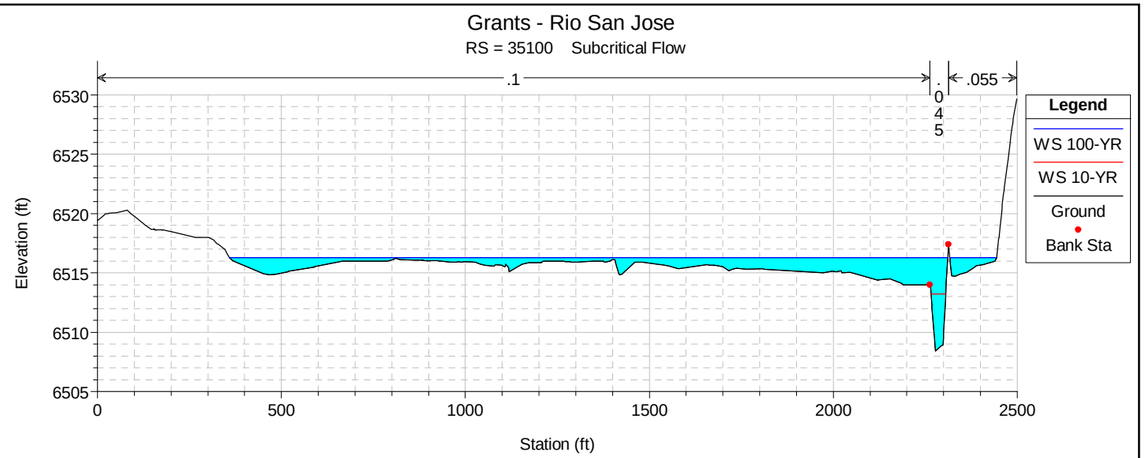

Grants - Rio San Jose
RS = 34500. Subcritical Flow
.1
.055
.04
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

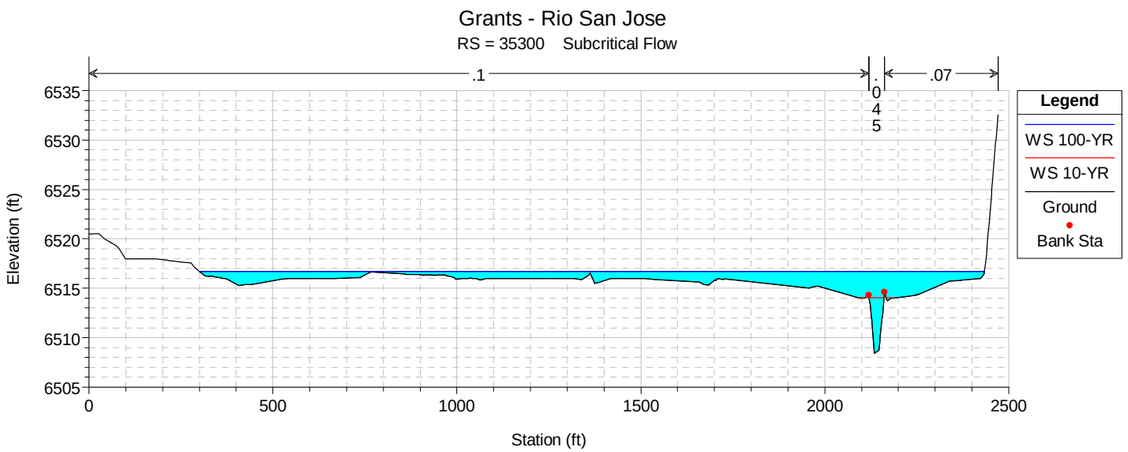

Grants - Rio San Jose
RS = 34990 Subcritical Flow
.1
.07
.045
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

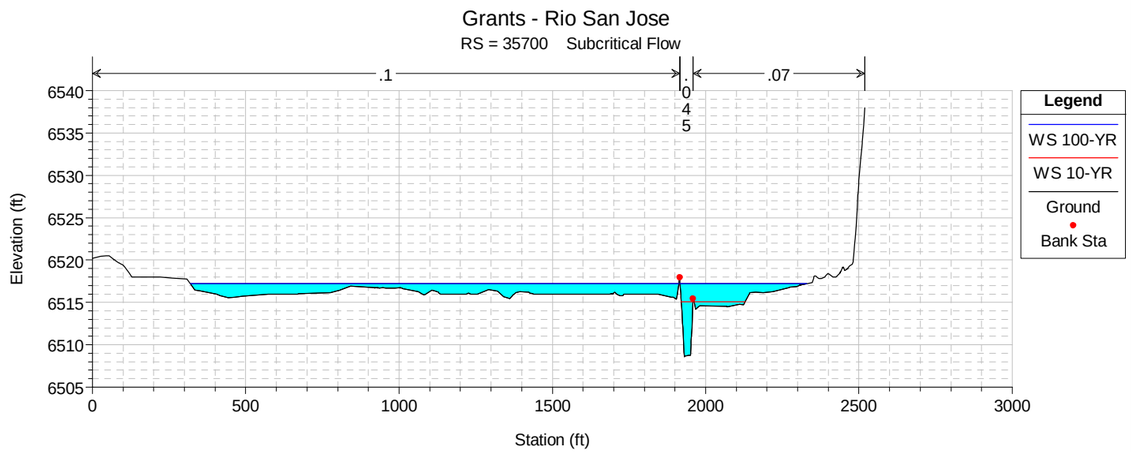

Grants - Rio San Jose
RS = 35000 BR Milan Street Subcritical Flow
.085
.04
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

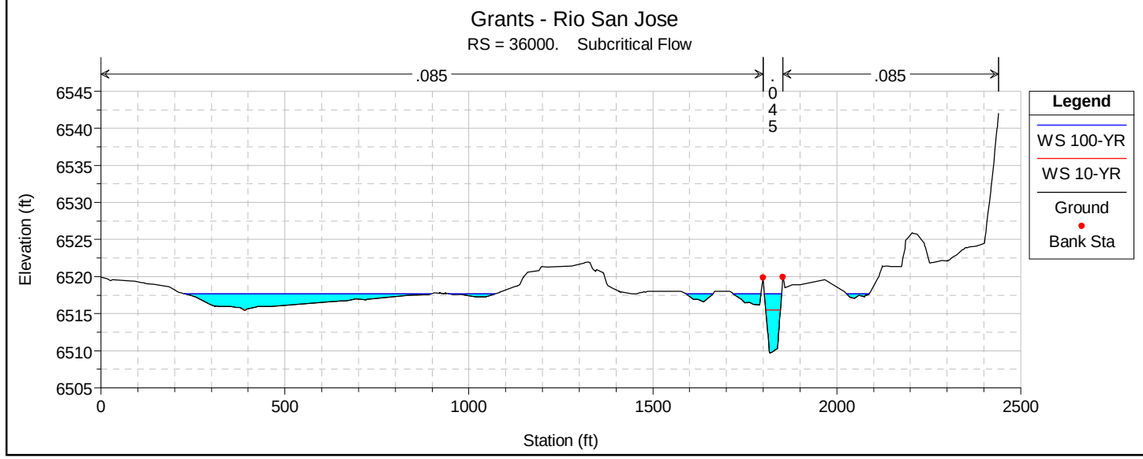

Grants - Rio San Jose
RS = 35000 BR Milan Street Subcritical Flow
.085
.04
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

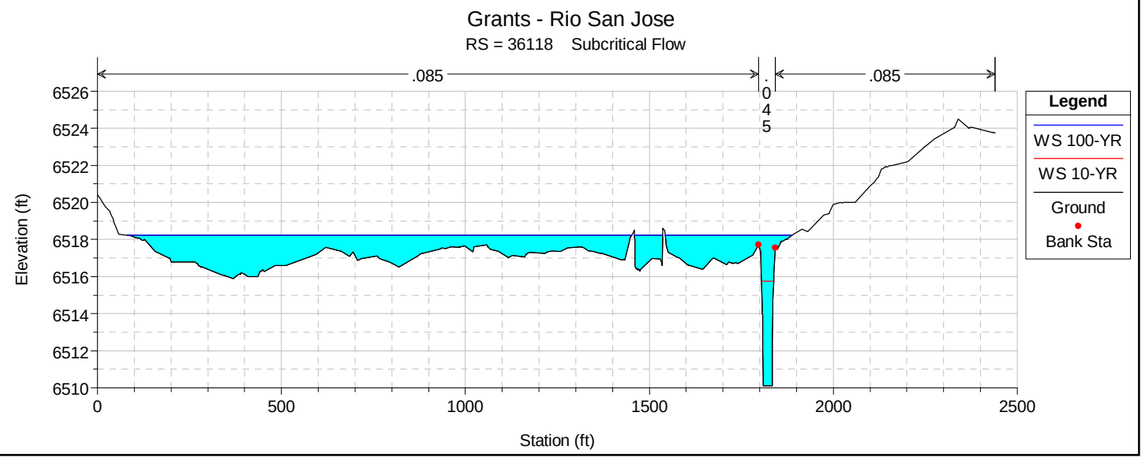

Grants - Rio San Jose
RS = 35050 Subcritical Flow
.1
.055
0
4
5
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
6530
6525
6520
6515
6510
6505
0
500
1000
1500
2000
2500

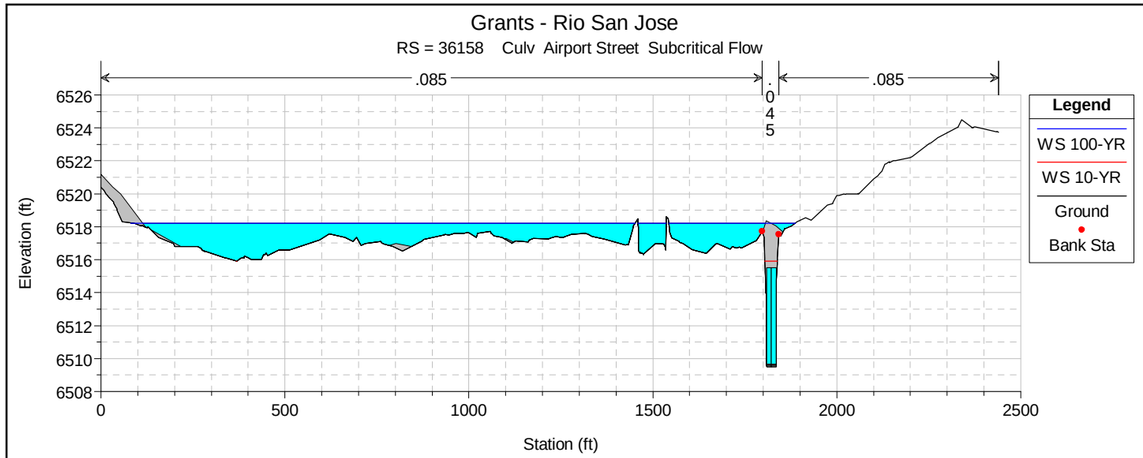

Grants - Rio San Jose
RS = 35100 Subcritical Flow
.1
.055
0
4
5
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
6530
6525
6520
6515
6510
6505
0
500
1000
1500
2000
2500

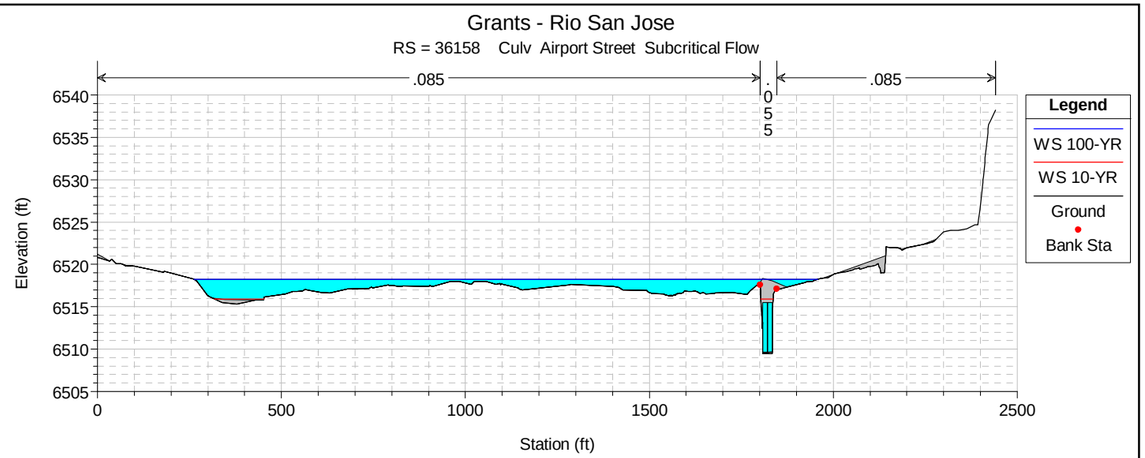

Grants - Rio San Jose
RS = 35300 Subcritical Flow
.1
.07
0
4
5
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
6535
6530
6525
6520
6515
6510
6505
0
500
1000
1500
2000
2500

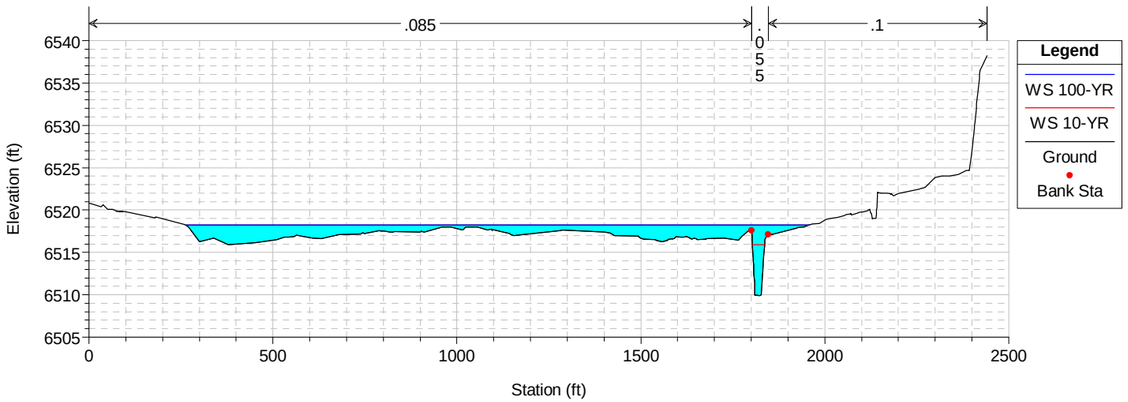

Grants - Rio San Jose
RS = 35700 Subcritical Flow
.1
.07
0
4
5
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
6540
6535
6530
6525
6520
6515
6510
6505
0
500
1000
1500
2000
2500
3000

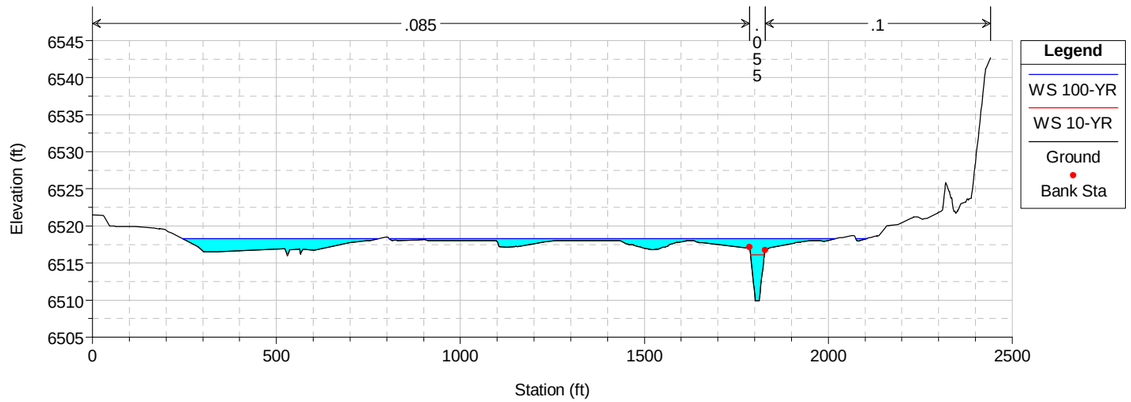

Grants - Rio San Jose
RS = 36000. Subcritical Flow
.085
.085
0
4
5
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
6545
6540
6535
6530
6525
6520
6515
6510
6505
0
500
1000
1500
2000
2500

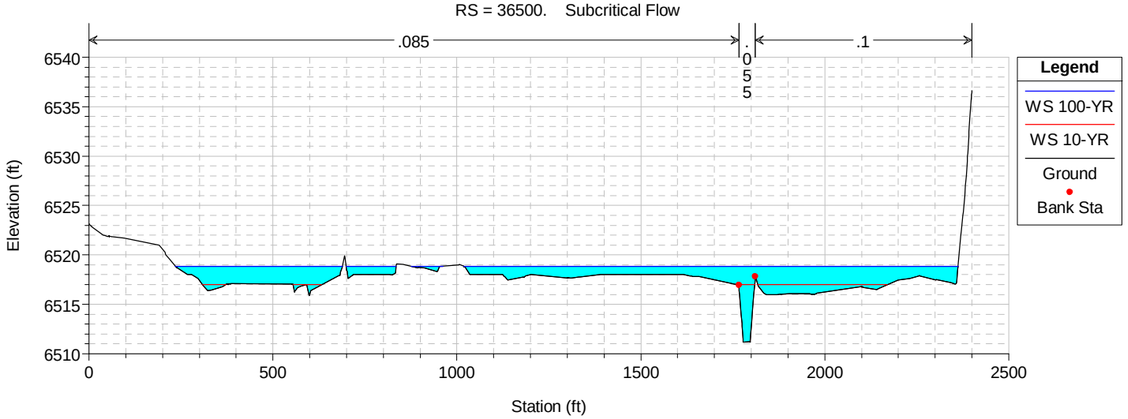

Grants - Rio San Jose
RS = 36118 Subcritical Flow
.085
.085
0
4
5
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
6526
6524
6522
6520
6518
6516
6514
6512
6510
0
500
1000
1500
2000
2500

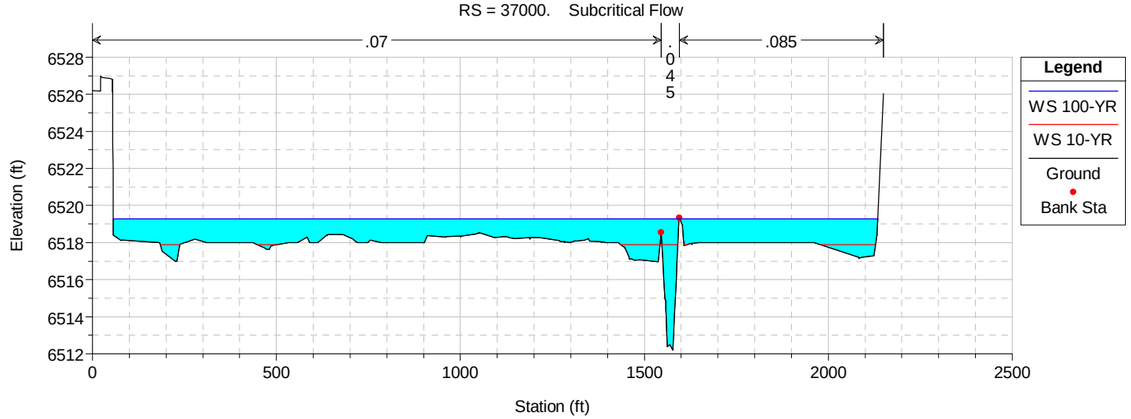

Grants - Rio San Jose
RS = 36158 Culv Airport Street Subcritical Flow
.085
.045
.085
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

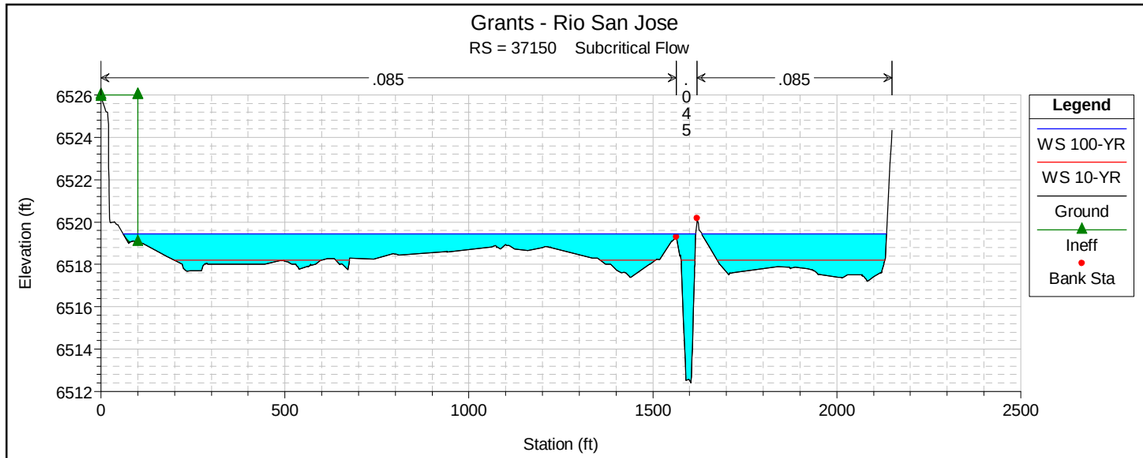

Grants - Rio San Jose
RS = 36158 Culv Airport Street Subcritical Flow
.085
.055
.085
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

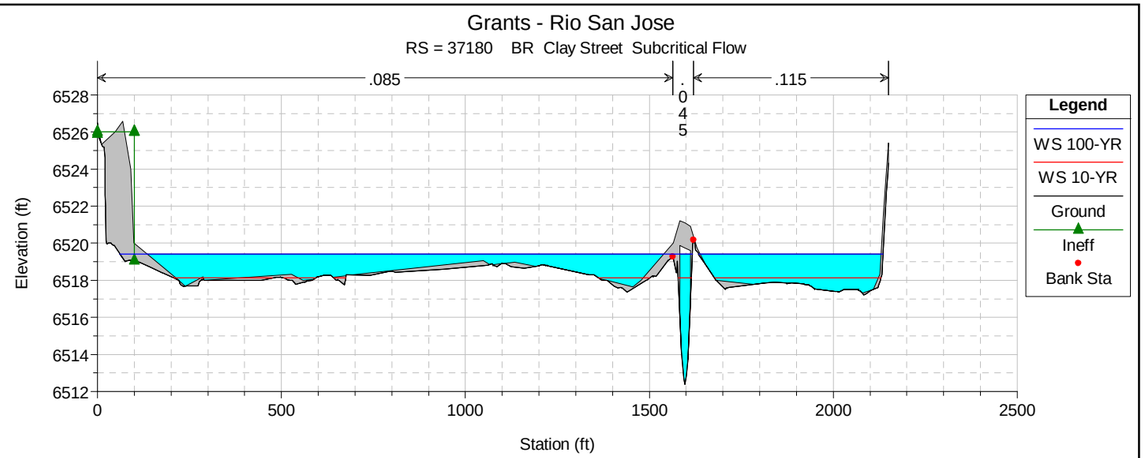

Grants - Rio San Jose
RS = 36205 Subcritical Flow
.085
.055
.1
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

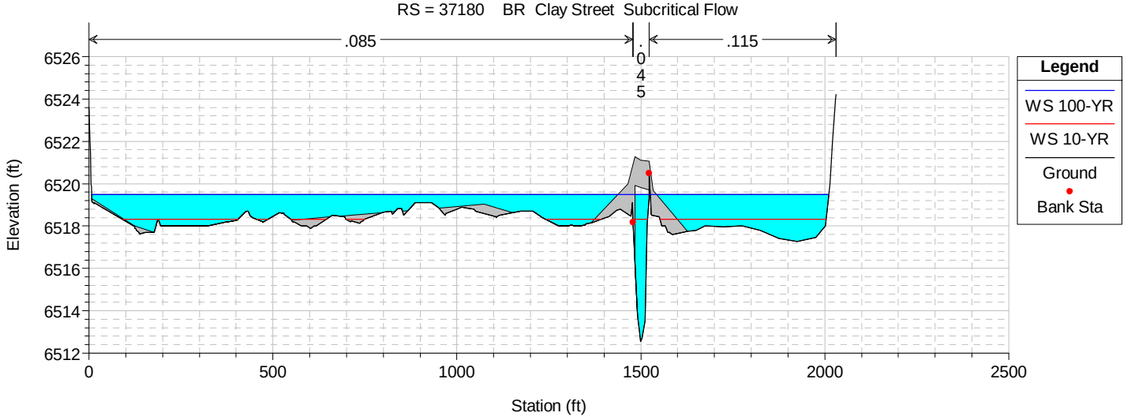

Grants - Rio San Jose
RS = 36255 Subcritical Flow
.085
.055
.1
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

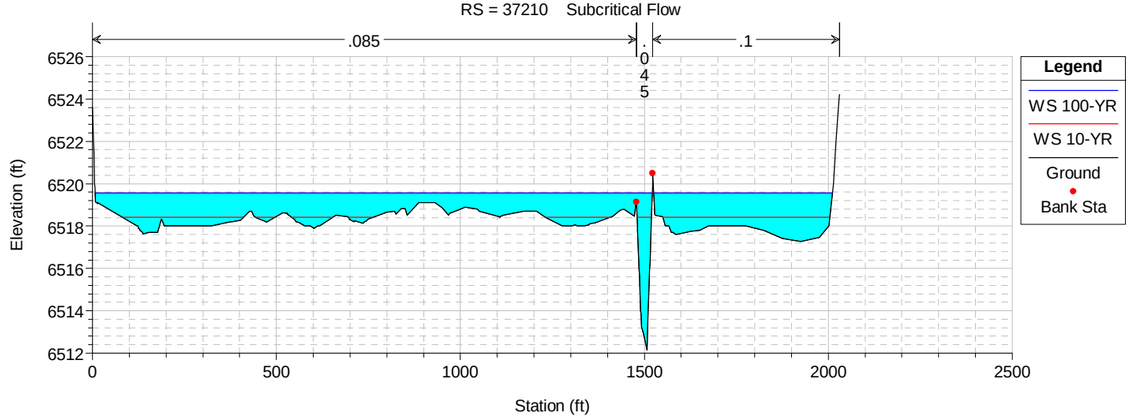

Grants - Rio San Jose
RS = 36500. Subcritical Flow
.085
.055
.1
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

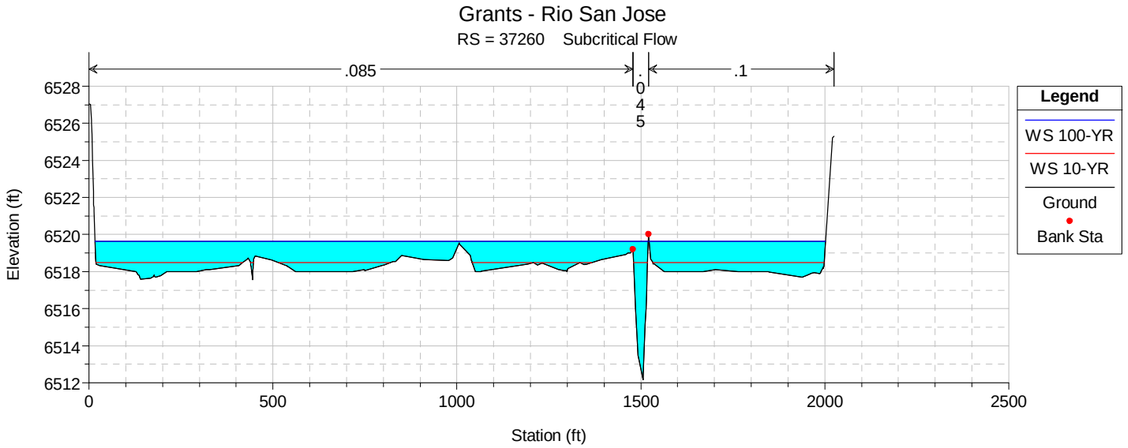

Grants - Rio San Jose
RS = 37000. Subcritical Flow
.07
.045
.085
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

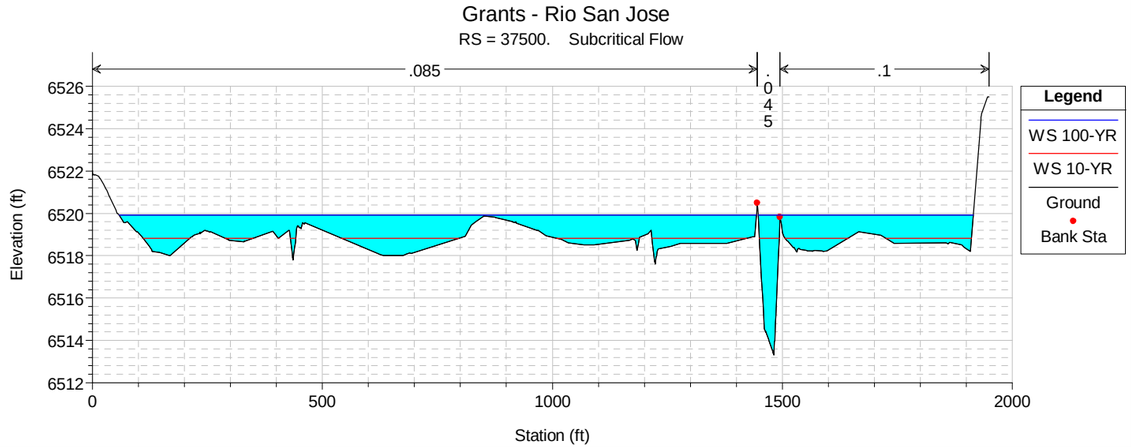

Grants - Rio San Jose
RS = 37150 Subcritical Flow
.085
.085
0
4
5
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

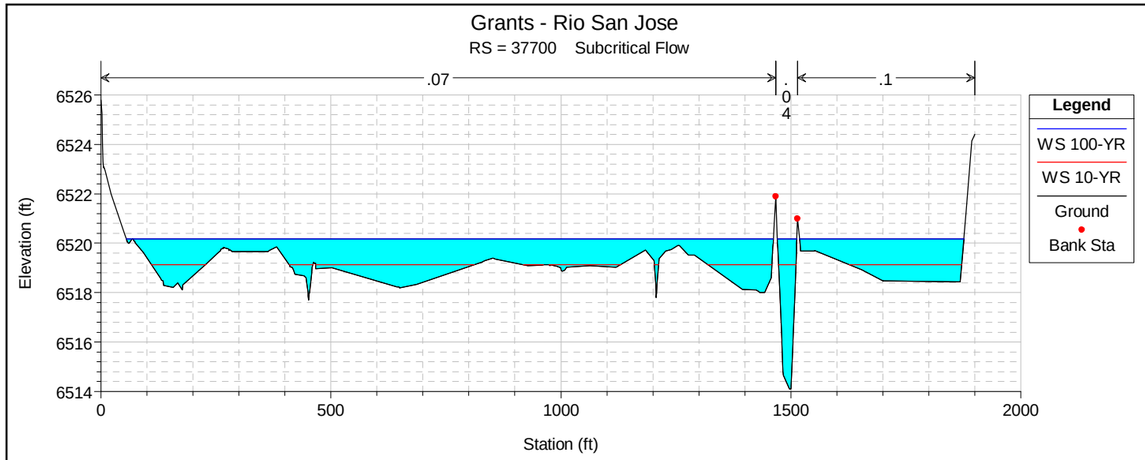

Grants - Rio San Jose
RS = 37180 BR Clay Street Subcritical Flow
.085
.115
0
4
5
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

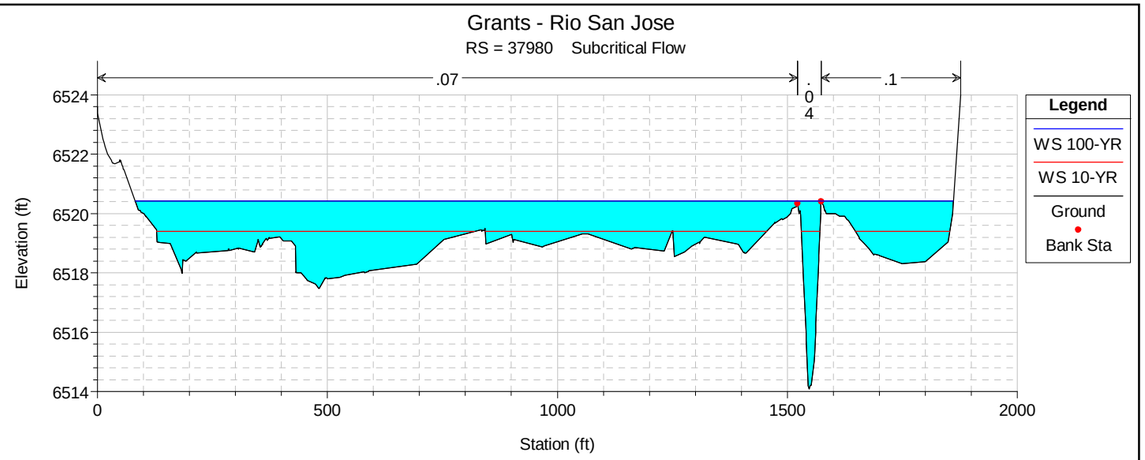

Grants - Rio San Jose
RS = 37180 BR Clay Street Subcritical Flow
.085
.115
0
4
5
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

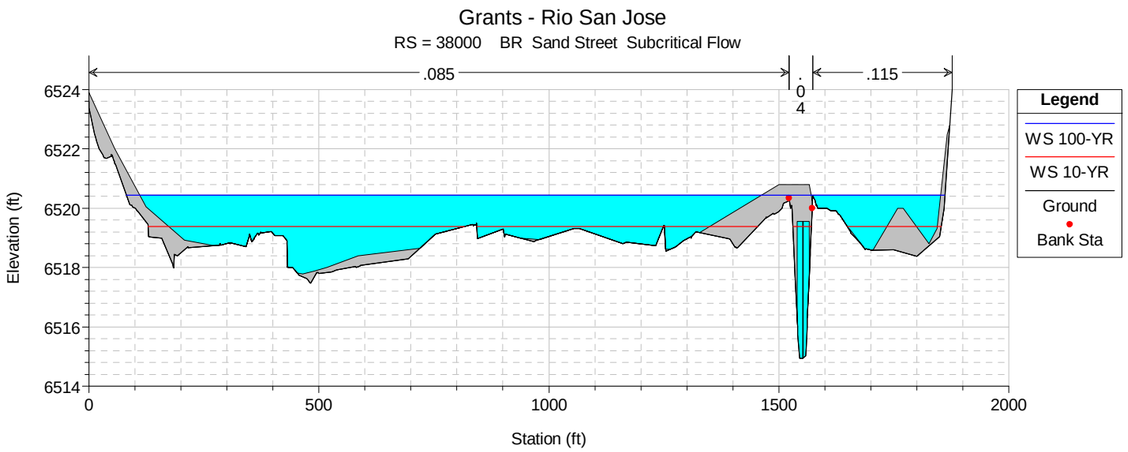

Grants - Rio San Jose
RS = 37210 Subcritical Flow
.085
.1
0
4
5
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

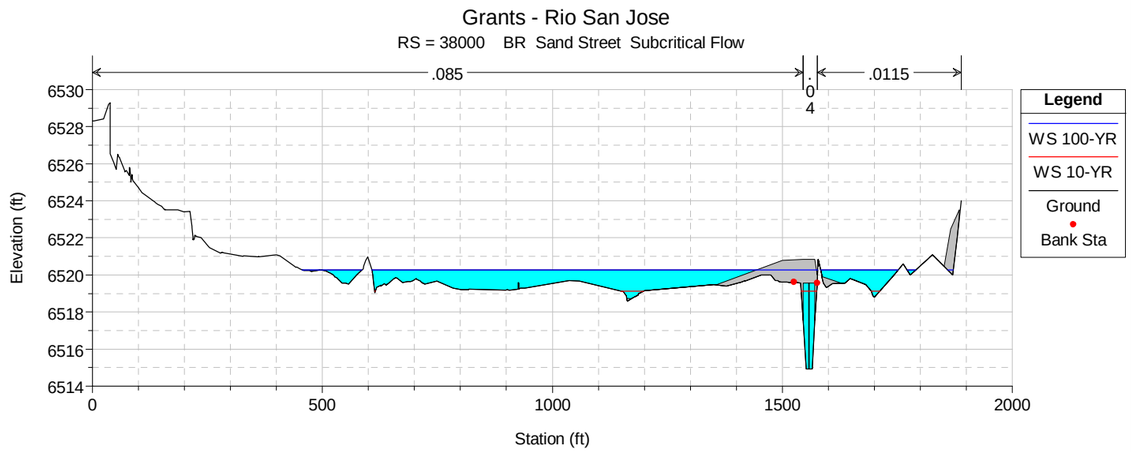

Grants - Rio San Jose
RS = 37260 Subcritical Flow
.085
.1
0
4
5
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

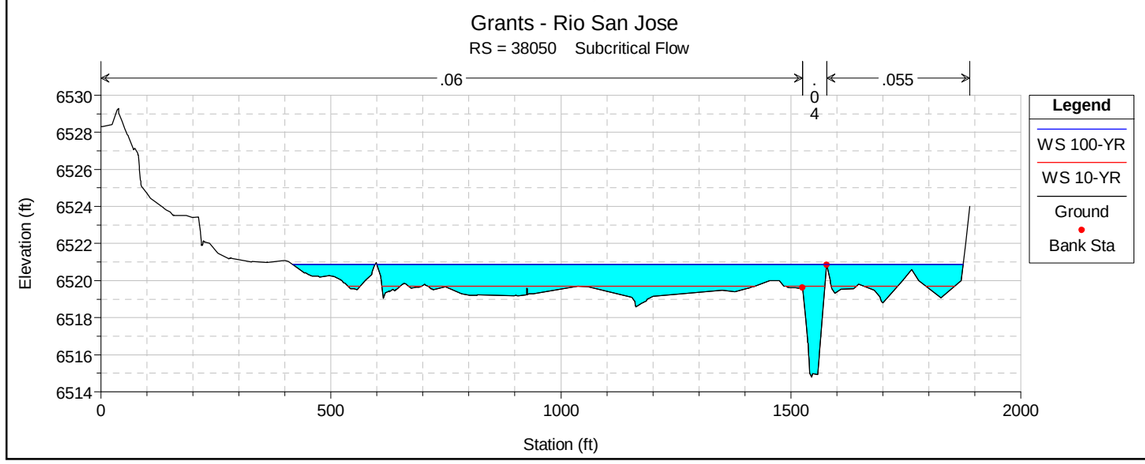

Grants - Rio San Jose
RS = 37500. Subcritical Flow
.085
.1
0
4
5
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

