

Summary Report New Years Flood of 2006

May 30, 2006

Prepared for:
City of Sparks, Department of Public Works



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Chapter 1 - Introduction and Purpose

Introduction

This report is intended to summarize the data collected during the flooding event that occurred on December 31, 2005 to January 2, 2006. HDR staff performed field and data investigations during and after the flooding event to compile information regarding areas of inundation, flow conditions in tributary drainages to the Truckee River and flow conditions in the Truckee River and the adjoining floodplain areas.

In addition to summarizing the data collected, this report will also present observations and recommendations regarding the data collected that has relevance to emergency action planning and flood control planning.

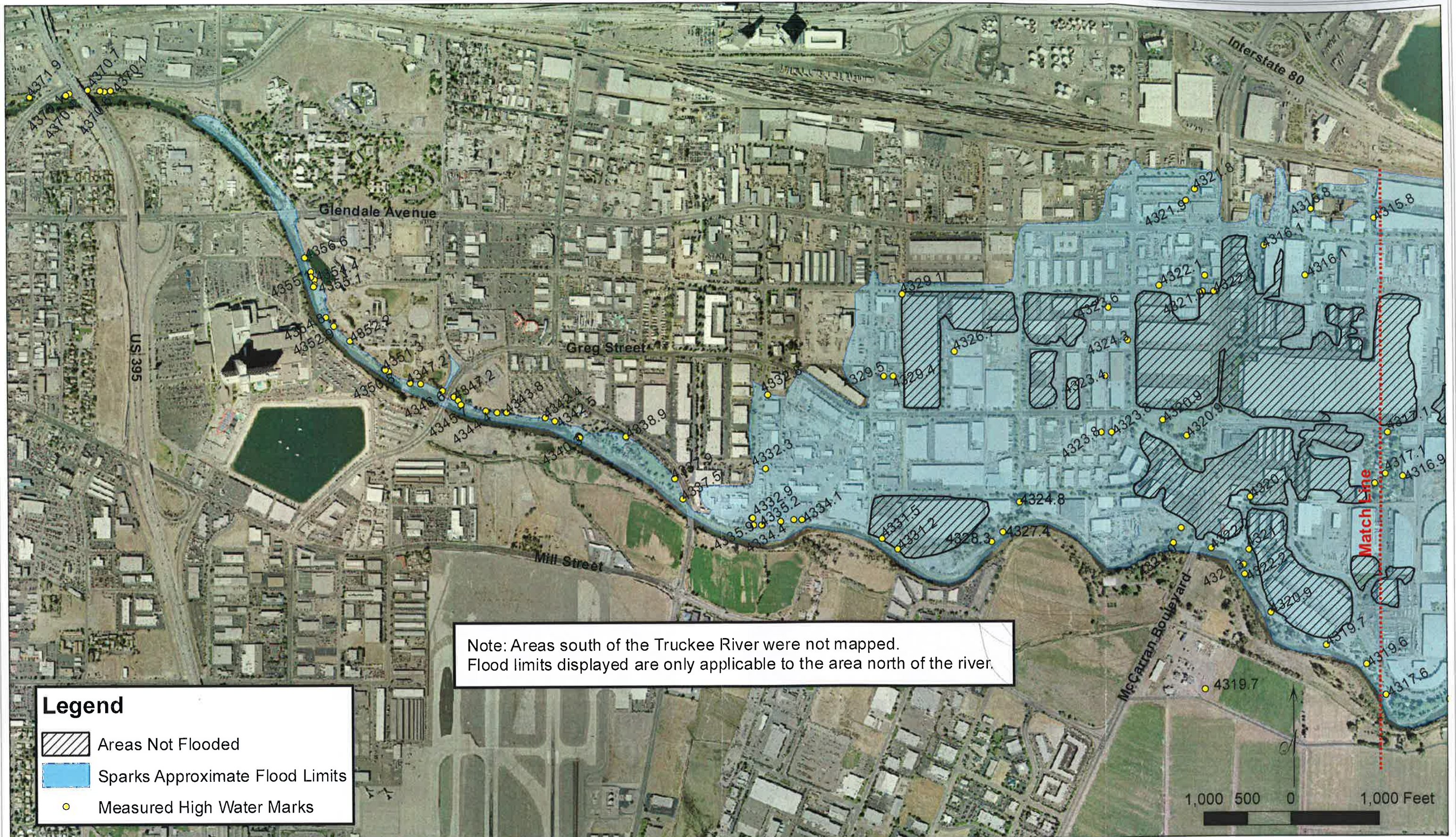
New Years Flooding Event of 2006

The New Year's flood of 2006 was the result of a warm general rain event that produced rainfall in all elevations bands of the Truckee River watershed from December 18, 2005 to January 4, 2006. The warm conditions and rainfall also contributed to partial melting of the existing snowpack which also contributed to runoff from the watershed. Approximately half of the rainfall during that 2 week period occurred in less than 48 hours on a saturated watershed from December 30 to January 1, 2006. The result was significant flooding in the Truckee River floodplain in isolated areas of downtown Reno and in the floodplain below Glendale Avenue.

Field investigations were performed immediately after the flooding event to document areas of inundation and to collect high water marks while they were still readily discernable. Snowfall in the days the followed the flooding made the need to document high water marks an immediate priority. Based upon the data collected, the areas inundated within the City of Sparks have been reconstructed from a combination of field observations and use of the high water marks and topographic mapping.




The 2006 event produced flow in the range of a 50-year recurrence interval on the Truckee River. Flows on the tributaries to the Truckee River ranged significantly in magnitude. The Truckee River remained within its banks in the reach from the West side of Reno to Glendale Boulevard. Below Glendale, flows overtopped the banks in a number of locations contributing to flooding on both sides of the River.