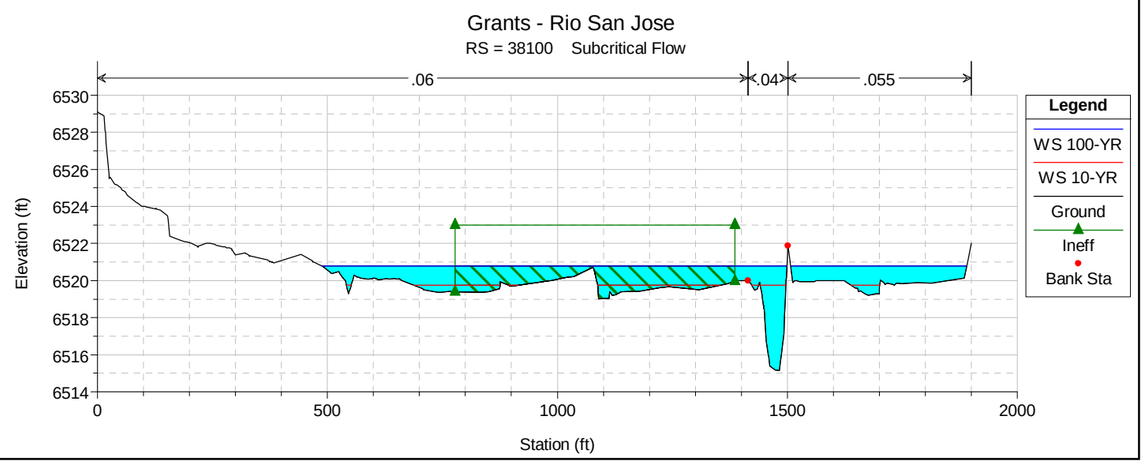

Grants - Rio San Jose
RS = 37700 Subcritical Flow
.07
.1
0
4
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

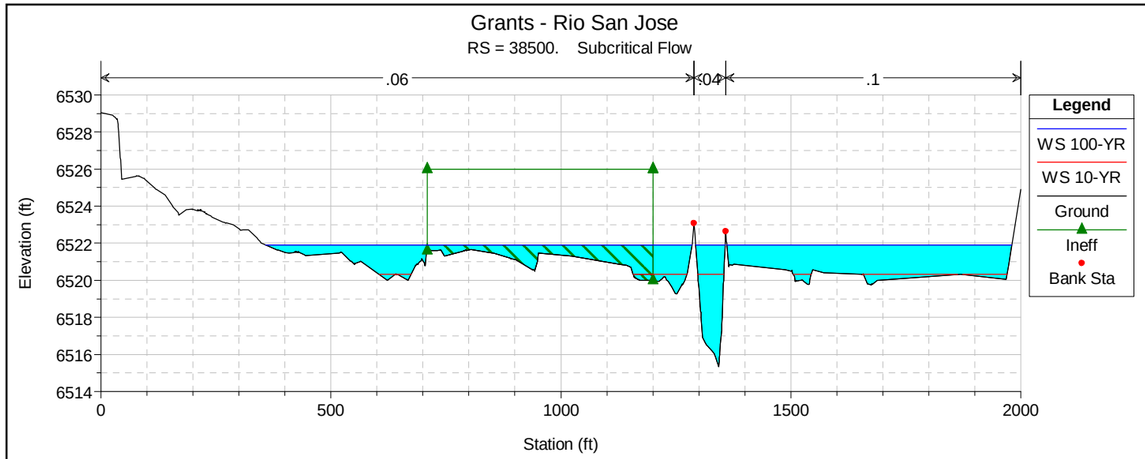

Grants - Rio San Jose
RS = 37980 Subcritical Flow
.07
.1
0
4
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

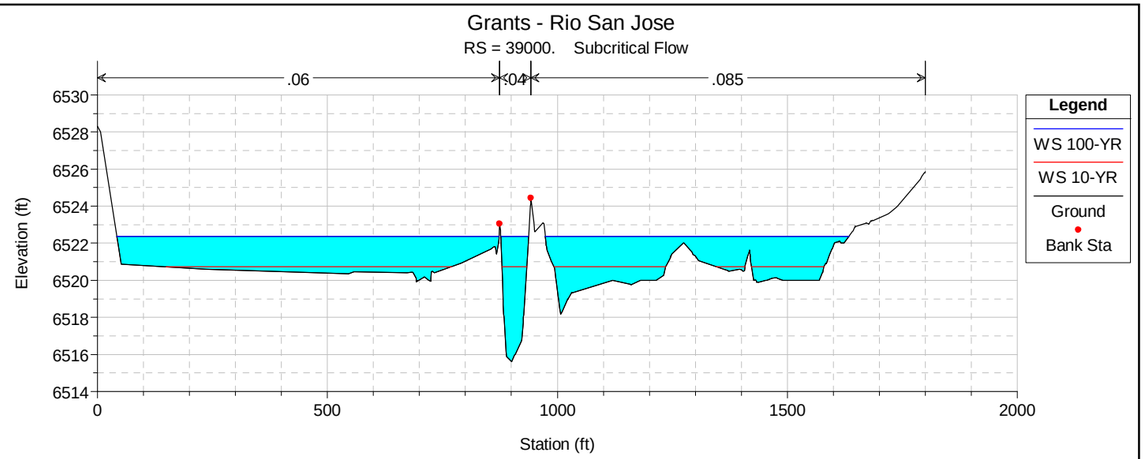

Grants - Rio San Jose
RS = 38000 BR Sand Street Subcritical Flow
.085
.115
0
4
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

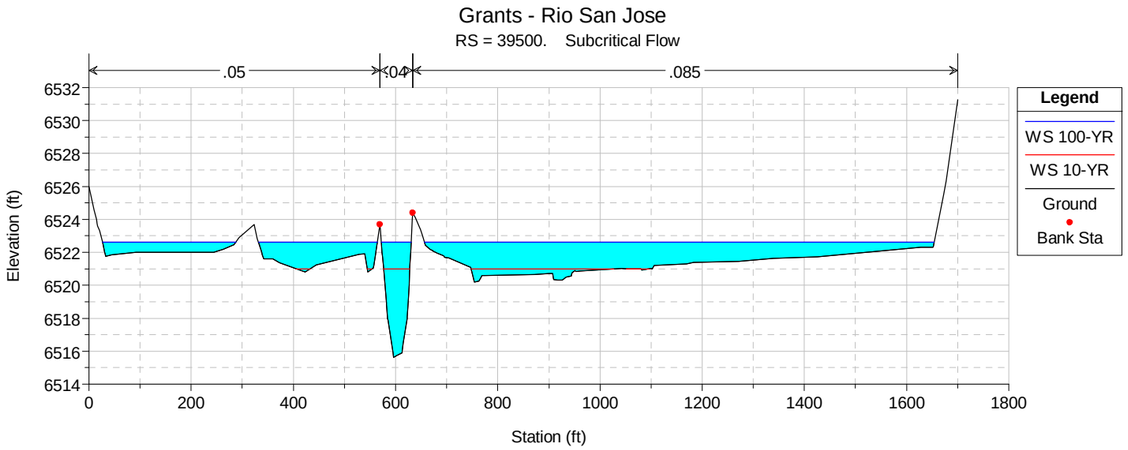

Grants - Rio San Jose
RS = 38000 BR Sand Street Subcritical Flow
.085
.0115
0
4
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

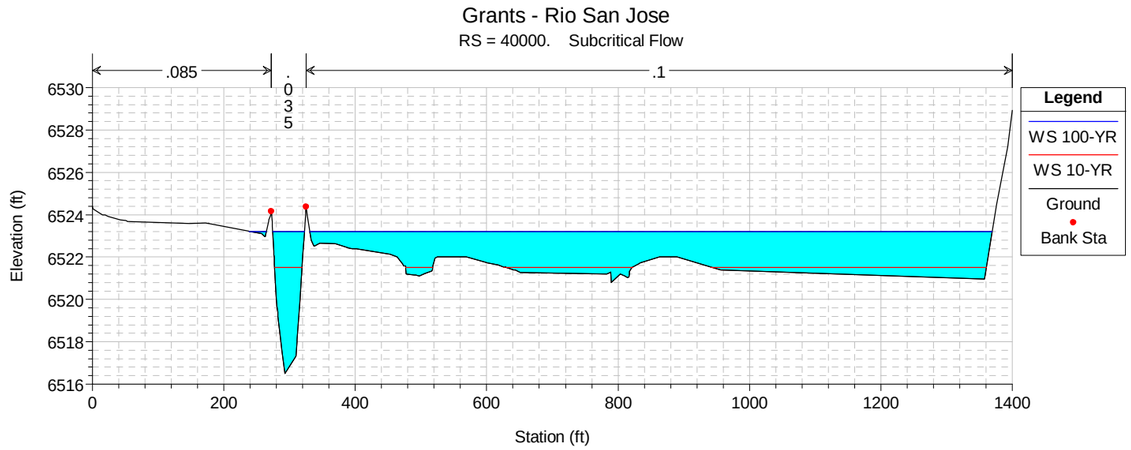

Grants - Rio San Jose
RS = 38050 Subcritical Flow
.06
.055
0
4
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

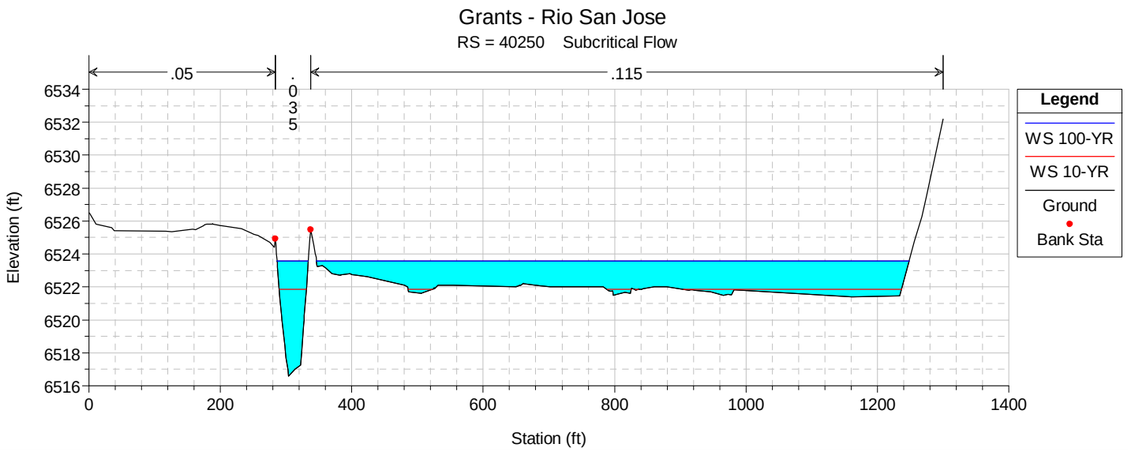

Grants - Rio San Jose
RS = 38100 Subcritical Flow
.06
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

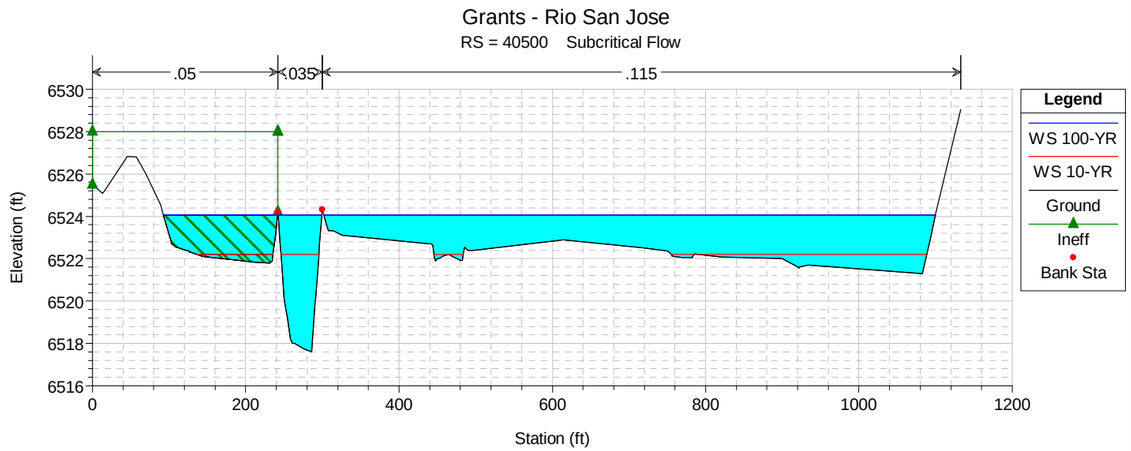

Grants - Rio San Jose
RS = 38500. Subcritical Flow
.06
.04
.1
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

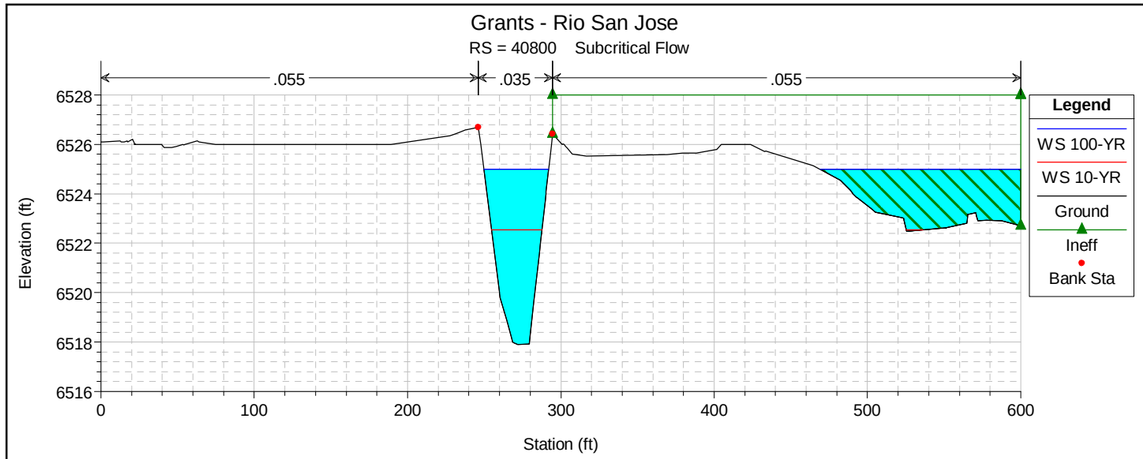

Grants - Rio San Jose
RS = 39000. Subcritical Flow
.06
.04
.085
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

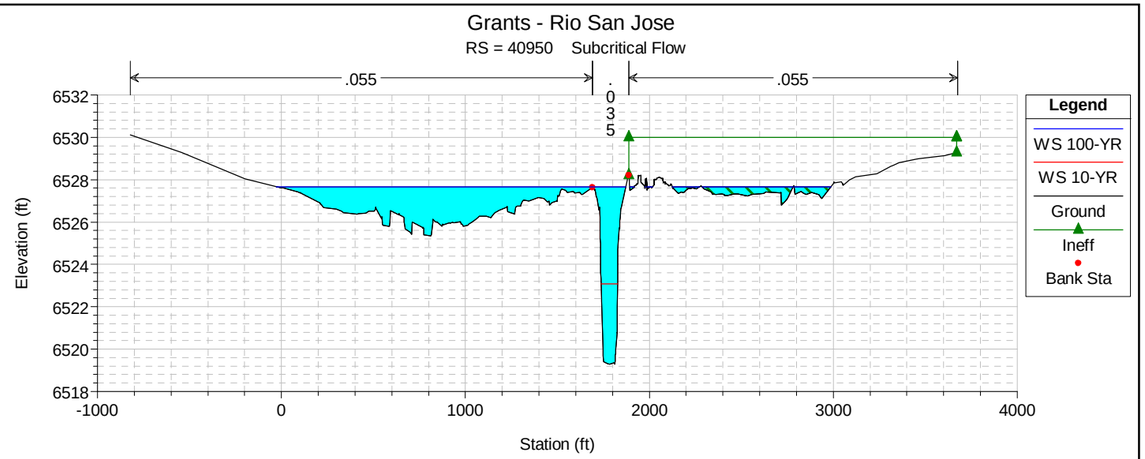

Grants - Rio San Jose
RS = 39500. Subcritical Flow
.05
.04
.085
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

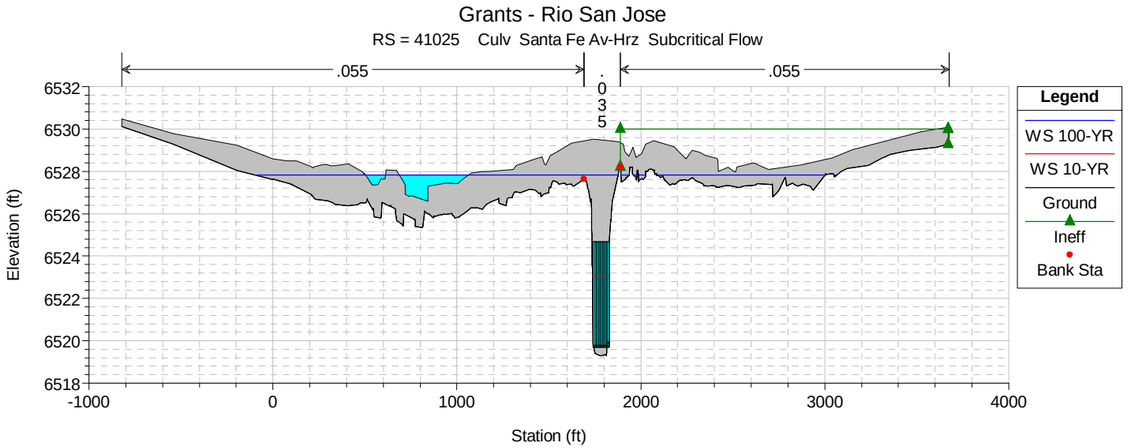

Grants - Rio San Jose
RS = 40000. Subcritical Flow
.085
.035
.1
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

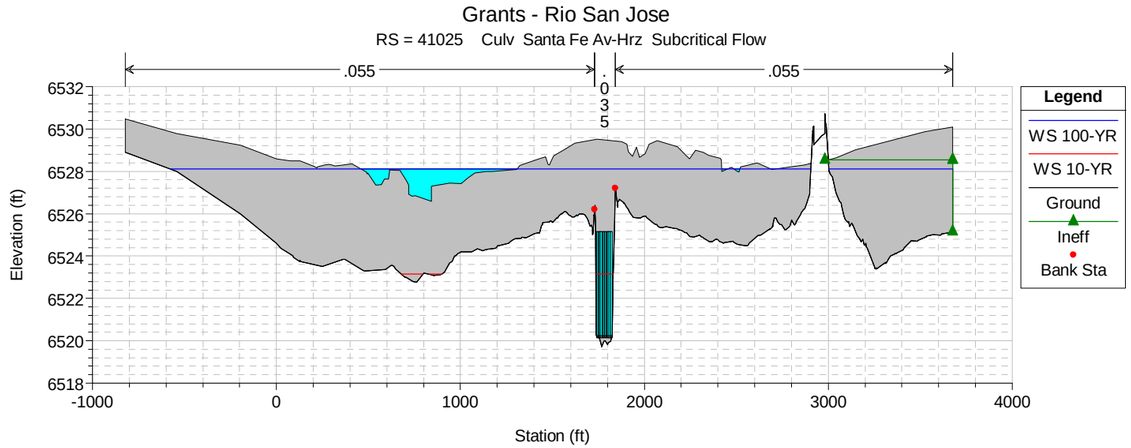

Grants - Rio San Jose
RS = 40250 Subcritical Flow
.05
.035
.115
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

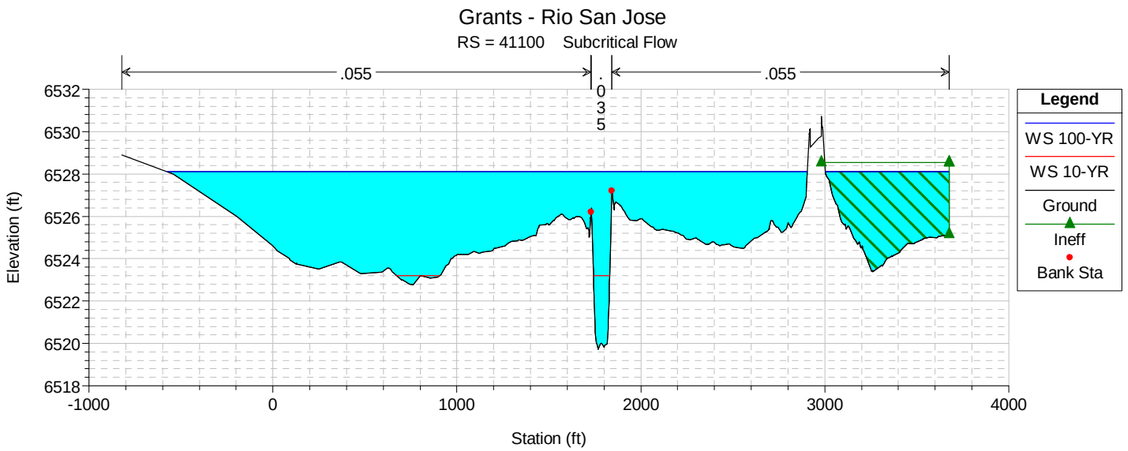

Grants - Rio San Jose
RS = 40500 Subcritical Flow
.05
.035
.115
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

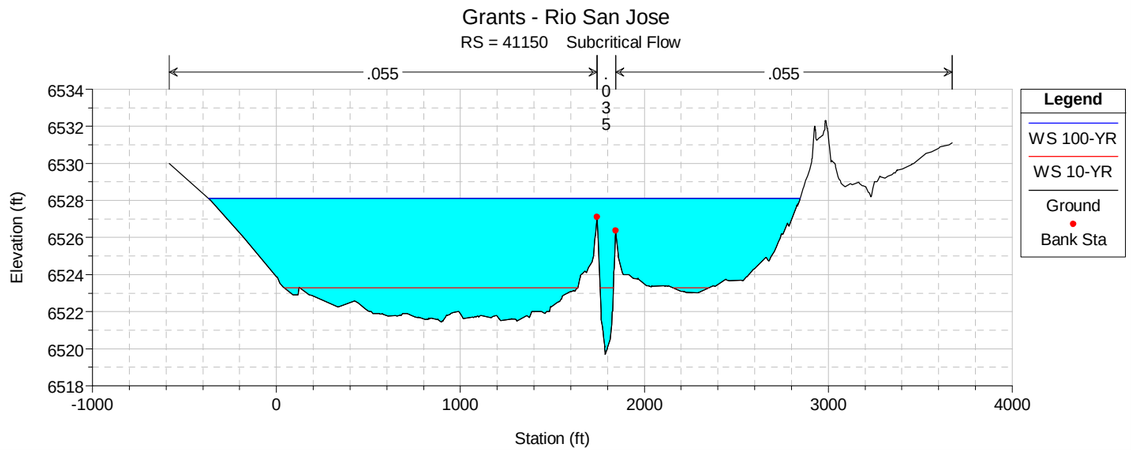

Grants - Rio San Jose
RS = 40800 Subcritical Flow
.055
.035
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

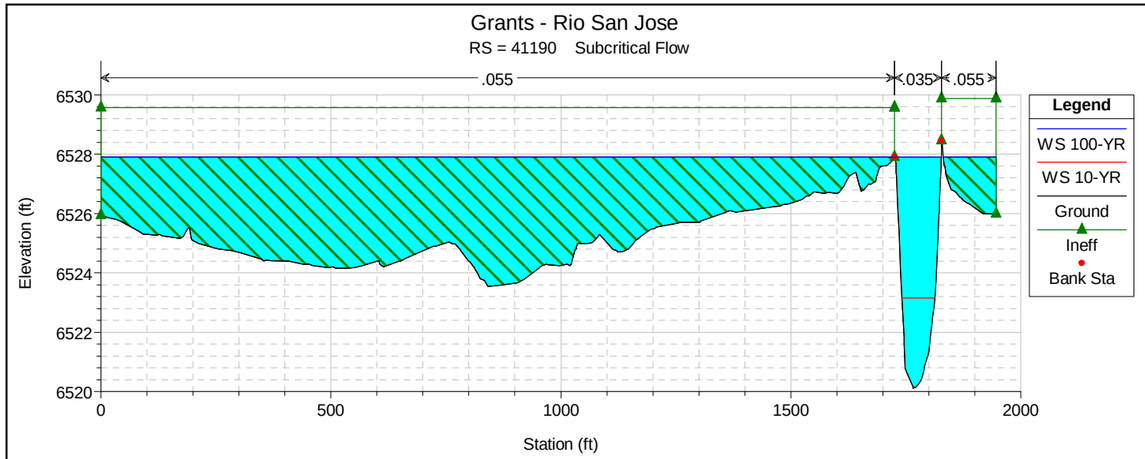

Grants - Rio San Jose
RS = 40950 Subcritical Flow
.055
.035
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

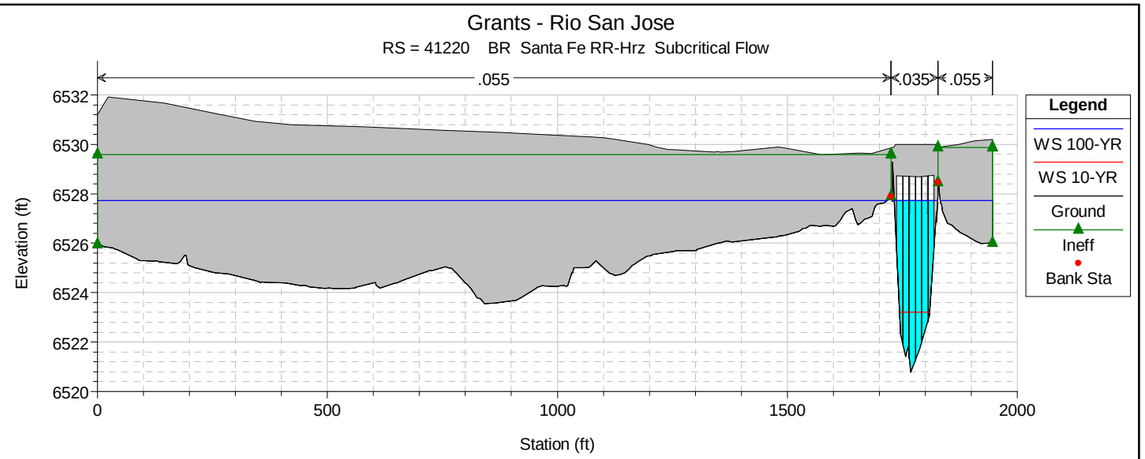

Grants - Rio San Jose
RS = 41025 Culv Santa Fe Av-Hrz Subcritical Flow
.055
.035
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

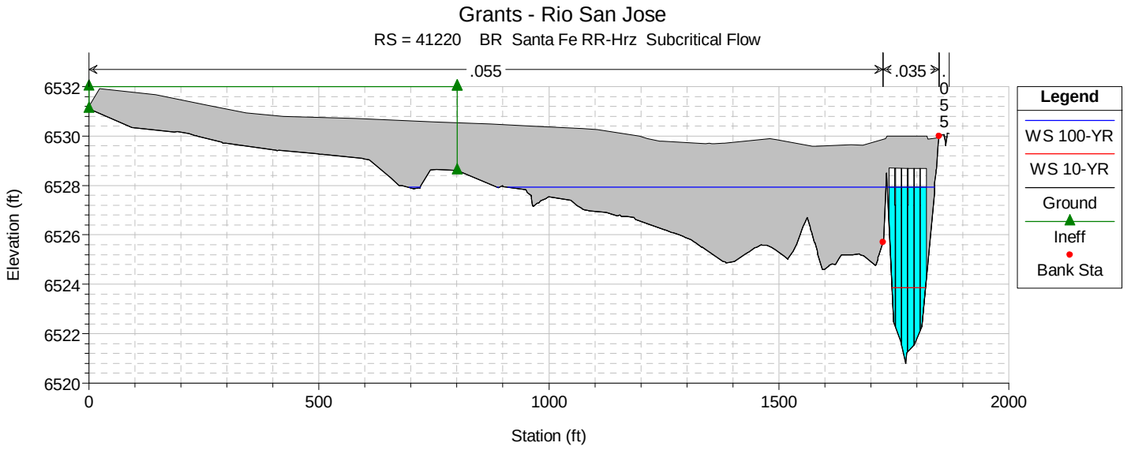

Grants - Rio San Jose
RS = 41025 Culv Santa Fe Av-Hrz Subcritical Flow
.055
.035
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

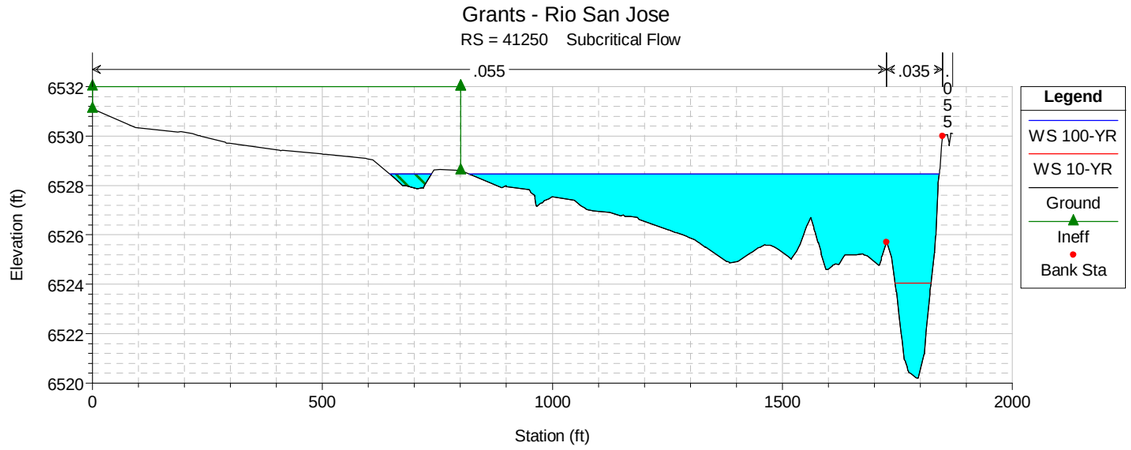

Grants - Rio San Jose
RS = 41100 Subcritical Flow
.055
.035
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

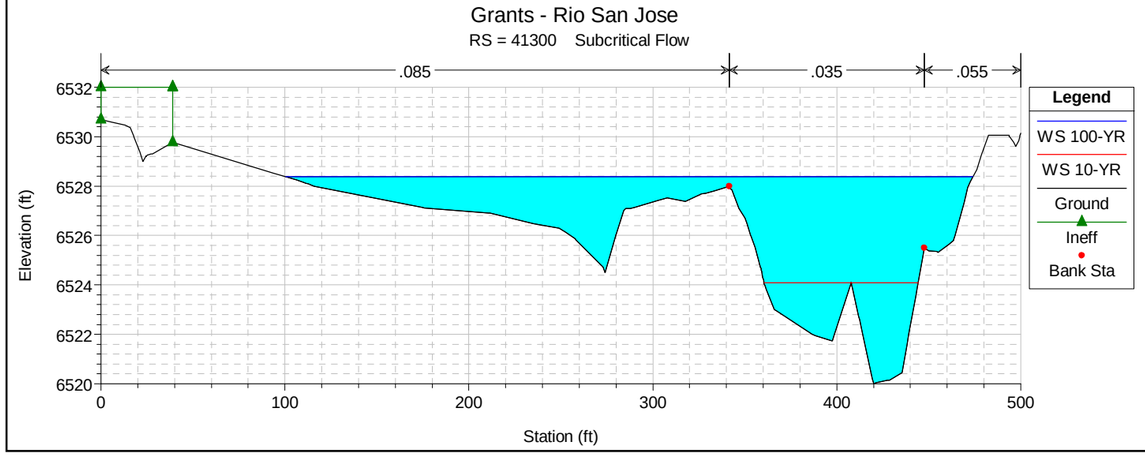

Grants - Rio San Jose
RS = 41150 Subcritical Flow
.055
.035
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

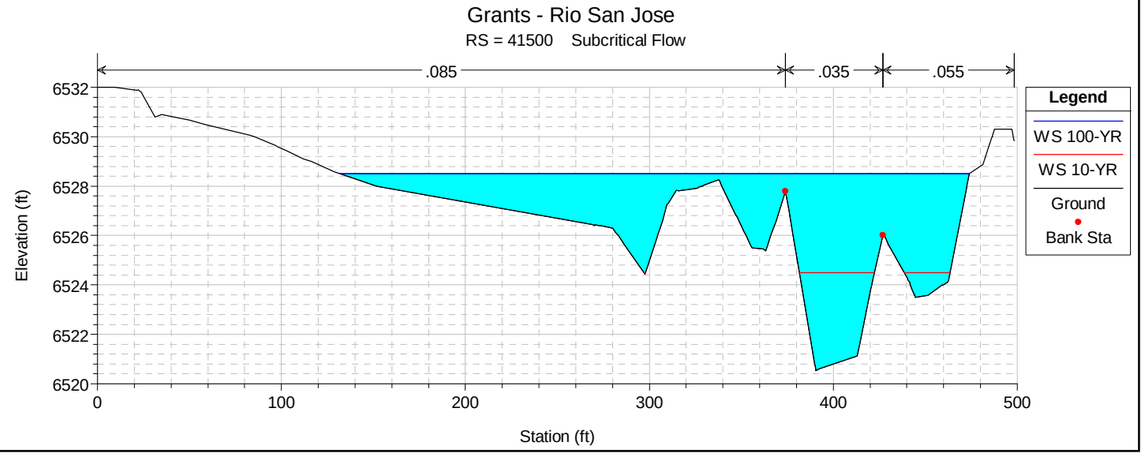

Grants - Rio San Jose
RS = 41190 Subcritical Flow
.055
.035
.055
Elevation (ft)
6530
6528
6526
6524
6522
6520
0
500
1000
1500
2000
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

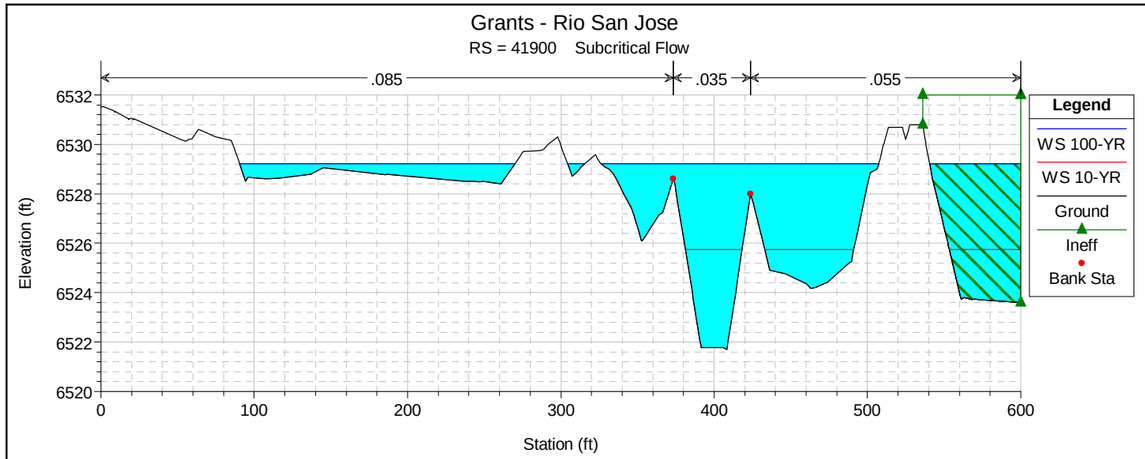

Grants - Rio San Jose
RS = 41220 BR Santa Fe RR-Hrz Subcritical Flow
.055
.035
.055
Elevation (ft)
6532
6530
6528
6526
6524
6522
6520
0
500
1000
1500
2000
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

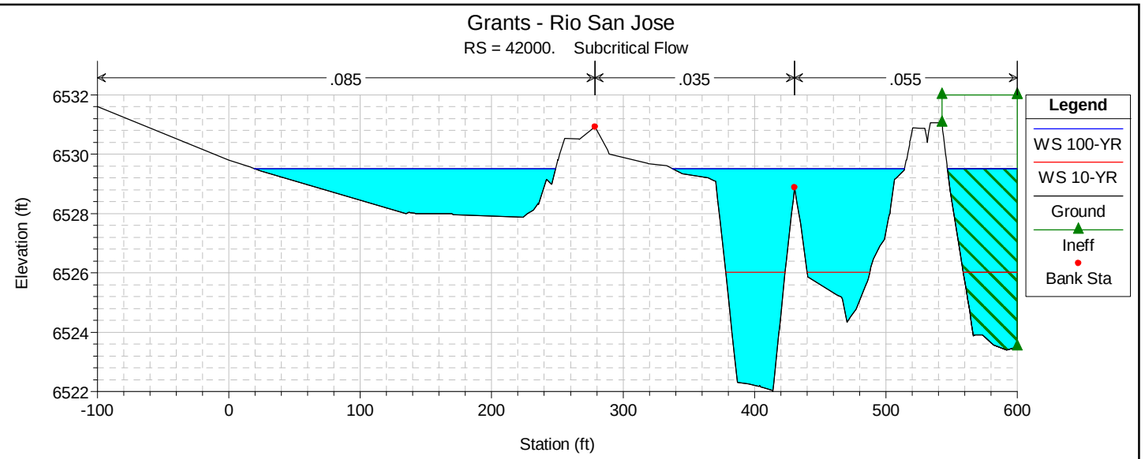

Grants - Rio San Jose
RS = 41220 BR Santa Fe RR-Hrz Subcritical Flow
.055
.035
Elevation (ft)
6532
6530
6528
6526
6524
6522
6520
0
500
1000
1500
2000
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

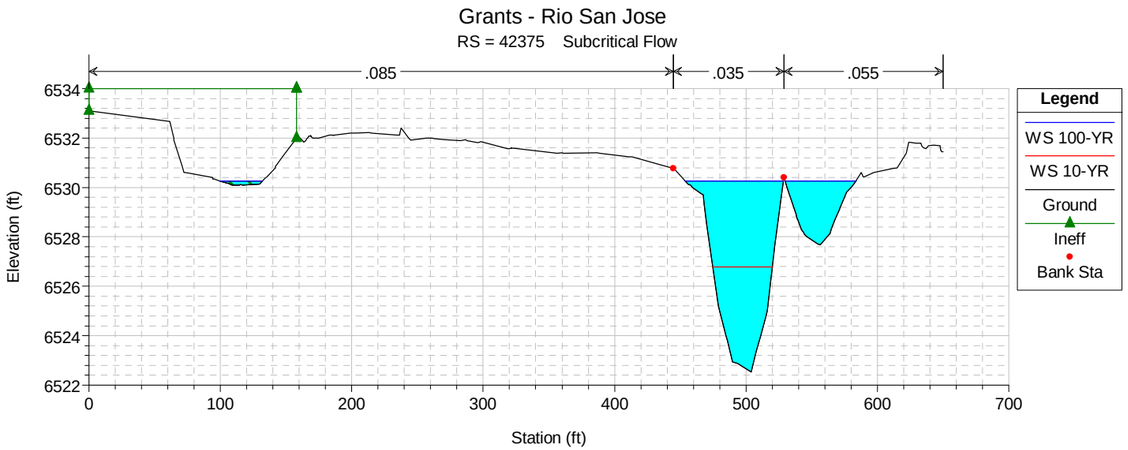

Grants - Rio San Jose
RS = 41250 Subcritical Flow
.055
.035
Elevation (ft)
6532
6530
6528
6526
6524
6522
6520
0
500
1000
1500
2000
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

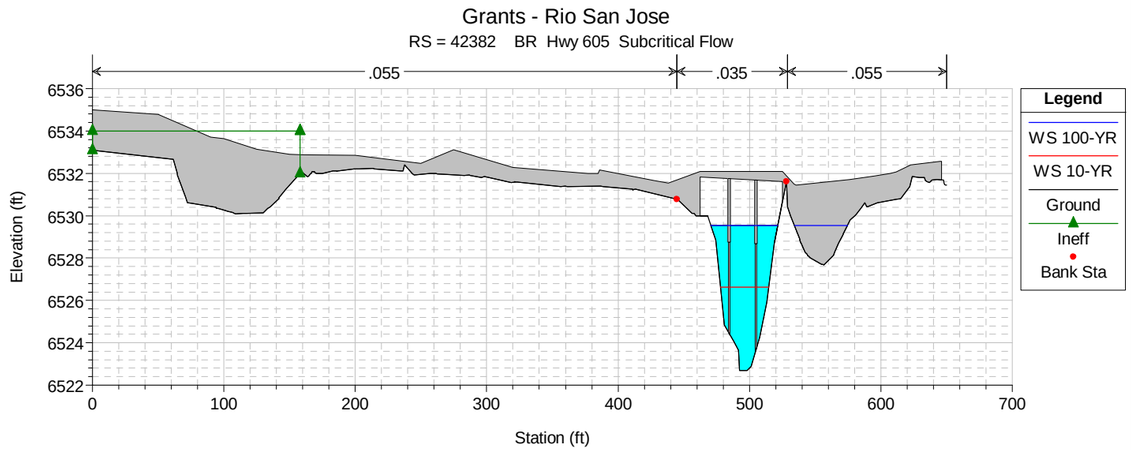

Grants - Rio San Jose
RS = 41300 Subcritical Flow
.085
.035
.055
Elevation (ft)
6532
6530
6528
6526
6524
6522
6520
0
100
200
300
400
500
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

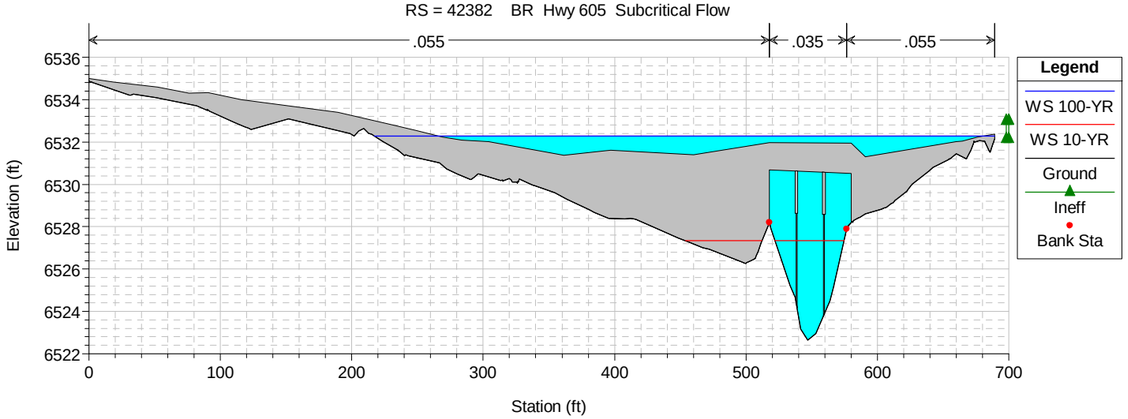

Grants - Rio San Jose
RS = 41500 Subcritical Flow
.085
.035
.055
Elevation (ft)
6532
6530
6528
6526
6524
6522
6520
0
100
200
300
400
500
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta

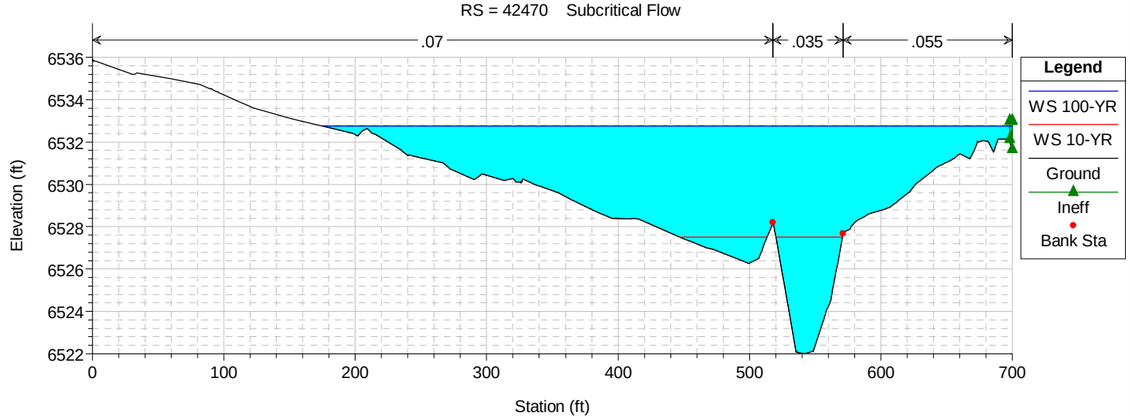

Grants - Rio San Jose
RS = 41900 Subcritical Flow
.085
.035
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

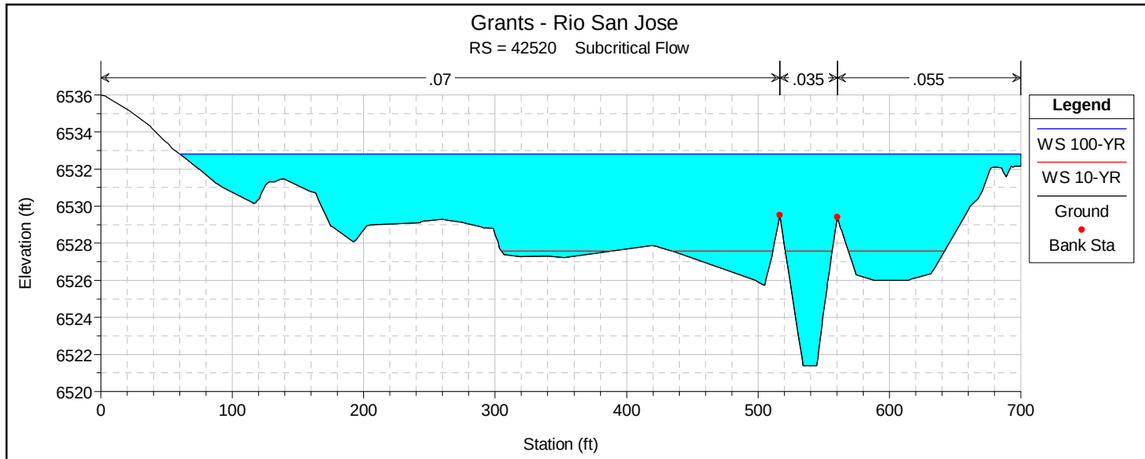

Grants - Rio San Jose
RS = 42000. Subcritical Flow
.085
.035
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

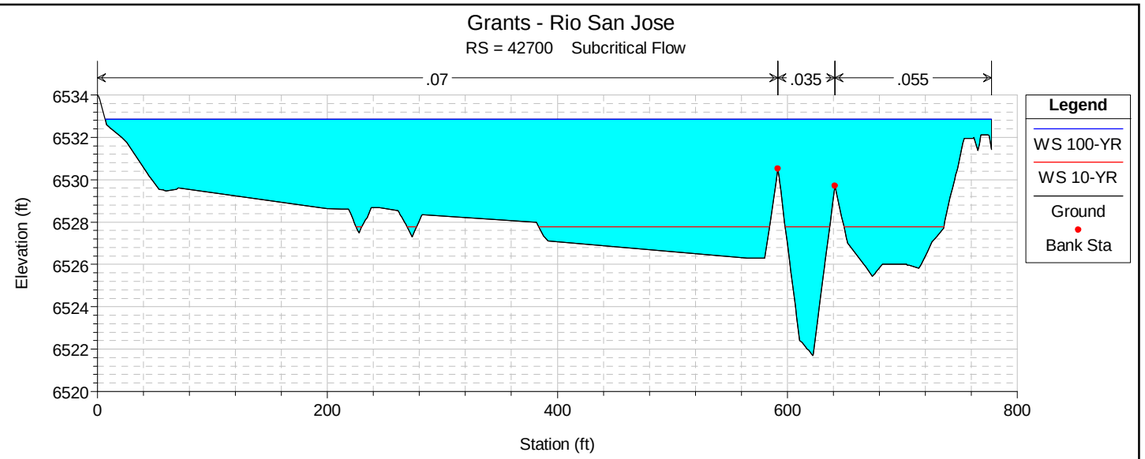

Grants - Rio San Jose
RS = 42375 Subcritical Flow
.085
.035
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

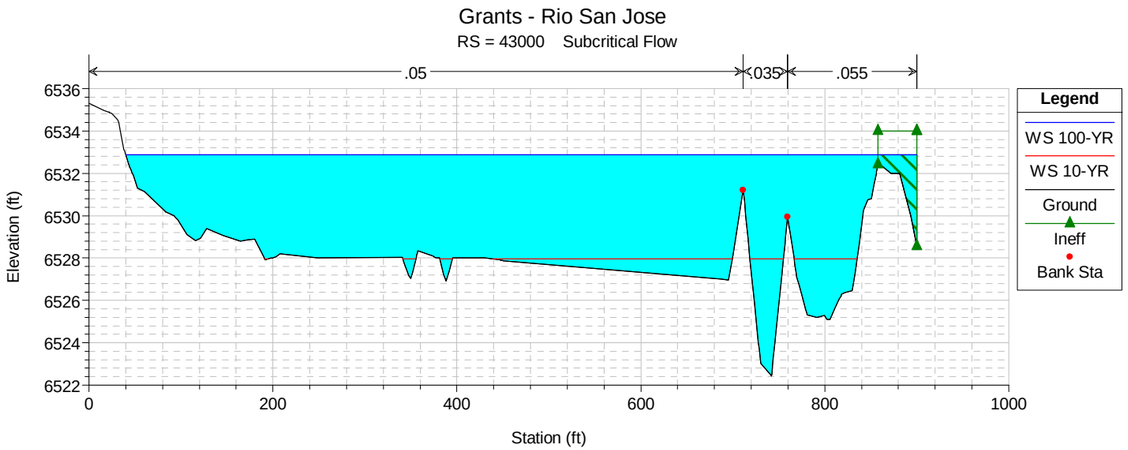

Grants - Rio San Jose
RS = 42382 BR Hwy 605 Subcritical Flow
.055
.035
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

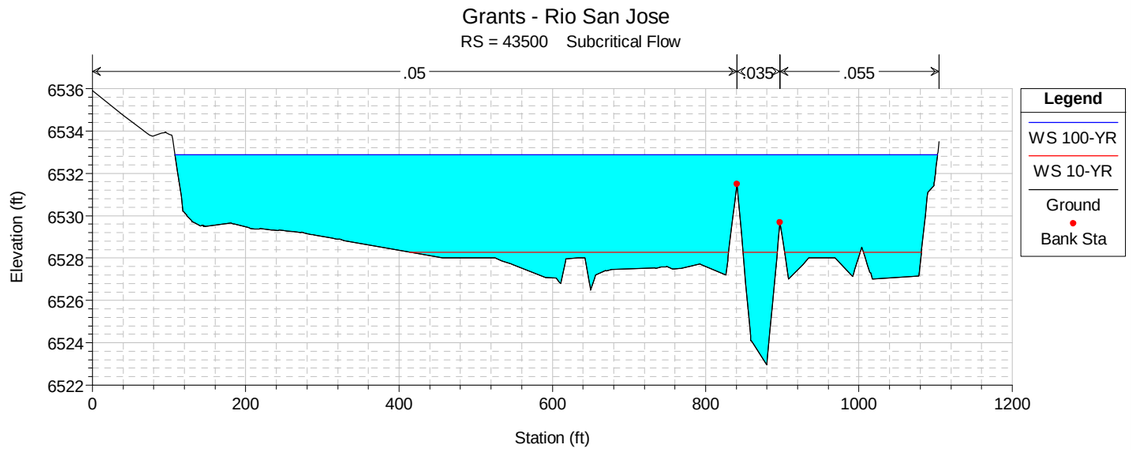

Grants - Rio San Jose
RS = 42382 BR Hwy 605 Subcritical Flow
.055
.035
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta

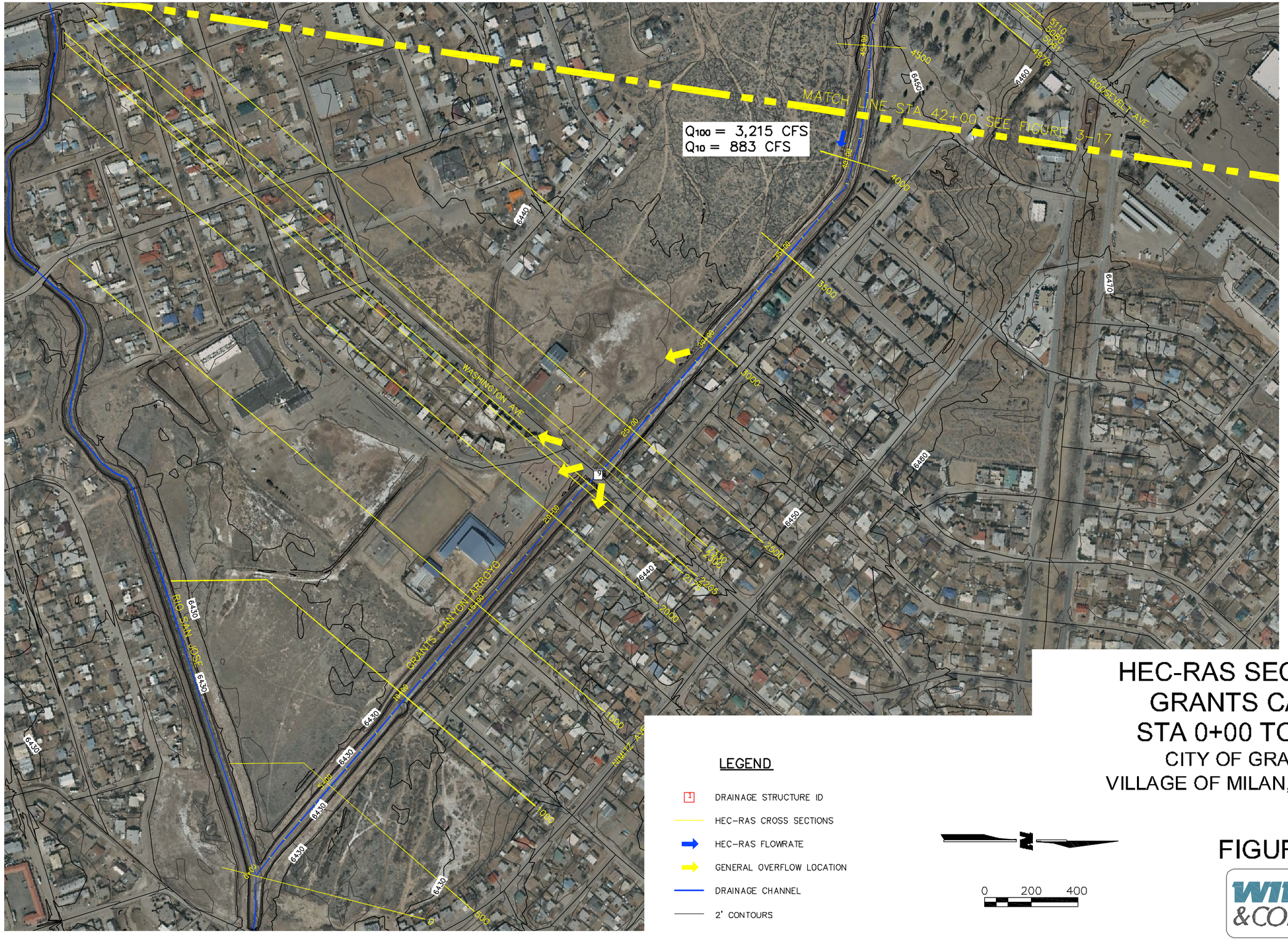

Grants - Rio San Jose
RS = 42470 Subcritical Flow
.07
.035
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta


Grants - Rio San Jose
RS = 42520 Subcritical Flow
.07
.035
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta


Grants - Rio San Jose
RS = 42700 Subcritical Flow
.07
.035
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta


Grants - Rio San Jose
RS = 43000 Subcritical Flow
.05
.035
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Ineff
Bank Sta


Grants - Rio San Jose
RS = 43500 Subcritical Flow
.05
.035
.055
Elevation (ft)
Station (ft)
Legend
WS 100-YR
WS 10-YR
Ground
Bank Sta



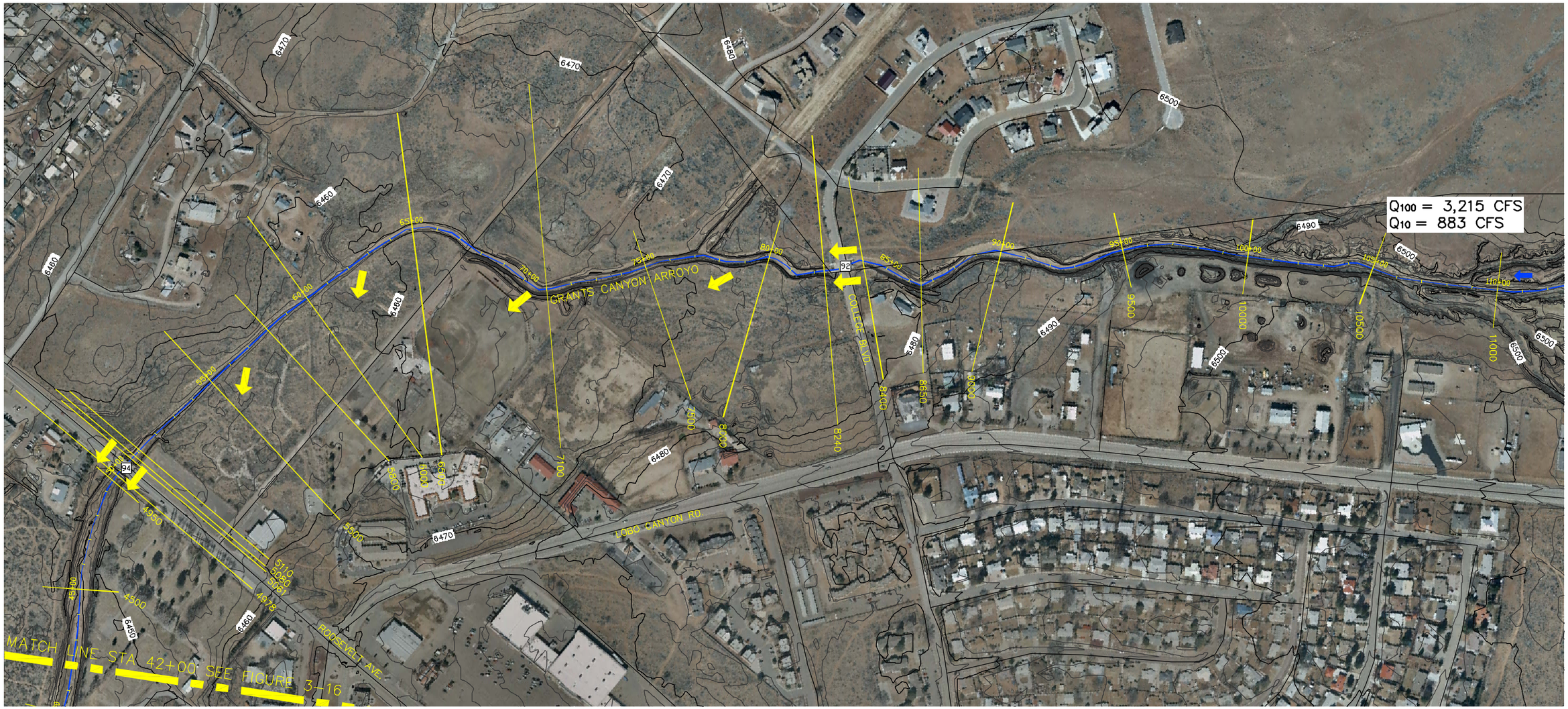
HEC-RAS SECTIONS GRANTS CANYON STA 0+00 TO 42+00

CITY OF GRANTS AND VILLAGE OF MILAN, NM DMP

09/22/2010

FIGURE 3-16

WILSON & COMPANY



0 200 400

LEGEND

- 1 DRAINAGE STRUCTURE ID
- HEC–RAS CROSS SECTIONS
- HEC–RAS FLOWRATE
- GENERAL OVERFLOW LOCATION
- DRAINAGE CHANNEL
- 2' CONTOURS

HEC-RAS SECTIONS
GRANTS CANYON
STA 42+00 TO 110+00

CITY OF GRANTS AND
VILLAGE OF MILAN, NM DMP

09/22/2010

FIGURE 3-17

WILSON & COMPANY

Profile Summary Table

HEC-RAS Plan: Grants River: Grants Canyon Reach: Arroyo

Reach	River Sta	Profile	Q Total	Q Left	Q Channel	Q Right	Min Ch El	W.S. Elev	Crit W.S.	Max Chl Dpth	E.G. Slope	Vel Left	Vel Chnl	Vel Right	Flow Area	Top Width	Froude # Chl
			(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(ft/s)	(sq ft)	(ft)	
Arroyo	0	100 YR	3215.00	1482.80	1732.20		6421.76	6432.00	6426.44	10.24	0.000163	0.68	2.47		2885.38	861.78	0.15
Arroyo	0	100 YR (FEMA)	3020.00	1392.86	1627.14		6421.76	6432.00	6426.27	10.24	0.000144	0.64	2.32		2885.38	861.78	0.14
Arroyo	0	10 YR	883.00	407.25	475.75		6421.76	6432.00	6423.85	10.24	0.000012	0.19	0.68		2885.38	861.78	0.04
Arroyo	500	100 YR	3215.00	1147.67	1154.41	912.92	6423.54	6432.11	6429.14	8.57	0.000182	0.67	2.35	0.77	3393.12	1063.87	0.15
Arroyo	500	100 YR (FEMA)	3020.00	1075.84	1087.27	856.88	6423.54	6432.09	6429.07	8.55	0.000162	0.63	2.22	0.72	3380.31	1063.69	0.15
Arroyo	500	10 YR	883.00	310.07	323.76	249.17	6423.54	6432.01	6425.81	8.47	0.000015	0.19	0.67	0.22	3293.68	1062.48	0.04
Arroyo	1000	100 YR	3215.00	172.83	1136.92	1905.24	6424.36	6432.21	6429.68	7.85	0.000229	0.43	2.50	0.69	3620.92	1515.01	0.17
Arroyo	1000	100 YR (FEMA)	3020.00	159.90	1075.89	1784.21	6424.36	6432.18	6429.39	7.82	0.000207	0.41	2.38	0.65	3585.75	1512.97	0.16
Arroyo	1000	10 YR	883.00	41.46	331.41	510.13	6424.36	6432.02	6426.62	7.66	0.000021	0.12	0.75	0.20	3337.55	1478.88	0.05
Arroyo	1500	100 YR	3215.00		2967.12	247.88	6424.91	6431.92	6430.30	7.01	0.002661		7.67	0.97	643.45	498.17	0.58
Arroyo	1500	100 YR (FEMA)	3020.00		2777.41	242.59	6424.91	6431.94	6430.14	7.03	0.002305		7.15	0.91	653.84	504.74	0.54
Arroyo	1500	10 YR	883.00		805.26	77.74	6424.91	6432.00	6427.66	7.09	0.000187		2.05	0.27	685.36	645.51	0.15
Arroyo	2000	100 YR	3215.00		3212.74	2.26	6426.77	6433.21	6431.82	6.44	0.003552		8.72	0.20	379.54	179.83	0.66
Arroyo	2000	100 YR (FEMA)	3020.00		3019.88	0.12	6426.77	6433.07	6431.65	6.30	0.003403		8.42	0.11	359.56	92.14	0.65
Arroyo	2000	10 YR	883.00		883.00		6426.77	6432.09	6429.09	5.32	0.000530		3.01		293.29	65.33	0.25
Arroyo	2175	100 YR	3215.00		3215.00		6427.27	6433.75	6432.69	6.48	0.004332		9.42		341.16	65.98	0.73
Arroyo	2175	100 YR (FEMA)	3020.00		3020.00		6427.27	6433.59	6432.48	6.32	0.004208		9.15		330.13	65.37	0.72
Arroyo	2175	10 YR	883.00		883.00		6427.27	6432.16	6429.73	4.89	0.000915		3.67		240.73	60.24	0.32
Arroyo	2205	100 YR	3215.00		3214.85	0.15	6427.58	6434.43	6432.43	6.85	0.002438		7.41	0.07	436.08	161.63	0.56
Arroyo	2205	100 YR (FEMA)	3020.00		3020.00		6427.58	6434.21	6432.25	6.63	0.002420		7.24		416.85	78.00	0.55
Arroyo	2205	10 YR	883.00		883.00		6427.58	6432.24	6429.84	4.65	0.000745		3.26		270.45	69.68	0.29
Arroyo	2278 Washington Ave		Culvert														
Arroyo	2300	100 YR	3215.00	22.33	2721.16	471.52	6430.70	6436.18	6436.18	5.48	0.004039	0.61	8.51	1.45	680.87	2371.51	0.70
Arroyo	2300	100 YR (FEMA)	3020.00	13.76	2645.54	360.70	6430.70	6436.00	6436.00	5.30	0.004302	0.55	8.61	1.38	593.09	1395.07	0.72
Arroyo	2300	10 YR	883.00		878.83	4.17	6430.70	6435.01	6432.95	4.30	0.000995		3.65	0.23	259.18	203.98	0.33
Arroyo	2330	100 YR	3215.00	22.48	2721.37	471.16	6430.92	6436.46	6436.46	5.54	0.003960	0.60	8.45	1.38	702.11	2450.88	0.69
Arroyo	2330	100 YR (FEMA)	3020.00	17.50	2603.77	398.73	6430.92	6436.38	6436.38	5.46	0.003827	0.55	8.23	1.29	656.85	2383.17	0.68
Arroyo	2330	10 YR	883.00		883.00		6430.92	6435.02	6433.20	4.10	0.001233		3.91		225.55	83.99	0.37
Arroyo	2500	100 YR	3215.00	156.69	1943.04	1115.27	6431.19	6437.58	6437.01	6.39	0.001453	0.51	5.31	0.98	1812.73	2738.40	0.42
Arroyo	2500	100 YR (FEMA)	3020.00	129.71	1944.66	945.63	6431.19	6437.44	6436.94	6.25	0.001587	0.50	5.46	0.95	1606.55	2510.65	0.44
Arroyo	2500	10 YR	883.00		865.88	17.12	6431.19	6435.24	6433.94	4.04	0.001824		4.32	1.03	216.75	83.34	0.44
Arroyo	3000	100 YR	3215.00		2504.64	710.36	6433.96	6438.97	6438.97	5.01	0.003923		7.80	1.47	803.24	602.21	0.68
Arroyo	3000	100 YR (FEMA)	3020.00		2416.63	603.38	6433.96	6438.88	6438.88	4.92	0.003928		7.71	1.39	746.27	588.36	0.68
Arroyo	3000	10 YR	883.00		883.00		6433.96	6436.55	6436.22	2.59	0.006274		6.24		141.56	69.94	0.77
Arroyo	3500	100 YR	3215.00		3215.00		6434.26	6440.55	6439.20	6.29	0.003422		8.40		382.66	74.89	0.66
Arroyo	3500	100 YR (FEMA)	3020.00		3020.00		6434.26	6440.46	6439.02	6.20	0.003193		8.04		375.58	74.57	0.63
Arroyo	3500	10 YR	883.00		883.00		6434.26	6438.24	6436.61	3.98	0.001415		4.04		218.45	67.03	0.39
Arroyo	4000	100 YR	3215.00		3215.00		6435.67	6442.42	6441.53	6.75	0.004811		9.17		350.64	78.73	0.77

HEC-RAS Plan: Grants River: Grants Canyon Reach: Arroyo (Continued)

Reach	River Sta	Profile	Q Total	Q Left	Q Channel	Q Right	Min Ch El	W.S. Elev	Crit W.S.	Max Chl Dpth	E.G. Slope	Vel Left	Vel Chnl	Vel Right	Flow Area	Top Width	Froude # Chl
			(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(ft/s)	(sq ft)	(ft)	
Arroyo	4000	100 YR (FEMA)	3020.00		3020.00		6435.67	6442.22	6441.36	6.55	0.004821		9.03		334.54	77.04	0.76
Arroyo	4000	10 YR	883.00		883.00		6435.67	6439.20	6438.74	3.53	0.005712		6.63		133.23	55.88	0.76
Arroyo	4500	100 YR	3215.00		3215.00		6438.29	6444.99	6444.50	6.69	0.005863		9.60		335.04	81.41	0.83
Arroyo	4500	100 YR (FEMA)	3020.00		3020.00		6438.29	6444.80	6444.32	6.51	0.005934		9.43		320.36	80.74	0.83
Arroyo	4500	10 YR	883.00		883.00		6438.29	6442.40	6442.15	4.11	0.006988		6.42		137.50	70.57	0.81
Arroyo	4950	100 YR	3215.00		3215.00		6442.31	6448.92	6448.92	6.61	0.008358		11.57		277.86	65.75	0.99
Arroyo	4950	100 YR (FEMA)	3020.00		3020.00		6442.31	6448.73	6448.73	6.42	0.008388		11.35		265.96	64.96	0.99
Arroyo	4950	10 YR	883.00		883.00		6442.31	6446.12	6446.12	3.81	0.010205		8.07		109.36	52.45	0.99
Arroyo	4978	100 YR	3215.00		3215.00		6442.80	6450.41		7.61	0.002138		7.26		443.07	71.52	0.51
Arroyo	4978	100 YR (FEMA)	3020.00		3020.00		6442.80	6450.19		7.39	0.002107		7.07		427.29	71.16	0.51
Arroyo	4978	10 YR	883.00		883.00		6442.80	6447.03		4.23	0.001682		4.22		209.16	66.78	0.42
Arroyo	5060 Roosevelt Ave		Culvert														
Arroyo	5061	100 YR	3215.00	9.26	3205.74		6446.80	6453.79	6452.07	6.99	0.005618	0.68	7.58		436.72	162.49	0.62
Arroyo	5061	100 YR (FEMA)	3020.00	10.44	3009.56		6446.80	6453.83	6451.88	7.03	0.004907	0.64	7.06		442.78	176.18	0.58
Arroyo	5061	10 YR	883.00		883.00		6446.80	6451.19	6449.23	4.39	0.002235		3.93		224.85	64.95	0.37
Arroyo	5080	100 YR	3215.00	3.05	3211.95		6446.89	6453.44	6452.91	6.55	0.011001	0.66	10.17		320.45	113.87	0.86
Arroyo	5080	100 YR (FEMA)	3020.00	9.52	3010.48		6446.89	6453.57	6452.73	6.68	0.009252	0.82	9.25		337.18	140.86	0.79
Arroyo	5080	10 YR	883.00		883.00		6446.89	6451.11		4.22	0.005033		5.36		164.86	55.70	0.55
Arroyo	5110	100 YR	3215.00	665.78	2224.54	324.68	6447.33	6454.88	6454.47	7.55	0.002996	1.64	6.26	1.59	964.42	590.36	0.46
Arroyo	5110	100 YR (FEMA)	3020.00	412.00	2423.11	184.89	6447.33	6454.45	6454.39	7.12	0.004499	1.57	7.36	1.45	719.01	564.77	0.56
Arroyo	5110	10 YR	883.00		883.00		6447.33	6451.20		3.86	0.006139		6.01		147.01	47.69	0.60
Arroyo	5500	100 YR	3215.00	1421.60	1311.00	482.40	6448.90	6456.43		7.53	0.004088	2.29	5.61	2.46	1051.13	585.50	0.51
Arroyo	5500	100 YR (FEMA)	3020.00	1349.75	1214.13	456.12	6448.90	6456.48		7.58	0.003360	2.11	5.13	2.26	1079.24	589.70	0.46
Arroyo	5500	10 YR	883.00	174.21	691.51	17.29	6448.90	6454.54	6454.54	5.64	0.011034	1.86	5.98	1.15	224.21	296.83	0.75
Arroyo	5800	100 YR	3215.00	1372.19	1820.76	22.05	6451.40	6457.89		6.49	0.010372	3.32	9.23	2.30	619.78	374.35	0.83
Arroyo	5800	100 YR (FEMA)	3020.00	1197.75	1803.91	18.34	6451.40	6457.71		6.31	0.011940	3.35	9.60	2.43	553.50	357.37	0.88
Arroyo	5800	10 YR	883.00	176.83	704.64	1.53	6451.40	6456.77		5.37	0.004804	1.40	5.01	1.01	268.43	250.11	0.53
Arroyo	6000	100 YR	3215.00	1171.10	1096.22	947.68	6453.30	6459.82		6.52	0.004398	1.95	5.59	2.48	1179.48	821.36	0.53
Arroyo	6000	100 YR (FEMA)	3020.00	1088.90	1042.29	888.81	6453.30	6459.79		6.49	0.004120	1.87	5.38	2.38	1149.17	811.08	0.51
Arroyo	6000	10 YR	883.00	15.21	582.98	284.81	6453.30	6458.14	6458.01	4.84	0.011200	0.79	5.75	2.77	223.68	298.90	0.75
Arroyo	6500	100 YR	3215.00	1385.48	1232.44	597.08	6456.95	6462.18	6462.18	5.23	0.004300	1.69	8.01	1.86	1292.97	1211.11	0.70
Arroyo	6500	100 YR (FEMA)	3020.00	1279.14	1182.75	558.11	6456.95	6462.15	6462.15	5.20	0.004052	1.61	7.74	1.78	1259.30	1208.33	0.68
Arroyo	6500	10 YR	883.00	66.53	769.67	46.81	6456.95	6461.22	6460.57	4.27	0.004020	0.62	6.54	0.72	290.14	783.48	0.65
Arroyo	7100	100 YR	3215.00	1578.93	1636.07		6460.79	6466.70	6466.70	5.91	0.007650	2.86	10.87		702.84	1206.24	0.91
Arroyo	7100	100 YR (FEMA)	3020.00	1483.27	1536.73		6460.79	6466.70	6466.70	5.91	0.006747	2.68	10.21		703.08	1206.74	0.85
Arroyo	7100	10 YR	883.00	139.54	743.46		6460.79	6465.40	6465.40	4.61	0.003985	1.11	6.84		233.89	603.98	0.64
Arroyo	7500	100 YR	3215.00	864.03	2350.97		6462.46	6470.46	6470.46	8.00	0.003830	2.04	9.46		673.22	474.96	0.68
Arroyo	7500	100 YR (FEMA)	3020.00	756.03	2263.97		6462.46	6470.35	6470.35	7.89	0.003763	1.94	9.28		632.65	463.36	0.67

HEC-RAS Plan: Grants River: Grants Canyon Reach: Arroyo (Continued)

Reach	River Sta	Profile	Q Total	Q Left	Q Channel	Q Right	Min Ch El	W.S. Elev	Crit W.S.	Max Chl Dpth	E.G. Slope	Vel Left	Vel Chnl	Vel Right	Flow Area	Top Width	Froude # Chl
			(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(ft/s)	(sq ft)	(ft)	
Arroyo	7500	10 YR	883.00		883.00		6462.46	6466.97	6466.19	4.51	0.004842		7.55		116.89	33.30	0.71
Arroyo	8000	100 YR	3215.00	632.92	2582.08		6466.08	6473.90	6473.90	7.82	0.002881	1.40	8.41		759.05	525.40	0.59
Arroyo	8000	100 YR (FEMA)	3020.00	512.64	2507.36		6466.08	6473.78	6473.78	7.70	0.002865	1.29	8.32		698.82	520.53	0.59
Arroyo	8000	10 YR	883.00		883.00		6466.08	6469.58		3.50	0.005618		7.52		117.50	38.51	0.76
Arroyo	8240	100 YR	3215.00	211.88	3003.12		6467.74	6475.15	6475.15	7.41	0.006969	3.07	12.19		315.42	87.15	0.91
Arroyo	8240	100 YR (FEMA)	3020.00	174.39	2845.61		6467.74	6474.92	6474.92	7.17	0.007084	2.94	12.06		295.33	83.36	0.91
Arroyo	8240	10 YR	883.00		883.00		6467.74	6471.14	6471.14	3.40	0.010252		9.57		92.23	32.87	1.01
Arroyo	8365 College Blvd		Culvert														
Arroyo	8400	100 YR	3215.00	154.58	2905.85	154.58	6470.32	6477.84	6477.84	7.52	0.004357	1.69	10.53	1.69	459.19	243.91	0.75
Arroyo	8400	100 YR (FEMA)	3020.00	118.54	2782.93	118.54	6470.32	6477.66	6477.66	7.34	0.004409	1.59	10.38	1.59	417.43	224.67	0.75
Arroyo	8400	10 YR	883.00	0.25	882.50	0.25	6470.32	6476.21	6473.56	5.89	0.001124	0.20	4.35	0.20	205.15	67.99	0.36
Arroyo	8650	100 YR	3215.00		3075.86	139.14	6471.87	6480.35	6480.35	8.48	0.006173		11.80	2.01	330.09	217.44	0.85
Arroyo	8650	100 YR (FEMA)	3020.00		2943.52	76.48	6471.87	6479.83	6479.83	7.96	0.007208		12.32	2.01	276.81	135.67	0.91
Arroyo	8650	10 YR	883.00		883.00		6471.87	6476.19	6475.90	4.32	0.007504		8.63		102.35	33.11	0.86
Arroyo	9000	100 YR	3215.00	238.64	2976.36		6474.82	6482.99	6481.11	8.17	0.002208	2.08	7.29		522.84	123.85	0.53
Arroyo	9000	100 YR (FEMA)	3020.00	207.73	2812.27		6474.82	6482.82	6480.81	8.00	0.002142	1.97	7.10		501.83	121.98	0.52
Arroyo	9000	10 YR	883.00		883.00		6474.82	6478.65	6477.76	3.83	0.003772		6.03		146.34	50.85	0.63
Arroyo	9500	100 YR	3215.00		3215.00		6477.48	6484.88	6484.88	7.40	0.008611		13.25		242.57	45.32	1.01
Arroyo	9500	100 YR (FEMA)	3020.00		3020.00		6477.48	6484.64	6484.64	7.16	0.008605		13.03		231.77	44.44	1.01
Arroyo	9500	10 YR	883.00		883.00		6477.48	6481.01	6481.01	3.53	0.010174		9.59		92.07	32.62	1.01
Arroyo	10000	100 YR	3215.00		3215.00		6480.38	6489.88	6487.58	9.50	0.003980		6.96		461.63	86.41	0.53
Arroyo	10000	100 YR (FEMA)	3020.00		3020.00		6480.38	6489.60	6487.37	9.22	0.004096		6.90		437.85	85.02	0.54
Arroyo	10000	10 YR	883.00		883.00		6480.38	6485.57	6484.02	5.19	0.005139		5.56		158.87	50.32	0.55
Arroyo	10500	100 YR	3215.00		3215.00		6485.11	6492.67	6492.66	7.56	0.015964		10.81		297.39	82.04	1.00
Arroyo	10500	100 YR (FEMA)	3020.00		3020.00		6485.11	6492.51	6492.49	7.40	0.016130		10.64		283.83	80.83	1.00
Arroyo	10500	10 YR	883.00		883.00		6485.11	6490.00	6490.00	4.89	0.020002		8.05		109.69	55.65	1.01
Arroyo	11000	100 YR	3215.00		3215.00		6488.90	6497.79	6496.08	8.89	0.005389		8.34		385.52	206.20	0.62
Arroyo	11000	100 YR (FEMA)	3020.00		3020.00		6488.90	6497.57	6495.91	8.67	0.005272		8.15		370.65	202.57	0.61
Arroyo	11000	10 YR	883.00		883.00		6488.90	6494.53	6493.01	5.63	0.004032		4.92		179.36	163.22	0.49