The results are shown in Figures 1 and 2. It is important to note that the flooding shown on Figure 1 and 2 does not show areas that were inundated south of the Truckee River. The focus of this report is related to flooding that occurred on the North side of the river. Information collected for the South side of the River would allow similar inundation mapping to be performed, but was beyond the scope of this study.

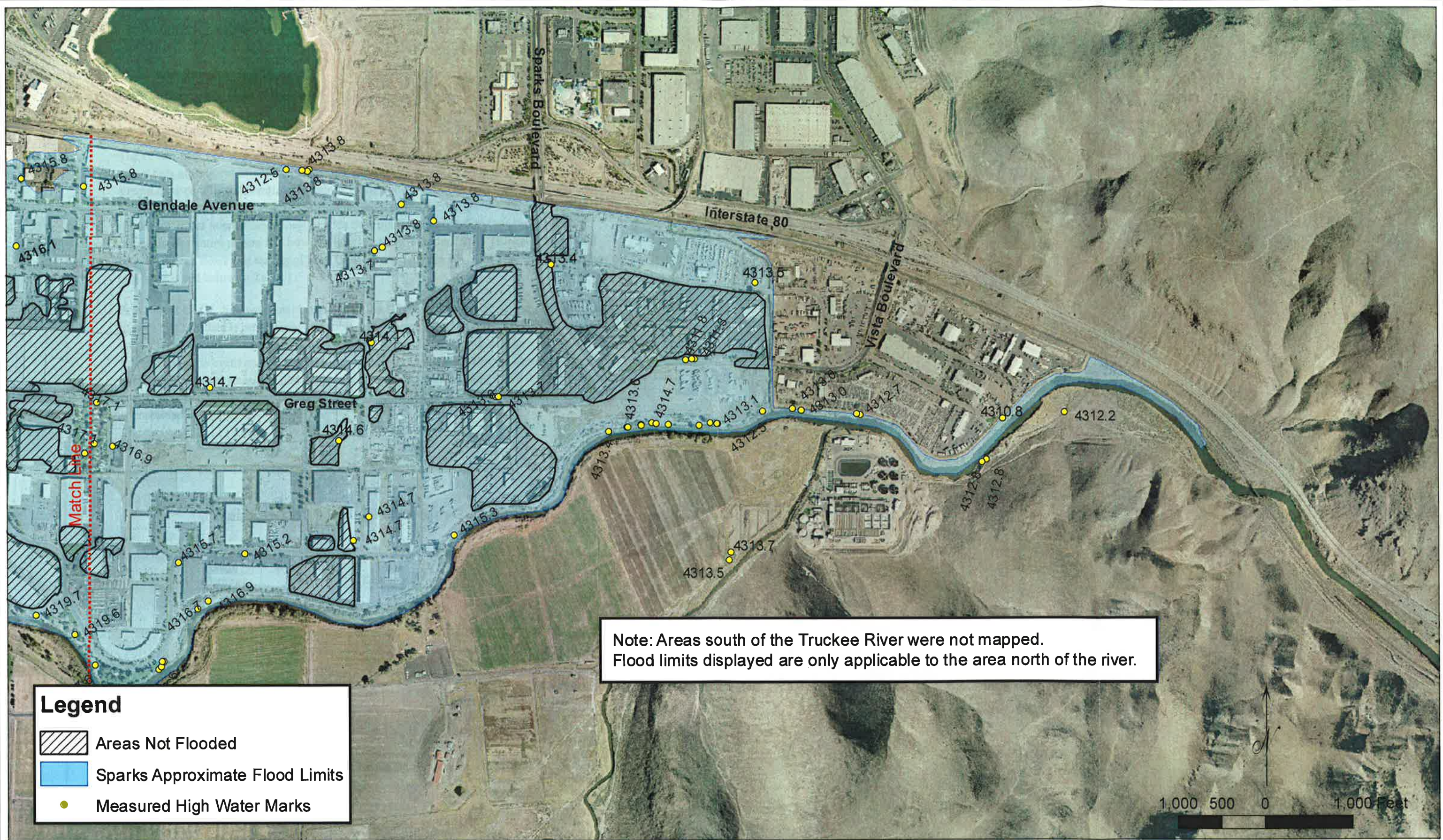


Note: Areas south of the Truckee River were not mapped.
 Flood limits displayed are only applicable to the area north of the river.

Legend




-  Areas Not Flooded
-  Sparks Approximate Flood Limits
-  Measured High Water Marks

Inundation Areas for Flood of January 1, 2006
 Figure 1



Note: Areas south of the Truckee River were not mapped.
 Flood limits displayed are only applicable to the area north of the river.

Legend

-  Areas Not Flooded
-  Sparks Approximate Flood Limits
-  Measured High Water Marks

Inundation Areas for Flood of January 1, 2006
 Figure 2

Chapter 2 - Data Collection

Stream Gage Data

The stream gages of primary interest to the City of Sparks are the USGS real time gages that report data at frequent intervals during an event. These gages provide a real time assessment of stream flow conditions at various locations in the watershed. The real time gages that are of interest are located on the Truckee River and some of the tributaries to the Truckee River. The tributaries are of interest since they provide information for assessing how an event is impacting the entire region and how the flows in the tributaries to the Truckee River could influence peak flows and timing of peak flows in the Truckee River. The relevant real time gages are listed below in Table 1.

Provisional USGS data was downloaded from the USGS surface water web site. It is important to note that this data is provisional and subject to change. Plots of the observed data at each gage site are contained in Appendices A and B. Appendix A contains the plots of observed stages during the event and plots of the estimate flows associated with the observed stage. The correlation between stage and discharge is accomplished with a rating curve that is developed using direct and indirect measurements at the gage location. Additional discussion of this topic is contained in Chapter 2.