Culvert Summary Table

HEC-RAS Plan: Grants River: Grants Canyon Reach: Arroyo

Reach	River Sta	Profile	Q Total	E.G. US.	E.G. DS	W.S. US.	W.S. DS	Delta WS	Q Weir	Min El Weir Flow	Weir Max Depth	Wr Top Wdth	Q Culv Group	Culv Inv El Up	Culv Inv El Dn	Culv Vel US	Culv Vel DS
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(ft)	(ft)	(ft)	(cfs)	(ft)	(ft)	(ft/s)	(ft/s)
Arroyo	2278 Washington Ave Washington	100 YR	3215.00	6436.77	6435.28	6436.18	6434.43	1.75	1891.96	6434.81	1.97	698.74	1323.04	6430.50	6429.53	9.69	7.80
Arroyo	2278 Washington Ave Washington	100 YR (FEMA)	3020.00	6436.69	6435.03	6436.00	6434.21	1.78	1744.47	6434.81	1.91	688.47	1275.53	6430.50	6429.53	10.24	7.79
Arroyo	2278 Washington Ave Washington	10 YR	883.00	6435.22	6432.40	6435.01	6432.24	2.77	31.69	6434.81	0.42	132.28	851.31	6430.50	6429.53	9.18	10.99
Arroyo	5060 Roosevelt Ave Roosevelt	100 YR	3215.00	6454.68	6451.23	6453.79	6450.41	3.39	1397.39	6453.53	1.15	725.20	1817.61	6446.87	6446.67	9.92	12.26
Arroyo	5060 Roosevelt Ave Roosevelt	100 YR (FEMA)	3020.00	6454.60	6450.96	6453.83	6450.19	3.64	1225.53	6453.53	1.08	710.77	1794.47	6446.87	6446.67	9.86	12.21
Arroyo	5060 Roosevelt Ave Roosevelt	10 YR	883.00	6451.43	6447.30	6451.19	6447.03	4.17		6453.53			883.00	6446.87	6446.67	7.28	9.17
Arroyo	8365 College Blvd College Blvd	100 YR	3215.00	6478.14	6477.32	6477.84	6475.15	2.69	2969.40	6475.21	2.93	487.28	245.60	6468.96	6468.17	5.15	5.15
Arroyo	8365 College Blvd College Blvd	100 YR (FEMA)	3020.00	6478.04	6477.05	6477.66	6474.92	2.75	2750.55	6475.21	2.83	475.34	269.45	6468.96	6468.17	5.65	5.65
Arroyo	8365 College Blvd College Blvd	10 YR	883.00	6476.51	6472.57	6476.21	6471.14	5.07	431.57	6475.21	1.31	291.12	451.43	6468.96	6468.17	9.46	11.04

Grants Canyon Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs

Legend

WS 100 YR

WS 100 YR (FEMA)

WS 10 YR

Ground

LOB

ROB

Elevation (ft)

6520

6500

6480

6460

6440

6420

6400

0

2000

4000

6000

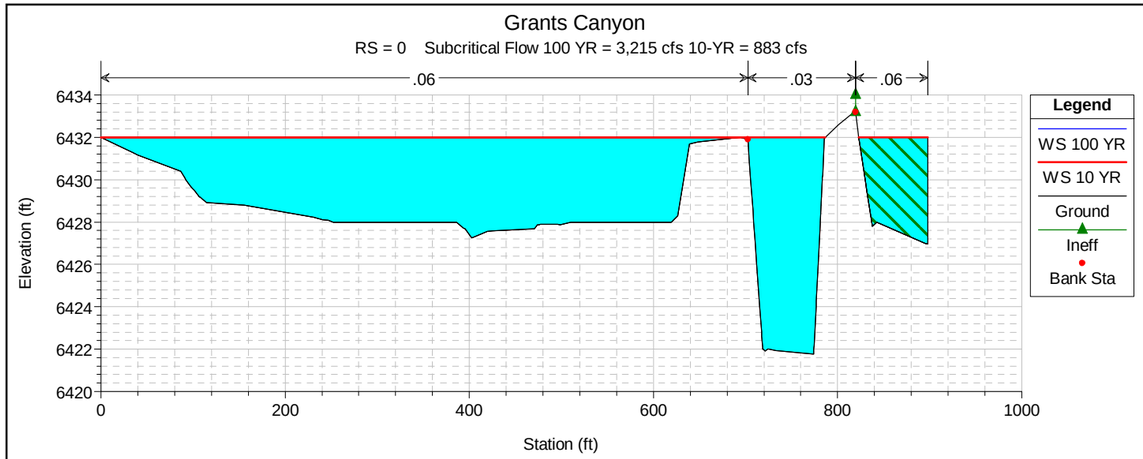
8000

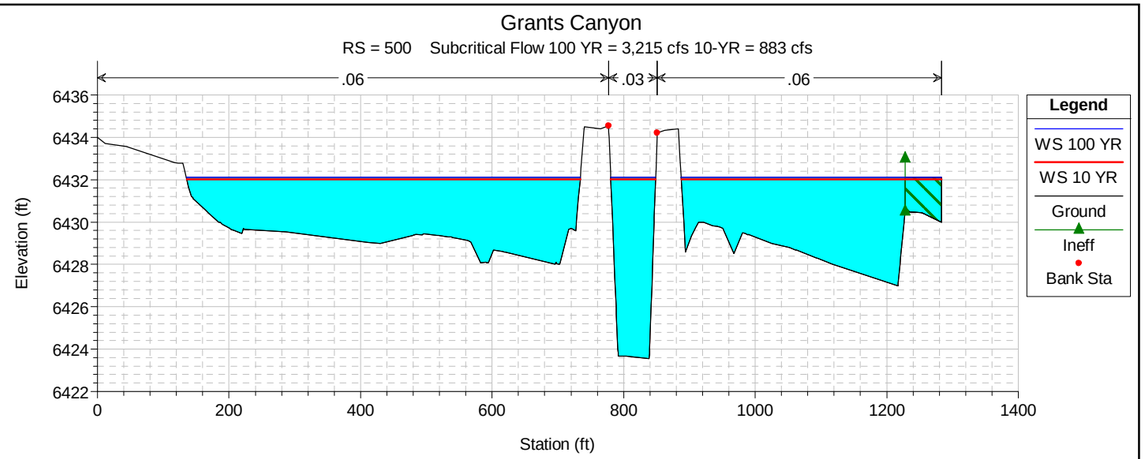
10000

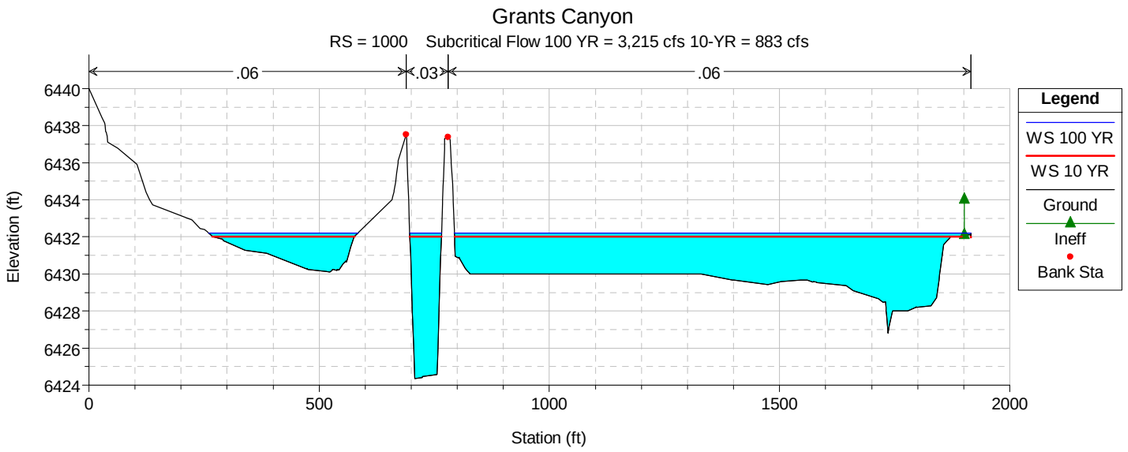
12000

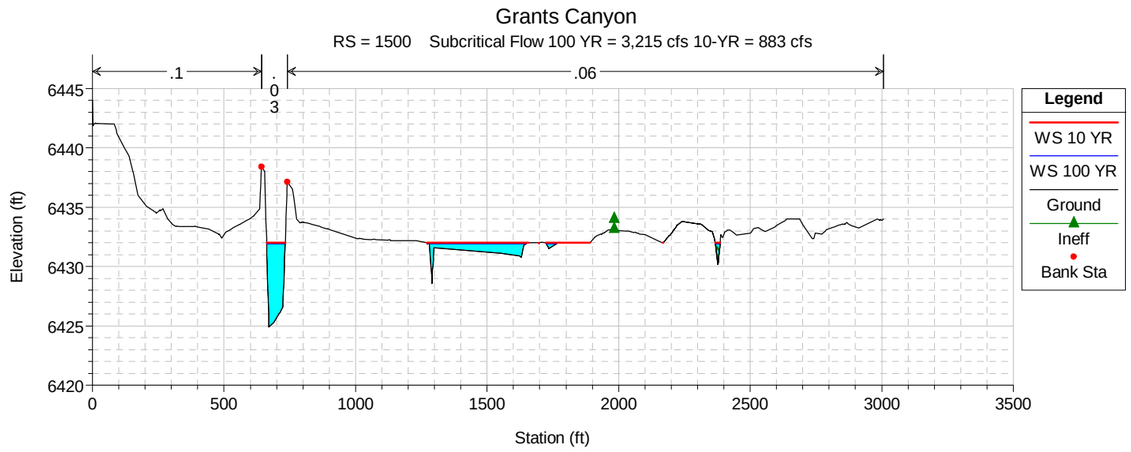
Main Channel Distance (ft)

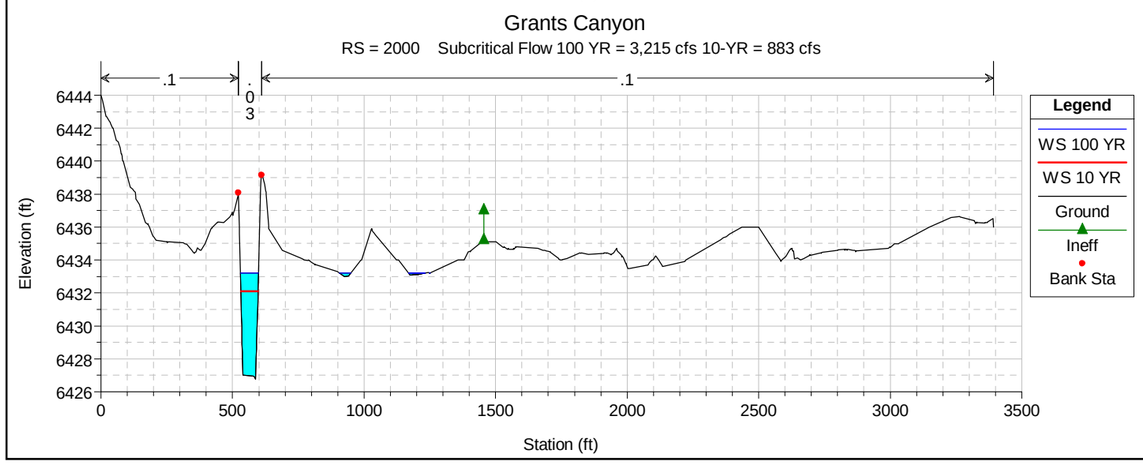
500 1000 1500 2000 2175 2300 2500 3000 3500 4000 4500 4950 5060 Roosevelt Ave 5500 5800 6000 6500 7100 7500 8000 8240 8365 College Blvd 8650 9000 9500 10000 10500 11000

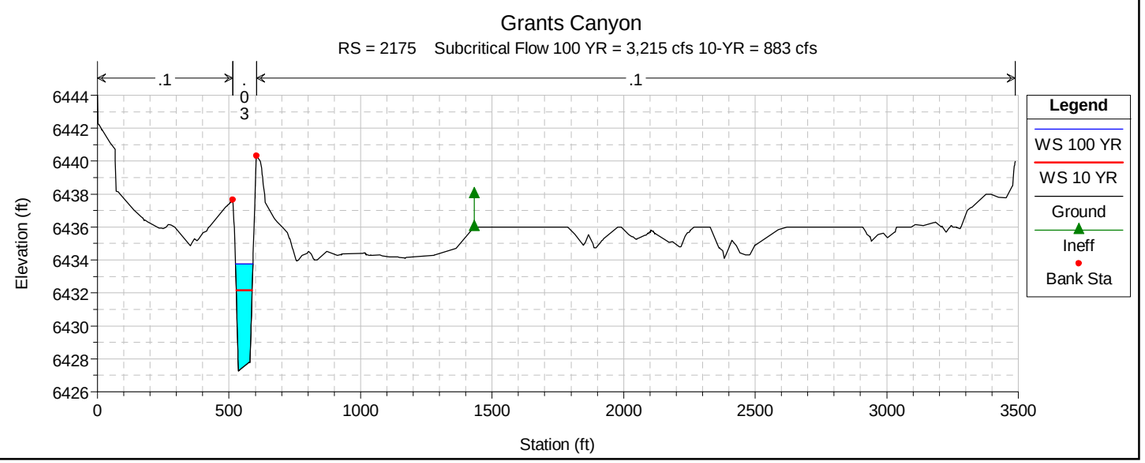

Grants Canyon
RS = 0 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.06
.03
.06
Elevation (ft)
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Ineff
Bank Sta

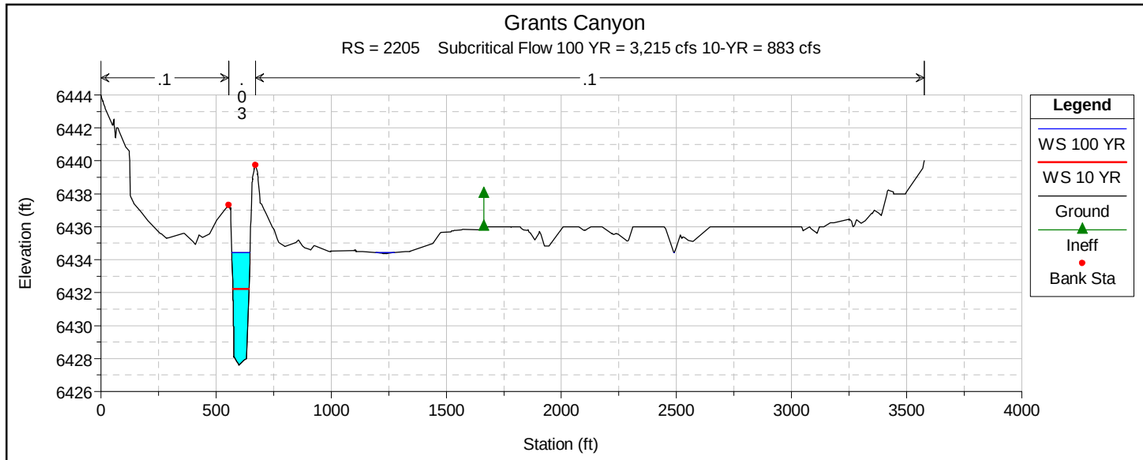

Grants Canyon
RS = 500 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.06
.03
.06
Elevation (ft)
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Ineff
Bank Sta

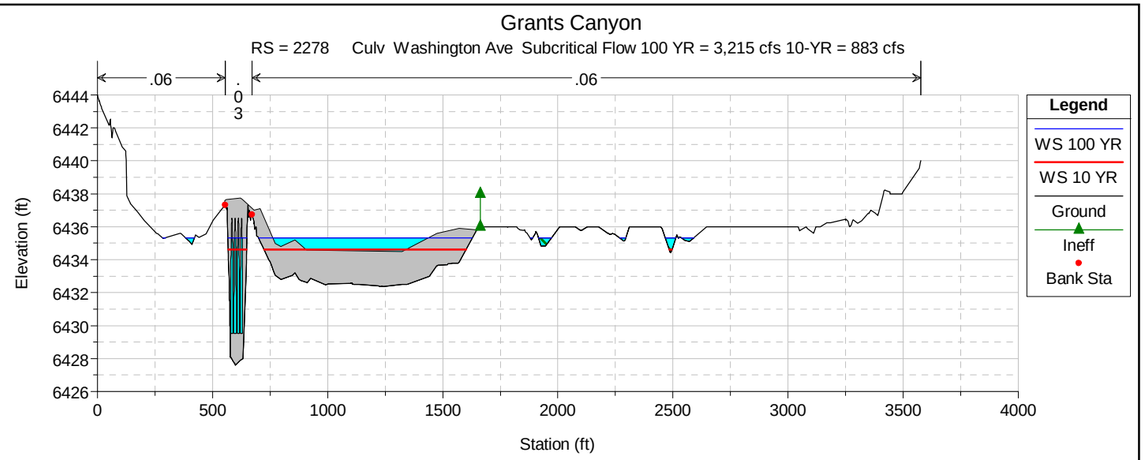

Grants Canyon
RS = 1000 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.06
.03
.06
Elevation (ft)
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Ineff
Bank Sta

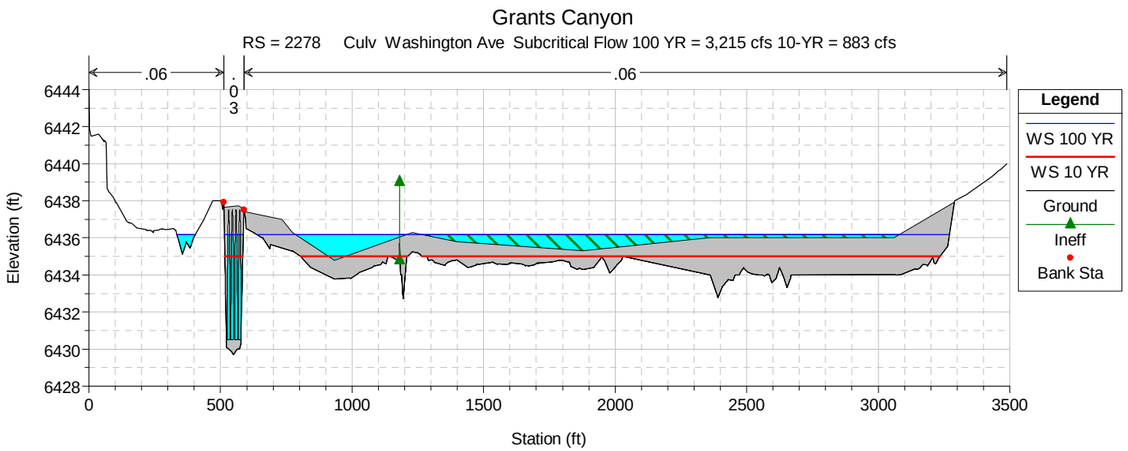

Grants Canyon
RS = 1500 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.1
.03
.06
Elevation (ft)
Station (ft)
Legend
WS 10 YR
WS 100 YR
Ground
Ineff
Bank Sta

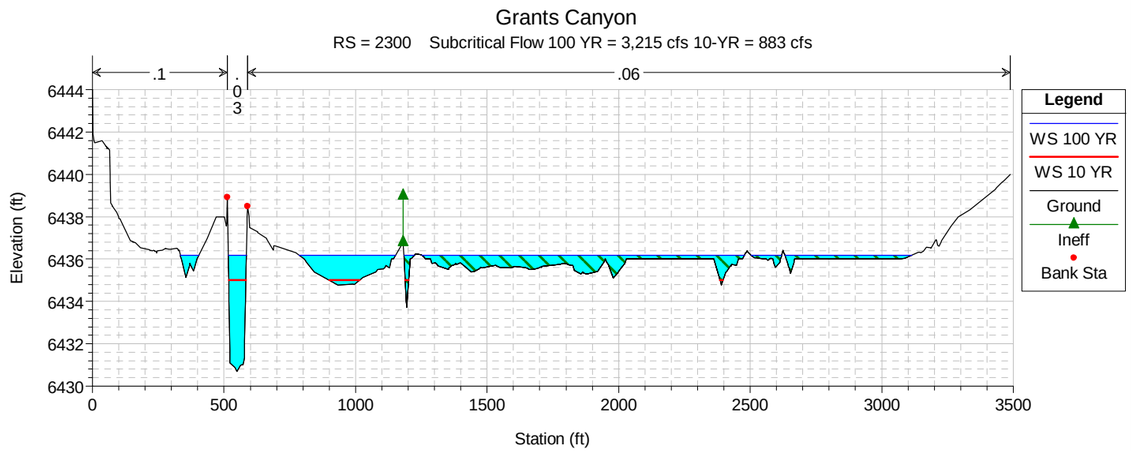

Grants Canyon
RS = 2000 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.1
.03
.1
Elevation (ft)
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Ineff
Bank Sta

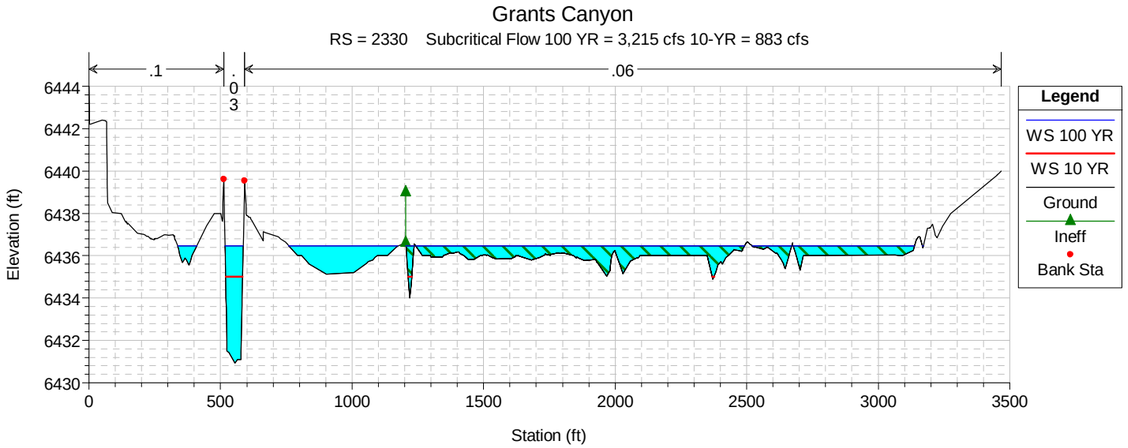

Grants Canyon
RS = 2175 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.1
.03
.1
Elevation (ft)
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Ineff
Bank Sta

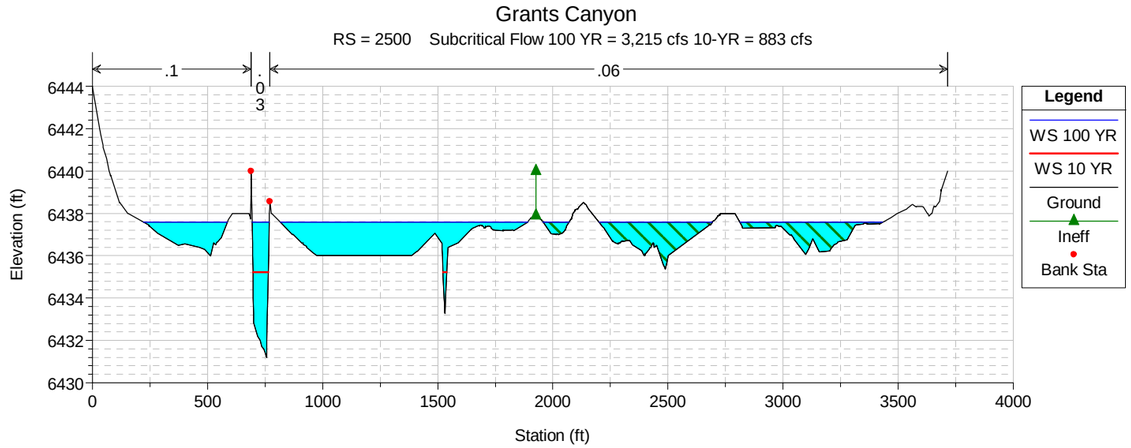

Grants Canyon
RS = 2205 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.1
.03
.1
Elevation (ft)
6444
6442
6440
6438
6436
6434
6432
6430
6428
6426
0
500
1000
1500
2000
2500
3000
3500
4000
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Ineff
Bank Sta

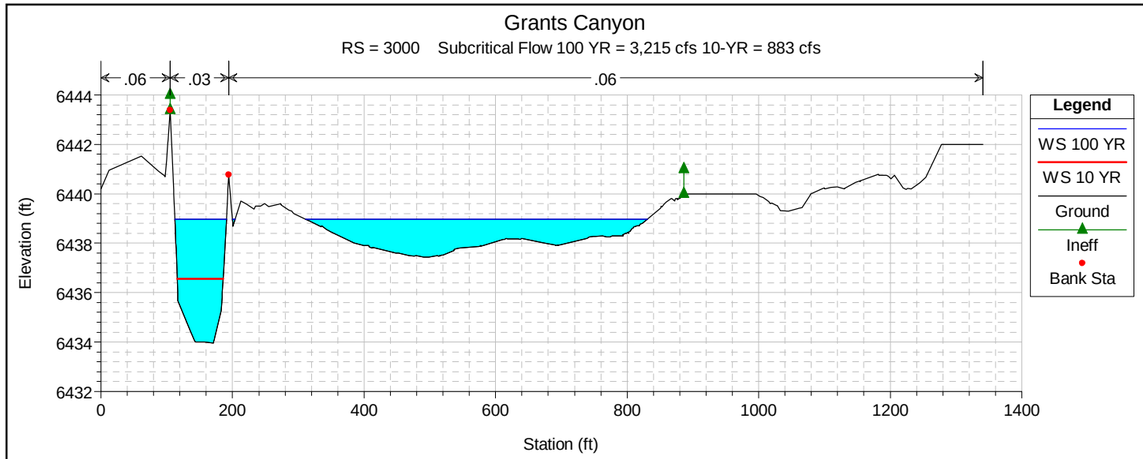

Grants Canyon
RS = 2278 Culv Washington Ave Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.06
.03
.06
Elevation (ft)
6444
6442
6440
6438
6436
6434
6432
6430
0
500
1000
1500
2000
2500
3000
3500
4000
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Ineff
Bank Sta

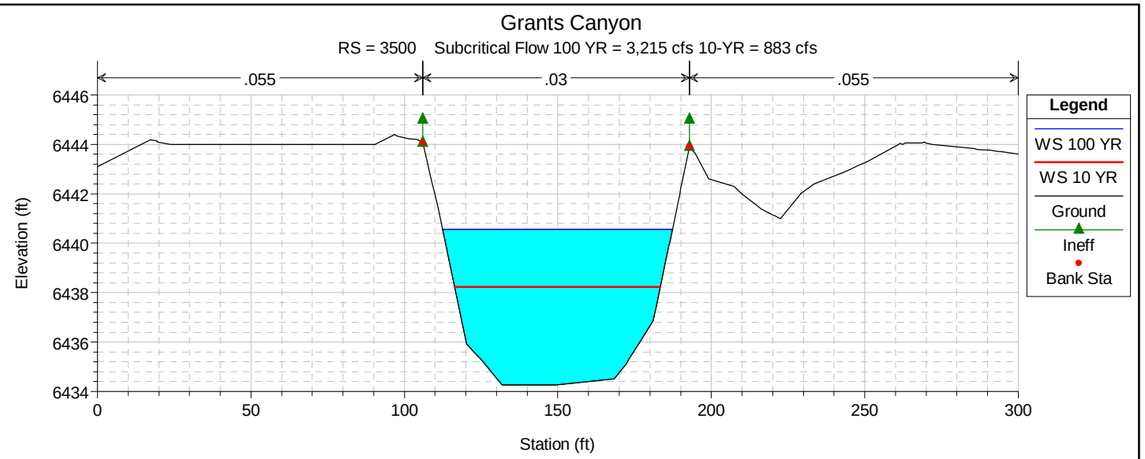

Grants Canyon
RS = 2278 Culv Washington Ave Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.06
.03
.06
Elevation (ft)
6444
6442
6440
6438
6436
6434
6432
6430
6428
0
500
1000
1500
2000
2500
3000
3500
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Ineff
Bank Sta

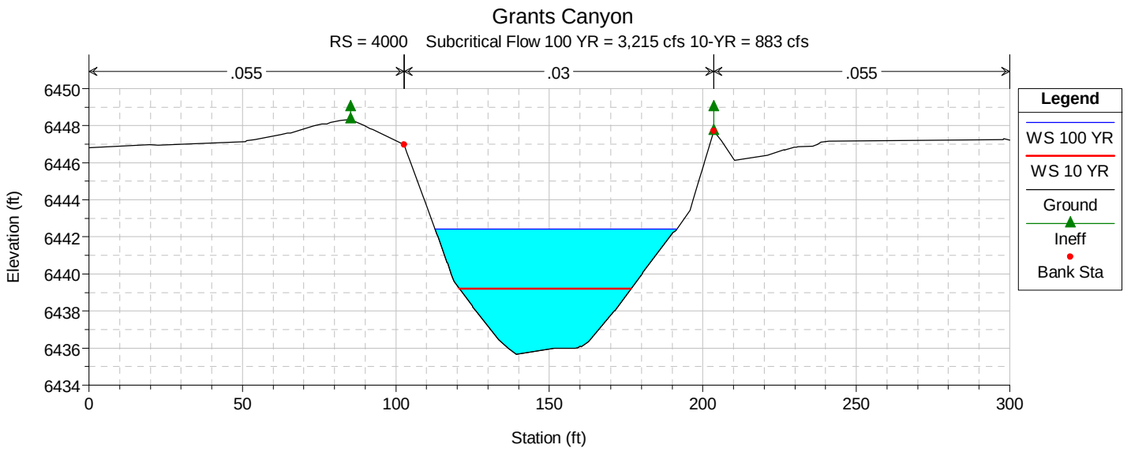

Grants Canyon
RS = 2300 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.1
.03
.06
Elevation (ft)
6444
6442
6440
6438
6436
6434
6432
6430
0
500
1000
1500
2000
2500
3000
3500
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Ineff
Bank Sta

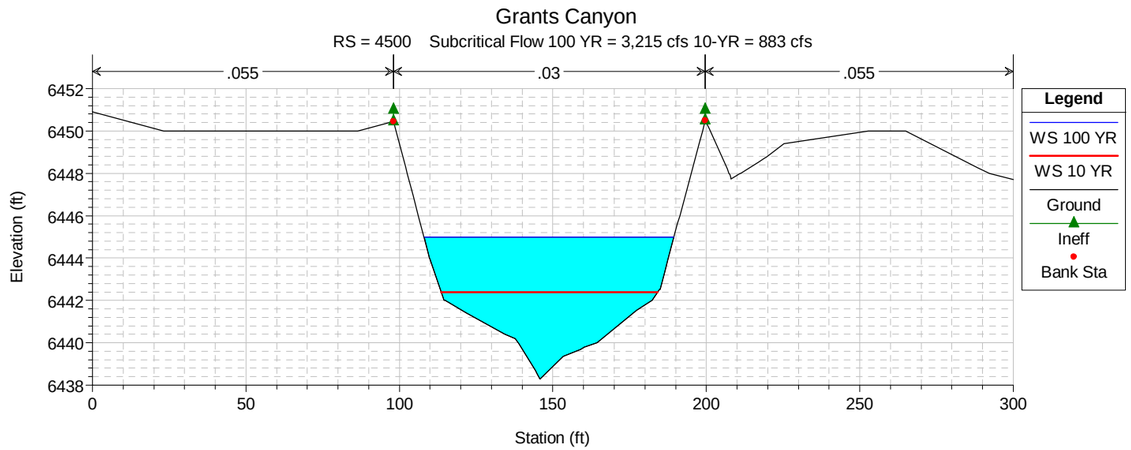

Grants Canyon
RS = 2330 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.1
.03
.06
Elevation (ft)
6444
6442
6440
6438
6436
6434
6432
6430
0
500
1000
1500
2000
2500
3000
3500
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Ineff
Bank Sta

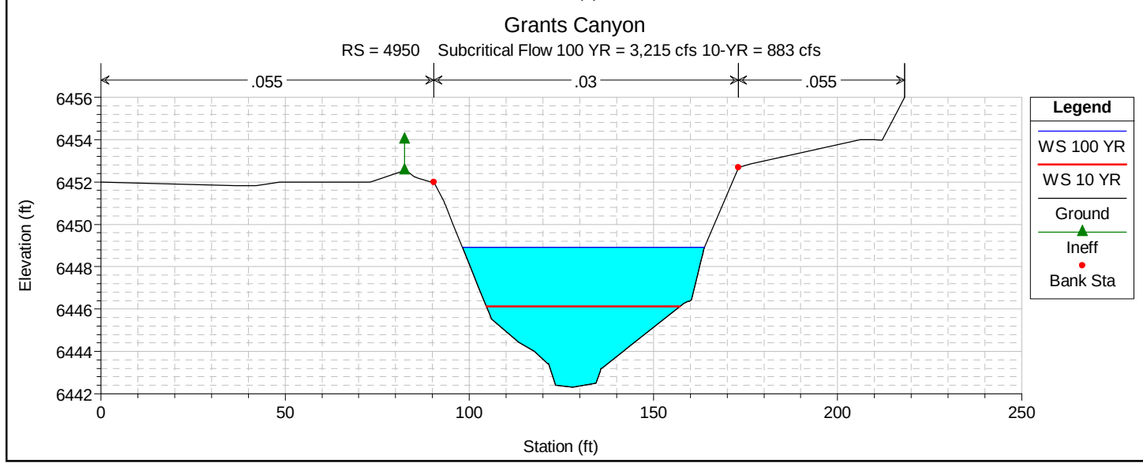

Grants Canyon
RS = 2500 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.1
.03
.06
Elevation (ft)
6444
6442
6440
6438
6436
6434
6432
6430
0
500
1000
1500
2000
2500
3000
3500
4000
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Ineff
Bank Sta

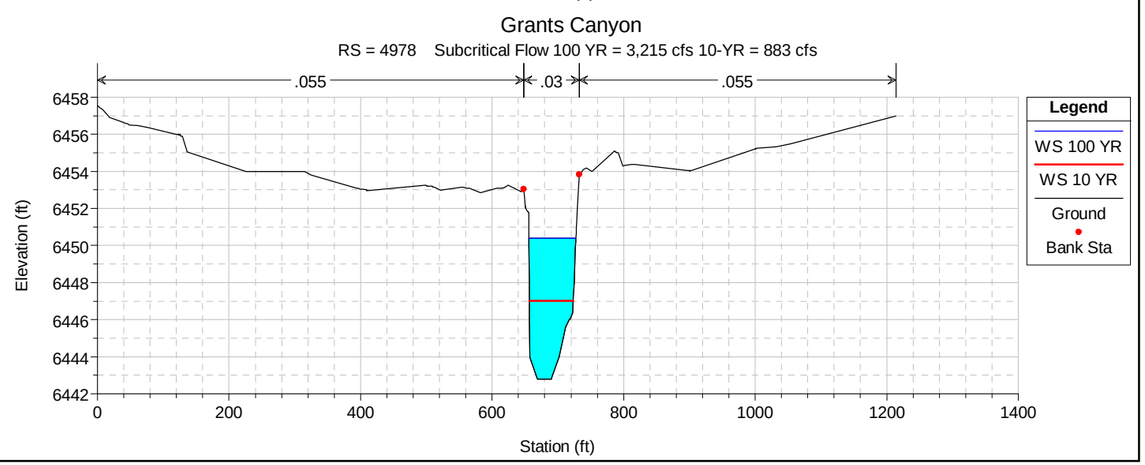

Grants Canyon
RS = 3000 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.06
.03
.06
Elevation (ft)
6444
6442
6440
6438
6436
6434
6432
0
200
400
600
800
1000
1200
1400
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Ineff
Bank Sta

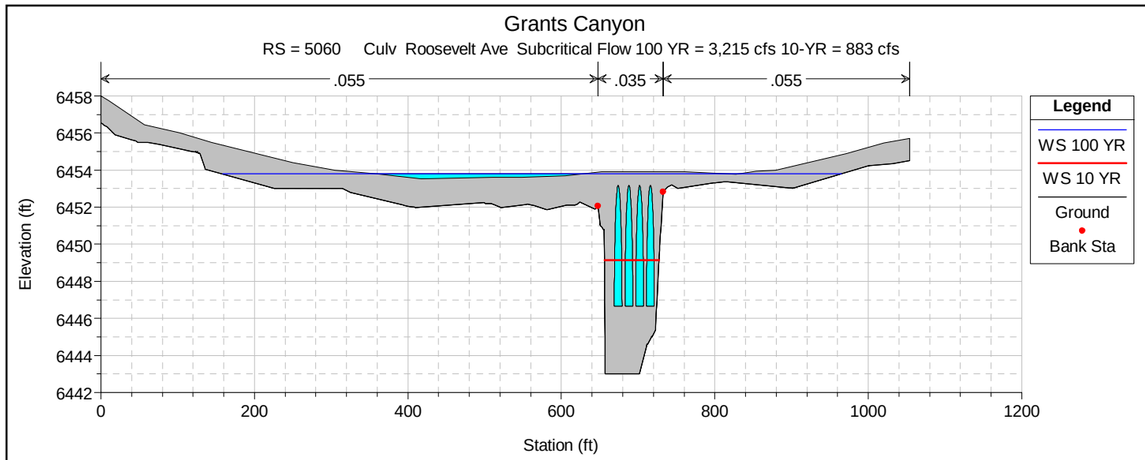

Grants Canyon
RS = 3500 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.055
.03
.055
Elevation (ft)
6446
6444
6442
6440
6438
6436
6434
0
50
100
150
200
250
300
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Ineff
Bank Sta

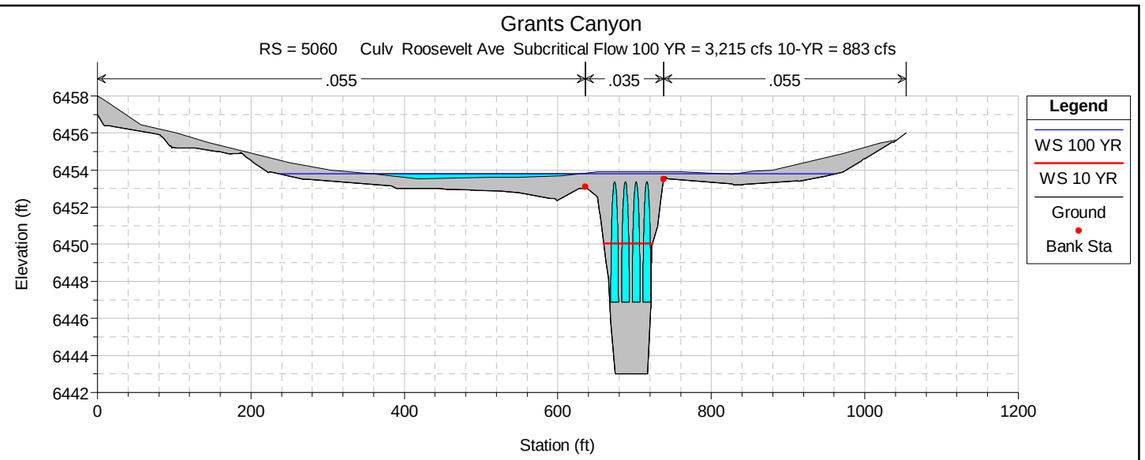

Grants Canyon
RS = 4000 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.055
.03
.055
Elevation (ft)
6450
6448
6446
6444
6442
6440
6438
6436
6434
0
50
100
150
200
250
300
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Ineff
Bank Sta

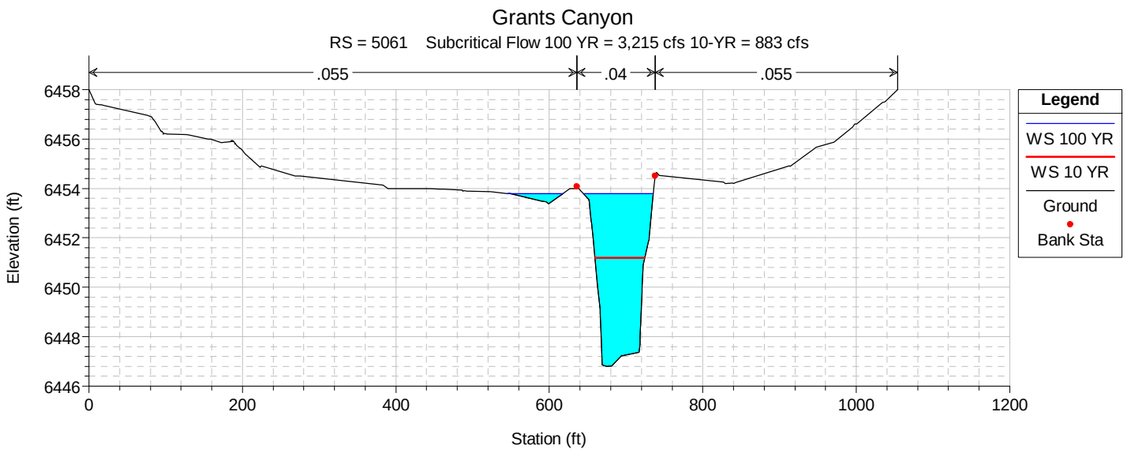

Grants Canyon
RS = 4500 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.055
.03
.055
Elevation (ft)
6452
6450
6448
6446
6444
6442
6440
6438
0
50
100
150
200
250
300
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Ineff
Bank Sta

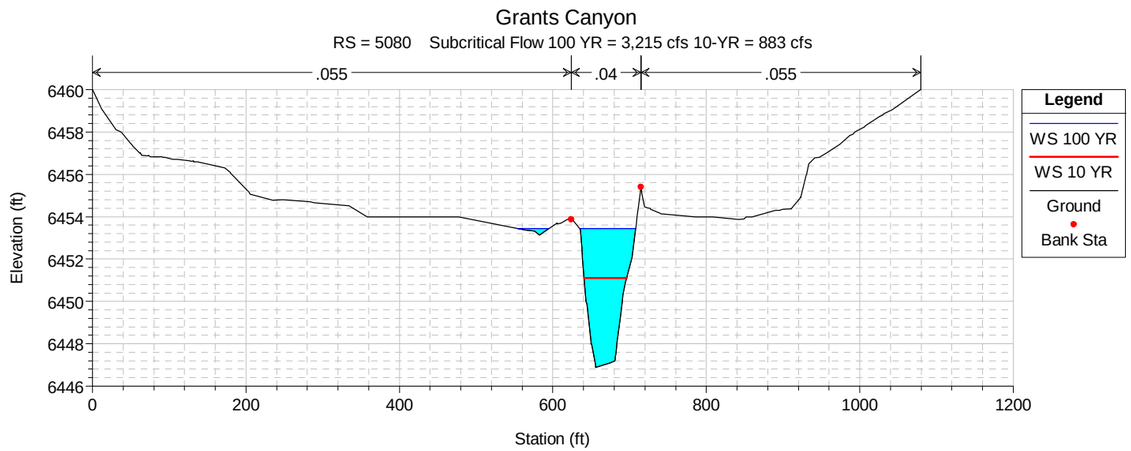

Grants Canyon
RS = 4950 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.055
.03
.055
Elevation (ft)
6456
6454
6452
6450
6448
6446
6444
6442
0
50
100
150
200
250
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Ineff
Bank Sta

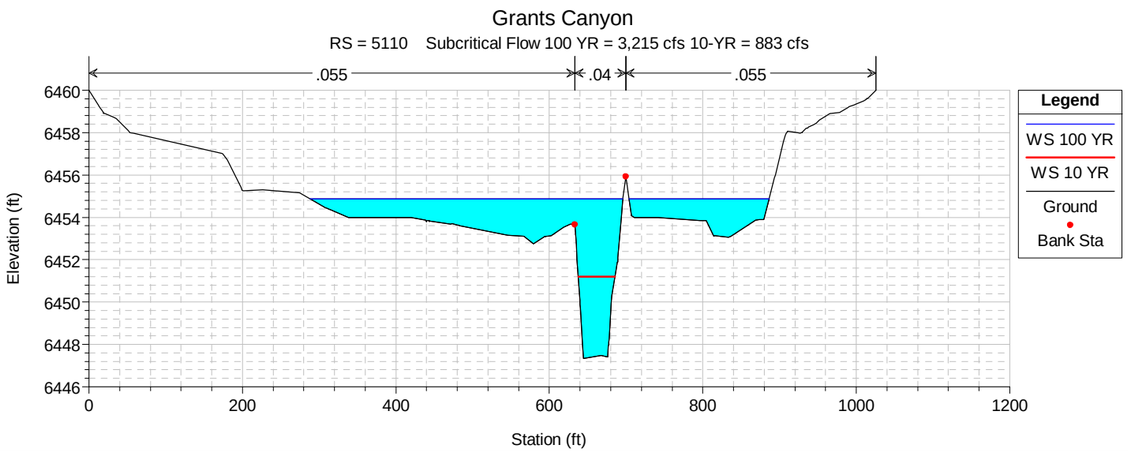

Grants Canyon
RS = 4978 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.055
.03
.055
Elevation (ft)
6458
6456
6454
6452
6450
6448
6446
6444
6442
0
200
400
600
800
1000
1200
1400
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Bank Sta

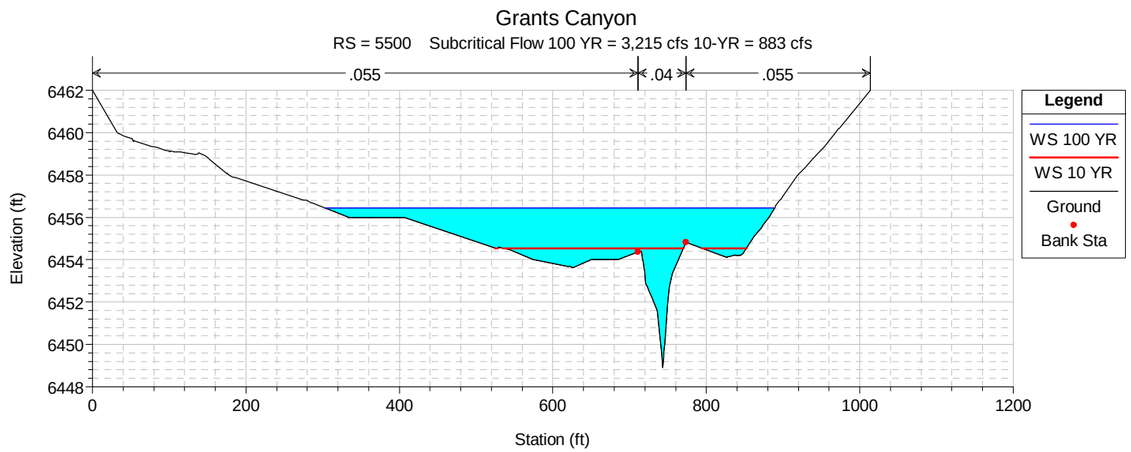

Grants Canyon
RS = 5060 Culv Roosevelt Ave Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.055
.035
.055
Elevation (ft)
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Bank Sta

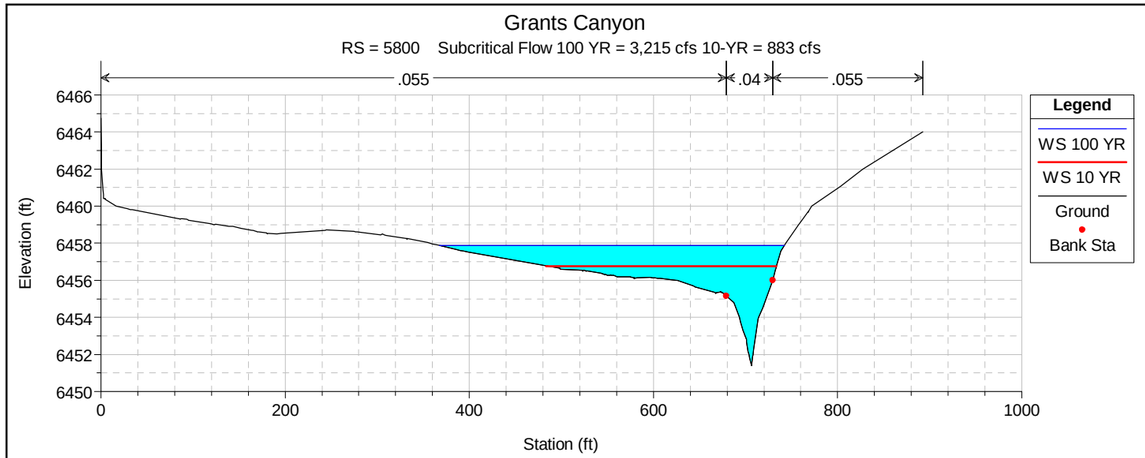

Grants Canyon
RS = 5060 Culv Roosevelt Ave Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.055
.035
.055
Elevation (ft)
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Bank Sta

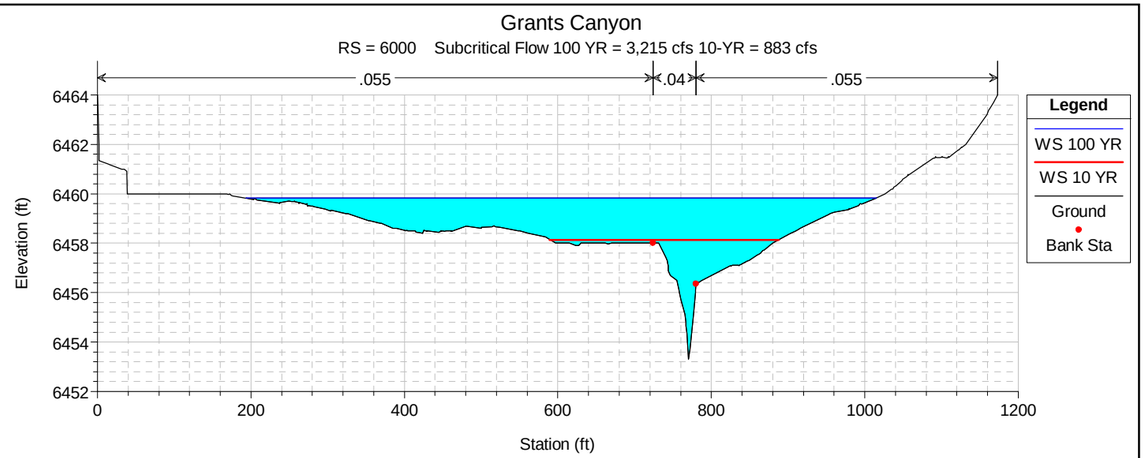

Grants Canyon
RS = 5061 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Bank Sta

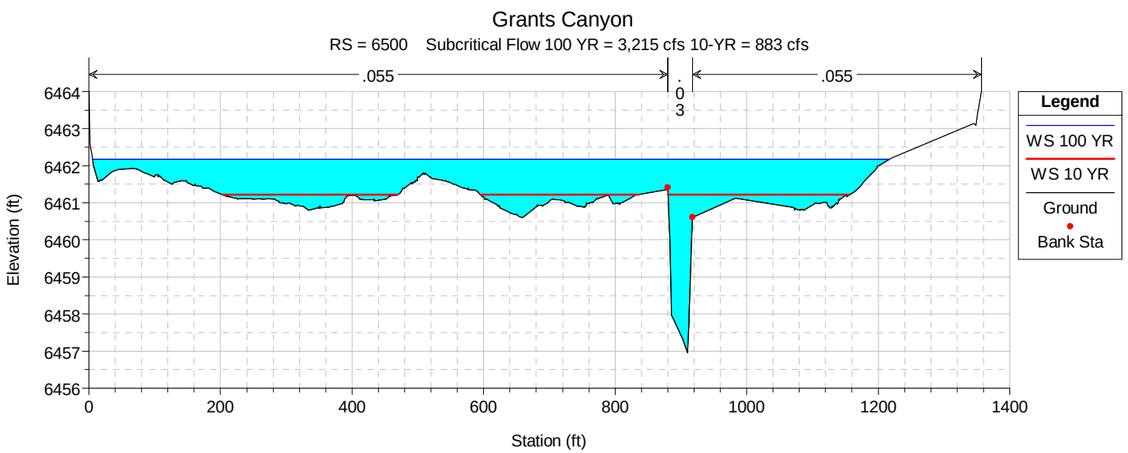

Grants Canyon
RS = 5080 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Bank Sta

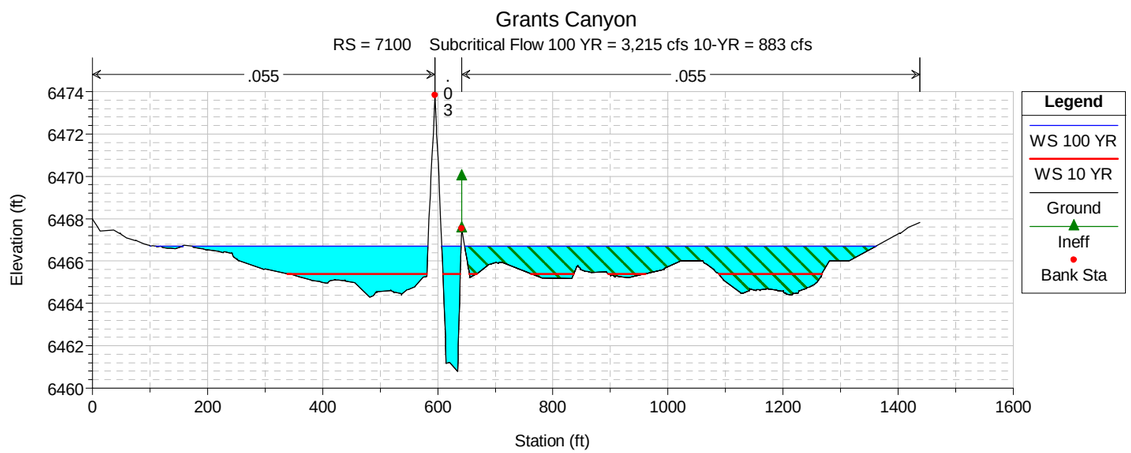

Grants Canyon
RS = 5110 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Bank Sta

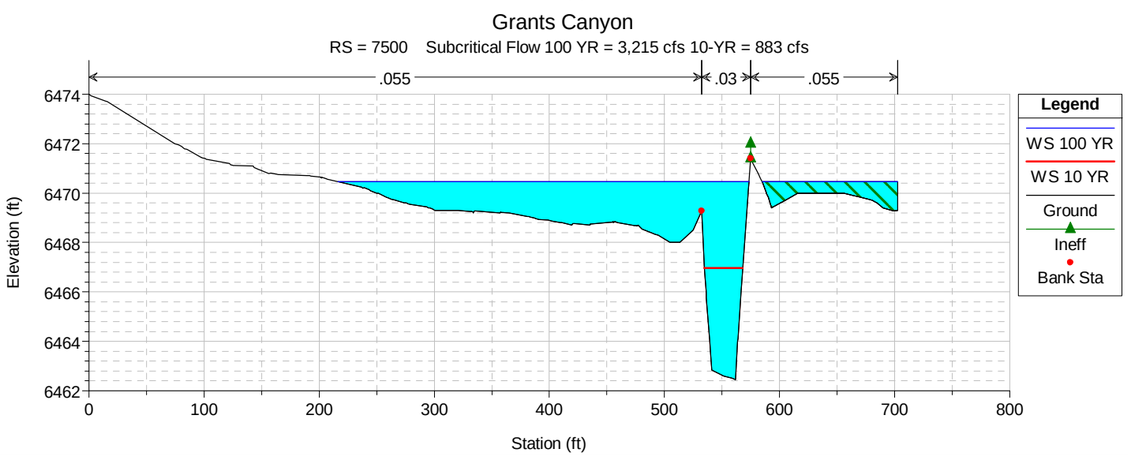

Grants Canyon
RS = 5500 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Bank Sta

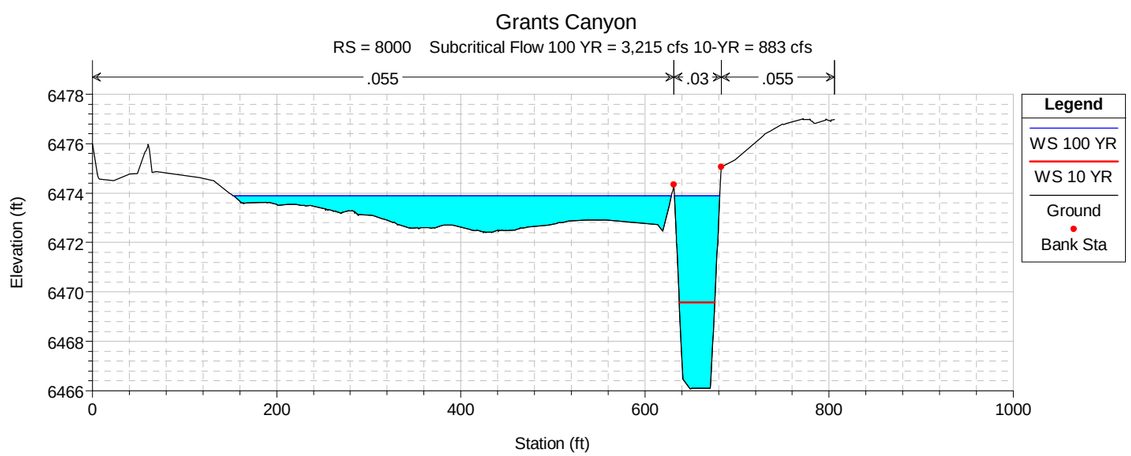

Grants Canyon
RS = 5800 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Bank Sta

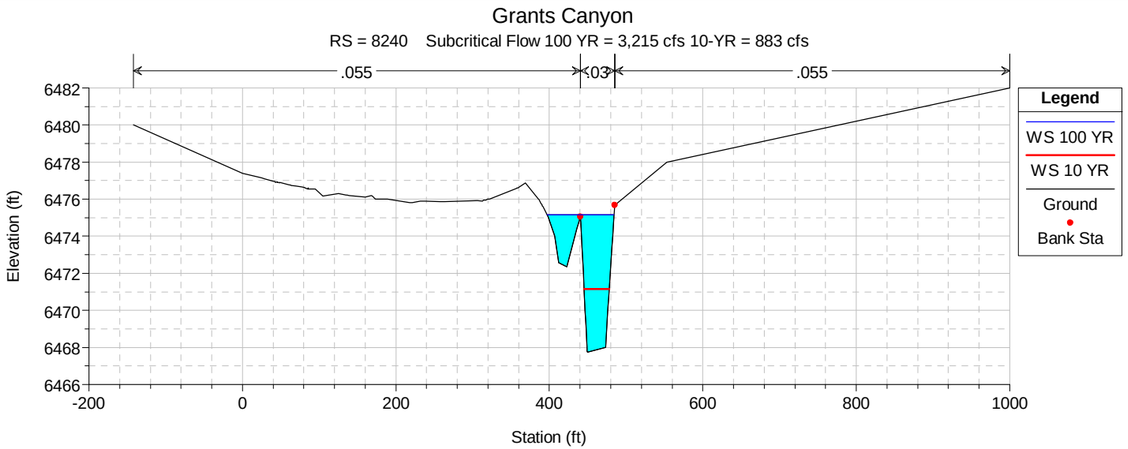

Grants Canyon
RS = 6000 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Bank Sta

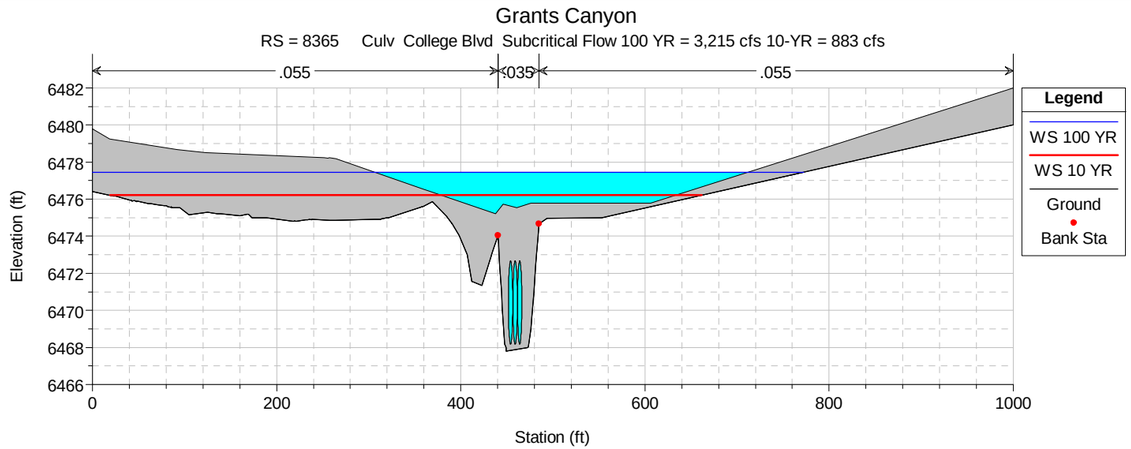

Grants Canyon
RS = 6500 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.055
.03
.055
Elevation (ft)
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Bank Sta

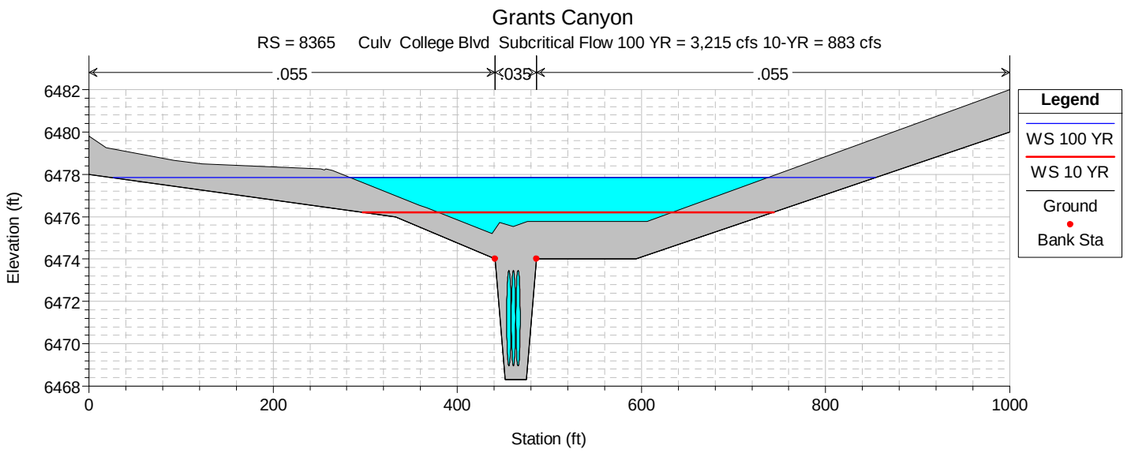

Grants Canyon
RS = 7100 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.055
.03
.055
Elevation (ft)
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Ineff
Bank Sta

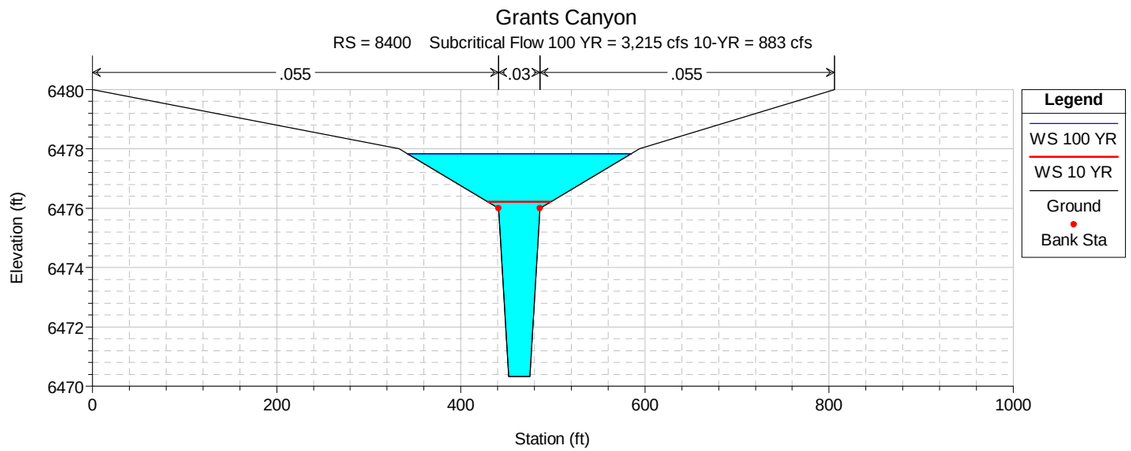

Grants Canyon
RS = 7500 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.055
.03
.055
Elevation (ft)
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Ineff
Bank Sta

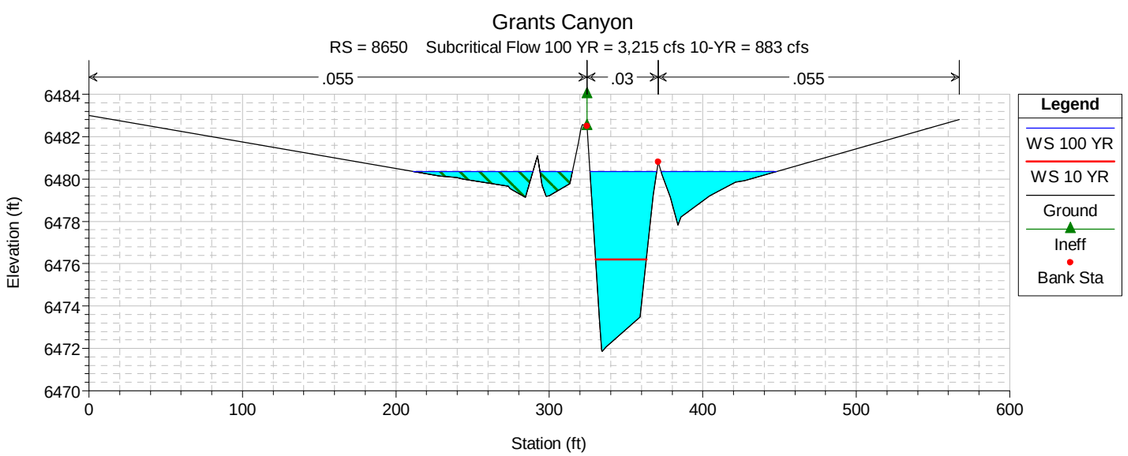

Grants Canyon
RS = 8000 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.055
.03
.055
Elevation (ft)
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Bank Sta

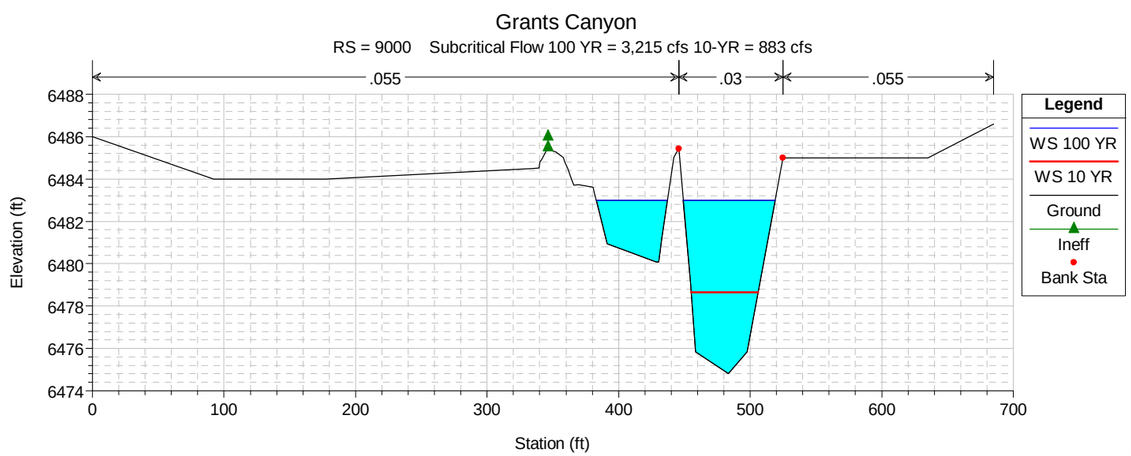

Grants Canyon
RS = 8240 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.055
.03
.055
Elevation (ft)
6482
6480
6478
6476
6474
6472
6470
6468
6466
-200
0
200
400
600
800
1000
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Bank Sta

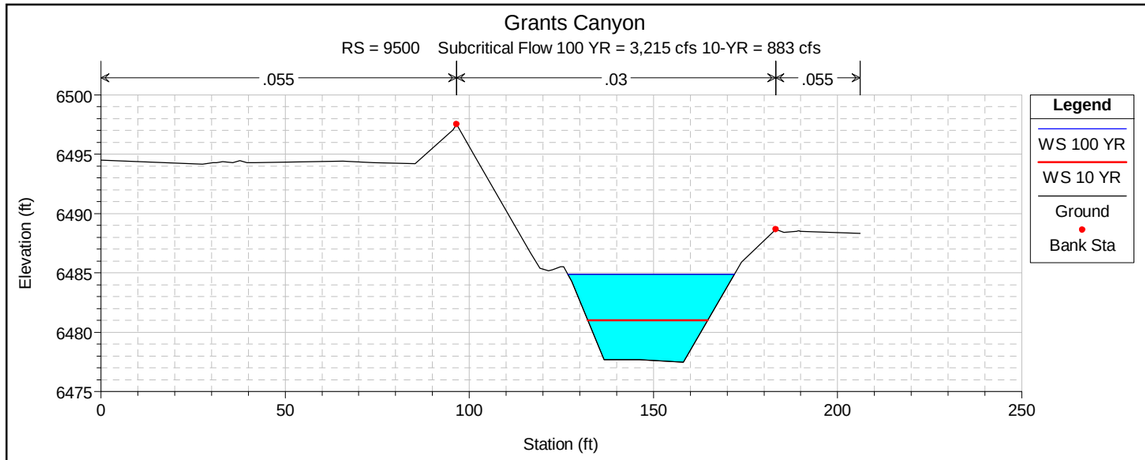

Grants Canyon
RS = 8365 Culv College Blvd Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.055
.035
.055
Elevation (ft)
6482
6480
6478
6476
6474
6472
6470
6468
6466
0
200
400
600
800
1000
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Bank Sta

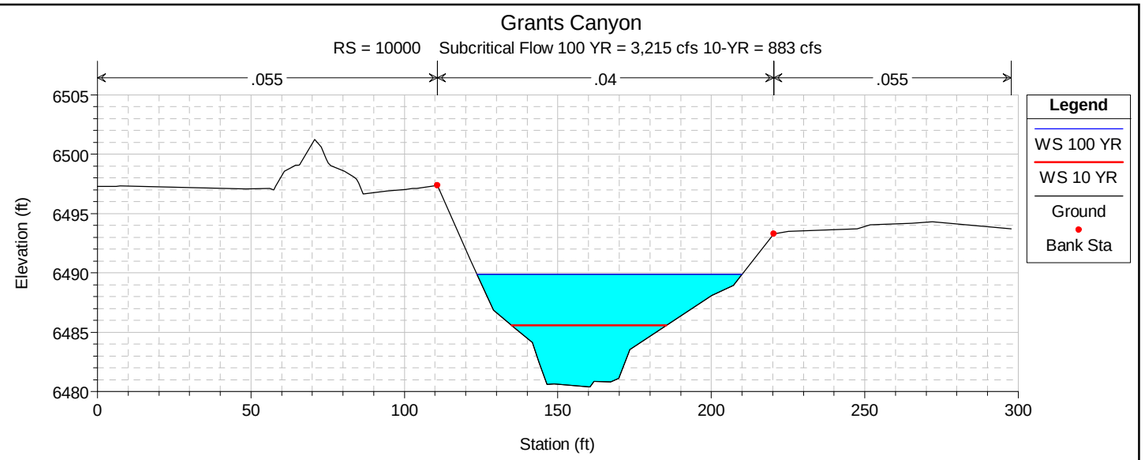

Grants Canyon
RS = 8365 Culv College Blvd Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.055
.035
.055
Elevation (ft)
6482
6480
6478
6476
6474
6472
6470
6468
0
200
400
600
800
1000
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Bank Sta

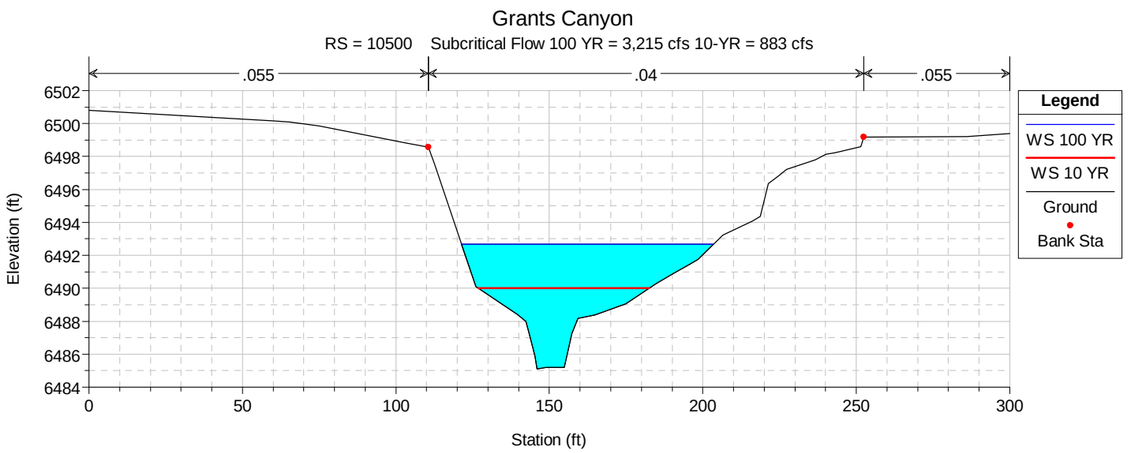

Grants Canyon
RS = 8400 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.055
.03
.055
Elevation (ft)
6480
6478
6476
6474
6472
6470
0
200
400
600
800
1000
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Bank Sta

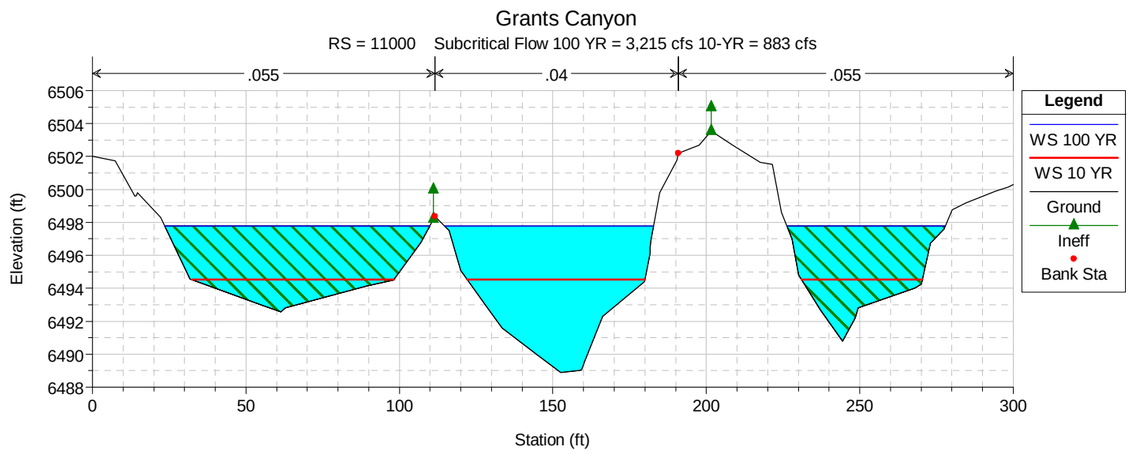

Grants Canyon
RS = 8650 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.055
.03
.055
Elevation (ft)
6484
6482
6480
6478
6476
6474
6472
6470
0
100
200
300
400
500
600
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Ineff
Bank Sta


Grants Canyon
RS = 9000 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.055
.03
.055
Elevation (ft)
6488
6486
6484
6482
6480
6478
6476
6474
0
100
200
300
400
500
600
700
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Ineff
Bank Sta


Grants Canyon
RS = 9500 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.055
.03
.055
Elevation (ft)
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Bank Sta


Grants Canyon
RS = 10000 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Bank Sta


Grants Canyon
RS = 10500 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Bank Sta


Grants Canyon
RS = 11000 Subcritical Flow 100 YR = 3,215 cfs 10-YR = 883 cfs
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS 100 YR
WS 10 YR
Ground
Ineff
Bank Sta

Appendix Section 4 - Drainage Problems

- Interview/meeting Summaries
- Photographs
- Newspaper Articles Summaries
- Drainage Report Summaries

WILSON & COMPANY

Meeting Summary

Arizona
California
Colorado
Kansas
Missouri
Nebraska
New Mexico
Oklahoma
Texas
Utah

To: Project File

From: Vance Fossinger

Date: 7-22-10

File Number: 10-600-033-00

Subject: Tour of frequent drainage problem areas with Manual Blea, Grants Public Works Director

Manual indicated the following areas as the most subject to drainage problems in the City of Grants on a frequent basis:

- At the NE corner of the intersection of Iron and High Streets, water ponds in a sump area that is drained by a very small drainage system (potentially only 4' dia.). This area takes a very long time to drain after runoff events.
- Manual identified the portion of First Street between Washington and Adams as the worst area in the City for frequent flooding problems.
- Second Street is also subject to frequent flooding north of Jefferson.
- 5th Street under the railroad bridge is subject to frequent flooding.
- Manual indicated that there is a small storm drain system in Roosevelt Ave. east of Lobo Canyon Rd. The last inlet is at the intersection with Bonita. Some local flooding occurs east of this system near the intersection of Roosevelt and Cordova Ct.
- The CMP culverts at the College Blvd, crossing over Grants Canyon Channel are missing end sections. Manual indicted that the channel flow overtops the street on an annual or more frequent basis.
- Mountain Road is subject to frequent flooding at a low point just south of Washington Avenue. The existing inlets and storm sewer are too small for the flow that collects at this location.
- Manual indicated that there are many more areas around the City that are subject to flooding, but the areas discussed above are the most problematic on a frequent basis.
- Manual discussed that the City purchased a large track mounted excavator a few years ago. The excavator is utilized for regular sediment removal from the Rio San Jose and Grants Canyon channel. Maintenance access to the portion of the Grants Canyon Channel that lies on land north of Roosevelt Avenue that is controlled by the US Forrest Service is apparently restricted by the Forrest Service. Thus, that portion of the channel is not regularly maintained.