Table 1 - USGS Real Time Stream Gages

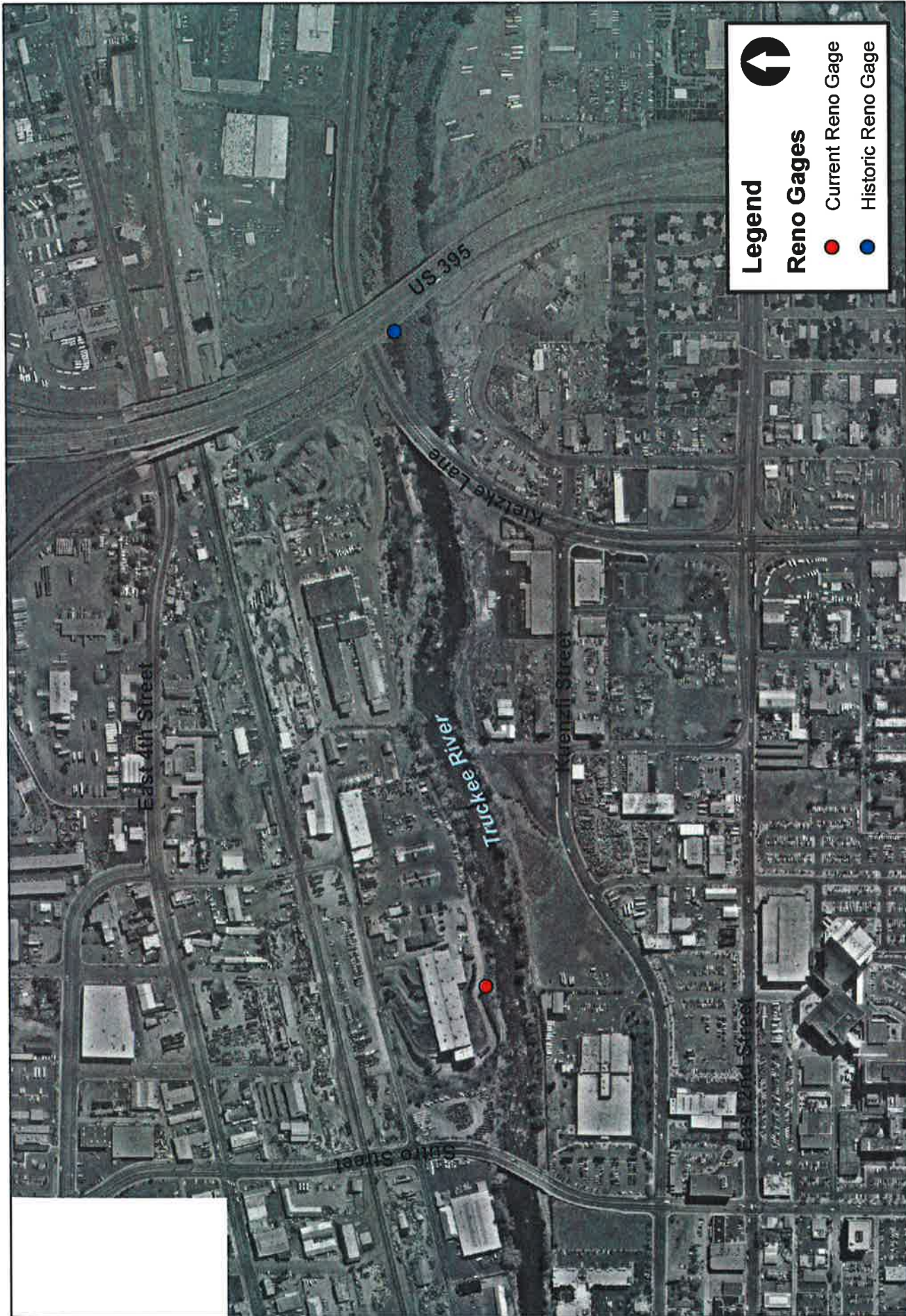
Gage Name	Gage Number	Watershed Area	Data Collected	Description
Truckee River Gages				
Truckee River Near Truckee, California	10338000	553 Square Miles	Stream stage	Lat 39°17'47", long 120°12'16" referenced to North American Datum of 1927, in SW ¼ NE ¼ sec.28, T.17 N., R.16 E., Placer County, Hydrologic Unit 16050102, Tahoe National Forest, on left bank, 1.4 mi downstream from Cabin Creek, and 2.5 mi southwest of Truckee.
Truckee River at Farad, California	10346000	932 Square Miles	Stream stage and Precipitation	Lat 39°25'41", long 120°01'59" referenced to North American Datum of 1927, in SE ¼ NE ¼ sec.12, T.18 N., R.17 E., Nevada County, Hydrologic Unit 16050102, on left bank, 0.5 mi upstream from Mystic Canyon, 0.7 mi downstream from Farad Powerplant, 2.5 mi north of Floriston, and 3.5 mi upstream from California-Nevada State line.



**Data Summary Report
New Years Flood of 2006**

Truckee River at Mogul, Nevada	10347460	1035 Square Miles	Stream stage and Precipitation	Latitude 39°30'26", Longitude 119°55'51" NAD27, Gage datum 4,690. feet above sea level NGVD29
Truckee River Near Reno, Nevada	10348000	1067 Square Miles	Stream stage	Latitude 39°31'49", Longitude 119°47'40" NAD27, Gage datum 4,431.97 feet above sea level NGVD29, located on north bank of Truckee River downstream of Sutro Avenue Bridge
Truckee River Near Sparks, Nevada	10348200	1070 Square Miles	Stream stage	Latitude 39°31'03.42", Longitude 119°44'29.92" NAD83, Gage datum 4,382.41 feet above sea level NGVD29. Gage located on north bank of Truckee River just upstream of East McCarran Boulevard.
Truckee River at Vista, Nevada	10350000	1431 Square Miles	Stream stage	Latitude 39°31'14", Longitude 119°42'00" NAD27, Gage datum 4,368.59 feet above sea level NGVD29. Gage located on south bank at Truckee Meadows Water Reclamation Facility.
Truckee River near Tracy, Nevada	10350340	1580 Square Miles	Stream stage	Latitude 39°33'24", Longitude 119°33'08" NAD27, Gage datum 4,300. feet above sea level NGVD29
Truckee River at Wadsworth, Nevada	10351650	1728 Square Miles	Stream stage	Latitude 39°37'56", Longitude 119°16'56" NAD27, Gage datum 4,039.00 feet above sea level NGVD29. Located on west bank of the Truckee River just upstream of Highway 427.
Tributaries to the Truckee River				
North Truckee Drain at Spanish Springs Road, Near Sparks, Nevada	10348245	80 Square Miles	Stream stage and Precipitation	Latitude 39°34'08", Longitude 119°43'32" NAD27, Gage datum 4,410. feet above sea level NGVD29
Dog Creek Near Verdi, Nevada	10347310	24.2 Square Miles	Stream stage	Latitude 39°31'28", Longitude 119°59'40" NAD27, Gage datum 4,900. Feet above sea level NGVD29.
Steamboat Creek at Geiger Grade, Near Steamboat, Nevada	10349495	140 Square Miles	Stream stage	Latitude 39°24'08.29", Longitude 119°44'37.61" NAD83, Washoe County, Nevada, Hydrologic Unit 16050102, Datum of gage is 4,543.00 feet above sea level NGVD29
Steamboat Creek Near Short Lane	10349849	Not determined	Stream stage	Latitude 39°27'57", Longitude 119°43'39" NAD27, Datum of gage is 4,415.00 feet above sea level NGVD29

It is important to note that the Reno and Vista gages were relocated after the 1997 event. The Vista gage was relocated upstream because of the influence of changes to the downstream irrigation diversion dam that was potentially impacting the lower range of flows in the rating curve. The Reno Gage was relocated for unknown reasons to an upstream reach that the USGS felt was a more stable section of the River for developing an accurate rating curve. Figures 3 and 4 shows the original and revised locations of these two gages. Chapter 2 will review the importance of this fact.



Relocation of Reno Stream Gage
Figure 3



Relocation of Vista Stream Gage
Figure 4

As the flood wave propagated from upstream of the Reno/Sparks area to Pyramid Lake, it is impacted by a number of additional flow contributions from streams and storm drain systems and from attenuation of the hydrograph resulting from overbank storage. Figure 5 is a plot of the hydrograph data for the each of the Truckee River gages as the flood progressed from Truckee, California to Wadsworth, Nevada.

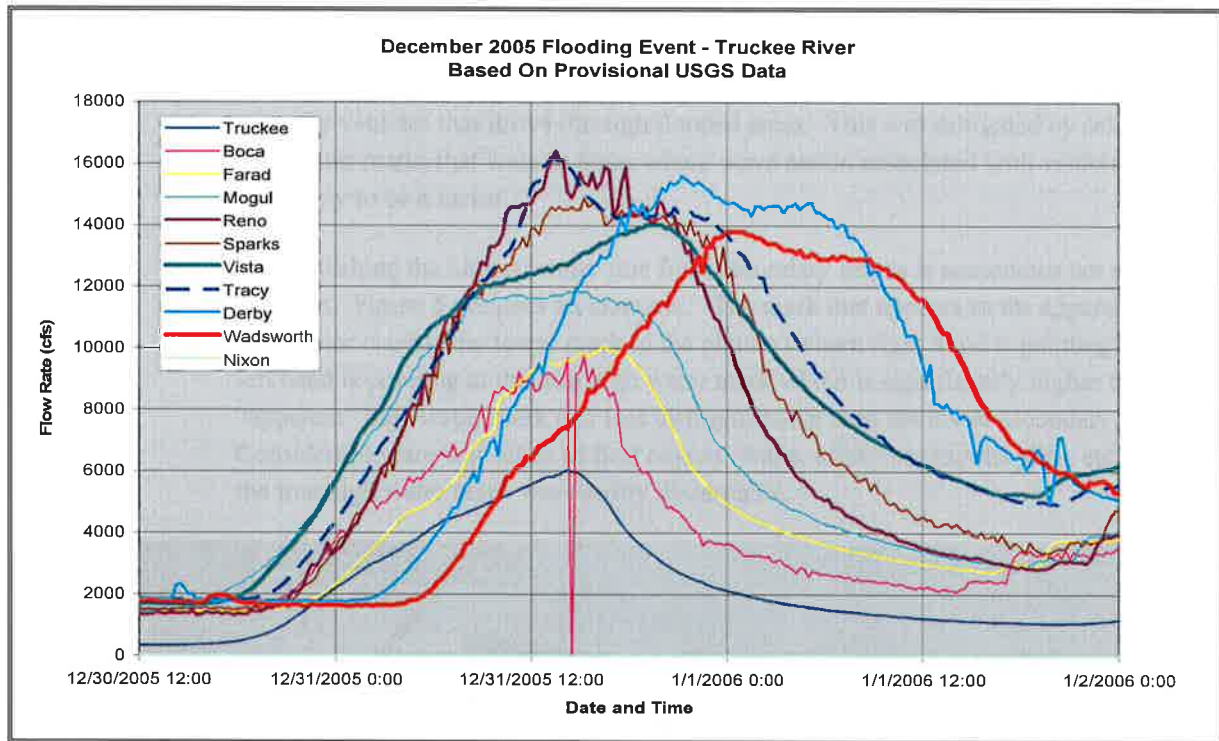


Figure 5 - USGS Provisional Data for 2006 Event for Truckee River Gages

High Water Mark Data

High water marks were identified and surveyed using GPS equipment shortly after the flooding receded in order to clearly identify water surface elevations along the river banks and in the overbank areas. High water marks were located by Mark Forest and surveyed by City of Sparks GPS survey crews. The high water mark data collected concentrated on the following locations:

- High water marks along the main channel banks of the Truckee River.
- High water marks in the north overbank which has a water surface profile that differs considerably from the main channel.
- High water marks in the south overbank, which has a different water surface profile than either the main channel or the north overbank.