HIGHER Relationships
SHARED OWNERSHIP • COLLABORATION
INTENSITY • DISCIPLINE • SOLUTIONS

WILSON & COMPANY

Meeting Summary

Arizona
California
Colorado
Kansas
Missouri
Nebraska
New Mexico
Oklahoma
Texas
Utah

To: Project File

From: Vance Fossinger

Date: 6-03 and 04-10

File Number: 10-600-033-00

Subject: Meetings with Ben Chavez, Public Works Director and tour of frequent drainage problem with Village Personnel

The following areas were noted as the most subject to drainage problems in the Village of Milan on a frequent basis:

- The area west of Highway 605 where the Rio San Jose channel is small and not well defined is subject to flooding across a wide area. Fences are sometime taken out by this flooding.
- The Milan Heights area is one of the most problematic. Runoff from the mesa fills ditches and culverts with sediment and spills over ditches to cross private properties. Erosion and flooding of private properties sometimes results from the flow. An area between Prewitt and Febco Streets is of particular concern.
- The intersection of Hotel Drive and Horizon Boulevard is subject to deep pools of water during and after rainstorms. A new storm sewer is under construction in the area. It is hoped that the new system will help mitigate this problem.
- Uranium Avenue in front of the Village Offices has very little grade and is subject to deep pools of during and after rainstorms. A new storm sewer in the area has helped, but since it is fairly small and drains to the North Street Arroyo pooling still occurs.
- There are several flat areas around the Village that drain poorly.

HIGHER Relationships
SHARED OWNERSHIP • COLLABORATION
INTENSITY • DISCIPLINE • SOLUTIONS

Interview with Bruce Lynn, Home and Business Owner in Milan

Milan, NM 87021

6/22/2010

Bruce and Jeff Holste drove around parts of Milan to discuss drainage related items. The following items were discussed and noted by Bruce to assist in the Drainage Master Plan for Milan and to identify areas with recurring flood problems.

- Elkins Rd is a county corridor owned and maintained by the county.
- Major drainage from the area crosses Elkins and Santa Fe.
- County may not restrict culvert type for culverts in Milan. Residents typically have culverts installed to allow access to property.
- An existing 24” culvert across Elkins Rd is buried with sediment and does not function.
- Properties near the end of Forest Park Rd have a berm along the back portion of the lots to protect the lots from runoff from the hillside of the Mesa. The berm receives minimal maintenance and has several areas where overtopping is a concern. Flow intercepted along this berm and channel travels to Crater where it enters the existing channel running along the south side of Crater.
- A small pond is located above the area of Forest Park Rd. This is up the hillside from the lot with the address of 1018 Forest Park.
- The residence at 1201 Forest Park has a swale along the back portion of the lot that collects flows and conveys them to Forest Park. This is at the intersection of Forest Park and Berryhill.
- Bruce commented that runoff seems to last around 3 hrs and the water off the mesa would probably fill a 24” or 36” pipe.
- Bruce did not recall ever seeing the channel along Crater out of its banks. It generally appears that the channel has capacity to convey the flow that reaches it based on our discussion. However, the ditch rarely sees flow.
- Key area of concern is along Forest Park and the intersections of Forest Park with Berryhill and Teitjen.
- Bruce commented that the minor storm events are of main concern for the area. He stated that they understand they are in a bad location for runoff and the large event will cause significant damage. The minor storm events cause damage on a more regular basis and are an ongoing concern for residents.
- Some form of runoff and erosion is experienced in the Forest Park area during frequent storm events. Bruce indicated that once every year or two significant runoff and erosion is seen in the area of Forest Park Rd.
-

- The ditch along the northeast side of Elkins appears to have a decent amount of conveyance capacity, but runoff from the hillside is unable to make it to the ditch without crossing private property and causing erosion and damage.
- There appears to be room for improvements to the ditch along the northeast side of Elkins. Specifically in areas south of Crater where then ditch capacity is very small.
- Several culvert pipes in the area are constructed from old vent pipes from local mines.
- Bruce indicated that a study had been conducted 3-4 years ago that proposed a 54” pipe to convey flows from higher up the hillside. This concept was not popular with the residents.
- Water flows from the hillside across many of the lots in the area. Significant surface flow is experienced
- Some old berms and diversions are shown on USGS quad maps that Bruce had but have since been removed or altered.

Flood Photos



North Street Arroyo Looking Towards Santa Fe Ave., 1999



North Street at Uranium Street, 2003



Flood Damaged Wall in the Milan Heights Area
(photo provided by Bruce Lynn)



Stormwater and Sediment Flowing from a Small Gully to Berryhill Street
(photo provided by Bruce Lynn)

Flood Photos









Thunderbird Road Area, North of Milan, Date Unknown

Newspaper and other Article Summary

Source	Date	Summary
Newspaper Article By: Grants Beacon	7/25/1967	Water surged through the Mt. Taylor Addition east of Grants doing thousands of dollars of property damage. One home had an estimated 2 feet of water in it at the peak of the flood.
Newspaper Article By: Grants Beacon	8/10/1967	Streets and roads and at least three houses in Milan were damaged by runoff after heavy rains in the Zuni Mountains. A low lying area near Sand Street absorbed the brunt of the water. A concave shaped area between the elementary school and the golf course reportedly held as much as 4 feet of water during the night.
Newspaper Article By: Cibola Beacon, Marian Hamilton	8/24/2004	This article about a Grant City Council meeting made several references to a recent flood. Grants street department supervisor Albino Jaramillo noted that the level of water in Riverwalk Park's waterway is too high indicating that "we need to raise the city or lower the ditch". It was indicated that City crews had been working overtime to cleanup from the flood. The article mentions that water was 2 to 3 feet deep at the Sargents/Nimitz intersection.
Newspaper Article By: Cibola Beacon, Will Kie	8/16/2005	Report of a local flood event. Article mentions that debris plugged the culverts at the Washington Street bridge sending floodwaters into the intersection of Sage and Washington. The article indicates that the Nimitz and Roosevelt culverts were also overrun by the floodwaters.
Newspaper Article By: Cibola Beacon, Marian Hamilton	8/23/2005	This article reports on a flood that occurred two weeks previously. The article reports that City officials estimated more than $100,000 of damage from the storm. The crossing between College Drive and North Hills Boulevard was reported as damaged by the flood as well as the Roosevelt and Washington Avenues Crossings. Rock walls and the sprinkler system was damaged in Grants Memorial Park but it was reported that no graves were affected.
Newspaper Article By: Cibola Beacon, Ilene Haluska	5/19/2006	This article reports on the discussion of a Grants City council meeting at which flooding of residential properties near the intersection of Nimitz Drive and Sargents Avenue was discussed. Problems reported by residents included flooding from a storm sewer when water rises in the Rio San Jose.
Newspaper Article By: Cibola Beacon, Diane Fowler	7/23/2007	Two thunderstorms occurring close together resulted in flooding in Grants during the annual Fire and Ice Motorcycle Rally. Some bikers reported water up to the seats of their motorcycles.
Newspaper Article By: Cibola Beacon, Lia Martin	7/23/2007	This article mentions a flood event on July 21, 2007 which caused water and mud damage to the Cibola County Office complex.
Newspaper Article By: Gallup Independent, Tim Tiffin	7/24/2007	Article reports on the annual Fire and Ice Bike Rally. The article mentions afternoon and evening thunderstorms that flooded downtown Grants with water that was knee deep. The article mentions a woman stumbling while carrying an infant in a car carrier and the carrier floating away with the baby in it. Several bikers apparently came to the rescue and caught the carrier and returned to baby to it's mother.
Newspaper Article By: Cibola Beacon, Rosanne Boyett	8/6/2010	This article discusses recent heavy thunderstorms in Cibola County. The article indicates that the 5th Street crossing under the railroad tracks was closed due to high water from the Rio San Jose.
Flood Insurance rate Study, Cibola County NM By: Federal Emergency Management Agency	12/17/2010	The most significant historical known occurrences of flooding in the City of Grants were August 28, 1952 flow from Zuni Canyon and the September 8, 1967 flow from Grants Canyon estimated to be 1,510 cfs at Roosevelt Avenue. On September 7, 1969 a local thunderstorm caused damage in three areas of the City of Grants. On August 11, 2005 several low water crossings in the City of Grants were covered with 2 to 3 feet of water. Several houses and apartments also had some ponding problems. On July 22, 2008 street flooding in the City of Grants reached a depth of 1 foot.

Elkins Road Drainage Study, Wilson & Company, June 2005

Wilson & Company evaluated the area of Milan near Elkins Road and Forest Park to determine flow rates generated and channel capacities for drainage channels in the area. The study is focused on this small area and associated drainage problems in Milan. FlowMaster was used to determine existing culvert capacities. The study presents several alternatives for collection and conveyance of stormwater to reduce the flooding of residential lots. The recommended alternative was an open channel to collect flows and convey them along existing flowpaths to the intersection of Elkins and Crater. This alternative includes the replacement of several structures. This study provided a detailed analysis of the study area and drainage problems in that area. The Elkins Road Drainage Study appears to provide more detailed information and alternatives than can realistically be provided in the current DMP for Grants/Milan/Cibola County.

City of Grants Drainage Master Plan, Gannett Fleming West, Inc, May 2000

Drainage study focused on flows affecting the 1st, 2nd, and Roosevelt areas and included areas between the Grants Canyon Channel and the Rio San Jose. This study included hydrologic and hydraulic analysis of the basins and channels leading to these areas. The report discusses design flow rates at several locations within the study area. Several alternatives are presented for drainage of the 2nd/Roosevelt area. HEC-1 and HEC-RAS models were developed for the study and are included in the appendix of the report. A large number of rational basins (~145 basins) were also developed for local drainage. Floodplain mapping is included in the report based on the analysis performed. Hydraulic modeling included a single Manning's n value for the channel and floodplain for the approximately 3,000 ft wide cross sections. The report includes a drainage ordinance for the City of Grants. Improvements for the eastern portion of Roosevelt are stated to be easily incorporated into street improvements while the west Roosevelt drainage improvements are not easily implemented due to issues with the existing grade and peak flow rates to be handled. Routing of flows for the Rational basins was not utilized so results are conservative flow rates. This report provides some comparison information for checking the hydrologic model and flow rates generated from the SCS Hydrograph Method. Some comparisons may also be drawn to the hydraulic model, however it is likely that a different approach to modeling of the floodplains will be utilized in the current study with higher anticipated Manning's n values for the floodplain areas. It does not appear from the HEC-RAS model data that any structures were modeled along either the Rio San Jose or the Grants Canyon Channel.

Relevant Report Summaries

City of Grants and Village of Milan, Drainage Master Plan

Storm Drainage Management for the City of Grants and Village of Milan: Areawide Management Guidelines, Volume I, Middle Rio Grande Council of Governments, 1973.

This document establishes the overall basin boundaries for the basins contributing to the Grants area and discusses the elements necessary for watershed management. Multiple agencies are identified and their roles in watershed management are discussed. The programs and guidelines for general watershed management are discussed along with general discussions of the drainage features present in this watershed. A background of drainage analysis along with basics for determining and evaluating storm runoff are included. Overall, this document is intended to provide direction on how drainage should be evaluated and the relevant items to be considered when performing an evaluation.

Storm Drainage Management for the City of Grants and Village of Milan: Structural Measures, Volume II, Gordon Herkenhoff and Associates, Inc, 1973.

This report evaluates existing drainage systems and provides specific alternative solutions for existing and potential drainage problems. Also provides guidelines and recommendations for the development and management of unincorporated areas to minimize drainage problems. This study strongly recommended a detention facility upstream in Grants Canyon to mitigate peak rates in the Grants Canyon diversion channel and ultimately the Rio San Jose in Grants. The concept of the detention facility was referenced as presented in SCS Small Watershed studies. This study noted that the majority of the crossings for the Rio San Jose were severely undersized. Hydrology was performed using SCS direct runoff curves developed for the area. Cost estimates are presented for several drainage improvements identified in the study. The study includes general background information regarding the terrain and land features in the area and some of the improvements that have taken place in Grants. Specifically, a Corps of Engineer's project to improve the capacity of the Rio San Jose through a portion of Grants is discussed in the study. This study used the Rational Method to evaluate basins smaller than 2,000 acres. Tables are presented to represent calculations for drainage channel carrying capacities. This study recommends the SCS Grants Bypass Channel reduce the flow in the Rio San Jose in the area of 1st and 2nd Street. Many of the ideas and improvements suggested in this report are consistent with the improvements seen necessary in the current study. The 1973 study presented a large amount of information and recommendations for several problem areas. Flow rates in excess of 3,500 cfs were estimated statistically in this study for the 100-yr event along the Grants Canyon Channel.

Grants Main Street Master Plan, Wilson & Company, June 2010

This study provides direction on redeveloping the Route 66 and Downtown corridors in Grants. Focus is on development of pedestrian and business friendly corridor. One map calls for a new bridge at 5th St and the railroad tracks and better flooding attenuation of the Rio San Jose. Detention/Retention ponds are identified in areas at the north end of Iron and Lead to alleviate flooding in the downtown area. Several areas are identified to have the zoning modified. Primary focus of the report is improving downtown and Route 66 corridors from an aesthetic and economic standpoint.

Rio San Jose Flood Control District Study and Report

This report identified drainage improvements presented in previous studies and discussed the elements of several of these improvements. Cost estimates for the projects are included and potential funding sources are identified. The study catalogs over 21 potential projects and provides a brief discussion of the project location and potential benefits of each project. A consolidated list of projects is also discussed along with more detailed information and preliminary cost estimates determined in the study.

Preliminary Drainage Report for Roosevelt Ave. in Grants, Leedshill-Herkenhoff, Inc. March 1995.

Report focuses on drainage reaching the Roosevelt Ave. corridor in Grants. The report includes discussion of existing storm sewer systems in Roosevelt, specifically at the intersection of Roosevelt and Lobo Canyon Rd. The major crossing of the Grants Canyon Arroyo at Roosevelt is also discussed in the report and box culvert hydraulic output is included for this crossing. Street capacity calculations are presented in the report for several sections of Roosevelt. USGS calculated discharge values based on years of gage data are included for the Grants Canyon Arroyo. Two alternatives for widening the Grants Canyon Arroyo crossing to accommodate a widening of Roosevelt were mentioned. Hydrology was calculated based on 1-hour storm event for the 10-yr and 100-hr storms. Typical cross sections for Roosevelt are also presented in this report.

Relevant Report Summaries

City of Grants and Village of Milan, Drainage Master Plan

Watershed Studies for the Pole-Zuni, San Mateo-Grants, and Rio San Jose watersheds, SCS, 1968-1976

Watershed studies were performed by the SCS in 1968 to determine feasible alternatives for reducing flooding in the Grants/Milan areas. Several alternatives are presented for the various watersheds contributing to the area. Alternatives presented for the Grants Canyon/Grants area included a detention facility in Grants Canyon to control floodwaters upstream of Grants and a bypass channel to keep flow in the Rio San Jose from entering Grants. The bypass channel was proposed to run along the south side of the railroad tracks from the location where flow crosses under the railroad and enters Grants to a location at the southeast side of Grants. This alternative would keep floodwaters from the Rio San Jose from reaching Grants and would allow for more adequate local drainage of Grants using the old Rio San Jose channel for conveyance. Several other memos and reports call for similar solutions for drainage issues in the Grants area. A memo dated in 1976 states that the structural improvements presented by the SCS in the Upper Rio Grande Basin Report had become unfeasible and would not be pursued by the SCS. A field report accompanied the memo and this report recommended several scenarios for additional funding for local improvements in the Grants area and the potential for coordination with the Corps for development of channel improvement projects. The studies include evaluations of the land cover, rainfall, and soils conditions for the evaluated watersheds as well as cost estimates.

Western Correctional Facility Drainage and Mechanical Systems Facility Assessment, Wilson & Company, February 19, 2009.

Drainage analysis was performed on the site with the existing correctional facility. The analysis included hydrologic calculations using the USGS regression equations for offsite basins tributary to the site location. Existing facilities were evaluated and proposed improvements were presented in the report. Specifically, a diversion channel and berm were presented to convey flows around the correctional facility. The proposed improvements also included substantially upsizing the culvert crossings of Lobo Canyon Rd. The internal drainage system for the site was also included in the analysis.

Relevant Report Summaries

City of Grants and Village of Milan, Drainage Master Plan

Master Drainage Study for Grants High School, Isaacson & Arfman, P.A., November 2005.

This study evaluated existing facilities for the high school and recommended improvement options to allow conveyance of 10-yr and 100-yr storm flows. Offsite basins upstream of the high school were delineated and included in the study along with onsite basins for the high school property. Existing and future buildings were included in the study for the high school campus. AHYMO was used to determine runoff from the basins for the 100-yr, 6-hr storm event. The study recommended a desiltation pond near the west end of Roosevelt. Additional culvert upgrades were also recommended mainly along Roosevelt, Washington, and 2nd St. Improvements to the channel along 2nd St. were also recommended to improve conveyance. The study appears to do a thorough job of evaluating the drainage facilities of the high school by looking at 12 analysis points and with recommendations for necessary improvements at each location.

Appendix Section 5 – Calibration Data

Hydrology

- NOAA Flood Event Records
- NEXRAD Imagery for Calibration Storm Event
- Rainfall Spatial Distribution for HEC-HMS Calibration Model
- Rainfall Hyetograph Tables for Calibration Storm Event
- Flow Rates and Water Surface Elevations Corresponding to Curve Number Calibration Values
- HEC-HMS Model Results for Calibration Storm
- Interview Summaries
- Newspaper Articles
- Regression Equations

Hydraulics

- Calibration Flood Exhibit with HEC-RAS Cross Section Locations and Approximate Boundary of Calibration Flood
- HEC-RAS Profile and Culvert Summary Tables
- HEC-RAS Profile Plot
- HEC-RAS Cross Sections
- USGS Peak Flow Data for Rio San Jose at Grants and Grants Canyon at Grants Stream Gage Locations
- Photographs of the Roosevelt Avenue culverts

Calibration Storm

Query Results

13 FLOOD event(s) were reported in **Cibola County, New Mexico** between **01/01/1950** and **07/31/2010**.

*Click on **Location or County** to display Details.*

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

New Mexico

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 Bluewater	07/29/1999	05:30 PM	Flash Flood	N/A	0	0	0	0
2 Fence Lake	08/10/2005	08:00 PM	Flash Flood	N/A	0	0	0	0
3 Grants	08/11/2005	06:00 PM	Flash Flood	N/A	0	0	0	0
4 San Fidel	08/07/2006	02:55 PM	Flash Flood	N/A	0	0	0	0
5 Laguna	08/07/2006	04:25 PM	Flash Flood	N/A	0	0	0	0
6 Anaconda	07/19/2008	19:46 PM	Flash Flood	N/A	0	0	5K	0K
7 San Mateo	07/22/2008	18:10 PM	Flash Flood	N/A	0	0	10K	0K
8 Bluewater	07/22/2008	18:45 PM	Flash Flood	N/A	0	0	40K	0K
9 Seama	08/05/2008	14:34 PM	Flash Flood	N/A	0	0	2K	0K
10 Bluewater	08/05/2008	15:00 PM	Flash Flood	N/A	0	0	3K	0K
11 Milan	06/28/2009	15:30 PM	Flash Flood	N/A	0	0	0K	0K
12 Seama	09/16/2009	15:30 PM	Flash Flood	N/A	0	0	5K	1K
13 Milan	07/25/2010	15:45 PM	Flash Flood	N/A	0	0	20K	0K
				TOTALS:	0	0	85K	1K

Top of Page

NOAA Satellite and Information Service
National Environmental Satellite, Data, and Information Service (NESDIS)
National Climatic Data Center
U.S. Department of Commerce

DOC >NOAA >NESDIS >NCDC Search Field: Search NCDC

Event Record Details

Event: **Flash Flood**
Begin Date: **11 Aug 2005, 06:00:00 PM MST**
Begin Location: **8 Miles North of Grants**
Begin LAT/LON: **35°16'N / 107°51'W**
End Date: **11 Aug 2005, 08:00:00 PM MST**
End Location: **4 Miles South East of Grants**
End LAT/LON: **35°07'N / 107°48'W**
Magnitude: **0**
Fatalities: **0**
Injuries: **0**
Property Damage: **$ 0.0**
Crop Damage: **$ 0.0**

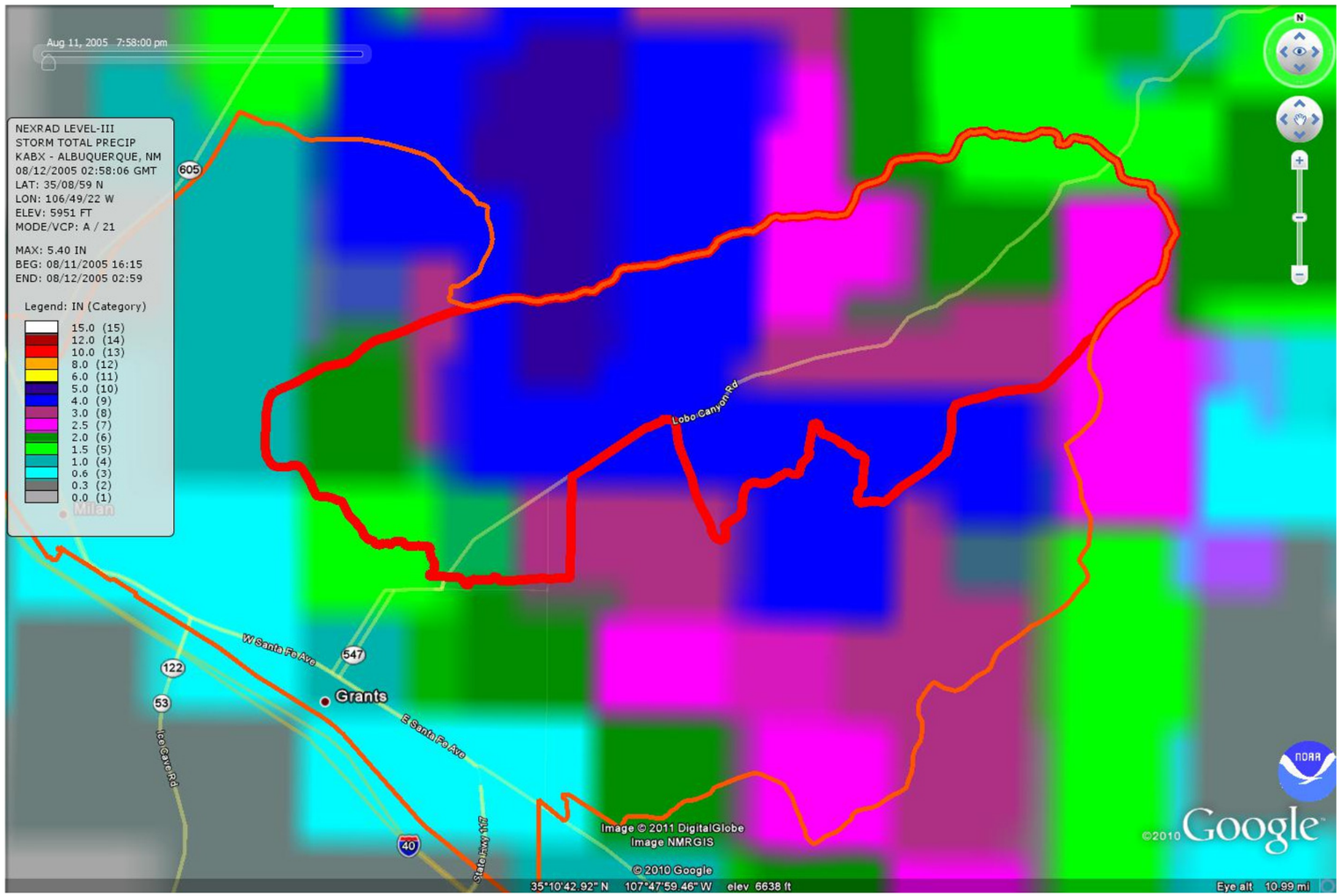
State: **New Mexico**
Map of Counties
County: **Cibola**

Description:
Heavy rains with flash flooding closed State Road 605 and State Road 117 near Grants while several low water crossings in town were closed with 2-3 foot of water. Several houses and an apartment complex also had some water ponding problems.

Privacy Policy HOW ARE WE DOING? A user survey FIRSTGOV Disclaimer

This page dynamically generated 02 Nov 2010 from:
http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~storms
Please send questions or comments about this system to Stuart.Hinson@noaa.gov
Please see the NCDC Contact Page if you have questions or comments.

Calibration Storm



Note: Subtract seven hours to convert from Greenwich Mean Time (GMT) to Mountain Standard Time (MST) for Grants, New Mexico. (2:58:06 GMT, August 12, 2005 = 19:58:06 MST, August 11, 2005)

Calibration Model Rainfall Depths

Total Rainfall Depths Utilized in the Calibration Event Simulation

Basin I.D.	Area (ac)	Rainfall Depth
6	600	2.5"
7	335	1.5"
8	636	2.0"
9	723	3.0"
10	892	2.5"
11	856	4.0"
12	593	4.0"
13	546	3.0"
14	683	4.0"
15	1,079	4.0"
19	224	1.5"
20	69	2.0"
21	107	2.0"
22	278	5.0"
23	821	2.0"
24	103	1.0"
25	33	1.0"
26	19	2.0"
27	214	3.0"

Spatial Rainfall Distribution Across Grants Canyon Watershed

Rainfall Depth	Coverage Area Based on NEXRAD (ac)	Coverage Area Utilized in HEC-HMS (ac)
1.0"	144	136
1.5"	556	559
2.0"	1,889	1,652
2.5"	1,499	1,492
3.0"	1,426	1,483
4.0"	3,025	3,211
5.0"	272	278
Total Area	**8,811**	**8,811**

Based on NEXRAD Data:

- Average rainfall for the watershed was 2.98" for the calibration storm
- Approximately 54% of the watershed received 3.0" or more during calibration storm
- Approximately 37% of the watershed received 4.0" or more during calibration storm

Rainfall Distributions Used in the HEC-HMS Calibration Model for the Grants Canyon Watershed

Calibration Storm Rainfall Distribution 1.0 Inch Rainfall Depth

Time	Depth	Time	Depth	Time	Depth
0.00	0.00	7.75	1.00	16.00	1.00
0.25	0.00	8.00	1.00	16.25	1.00
0.50	0.00	8.25	1.00	16.50	1.00
0.75	0.00	8.50	1.00	16.75	1.00
1.00	0.00	8.75	1.00	17.00	1.00
1.25	0.00	9.00	1.00	17.25	1.00
1.50	0.00	9.25	1.00	17.50	1.00
1.75	0.00	9.50	1.00	17.75	1.00
2.00	0.00	9.75	1.00	18.00	1.00
2.25	0.00	10.00	1.00	18.25	1.00
2.50	0.00	10.25	1.00	18.50	1.00
2.75	0.00	10.50	1.00	18.75	1.00
3.00	0.00	10.75	1.00	19.00	1.00
3.25	0.00	11.00	1.00	19.25	1.00
3.50	0.00	11.25	1.00	19.50	1.00
3.75	0.00	11.50	1.00	19.75	1.00
4.00	0.00	11.75	1.00	20.00	1.00
4.25	0.00	12.00	1.00	20.25	1.00
4.50	0.00	12.25	1.00	20.50	1.00
4.75	0.00	12.50	1.00	20.75	1.00
5.00	0.00	12.75	1.00	21.00	1.00
5.25	0.02	13.00	1.00	21.50	1.00
5.50	0.07	13.50	1.00	21.75	1.00
5.75	0.24	13.75	1.00	22.00	1.00
6.00	0.61	14.00	1.00	22.25	1.00
6.25	0.73	14.25	1.00	22.50	1.00
6.50	0.98	14.50	1.00	22.75	1.00
6.75	1.00	14.75	1.00	23.00	1.00
7.00	0.73	15.00	1.00	23.25	1.00
7.25	0.98	15.25	1.00	23.50	1.00
7.50	1.00	15.50	1.00	23.75	1.00
		15.75	1.00	24.00	1.00

Calibration Storm Rainfall Distribution 1.5 Inch Rainfall Depth

Time	Depth	Time	Depth	Time	Depth
0.00	0.00	7.75	1.50	16.00	1.50
0.25	0.00	8.00	1.50	16.25	1.50
0.50	0.00	8.25	1.50	16.50	1.50
0.75	0.00	8.50	1.50	16.75	1.50
1.00	0.00	8.75	1.50	17.00	1.50
1.25	0.00	9.00	1.50	17.25	1.50
1.50	0.00	9.25	1.50	17.50	1.50
1.75	0.00	9.50	1.50	17.75	1.50
2.00	0.00	9.75	1.50	18.00	1.50
2.25	0.00	10.00	1.50	18.25	1.50
2.50	0.00	10.25	1.50	18.50	1.50
2.75	0.00	10.50	1.50	18.75	1.50
3.00	0.00	10.75	1.50	19.00	1.50
3.25	0.00	11.00	1.50	19.25	1.50
3.50	0.00	11.25	1.50	19.50	1.50
3.75	0.00	11.50	1.50	19.75	1.50
4.00	0.00	11.75	1.50	20.00	1.50
4.25	0.00	12.00	1.50	20.25	1.50
4.50	0.00	12.25	1.50	20.50	1.50
4.75	0.00	12.50	1.50	20.75	1.50
5.00	0.00	12.75	1.50	21.00	1.50
5.25	0.04	13.00	1.50	21.50	1.50
5.50	0.11	13.50	1.50	21.75	1.50
5.75	0.37	13.75	1.50	22.00	1.50
6.00	0.91	14.00	1.50	22.25	1.50
6.25	1.10	14.25	1.50	22.50	1.50
6.50	1.46	14.50	1.50	22.75	1.50
6.75	1.50	14.75	1.50	23.00	1.50
7.00	1.50	15.00	1.50	23.25	1.50
7.25	1.50	15.25	1.50	23.50	1.50
7.50	1.50	15.50	1.50	23.75	1.50
		15.75	1.50	24.00	1.50

Calibration Storm Rainfall Distribution 2.0 Inch Rainfall Depth

Time	Depth	Time	Depth	Time	Depth
0.00	0.00	7.75	2.00	16.00	2.00
0.25	0.00	8.00	2.00	16.25	2.00
0.50	0.00	8.25	2.00	16.50	2.00
0.75	0.00	8.50	2.00	16.75	2.00
1.00	0.00	8.75	2.00	17.00	2.00
1.25	0.00	9.00	2.00	17.25	2.00
1.50	0.00	9.25	2.00	17.50	2.00
1.75	0.00	9.50	2.00	17.75	2.00
2.00	0.00	9.75	2.00	18.00	2.00
2.25	0.00	10.00	2.00	18.25	2.00
2.50	0.00	10.25	2.00	18.50	2.00
2.75	0.00	10.50	2.00	18.75	2.00
3.00	0.00	10.75	2.00	19.00	2.00
3.25	0.00	11.00	2.00	19.25	2.00
3.50	0.00	11.25	2.00	19.50	2.00
3.75	0.00	11.50	2.00	19.75	2.00
4.00	0.00	11.75	2.00	20.00	2.00
4.25	0.00	12.00	2.00	20.25	2.00
4.50	0.00	12.25	2.00	20.50	2.00
4.75	0.00	12.50	2.00	20.75	2.00
5.00	0.00	12.75	2.00	21.00	2.00
5.25	0.05	13.00	2.00	21.50	2.00
5.50	0.15	13.50	2.00	21.75	2.00
5.75	0.49	13.75	2.00	22.00	2.00
6.00	1.22	14.00	2.00	22.25	2.00
6.25	1.46	14.25	2.00	22.50	2.00
6.50	1.95	14.50	2.00	22.75	2.00
6.75	2.00	14.75	2.00	23.00	2.00
7.00	2.00	15.00	2.00	23.25	2.00
7.25	2.00	15.25	2.00	23.50	2.00
7.50	2.00	15.50	2.00	23.75	2.00
		15.75	2.00	24.00	2.00

Calibration Storm Rainfall Distribution 2.5 Inch Rainfall Depth

Time	Depth	Time	Depth	Time	Depth
0.00	0.00	7.75	1.00	16.00	1.00
0.25	0.00	8.00	1.00	16.25	1.00
0.50	0.00	8.25	1.00	16.50	1.00
0.75	0.00	8.50	1.00	16.75	1.00
1.00	0.00	8.75	1.00	17.00	1.00
1.25	0.00	9.00	1.00	17.25	1.00
1.50	0.00	9.25	1.00	17.50	1.00
1.75	0.00	9.50	1.00	17.75	1.00
2.00	0.00	9.75	1.00	18.00	1.00
2.25	0.00	10.00	1.00	18.25	1.00
2.50	0.00	10.25	1.00	18.50	1.00
2.75	0.00	10.50	1.00	18.75	1.00
3.00	0.00	10.75	1.00	19.00	1.00
3.25	0.00	11.00	1.00	19.25	1.00
3.50	0.00	11.25	1.00	19.50	1.00
3.75	0.00	11.50	1.00	19.75	1.00
4.00	0.00	11.75	1.00	20.00	1.00
4.25	0.00	12.00	1.00	20.25	1.00
4.50	0.00	12.25	1.00	20.50	1.00
4.75	0.00	12.50	1.00	20.75	1.00
5.00	0.00	12.75	1.00	21.00	1.00
5.25	0.06	13.00	1.00	21.50	1.00
5.50	0.18	13.50	1.00	21.75	1.00
5.75	0.61	13.75	1.00	22.00	1.00
6.00	1.52	14.00	1.00	22.25	1.00
6.25	1.83	14.25	1.00	22.50	1.00
6.50	2.44	14.50	1.00	22.75	1.00
6.75	2.50	14.75	1.00	23.00	1.00
7.00	2.50	15.00	1.00	23.25	1.00
7.25	2.50	15.25	1.00	23.50	1.00
7.50	2.50	15.50	1.00	23.75	1.00
		15.75	1.00	24.00	1.00

Calibration Storm Rainfall Distribution 3.0 Inch Rainfall Depth

Time	Depth	Time	Depth	Time	Depth
0.00	0.00	7.75	1.50	16.00	1.50
0.25	0.00	8.00	1.50	16.25	1.50
0.50	0.00	8.25	1.50	16.50	1.50
0.75	0.00	8.50	1.50	16.75	1.50
1.00	0.00	8.75	1.50	17.00	1.50
1.25	0.00	9.00	1.50	17.25	1.50
1.50	0.00	9.25	1.50	17.50	1.50
1.75	0.00	9.50	1.50	17.75	1.50
2.00	0.00	9.75	1.50	18.00	1.50
2.25	0.00	10.00	1.50	18.25	1.50
2.50	0.00	10.25	1.50	18.50	1.50
2.75	0.00	10.50	1.50	18.75	1.50
3.00	0.00	10.75	1.50	19.00	1.50
3.25	0.00	11.00	1.50	19.25	1.50
3.50	0.00	11.25	1.50	19.50	1.50
3.75	0.00	11.50	1.50	19.75	1.50
4.00	0.00	11.75	1.50	20.00	1.50
4.25	0.00	12.00	1.50	20.25	1.50
4.50	0.00	12.25	1.50	20.50	1.50
4.75	0.00	12.50	1.50	20.75	1.50
5.00	0.00	12.75	1.50	21.00	1.50
5.25	0.07	13.00	1.50	21.50	1.50
5.50	0.22	13.50	1.50	21.75	1.50
5.75	0.73	13.75	1.50	22.00	1.50
6.00	1.83	14.00	1.50	22.25	1.50
6.25	2.20	14.25	1.50	22.50	1.50
6.50	2.93	14.50	1.50	22.75	1.50
6.75	3.00	14.75	1.50	23.00	1.50
7.00	3.00	15.00	1.50	23.25	1.50
7.25	3.00	15.25	1.50	23.50	1.50
7.50	3.00	15.50	1.50	23.75	1.50
		15.75	1.50	24.00	1.50

Calibration Storm Rainfall Distribution 4.0 Inch Rainfall Depth

Time	Depth	Time	Depth	Time	Depth
0.00	0.00	7.75	2.00	16.00	2.00
0.25	0.00	8.00	2.00	16.25	2.00
0.50	0.00	8.25	2.00	16.50	2.00
0.75	0.00	8.50	2.00	16.75	2.00
1.00	0.00	8.75	2.00	17.00	2.00
1.25	0.00	9.00	2.00	17.25	2.00
1.50	0.00	9.25	2.00	17.50	2.00
1.75	0.00	9.50	2.00	17.75	2.00
2.00	0.00	9.75	2.00	18.00	2.00
2.25	0.00	10.00	2.00	18.25	2.00
2.50	0.00	10.25	2.00	18.50	2.00
2.75	0.00	10.50	2.00	18.75	2.00
3.00	0.00	10.75	2.00	19.00	2.00
3.25	0.00	11.00	2.00	19.25	2.00
3.50	0.00	11.25	2.00	19.50	2.00
3.75	0.00	11.50	2.00	19.75	2.00
4.00	0.00	11.75	2.00	20.00	2.00
4.25	0.00	12.00	2.00	20.25	2.00
4.50	0.00	12.25	2.00	20.50	2.00
4.75	0.00	12.50	2.00	20.75	2.00
5.00	0.00	12.75	2.00	21.00	2.00
5.25	0.10	13.00	2.00	21.50	2.00
5.50	0.29	13.50	2.00	21.75	2.00
5.75	0.98	13.75	2.00	22.00	2.00
6.00	2.44	14.00	2.00	22.25	2.00
6.25	2.93	14.25	2.00	22.50	2.00
6.50	3.90	14.50	2.00	22.75	2.00
6.75	4.00	14.75	2.00	23.00	2.00
7.00	4.00	15.00	2.00	23.25	2.00
7.25	4.00	15.25	2.00	23.50	2.00
7.50	4.00	15.50	2.00	23.75	2.00
		15.75	2.00	24.00	2.00

Calibration Storm Rainfall Distribution 5.0 Inch Rainfall Depth

Time	Depth	Time	Depth	Time	Depth
0.00	0.00	7.75	2.00	16.00	2.00
0.25	0.00	8.00	2.00	16.25	2.00
0.50	0.00	8.25	2.00	16.50	2.00
0.75	0.00	8.50	2.00	16.75	2.00
1.00	0.00	8.75	2.00	17.00	2.00
1.25	0.00	9.00	2.00	17.25	2.00
1.50	0.00	9.25	2.00	17.50	2.00
1.75	0.00	9.50	2.00	17.75	2.00
2.00	0.00	9.75	2.00	18.00	2.00
2.25	0.00	10.00	2.00	18.25	2.00
2.50	0.00	10.25	2.00	18.50	2.00
2.75	0.00	10.50	2.00	18.75	2.00
3.00	0.00	10.75	2.00	19.00	2.00
3.25	0.00	11.00	2.00	19.25	2.00
3.50	0.00	11.25	2.00	19.50	2.00
3.75	0.00	11.50	2.00	19.75	2.00
4.00	0.00	11.75	2.00	20.00	2.00
4.25	0.00	12.00	2.00	20.25	2.00
4.50	0.00	12.25	2.00	20.50	2.00
4.75	0.00	12.50	2.00	20.75	2.00
5.00	0.00	12.75	2.00	21.00	2.00
5.25	0.12	13.00	2.00	21.50	2.00
5.50	0.37	13.50	2.00	21.75	2.00
5.75	1.22	13.75	2.00	22.00	2.00
6.00	3.05	14.00	2.00	22.25	2.00
6.25	3.66	14.25	2.00	22.50	2.00
6.50	4.88	14.50	2.00	22.75	2.00
6.75	5.00	14.75	2.00	23.00	2.00
7.00	5.00	15.00	2.00	23.25	2.00
7.25	5.00	15.25	2.00	23.50	2.00
7.50	5.00	15.50	2.00	23.75	2.00
		15.75	2.00	24.00	2.00

Notes:

1. Rainfall depths based on NEXRAD "Storm Total Precipitation" for the calibration event.
2. NEXRAD "Storm Total Precipitation" data provided at time intervals of approximately 5-10 minutes. Rainfall distribution based on incremental change in rainfall depth and corresponding time period during the calibration event.