There is considerable difficulty locating reliable high water marks because of localized conditions. The factors that can create erroneous high water marks include:

- Along the main channel, high water marks can be impacted by flow surges / wave action and super elevation around channel bends. This was mitigated by locating high water marks in backwater areas on straight reaches where wave action was less significant and super elevation was not a factor.
- In urban areas in the north overbank, high water marks were impacted by wave action cause by vehicles that drove through flooded areas. This was mitigated by selecting high water marks that were in areas where wave action associated with vehicles was less likely to be a factor.
- Distinguishing the highest water line from secondary marks is sometimes not readily apparent. Figure 5 presents an example. The mark that appears to the apparent “true” high water mark is the lower mark in the picture (where right hand is pointing). His left hand is pointing at the true high water mark which is significantly higher than the “apparent” high water mark and less distinguishable than the lower secondary mark. Considerable care was taken to find objects (walls, utility boxes, dirt piles, etc.) where the true high water mark was readily discernable.



Figure 6 - Example of Apparent and True High Water Mark

The high water mark data collected is plotted on Figures 1 and 2.

Discharge Estimates

The USGS gages do not measure discharge, although a discharge is reported. The gage is only measuring stage. The USGS relies upon rating curves developed for the gage site to transform the measured stage to its corresponding discharge estimate. The data used to develop the rating curves is from direct and indirect measurements. Direct measurements are made using a flow meter and measured stream cross section at the rating location. These estimates are generally within approximately 5% of the true discharge. Indirect measurements are made using 3 to 5 cross sections and high water marks surveyed after the passage of a flood event using the Slope-Area method to estimate discharge at the time of peak. These estimates are subject to greater potential error associated with the identification of high water marks and choices of model parameters.

The rating curves for the two gages of primary interest (Reno and Vista) have been modified by the USGS on a number of occasions. Prior to the 1986 event the rating curves were modified only slightly as additional data was developed. After the 1997 event, the USGS estimated the magnitude of the event using indirect methods. Due to the extent of flooding that occurred during that event which demanded USGS crews in a number of locations in Northern Nevada, these indirect measurements were made weeks after the passage of the event when high water marks were more difficult to discern. The resulting estimates at both gages fell below the previously developed rating curves for each gage. Despite the discrepancy between the new estimate and the previous estimates, the USGS chose to modify the rating curves to fit the new estimate. The result was an underestimate of the 1997 peak flow since the adjusted rating curve was an incorrect representation of the conditions at the two gages. A more refined estimate was developed with a detailed unsteady flow model of the Truckee River performed collaboratively by Mark Forest (previously with WRC Nevada, Inc.) and the Corps of Engineers Hydrologic Engineering Center for the Truckee Meadows flood control project. The model demonstrated that the previous USGS rating curves (prior to the adjustment for the 1997 event) were more representative of flow conditions.

As described in Chapter 2, the relocation of the Reno and Vista gages created the need for the USGS to develop new rating curves for the new gage locations. During the 2006 event, direct and indirect measurements were developed by the USGS. The new direct and indirect measurements are shown on the graphs by the USGS included in Appendix A. The rating curves at the new locations agree closely with the model developed for the Truckee Meadows flood control project.

The resulting USGS estimates of peak flow at the Reno and Vista Gages are 16,400 cfs and 14,000 cfs, respectively. These flow estimates agree very closely with the Truckee Meadows flood project model and the pre-1997 USGS rating curves, but do not agree with the post-1997 rating curves. This fact is significant since it indicates that the peak flow estimates reported by

the USGS for the 1997 event are in error. The underestimated values for this event frequently cause significant confusion as professionals attempt to draw conclusions and comparisons between flooding events and compare the 1997 to the estimated 100-year event. Correction of this error would eliminate a significant amount of confusion and misinterpretation of the data.

The lower flow rate at Vista compared to the Reno gage location is due to the attenuation that the hydrograph experiences as a result of significant overbank storage in the lower Truckee Meadows. The tabular data for each gage is included on a data CD transmitted with this report to the City of Sparks. The data included on the CD is provisional USGS data obtained from the USGS website and may be subject to changes as the USGS refines and processes the recorded data.

Discharge-Frequency Estimates

Two sources of data are generally used for estimating return period for a given flow rate in the Truckee River. The first is the Federal Emergency Management Agency (FEMA) as reported in the Flood Insurance Study for Washoe County. The estimates in this study were developed in 1979 for the original Flood Insurance Study for the Truckee River and have not been modified by FEMA since that time. As a result of the age of this study, there are numerous significant events in the record since the 1979 study that are not considered.

The second source of data is the Corps of Engineers (COE) Truckee Meadows flood project reports. The COE has developed more recent estimates using the additional record until 1999. The 2006 event is not considered in this analysis. Appendix D contains the plotted results for the Reno and Vista gages. The COE estimates are considered to be the best available data.

Based on the COE estimate the 2006 event is has a recurrence interval of 50 years. This event is similar in magnitude to the February 1986 event with respect to flows in the Truckee River but considerably lower than the 1986 event with respect to flows in Steamboat Creek.

Other Data

Additional high water mark data and other observations were made by Washoe County staff. HDR did not have access to that data. The additional data will provide a better understanding of the conditions that existed south of the Truckee River.

Tributary Drainages

The rainfall from this event appeared to have produced significant precipitation during the peak period in the upper portion of the Truckee River watershed. The area north of the Reno/Sparks area also experienced significant precipitation. This included the Silver Lake / Lemmon Valley area and Sun Valley watersheds. The storm began to dissipate by the time it reached the west side of Spanish Springs Valley. There was some flow from the drainages in the west side of the

valley that produced flooding of the Pyramid Highway and La Pasada intersection, where roadway flooding is common.

The Sun Valley discharges enter the Sun Valley Stormwater Detention facility and filled the facility to approximately three fourths of its capacity. The attenuated flows leaving the basin caused wide shallow flooding in the Wild Creek Golf Course. As the flow leaves the golf course it enters a recently constructed storm drain that intercepts the flows on the north side of Wedekind Road. The storm drain is designed to convey flows at approximately the rate that the inlet at McCarran Boulevard can accept. Minor overflow of Wedekind occurred during the peak of the event which was caused by a flow rate that caused submergence of the McCarran inlet as well. Therefore, this storm drain system and associated trash rack appeared to perform as designed.

The flow entering the storm drain system in McCarran Boulevard has been known to cause surcharging of the storm drain system in the residential area that is located south of Baring Boulevard and west of North Truckee Drain. The inlets and manholes in this neighborhood are lower than the potential hydraulic grade line in the large storm drain system that discharges to the North Truckee Drain in the box culvert that is under Baring Boulevard. During this event several streets required closure due to street flooding.

The watersheds on the East side of Sparks produced only minor flows. Therefore, the flood control facilities in D'Andrea did not experience flow of any significance.

During this event North Truckee Drain produced only moderate flows since most of the Spanish Springs watershed and the watersheds on the East side of Sparks did not produce significant flow.

Flows from the Paradise Park watershed were significant resulting in Paradise Pond reaching relatively high levels and significant discharge from the storm drain outlet. The storm drain exiting Paradise Pond is an independent system designed for pressure flow and calls for the manhole lids to be bolted to prevent surcharge. The bolts had been removed the manholes resulting in surcharging from several of the manholes that caused street flooding in B Street and surrounding areas.

As is common with events such as this one, flooding occurred in the Oxford Avenue and Pyramid Way / Greenbrae intersection. This frequently occurs because of storm drain surcharging in this low area of the drainage network.

The watershed entering the Sparks Marina experience only minor flows.

Included with this report is a DVD containing photos of many of these areas of the City taken at various times during the event.

Chapter 3 - Conclusions and Recommendations

The following conclusions and recommendations were made with respect to the data:

1. This event produced a flow that produced some levee overtopping and storm drain surcharging in various locations of the north overbank. Overtopping of the north bank levee occurred near the Federal Express site, at park on Spice Island Drive, upstream of East McCarran Boulevard and at a number of locations downstream of East McCarran Boulevard. The overbank flow was in range that produced a series of inundation areas that overflowed physical features and caused a stepped flood pool as it progressed easterly.
2. The peak flow rate for this event was slightly in excess of a 50-year recurrence interval for the Truckee River.
3. It is recommended that the high water mark data collected by HDR and Washoe County be evaluated with respect to the results of the Truckee Meadows existing conditions hydraulic model developed for the flood control project. This data provides an opportunity to validate the model that was calibrated to a single event, the 1997 event.
4. It is recommended that the Cities of Reno and Sparks and Washoe County work with the USGS to evaluate and correct the 1997 estimates for clarity of the record and to eliminate the confusion that the differing COE and USGS estimates for the event that the incorrect estimates cause. Preliminary discussions with USGS staff have been conducted by HDR. The USGS has indicated an understanding of this need, but lacks the funding to revise the estimate. The data developed for the Truckee Meadows project could be summarized for the USGS to assist in their review of the estimate and potentially reduce the cost to the USGS.
5. It is recommended that the Emergency Action Plan developed by HDR be updated to reflect the new gage data for the Reno and Vista Gages developed by the USGS. This plan uses the stages reported for the previous USGS gage locations which caused considerable confusion during the emergency operations associated with the 2006 event since the stages predicted by the National Weather Service River Forecast Center did not match the old gage stage data used in the Emergency Action Plan.

Chapter 4 - Data Analysis

A limited amount of analysis has been performed on the observed data. This chapter will review the analyses performed. Chapter 4 will present our recommendations for future analyses that could be performed to improve our understanding of this event and provide a comparison to planning and emergency action models currently being used.