Flow Rates and Water Surface Elevations Corresponding to Reduced Curve Number Values at the Roosevelt Crossing of the Grants Canyon Arroyo

HEC-RAS Calibration Model Summary				HEC-HMS Calibration Model Summary (Model Simulating Calibration Event[2])	
Modeled Flow Rate	**WSEL at Roosevelt**	**Culvert Q (cfs)**	**Weir Q (cfs)**	**Percent of Normal CNs Utilized**	**Predicted Peak Flow Rate at Roosevelt Avenue**
5,000	6454.77	1,244	3,756	80%	4,950
6,000	6455.20	628	5,372	84%	6,070
7,000	***6455.47*** [1]	***346***	***6,654***	***87%***	***6,950***
8,000	***6455.62*** [1]	***317***	***7,683***	***91%***	***8,210***
8,500	6455.81	340	8,160	92%	8,590

HEC-HMS Calibration Model Summary (Model Simulating Modified NOAA-SCS Rainfall 24-hour Depths and Distribution[3])		
Percent of Normal CNs Utilized	**Predicted Peak Flow Rate at Roosevelt Avenue**	
	Q_{10} (cfs)	**Q_{100} (cfs)**
80%	255	1,500
84%	460	2,175
87%	680	2,725
89%	***875***	***3,200***
91%	1,075	3,670
92%	1,190	3,895

Notes

1. Assumed maximum water surface elevation (WSEL) range at Roosevelt Avenue based on eye witness accounts for calibration flood.

2. Distribution per NEXRAD data for calibration storm event. Precipitation depths varied throughout the watershed to approximate depths reported in NEXRAD data for the calibration storm event.

3. SCS 24-hour Type II-a distribution modified in accordance with direction given in NMSHTD Drainage Manual. 24-hour P_{10}=1.86", P_{100}=2.76" per NOAA Atlas 14.

Calibration Effort Conclusions

• Hydraulic calculations performed with HEC-RAS indicated that the peak flow rate associated with the calibration flood level per eye witness accounts is in the range of 7,000 to 8,000 cfs.

• Reducing the watershed curve numbers (CNs) to 87 to 91 percent of the normal CN values resulted in the HEC-HMS model producing flow rates similar to 7,000 and 8,000 cfs, respectively. Thus, CN values reduced to an average of 89 percent of the normal CNs were adopted as calibration CNs.

• HEC-HMS simulations with the calibrated CNs (89 percent of normal) and the 24-hour NMSHTD Modified SCS Type II-a distribution and NOAA Atlas 14 100-year, 24-hour precipitation depth predicted a 100-year peak flow rate of approximately 3,200 cfs at the Roosevelt Avenue crossing of the Grants Canyon Arroyo. This 100-year flow rate correlates well to the 3,020 cfs 100-year flow rate utilized in the effective FEMA Flood Insurance Rate Study for this section of the Grants Canyon Arroyo.

HEC-HMS Simulation Output
Calibration Storm Utilizing CNs Reduced to 89% of Normal CNs
Grants Canyon Arroyo at Roosevelt Avenue

Project: Grants Canyon Calibration M
Simulation Run: August 11, 2005 Calibration Junction: J28

Start of Run:	11Aug2005, 11:00	Basin Model:	Grants/Cibola County DMP
End of Run:	12Aug2005, 11:00	Meteorologic Model:	8-11-05 Calibration
Compute Time:	14Feb2011, 10:34:50	Control Specifications:	Control

Volume Units: AC-FT

Computed Results

Peak Outflow :	7630.9 (CFS)	Date/Time of Peak Outflow :	11Aug2005, 17:52
Total Outflow :	663.6 (AC-FT)		

Summaries of Interviews Regarding the Calibration Storm

Telephone interview with Kayci Collins-Superintendent of El Malpais National Monument regarding storm on 8-11-2005

- Kayci noted that a seasonal employee had been trapped at the office during the storm.
- The office is located adjacent to the west side of the arroyo south of Roosevelt. The office is east of the high point in Roosevelt before Roosevelt extends down to 1st and 2nd Streets to the west.
- Kayci was not at the office during the storm so she provided the contact information for Steve Baumann who was the employee trapped at the office.

Telephone interview with Steve Baumann-Seasonal employee at El Malpais National Monument regarding storm on 8-11-2005

- Water was on the east, west, and north sides of the building
- Water came in the back door on the east side of the building and smaller amount of water came through door in west side of the building.
- Too much rain was falling to allow visibility across the arroyo.
- Railroad ties were floating through the parking lot on the east side of the building with at least 5 inches of water flowing through the parking lot.
- Floor drains in the basement were bringing up muddy water and flooded the basement mechanical room.
- Water was flowing over the access to Roosevelt and into the parking lot.
- The parking lot was flowing like a river through the lot.
- The curb on the north side of the building along Roosevelt was not visible due to the depth of the water.
- Water was against the north side of the building.
- 4-5 inches of water flowed through the maintenance area south of the main building
- Steve thought a storm came through the area in 2007 that resulted in water roaring down the arroyo. Flow stayed in the channel and a pickup truck managed to go into the arroyo and plug a portion of one of the culverts. Water did not run over the roadway.

Telephone interview with Manual Blea with the Grants Street Department regarding storm on 8-11-2005

- Flooding at three crossings along the Grants Canyon arroyo was discussed.
- Approximately 1' of flow was crossing Roosevelt when Manual arrived. Manual thought that the water may have been higher before he arrived and that water depths up to 2' may have been possible.
- The corner of the cinder block wall along the cemetery was damaged by flow trying to re-enter the arroyo.
- Water was approximately half way up to the Dollar General located northeast of the arroyo crossing at Roosevelt.
- At least a portion of the cemetery overflow parking lot north of Roosevelt was under water. Some of the fencing around the lot was damaged by debris.
- The storm brought some trees and debris down the arroyo from upper portions of the basin. Debris was left in the arroyo after the storm flows subsided.
- Roosevelt culverts were functioning during the storm with no indication of clogging due to debris.
- Culverts at College Avenue were clogged from debris and flows were overtopping the roadway. This crossing was severely damaged and is in need of repair.
- The culverts at Washington had some trees and debris stacked up against them.
- Water at Washington pushed out of the arroyo to the east and west and also went over the roadway. Maybe 2-3' of water flowed across Washington and blocked the roadway.
- Houses close to each side of the Washington crossing were damaged due to the floodwaters.
- The City crews used loaders and excavators to clean debris and sediment out of the arroyo from approximately a quarter mile upstream of College Avenue down to the confluence with the Rio San Jose. The stretch of the arroyo through Federal land just upstream of Roosevelt did not receive any cleaning after the storm.
- Material cleaned out of the arroyo was piled along the tops of the channel banks to add capacity to the arroyo. Elevated arroyo banks were not present along some portions of the arroyo before the storm and are a result of the sediment removed from the arroyo.
- George Hannosh also received flooding adjacent to the Rio San Jose. Flows reaching this low area typically pond up and cross George Hannosh.

Telephone interview with Eloisa White-Manager for Dollar General regarding storm on 8-11-2005

- Eloisa was not at the store for the entire storm but provided some information based on the flooding she witnessed.
- Water was really rushing down the arroyo.
- Debris was likely in the flow as she saw several logs larger than 12 inches in diameter and large rocks in the flows as she traveled up Lobo Canyon on her way home.
- She recalled the arroyo being 4-5 times wider than normal in the Roosevelt area.
- Very heavy rain fell over the area.
- Water came in the back door of Dollar General, but was more likely to be from local flooding onsite due to a common occurrence of shallow flooding at the back door. She mentioned an issue with the threshold sealing improperly.
- Eloisa did not have a clear recollection of the water level from the arroyo, but she felt that it was likely that water backed up close to Dollar General based on what she remembered from the storm.
- Note: This account provided some information but was somewhat lacking in perspective as to the scale of the flooding that was witnessed.

Summaries of Interviews Regarding the Calibration Storm

Telephone interview with Don Jaramillo-Publisher for Cibola County Beacon regarding storm on 8-11-2005

- College Ave. was overflowing with debris plugging the culverts. Water was everywhere.
- Don did not go to the Roosevelt crossing during the storm.
- Debris was all over town in the stormwater.
- Don noted that there were weeds and willows in the arroyos prior to the storm.
- Arroyos are drastically different today in that they are cleaned and much of the vegetation has been removed. The arroyos are also deeper and wider than they had been in 2005 due to the removal of sediment.
- Don felt it was hard to pinpoint specific drainage items because of the vast flooding around the area.
- The Mesa View School near Washington Ave. had so much water around it you could not see the fence posts.
- Residents west of the Grants Canyon arroyo at Washington has so much water around them that they were literally in boats. The entire area at the arroyo and west of the arroyo was covered in water.
- 2-3 years ago Grants had a summer with lots of rain and mild temps. However, in 2005 the summer was dry until the monsoons hit and then there were extreme storm events. The 2005 summer seemed somewhat typical of New Mexico summers in Don's opinion.

Telephone interview with Cynthia Spidell-Rio San Jose Flood Control District regarding storm on 8-11-2005

- Cynthia was not in town during that storm event. She recalled many of the crossings being closed around town when she returned that evening. She did provide some contact information for other individuals that may have been around for the storm event.
- The National Parks Service-El Malpais National Monument office 505-285-4641
- Cynthia mentioned another storm event that she remembered seeing a large amount of water in the Grants Canyon arroyo. She thought that storm may have occurred on a Saturday or Sunday in 2009. She recalled speaking to Councilman Martin "Mody" Hicks while watching the flow in the arroyo. Cynthia did not recall specifics of the flow in the arroyo, but did recall that it stayed in the banks of the arroyo and did not cross over top of Roosevelt.
- Cynthia did not have additional flow data for the USGS gage that was located at Roosevelt. She thought that the City of Grants may have sponsored the gage when it was in operation by the USGS.

News Articles Related to the Calibration Storm

Flash flood activates emergency workers

GRANTS - What should be welcome precipitation turned many residents of Grants into stunned onlookers as the banks of the Rio San Jose overflowed wreaking havoc on several parts of Grants Thursday night.

According to Grants-Milan Municipal Airport Manager Wes Hobbs, "The rain was unique because it was structured up above Mt. Taylor. The water that washed down the mountain caused the flash flooding."

Grants Police Department (GPD) spokesperson Maxine Spidle was in the middle of the rainstorm Thursday making sure no one got hurt during the flood.

"Right now, we are worried about what is happening tonight. We received a message that the Thoreau and Prewitt areas are getting flooded and that [more] rain is headed this way," Spidle said.

Spidle said four families were evacuated from their homes and chose to stay with families that were not affected by the storm. She said Mt. Taylor Elementary School was opened as a shelter in case other families decided they needed to evacuate, but GPD Chief Marty Vigil said the Mt. Taylor shelter was eventually closed after it was decided it was not needed.

Vigil said he was on his way home from Albuquerque when he noticed the storm over the city. "From the look of it, I knew this was going to be a bad one," Vigil said. Vigil said Grants Mayor Ron Ortiz had declared Grants a disaster area and Peggy Jordan, the Cibola County Emergency Management Coordinator, was already on the phone with officials in Santa Fe to get the paper work started so the City of Grants could receive money to help with the cleanup and emergency repairs.

Vigil said he and other city officials would be taking a tour of the area to determine the extent of flood damage to roads, bridges and homes that may need to be fixed.

"Unexpectedly, water is a very powerful thing. It is a powerful form of nature and a lot of us in this area do not expect to see [the flooding]," Vigil said.

John Rhoderick, the assistant city engineer, said several Grants-area homes sustained some structural and internal damage. He said the full extent of the damage would not be known until Friday when he and other officials have a chance to get out to all the homes to assess the damage.

Rhoderick said the initial inspection of the bridges in the Grants area did not reveal any damage, but, again, a more thorough inspection will have to wait until Friday. Rhoderick did express concern that debris could clog the drainage pipes under the bridges, causing the type of flooding that occurred at the Washington Street bridge.

Debris plugged the Washington Street bridge sending a torrent of floodwater into the streets at the Washington and Sage intersection. The Nimitz Street bridge and Roosevelt bridge were also overrun by water from the storm.

County emergency manager Peggy Jordan said in a press release to the Beacon that flash floods cannot easily be predicted and occur too rapidly for anyone to prepare, or for the local emergency services to issue warnings. "Assess your home for possible emergencies and stay alert to the weather conditions," Jordan said.

By Will Kie



Raging waters scare Grants residents

GRANTS - For many residents affected by the flood on Thursday night in Grants, the water swept into their lives without warning.

Rains pounded Mt. Taylor and cascaded down to the city, filling narrow drainage ditches and littering streets with muddy water and debris.

If not directly affected by the storm, almost everyone in this close-knit community knew someone who was. Three residents were willing to share their stories with the Beacon.

Jenny Lester said she and her family were lucky. "I think we got hit the worst, but I am not so sure about that," Lester said. Lester's home is located at the northwest corner of Sage and Washington.

Lester's fence was smashed when the water backed up at the Washington Street bridge and overflowed its banks on either side. The force of the raging torrents quickly filled her yard with mud and, of course, water before invading Lester's home and ruining her carpet. By Friday afternoon, Lester and her family were busy tearing the soaked carpet out of their home.

Lester said she already made calls to her agent at a State Farm Insurance office in Grants, but the agent did not want to talk with her. "I paid flood insurance because we are in a flood area, and homeowner insurance, and neither one is helping," Lester said. She said the flood insurance will only take care of damage to the structure of the house and the homeowner insurance will not cover natural disasters.

"I am so upset [with State Farm] because we have been here since 1973 and all that time we have been paying flood insurance and homeowner insurance and now they won't pay us nothing," Lester said. She said she wants to make sure other residents question their insurance agents to be sure they know what is and is not covered in their policies.

Lester said what she saw in her backyard is a sight she will never forget. "It was horrifying, you could look out [this window] and see it flowing level with my fence," said Lester. Lester said that within a couple of minutes, the water broke through her fence, taking many of the contents of her backyard down Sage Street towards Allsup's.

Across the street from the Lesters live Aaron Barela and his family. Barela said he saw the water spilling over the second rail of the bridge. "I have not seen that happen in over 30 years, it was pretty wild," he said.

Barela was a bit more fortunate than his neighbors. He said the flood brought several inches of mud to his backyard. "I was out here until 11 p.m. last night, and then in my backyard until about 2 a.m. [dealing with the mud]," said Barela.

Rose Parkman lives out on Los Pinos Boulevard. "It was rushing so fast, it was almost like the water was coming from all directions. I have never seen that before," Parkman said.

Parkman said she was on her way home from a local casino when she found her property underwater and her road a raging river. "I was driving by memory, trying to remember where my road was, there was nothing to tell me I was on the road," said Parkman.

Parkman said steering the car through the rushing water was difficult. "It felt like water was hitting my car on both sides, but I did not panic because I did not want to walk [up to my house]," Parkman said. She said her husband Gilbert told her the lightening was hitting close to their home.

Parkman said the water rushing off the mesa filled up the lower lying areas of their property. "It looked like water falls coming off the mesa and all this [she motioned with her hand indicating her property] was underwater and it looked like a lake," Parkman said.

The water that flowed through her property was strong enough to dislodge a plastic pond buried in the ground. The road leading up to the Parkman's house, once smooth and covered with gravel, had been transformed. The storm had washed most of the gravel on Parkman's driveway down Los Pinos Boulevard.

Parkman, like the rest of the residents affected by the flood, was already working to fix her road. "What is it gonna cost me, Benny?" Parkman asked her friend Benny Griego, owner of Griego's Trucking Company.

"I'll get back to you," replied Griego.

By Will Kie

http://www.cibolabeacon.com/articles/2005/08/16/news/news2.prt 11/4/2010

City assesses flood damage

GRANTS - Two weeks ago Grants suffered one of its worst flash floods in decades.

When the waters receded last week, city officials say they discovered that the rains had left behind more than $100,000 worth of damage.

Milan and Cibola County officials said their respective areas did not receive enough damage of public structures such as roads, bridges and culverts to justify asking for emergency funding.

Assistant city engineer John Rhoderick said the City of Grants did sustain enough damage to ask for disaster funding. He checked city properties and every bridge, channel and road affected by the flooding last week, and found everything from washed-out banks to structural damage. The following areas were affected:

- The road crossing between College Drive and North Hills Boulevard north of town was damaged.
- Fences, parking lots and the field at Kerr McGee Park were damaged.
- The rock walls and sprinkler system at Grants Memorial Park were damaged, although Rhoderick said none of the graves at the cemetery were affected.
- The overflow parking lot across from Grants Memorial Park was destroyed.
- Roosevelt Bridge near the cemetery sustained damage.
- The Grants water channel from the northern city limits to the Rio San Jose accumulated damage to its banks and filled up with sediment. "It will have to be dredged and cleaned," Rhoderick said, "and we'll have to do some earth work too."
- The bridge over Washington Avenue near Future Foundations Family Center was damaged, and earthwork will be needed.
- More earthwork will be needed to the channel near Nimitz Avenue. Since this is part of a U.S. Corps of Engineers project, Rhoderick said he will have to meet with representatives of that organization to negotiate repairs to the banks of the channel.
- The area where ditches have been built under George Hanosh Boulevard and NM 117 on the east side of town have been damaged. Rhoderick said the city is working with the New Mexico Department of Transportation (NMDOT) to fix those areas.

Rhoderick estimated the cost of repairing all the damage caused by the early August floods at between $100,000 and $200,000. "And that's just for repairs, not for replacing anything," he added. Flood damage to private property within city limits is being handled by the American Red Cross and insurance companies, Rhoderick said.

The city is hoping to get a little help in putting everything under its purview back to normal as soon as possible. Rhoderick said he met with representatives of NMDOT last Monday and the two groups are discussing technical and construction assistance. The city is also talking with the Corps of Engineers,

the Rio San Jose Flood Control District (RSJFCD) and possibly state officials. A special meeting scheduled for Monday night included a municipal resolution requesting emergency/disaster funding to help clean up the mess. Results of the meeting were not available at press time. According to Cibola County Emergency Management Coordinator Peggy Jordan, that resolution will become part of the paperwork that will be sent to the New Mexico Disaster Assistance Program in Santa Fe.

Rhoderick said he will also meet with Corps of Engineers representatives sometime this week. "We're hoping for design or construction funding," he said.

Finally, Rhoderick said he is scheduled to meet with RSJFCD officials on Thursday night, and added he will continue asking them for funding even though the city's last two requests have both been rejected or tabled.

All of this will help in the short term, Rhoderick said, but will not necessarily solve the city's flash-flood risk. "In the long term we can't stop flash floods like this," he said. "What we're dealing with is putting the infrastructure back in place for the next time."

By Marian Hamilton

News Articles Related to the Calibration Storm

THE TRUTH WELL TOLD
Independent
WEB EDITION
500 N. 9th Street
Gallup, NM 87305
505.863.6811
HOME DAILY NEWS ARCHIVE CLASSIFIEDS SUBSCRIBE

Rising water
Grants, other areas flood

Jim Maniaci
Staff Writer

GRANTS — Once again flooding severed the residential areas of Grants from the main business district last night, but no injuries were reported.



A frightened Zachary Etsitty clings to his mother, Marsha, after being safely brought to dry land during a rescue effort Thursday near the Casamero Lake Chapter house, north of Prewitt, N.M. Firefighters from Thoreau, Bluewater Lake, Pinedale/Mariano Lake and Crownpoint responded to the area to rescue the family after heavy rains caused their mobile home to flood and begin to tilt. With no way to access the home by land, firefighters used a boat to safely ferry two adults and four children to dry land. [Photo by Jeff Jones/Independent]

And there is more to come, warned Grants Police Department spokesman Officer Moses Marquez. At 3 a.m. today he said the waters were rising again on San Jose Drive, the through street south of the railroad tracks where the Rio San Jose turns north to skirt around the downtown area.

Flooding also occcured in the Tse Bonito area Thursday where a bridge was washed out, and offices and several buildings were flooded.

Related Story:
Gallup surpasses average year-to-date rainfall totals

Thursday night three families were evacuated from apartments on the lower end of Sage Avenue as the flood waters from the Mount Taylor watershed overflowed the banks of the drainages, especially the river which snakes its way through the Cibola County seat. All the Rio San Jose's tributary creeks and irrigation ditches also rose above their banks

Marquez said the three families were offered shelter at the Mount Taylor Elementary School. Although the school is in the flood area, it sits on higher ground. Instead the families chose to take sanctuary with relatives, he said.

The first call came into the police station at 6:08 p.m., beginning a flood of calls about impassable streets. The station sits on high ground on Roosevelt Avenue west of the cemetery.

Friday
August 12, 2005
Selected Stories:

Leaders to discuss casino sites; Shirley wants to meet with Gallup mayor to mull potential locations

Energy vs. Self-rule; Groups fight attempts to remove power to charge companies for the use of tribal lands

Rising water; Grants, other areas flood

Weekend archery tournament slated; Sky City co-hosting event

Deaths

So many calls came into the station, he said, that the department ran short of officers. All available emergency personnel, including several New Mexico State Police officers, plus the Fire-Rescue Department and the private ambulance service, along with the Cibola County Sheriff's Office deputies, were called to duty.

Officers began stringing up yellow crime scene tape in an attempt to keep drivers from entering the fast-flowing low-lying areas, but to no avail. This prompted citizens to man the barricades as motorists insisted upon entering the flooded intersections. Marquez said several stalled, but no dramatic rescues had to be attempted.

"Even the mayor (Ron Ortiz) manned the barricades," Marquez added.

At one time briefly several hours after the first call, every major arterial north-south street in a 4-mile-wide stretch across the city was blocked off.

After about a quarter-hour, around 8 p.m., the city streets department reopened the sole north-south link, Sakerulas Boulevard, even though it resembled a canal in the Italian seaside city of Venice. Headlights shone through the darkened streets, resembling a 2-lane Route 66 of the past.

Even First and Second streets, the main north-south, one-way couplet from the downtown area, was closed for a short time, Marquez said.

But the high waters soon flowed downstream to the Washington and Jefferson streets crossings. Water was 3-4 feet deep over the Washington bridge at one time

Early this morning, he said, an inspector cleared the Washington bridge for traffic, even though it sustained minor damage, including some small cracks.

By about 9 p.m., the officer said the worst of the flooding was over and the water levels began to drop.

Quick work, he added, by the city and state streets and highway departments' crews cleared the mud and debris from most of the intersections which are open this morning.

However, one major street, George Hanosh Boulevard, remained closed at the intersection with Elm Street.

"For the other streets to drain, the water has to stay there a while," the officer explained.

Monday night the City Council appointed a five-member committee to seek solutions to the ever-present flooding problem.

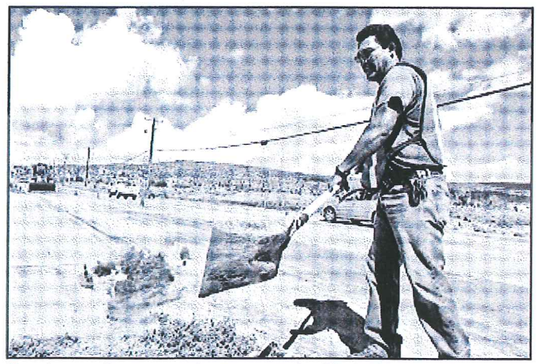
News Articles Related to the Calibration Storm

The heavy rain also washed out N.M. 605 north of Milan and standing water forced the closure of N.M. 117 to the east, according to Peter Olson, a spokesman for the state Department of Public Safety.

Tne National Weather Service issued a flash flood warning for north-central Cibola County late Thursday. Warnings were also issued for Taos, Santa Fe and Rio Arriba counties, where rainfall rates ranged between 2 to 3 inches in an hour.

— To contact reporter Jim Maniaci, telephone (505) 285-6184 or (505) 870-7775.

All contents property of the Gallup Independent.
Any duplication or republication requires consent of the Gallup Independent.
Please send the Gallup Independent feedback on this website and the paper in general.
Send questions or comments to gallpind@cia-g.com



Mopping up: Grants street department worker Martin Uriosto cleans mud from Roosevelt Ave. in Grants Tuesday from a flood next to the cemetery. The water destroyed a cinder block wall at the cemetery and pushed blocks over 100 feet. Crews used shovels and a front end loader to remove much of the mud and debris that washed into the road before a street sweeper came in for cleanup. [Photo by John A. Bowersmith/Independent]

City declared a disaster area

GRANTS -- Mayor Ron Ortiz declared Grants in a state of disaster Monday night at an emergency city council meeting.

The declaration was part of a resolution requesting funding from the NM Disaster Relief Fund after recent flooding. The city is officially asking for $298,006 for repairs to public property only. Assistance for private properties will come from the Red Cross at this time, said Peggy Jordan, coordinator of Cibola County Emergency Management.

Many areas were affected by the two flash floods two weeks ago. The first flood from the Grants arroyo, which is natural water flow from Mt. Taylor and parallels Lobo Canyon Road, began about 6:30 p.m on Aug. 11. The second flood came through town around midnight.

"Grants [channel] is notorious [for floods]," said Assistant City Engineer John Rhoderick. Otherwise the channel is dry 99 percent of the time, he added.

The water peaked at nine feet, Rhoderick said, based on visible debris lines. The floods affected about1,000 square miles, including Milan.

The water flow from the Grants arroyo crossed Roosevelt Avenue and affected residential areas at Washington, Jefferson and North Sage streets. Rhoderick said 1st and 2nd Streets usually get the brunt of arroyo floods, but this time the Rio San Jose gushed across the Nimitz Avenue crossing as well.

The city estimated that most damage occurred at the Washington Avenue crossing, with damages to the bridge estimated at $150,000. At Kerr McGee Park, damages are estimated at $41,817 for fencing, grass and the parking lot. Repairs and cleanup of the channels will total $72,000, or $36,000 each.

The city is also requesting assistance from the U. S. Army Corps of Engineers. Ortiz and Rhoderick said the Corps tells the city what it can and cannot do to control the flooding in the Rio San Jose channel, but the city can control damage and cleanup of the Grants Canyon channel.

"The Corps of Engineers is really the one who calls the shots," Ortiz said of repairing the Rio San Jose channel.

Jordan said it could take up to six months for Grants to receive the funds from New Mexico or the federal government. To meet the requirements for funding, the city must meet a new compliance of the National Incident Management System, which begins this year for having an emergency disaster committee in place. The city began the emergency committee process just before the flooding.

Jordan said response to the flood would have been smoother if Grants had an emergency plan already in place. "Predicting floods isn't easy," she said.

Although the city is receiving funds for many water projects from New Mexico this year, those projects are for drinking water and sewage, Rhoderick said.

"It hit real hard, real fast in one spot," Rhoderick said.

By Ilene Haluska

Gage Station Data and Regression Equations

Appendix 1. Selected basin, climatic, and flood characteristics; maximum peak discharge recorded; and low-discharge threshold for gaging stations.—Continued

[Peak discharge values in cubic feet per second: first line, station value used in regression analysis; second line, predicted value determined by using regression equation; third line, weighted value determined with skew coefficient with station and predicted value. --, no data. Drainage area: first line determined from geographic information system analysis; second line, previously published from manual delineation (Dempster, 1983)]

Gaging-station number	Gaging-station name	Drainage area (square miles)	Map identifier (fig. 1)	Gaging-station number	Peak discharge (cubic feet per year) Recurrence interval (years) 2	5	10	25	50	100	500	Maximum peak discharge recorded (year)	Low-discharge threshold	Record length (years)	Map identifier (fig. 1)
Central mountain valley flood region (6)—Continued				Central mountain valley flood region (6)—Continued											
08343100	Grants Canyon at Grants, New Mexico	11.8 13.0	212	08343100	175 375 179	508 837 525	844 1,260 879	1,400 1,950 1,470	1,900 2,590 2,010	2,470 3,330 2,630	4,050 5,550 4,360	1,550 (1963) --	0 -- --	34 -- --	212

Copy of data related to Historic USGS Gage Station Number 0834100, On Grants Canyon Arroyo at Roosevelt Avenue, from SIR 2008-5119, Waltemeyer, 2008

Regional Flood-Frequency Equations For Central Mountain Flood Region (6), (SIR 2008-5119, Waltemeyer, 2008)

$$Q_{10} = 4.906 \times 10^{2} * A^{0.383}$$

where,

Q_{10} = 10-year peak discharge (cfs)
A = drainage basin area (sq. mi.)

$$Q_{100} = 1.374 \times 10^{3} * A^{0.359}$$

where,

Q_{100} = 100-year peak discharge (cfs)
A = drainage basin area (sq. mi.)

Weighted Estimate at Gage Stations Equation (SIR 2008-5119, Waltemeyer, 2008)

$Q_w = (n_i y_i + en_i x_i b) / (n_i + en_i)$
where,
Q_w = weighted flood-frequency data at the gaging station in cfs
n_i = actual record length in years
y_i = flood-frequency data at the gaging station
en_i = equivalent record length in years
$x_i b$ = predicted flood-frequency data at the gaging station determined using the regional regression equation in cfs

$n_{i\,10}$ and n_{i100} were determined to be 3.13 and 7.77 for station 08343100 by solving for them using the published values of Q_w, n_i, *and* $x_i b$ at the station. The published study used an area of 11.8 sq. mi. to calculate $x_i b$ at station 08343100. When this equation was applied at 08343100 in the current study, $x_i b$ values of 1341csf and 3526 cfs were used . These values were calculated with the Flood Region 6 equations using the 13.77 drainage area as determined by the current study.

Drainage-Area Ratio Adjustment Equation, For Ungaged Sites Having Nearby Gaging Stations, (SIR 2008-5119, Waltemeyer, 2008)

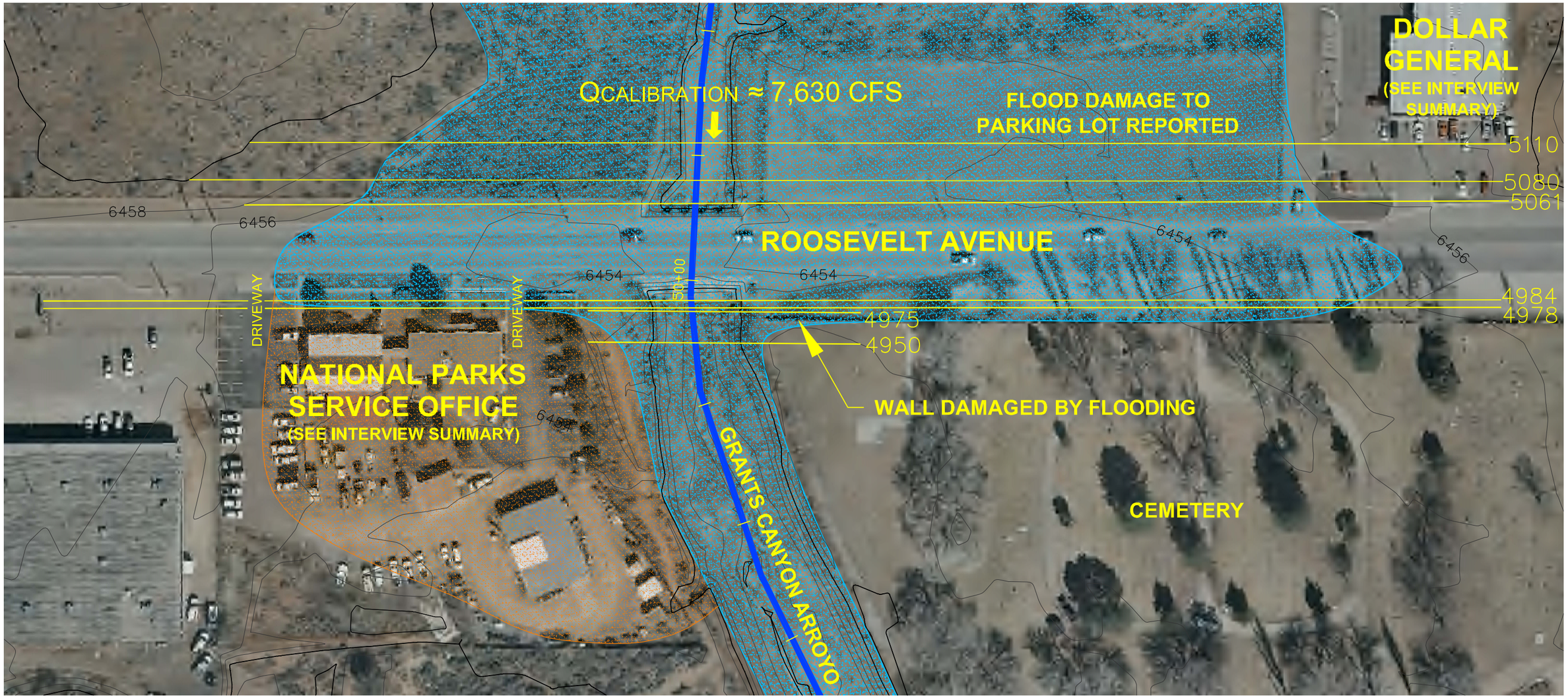
$$Q_{T(U)} = Q_{T(G)} (A_u / A_g)^{x}$$

where,

$Q_{T(U)}$ = weighted flood frequency estimate at the ungaged site in cfs
$Q_{T(g)}$ = flood frequency estimate at the gaging station
A_u = drainage area at the ungaged site in sq. mi.
A_g = drainage area at the gaged site in sq. mi.
x = exponent of the drainage area of the applicable regional regression equation

When applied in the current study, the weighted estimates at station 08343100 (recalculated to adjust for the larger watershed area at the station as previously described) were used as $Q_{T(g)}$.

According to the text in SIR 2008-5119, Waltemeyer, 2008, the equation is most applicable for drainage area ratios between 0.5 and 1.5. The text credits the equation to Saur (1974).