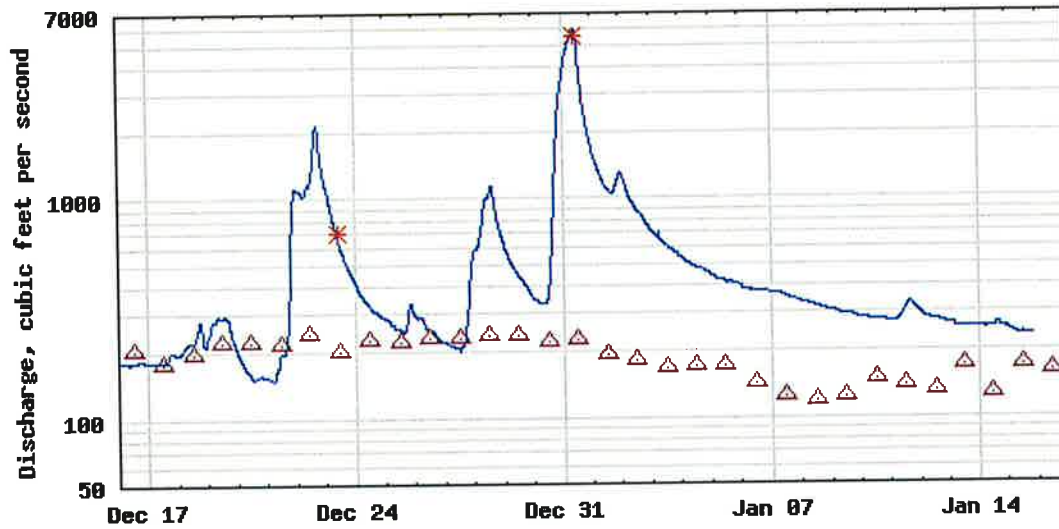
Appendix A



USGS Provisional Streamflow Data

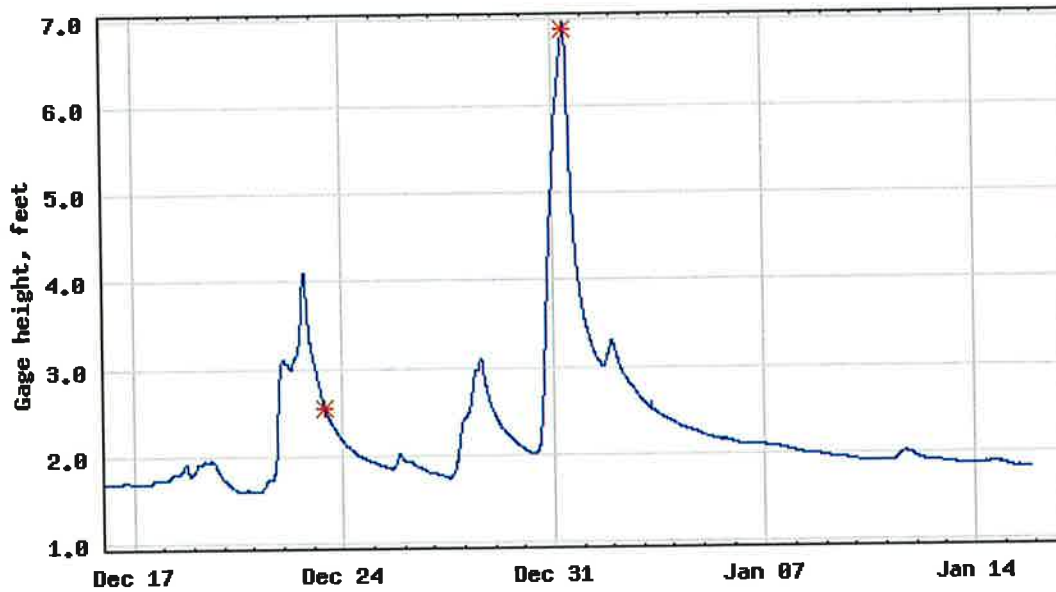
Truckee River near Truckee, California

USGS 10338000 TRUCKEE R NR TRUCKEE CA



----- EXPLANATION -----
— DISCHARGE
△ MEDIAN DAILY STREAMFLOW BASED ON 33 YEARS OF RECORD
* MEASURED Discharge

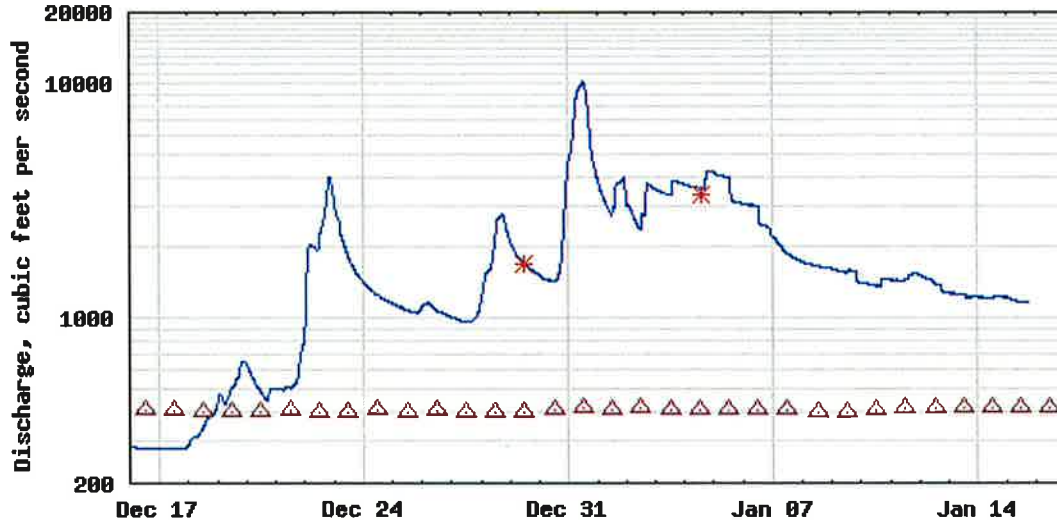
USGS 10338000 TRUCKEE R NR TRUCKEE CA



----- EXPLANATION -----
— GAGE HEIGHT
* MEASURED Gage height