LEGEND

- HEC-RAS CROSS SECTIONS
- HEC-RAS FLOWRATE
- APPROXIMATE BOUNDARY OF CALIBRATION FLOOD
- ESTIMATED AREA OF SHALLOW FLOODING
- DRAINAGE CHANNEL ALIGNMENT
- 2' CONTOURS

N

0 40 80

HEC-RAS CALIBRATION MODEL SECTIONS AT ROOSEVELT AVENUE

CITY OF GRANTS AND
VILLAGE OF MILAN, NM DMP

02/11/2011

WILSON & COMPANY

Profile Summary Table

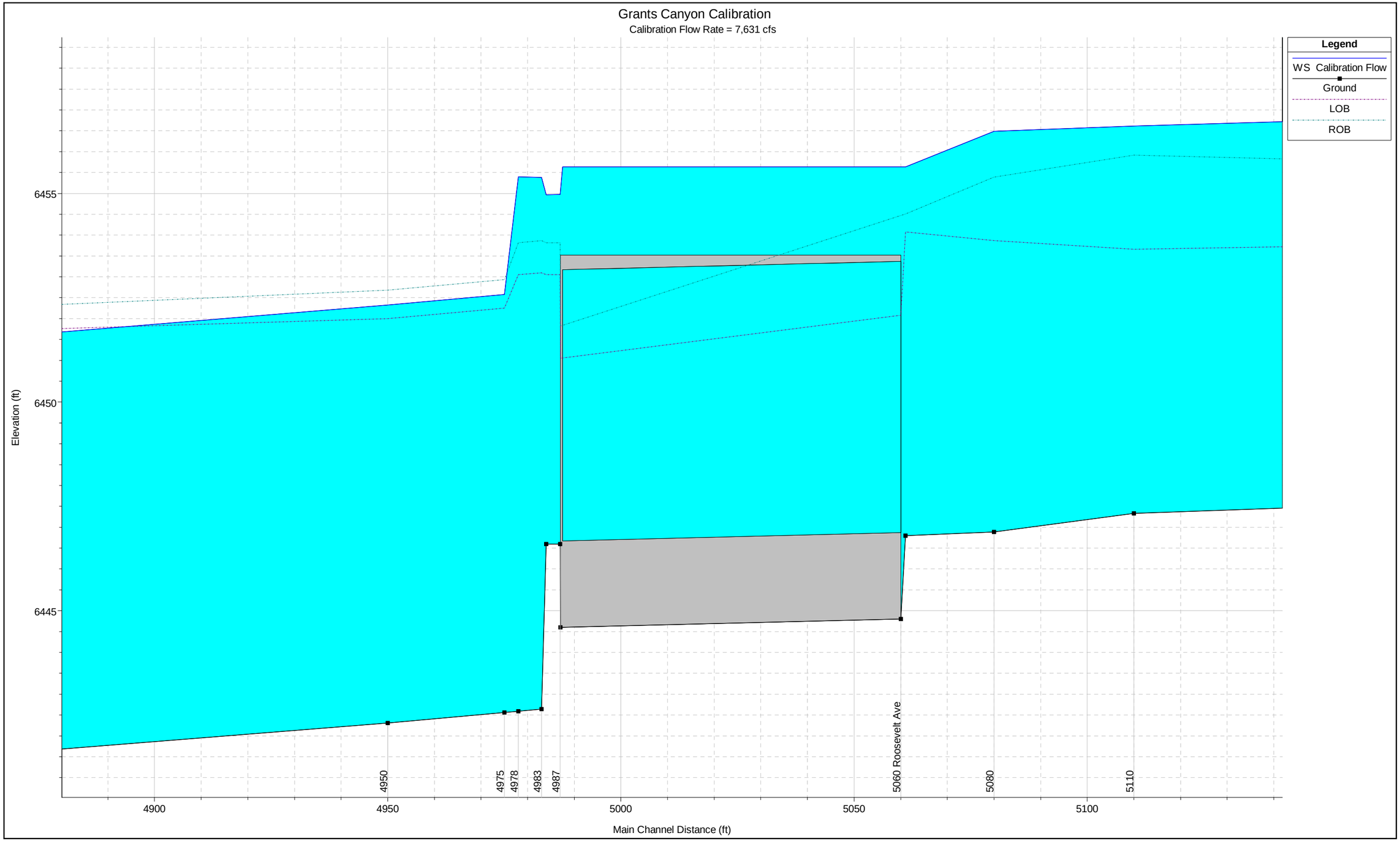
HEC-RAS Plan: Grants Canyo Locations: User Defined Profile: Calibration Flow

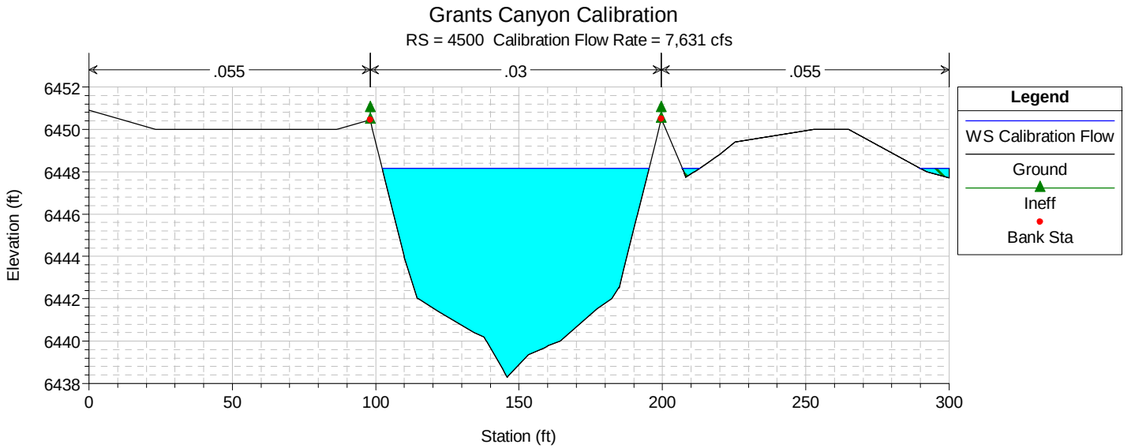
River	Reach	River Sta	Profile	Q Total	Q Left	Q Channel	Q Right	Min Ch El	W.S. Elev	Crit W.S.	Max Chl Dpth	E.G. Slope	Vel Left	Vel Chnl	Vel Right	Flow Area	Top Width	Froude # Chl
				(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft/s)	(ft/s)	(sq ft)	(ft)	
Grants Canyon	Grants Canyon	4500	Calibration Flow	7631.00		7631.00		6438.29	6448.17	6447.48	9.88	0.005372		12.45		613.10	109.64	0.85
Grants Canyon	Grants Canyon	4950	Calibration Flow	7631.00	0.97	7630.03		6442.31	6452.33	6452.33	10.02	0.007413	0.81	14.40		531.00	166.26	1.00
Grants Canyon	Grants Canyon	4975	Calibration Flow	7631.00	0.97	7630.03		6442.56	6452.58	6452.58	10.02	0.007413	0.81	14.40		531.00	166.26	1.00
Grants Canyon	Grants Canyon	4978	Calibration Flow	7631.00	1282.86	6132.30	215.84	6442.59	6455.40	6451.21	12.81	0.001130	1.36	7.22	0.82	2055.78	907.19	0.40
Grants Canyon	Grants Canyon	4983	Calibration Flow	7631.00	1235.43	6197.45	198.12	6442.64	6455.39		12.75	0.001180	1.36	7.35	0.81	1997.51	896.77	0.41
Grants Canyon	Grants Canyon	4984	Calibration Flow	7631.00	965.60	6552.39	113.01	6446.60	6454.97	6454.97	8.37	0.001526	1.34	10.48	0.77	1493.39	825.18	0.68
Grants Canyon	Grants Canyon	4987	Calibration Flow	7631.00	971.48	6544.55	114.97	6446.60	6454.98		8.38	0.001517	1.34	10.45	0.77	1500.65	827.00	0.68
Grants Canyon	Grants Canyon	5060 Roosevelt Ave		Culvert														
Grants Canyon	Grants Canyon	5061	Calibration Flow	7631.00	1389.00	5873.18	368.82	6446.80	6455.64	6455.64	8.84	0.003643	2.13	9.64	1.68	1481.81	750.11	0.70
Grants Canyon	Grants Canyon	5080	Calibration Flow	7631.00	2472.97	3925.09	1232.94	6446.89	6456.49		9.60	0.002837	2.41	6.74	2.48	2105.71	783.51	0.47
Grants Canyon	Grants Canyon	5110	Calibration Flow	7631.00	2958.15	3217.71	1455.15	6447.33	6456.61		9.28	0.002685	2.59	6.86	2.71	2146.03	717.00	0.45

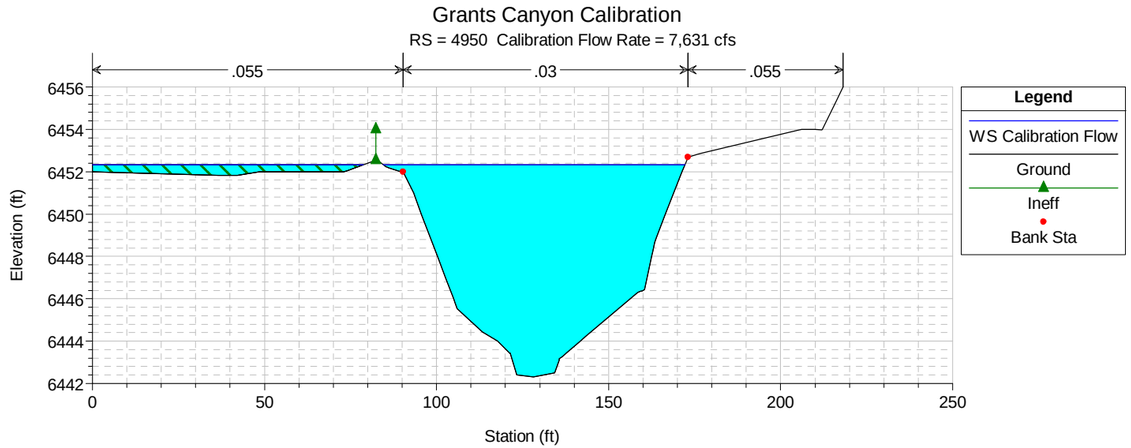
Culvert Summary Table

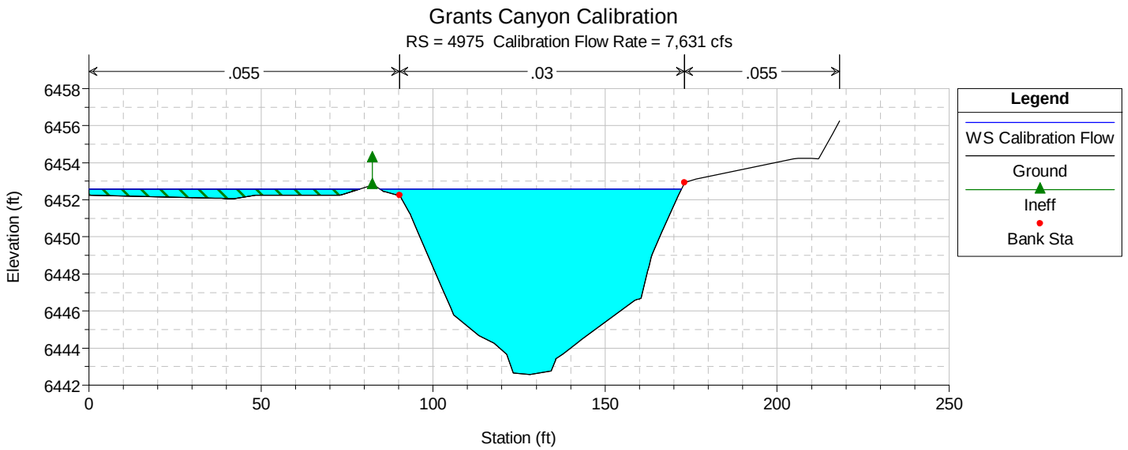
HEC-RAS Plan: Grants Canyo Locations: User Defined Profile: Calibration Flow

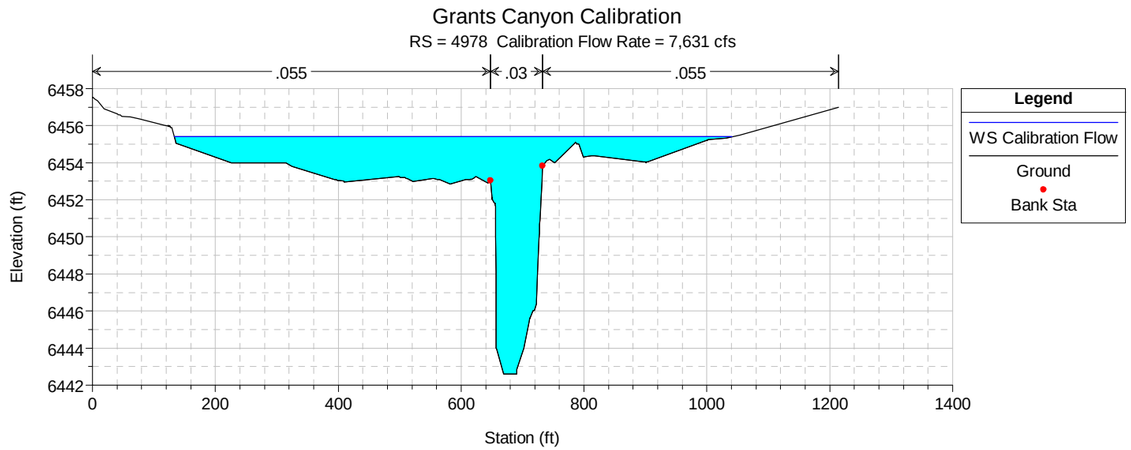
River	Reach	River Sta	Profile	Q Total	E.G. US.	E.G. DS	W.S. US.	W.S. DS	Delta WS	Q Weir	Min El Weir Flow	Weir Max Depth	Wr Top Wdth	Q Culv Group	Culv Inv El Up	Culv Inv El Dn	Culv Vel US	Culv Vel DS
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(ft)	(ft)	(ft)	(cfs)	(ft)	(ft)	(ft/s)	(ft/s)
Grants Canyon	Grants Canyon	5060 Roosevelt Ave Roosevelt	Calibration Flow	7631.00	6456.46	6456.43	6455.64	6454.98	0.66	7403.08	6453.53	2.94	998.39	227.92	6446.87	6446.67	1.12	1.12

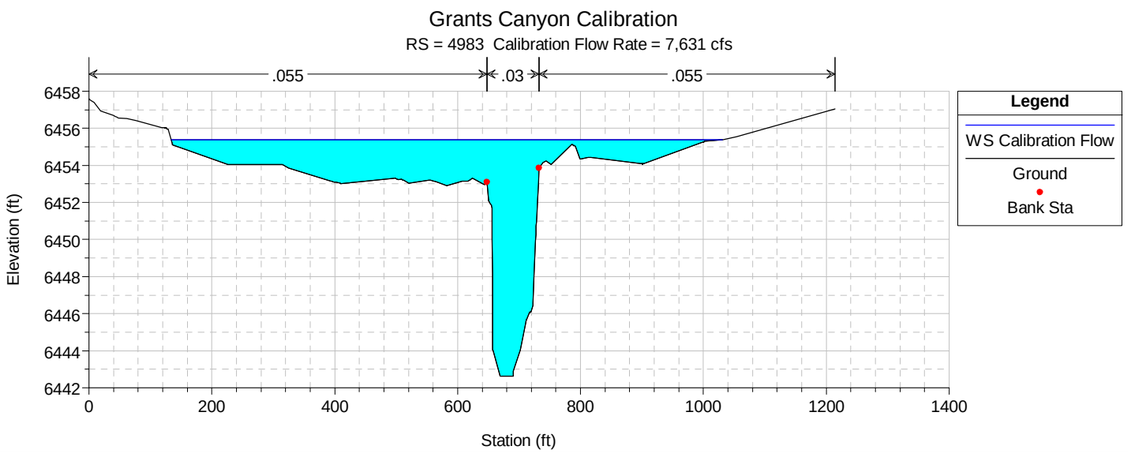

Grants Canyon Calibration
Calibration Flow Rate = 7,631 cfs
Legend
WS Calibration Flow
Ground
LOB
ROB
Elevation (ft)
6455
6450
6445
4950
4975
4978
4983
4987
5060 Roosevelt Ave
5080
5110
4900
4950
5000
5050
5100
Main Channel Distance (ft)

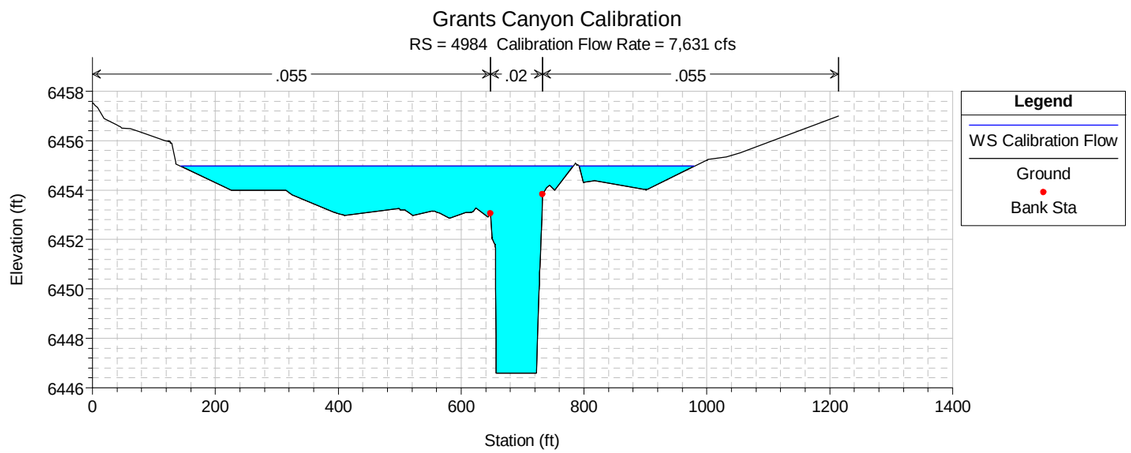

Grants Canyon Calibration
RS = 4500 Calibration Flow Rate = 7,631 cfs
.055
.03
.055
Elevation (ft)
Station (ft)
Legend
WS Calibration Flow
Ground
Ineff
Bank Sta

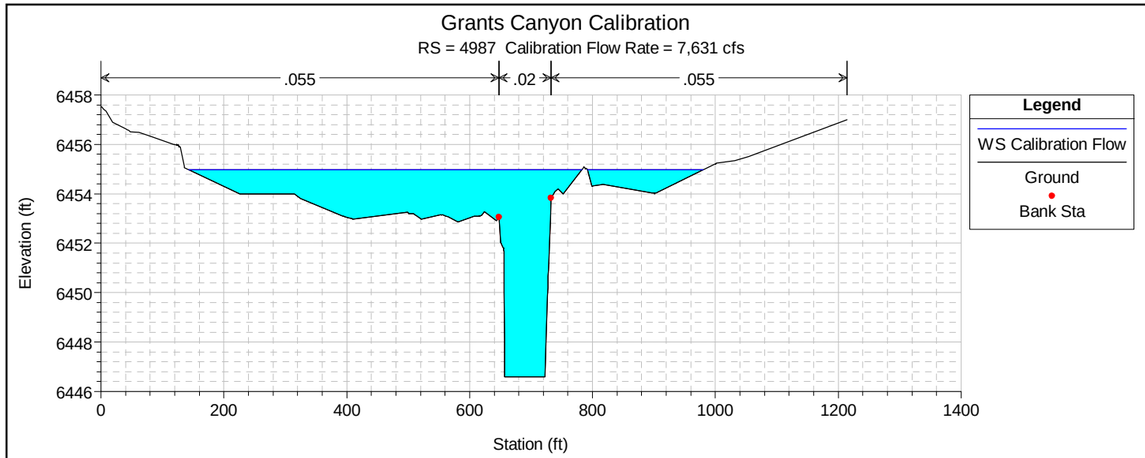

Grants Canyon Calibration
RS = 4950 Calibration Flow Rate = 7,631 cfs
.055
.03
.055
Elevation (ft)
Station (ft)
Legend
WS Calibration Flow
Ground
Ineff
Bank Sta

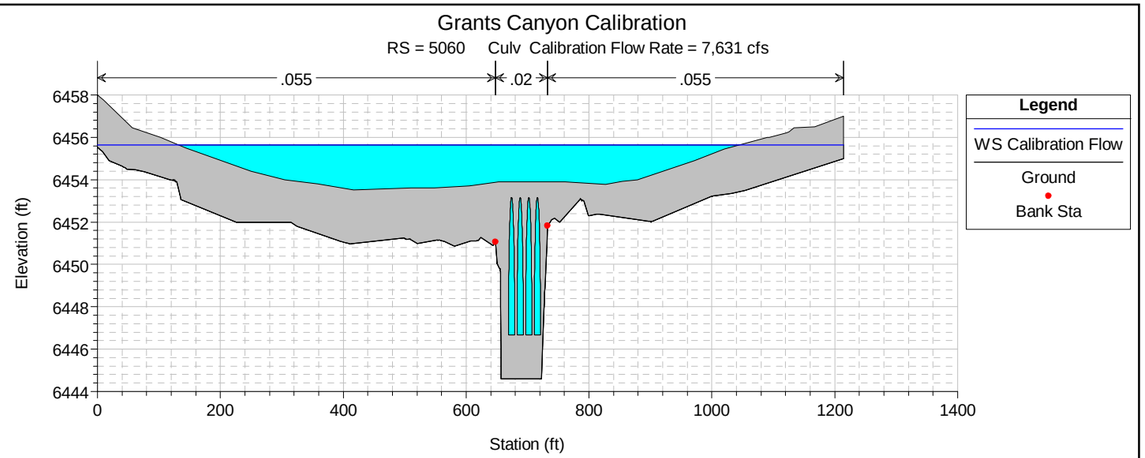

Grants Canyon Calibration
RS = 4975 Calibration Flow Rate = 7,631 cfs
.055
.03
.055
Elevation (ft)
Station (ft)
Legend
WS Calibration Flow
Ground
Ineff
Bank Sta

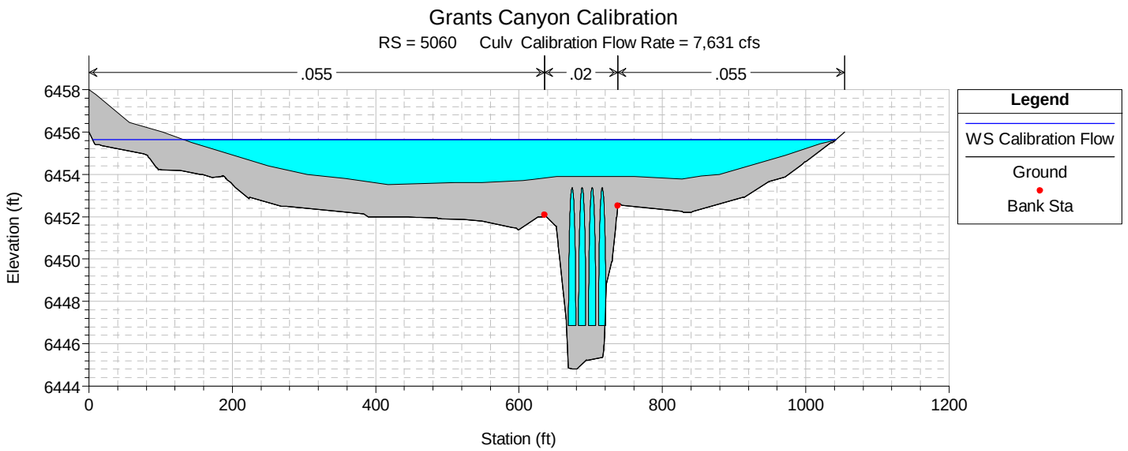

Grants Canyon Calibration
RS = 4978 Calibration Flow Rate = 7,631 cfs
.055
.03
.055
Elevation (ft)
Station (ft)
Legend
WS Calibration Flow
Ground
Bank Sta

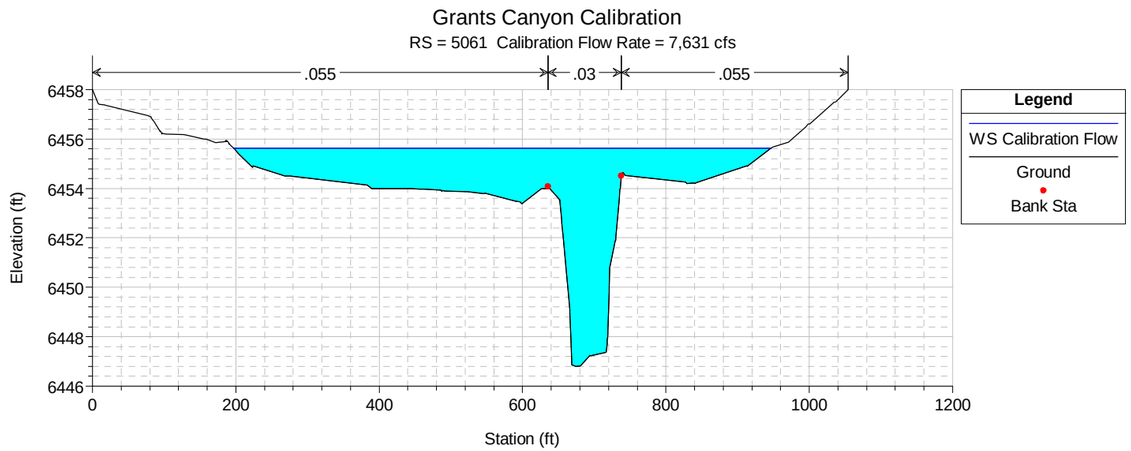

Grants Canyon Calibration
RS = 4983 Calibration Flow Rate = 7,631 cfs
.055
.03
.055
Elevation (ft)
Station (ft)
Legend
WS Calibration Flow
Ground
Bank Sta

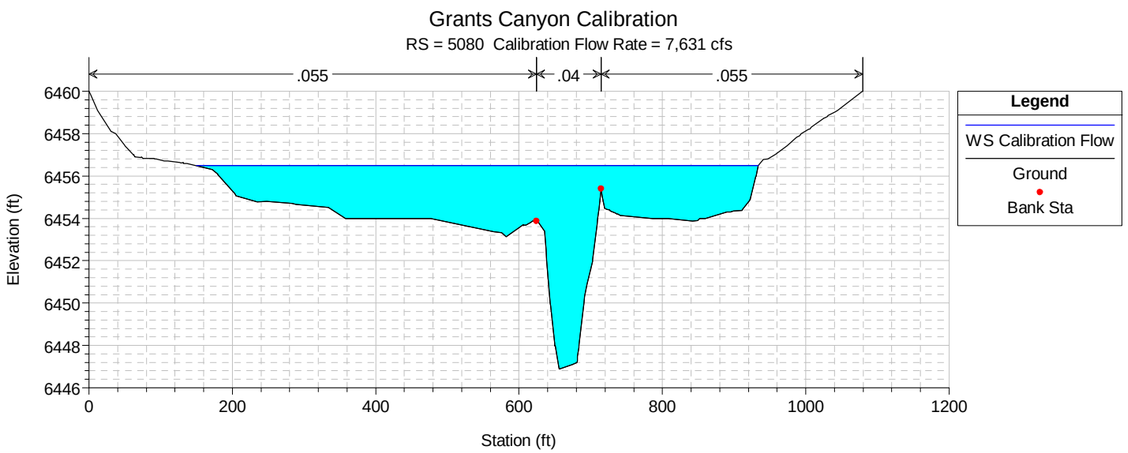

Grants Canyon Calibration
RS = 4984 Calibration Flow Rate = 7,631 cfs
.055
.02
.055
Elevation (ft)
Station (ft)
Legend
WS Calibration Flow
Ground
Bank Sta

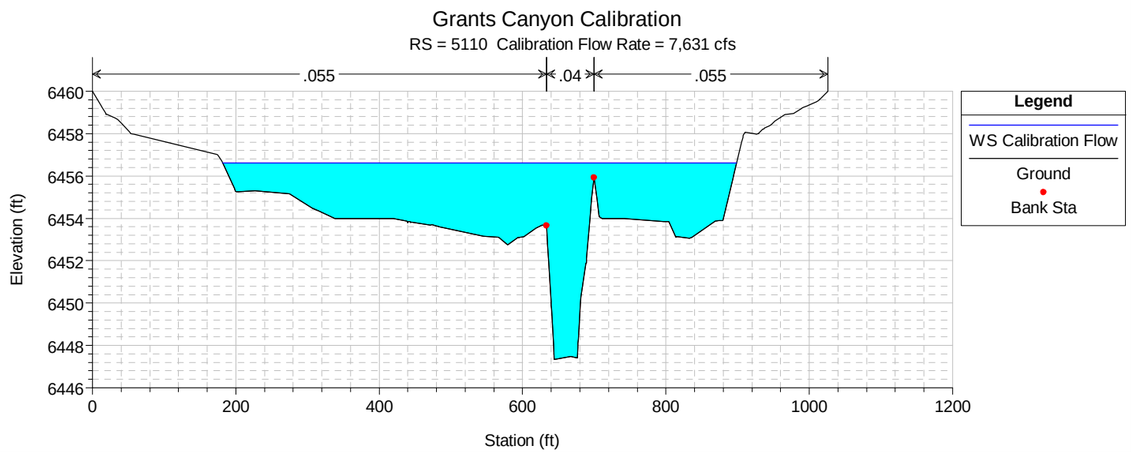

Grants Canyon Calibration
RS = 4987 Calibration Flow Rate = 7,631 cfs
.055
.02
.055
Elevation (ft)
Station (ft)
Legend
WS Calibration Flow
Ground
Bank Sta


Grants Canyon Calibration
RS = 5060 Culv Calibration Flow Rate = 7,631 cfs
.055
.02
.055
Elevation (ft)
Station (ft)
Legend
WS Calibration Flow
Ground
Bank Sta

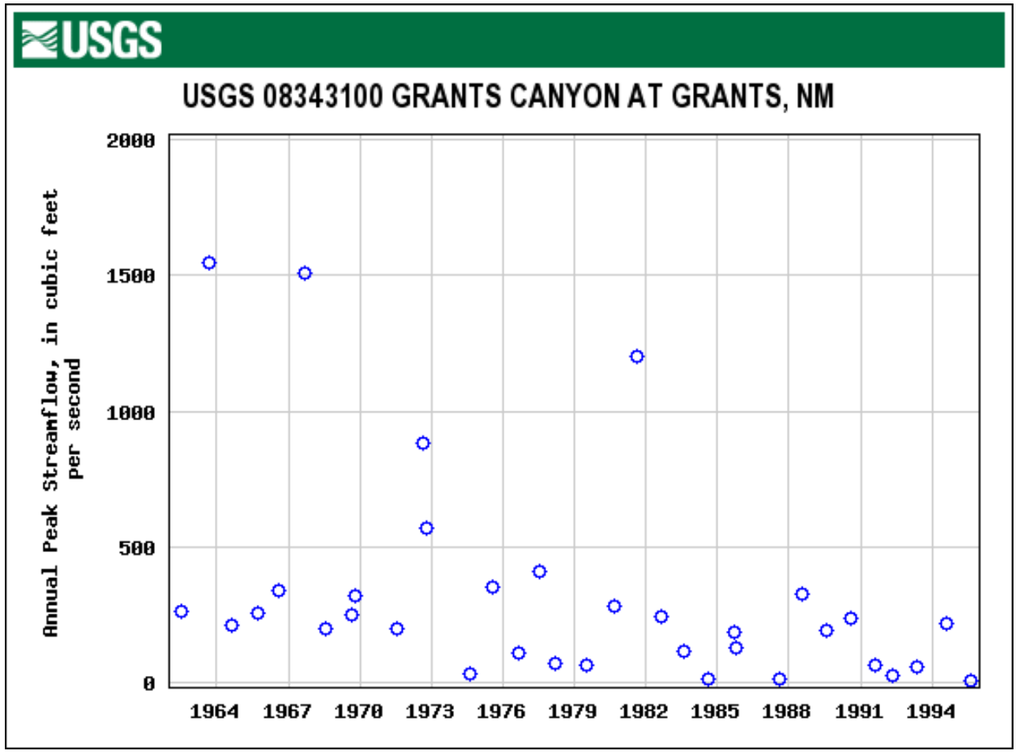

Grants Canyon Calibration
RS = 5060 Culv Calibration Flow Rate = 7,631 cfs
.055
.02
.055
Elevation (ft)
Station (ft)
Legend
WS Calibration Flow
Ground
Bank Sta

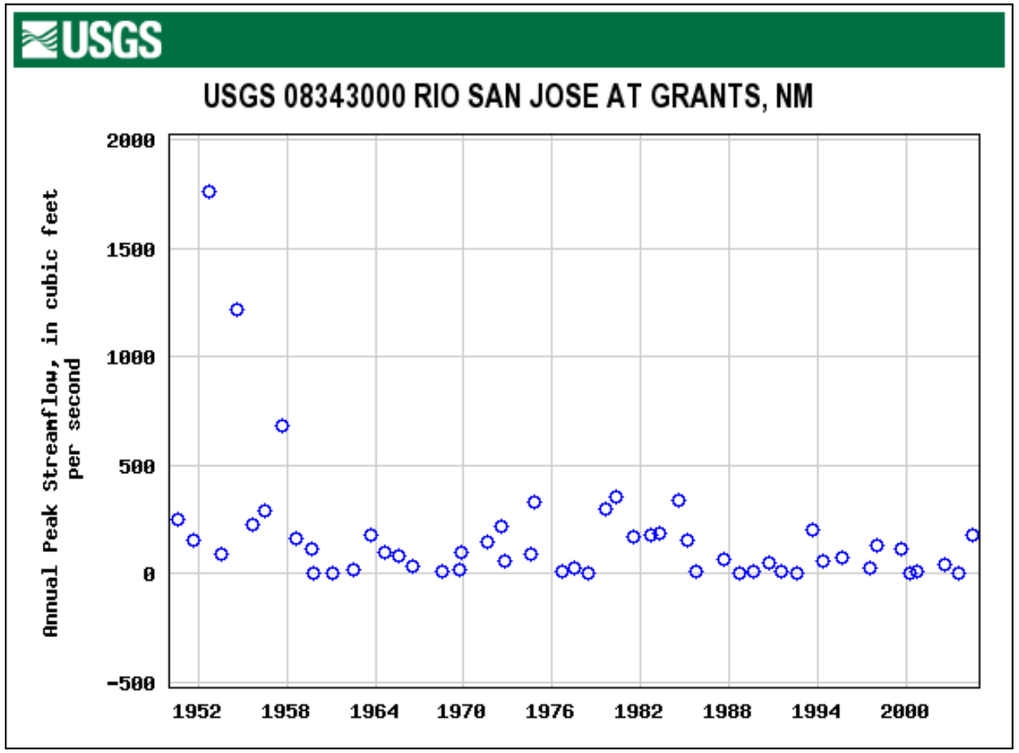

Grants Canyon Calibration
RS = 5061 Calibration Flow Rate = 7,631 cfs
.055
.03
.055
Elevation (ft)
Station (ft)
Legend
WS Calibration Flow
Ground
Bank Sta

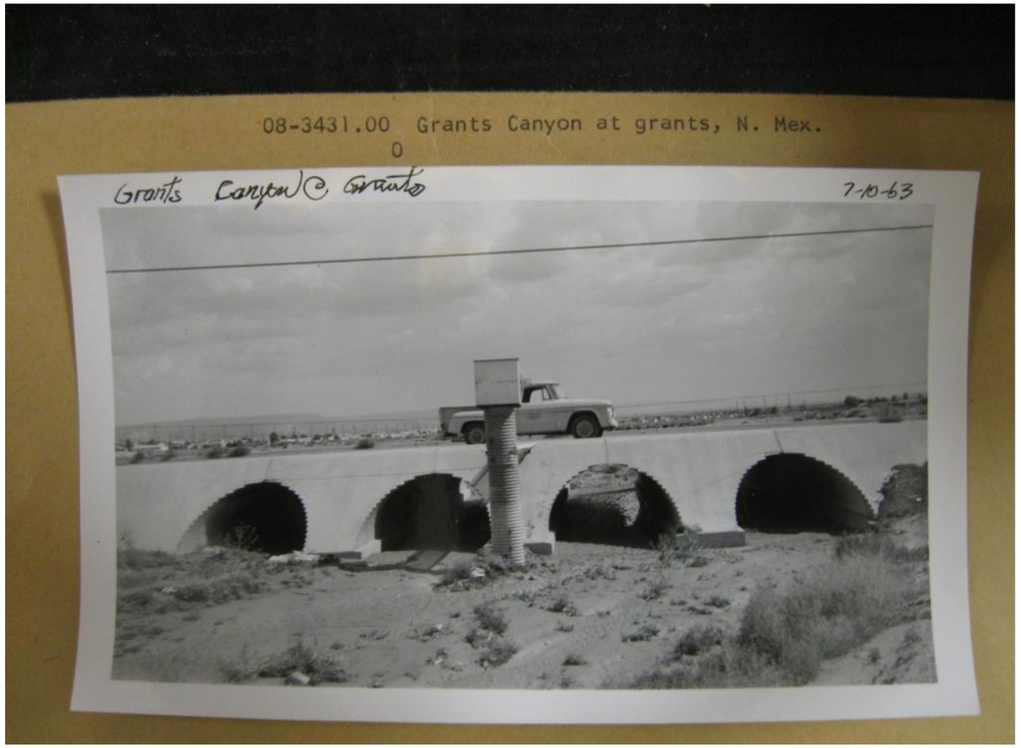

Grants Canyon Calibration
RS = 5080 Calibration Flow Rate = 7,631 cfs
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS Calibration Flow
Ground
Bank Sta


Grants Canyon Calibration
RS = 5110 Calibration Flow Rate = 7,631 cfs
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS Calibration Flow
Ground
Bank Sta

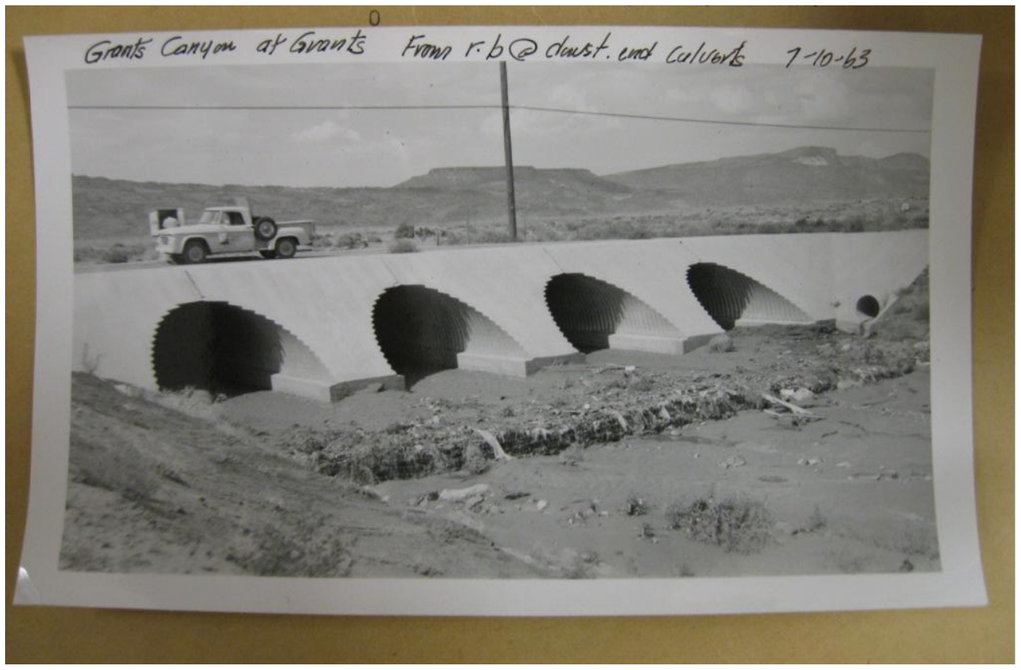
USGS Stream Gage Peak Streamflow Records







Roosevelt Avenue culverts at the Grants Canyon Arroyo crossing photgraphed during USGS data collection on July 10, 1963. The top photo shows the USGS gage located at the upstream end of the cuverts and the bottom photo shows gabion baskets originally installed in the bottom of the arroyo downstream of the culverts.





Existing Roosevelt Avenue culverts at the Grants Canyon Arroyo crossing photographed on June 4, 2010. The top photo is a view of the upstream end of the culverts and the bottom photo shows the downstream end of the culverts and degradation of the channel directly downstream of the culverts.



WILSON
&COMPANY
ENGINEERS & ARCHITECTS