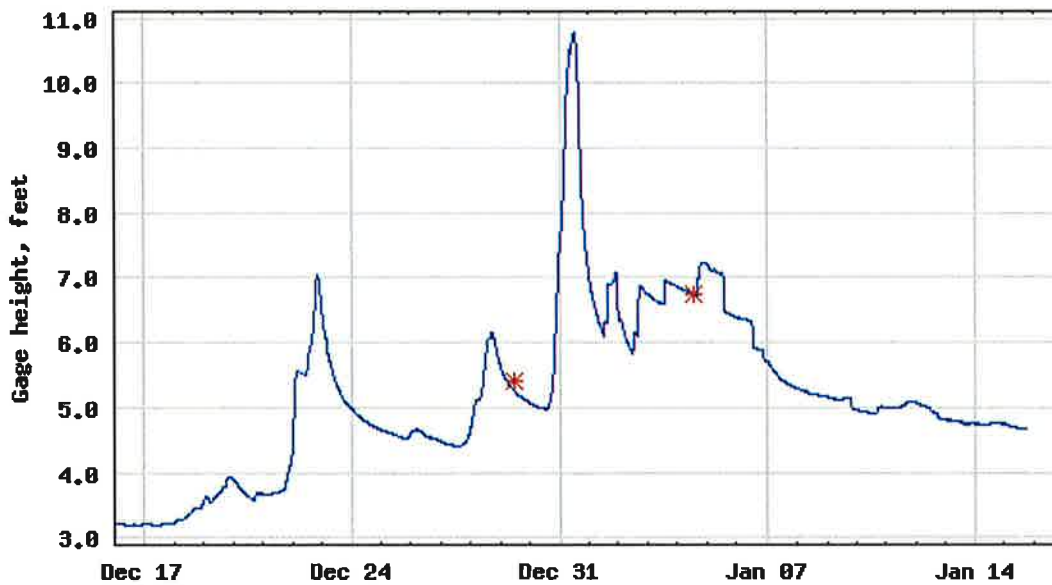
Truckee River at Farad, California

USGS 10346000 TRUCKEE R A FARAD CA



----- EXPLANATION -----
 — DISCHARGE
 △ MEDIAN DAILY STREAMFLOW BASED ON 95 YEARS OF RECORD
 * MEASURED Discharge

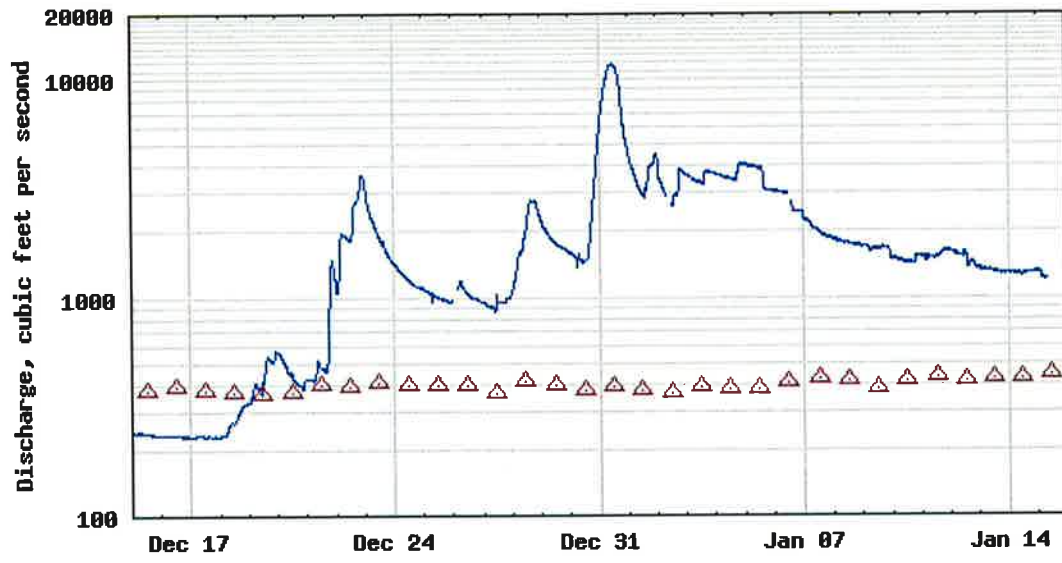
USGS 10346000 TRUCKEE R A FARAD CA



----- EXPLANATION -----
 — GAGE HEIGHT
 * MEASURED Gage height

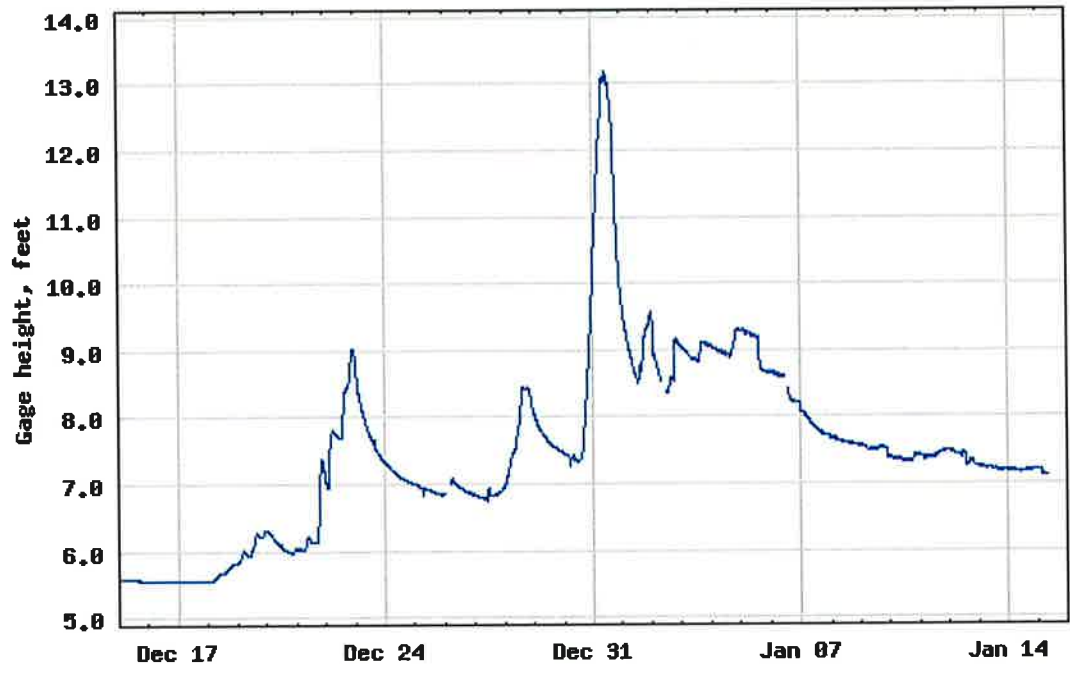
Truckee River at Mogul, Nevada

USGS 10347460 TRUCKEE RIVER NR MOGUL, NV



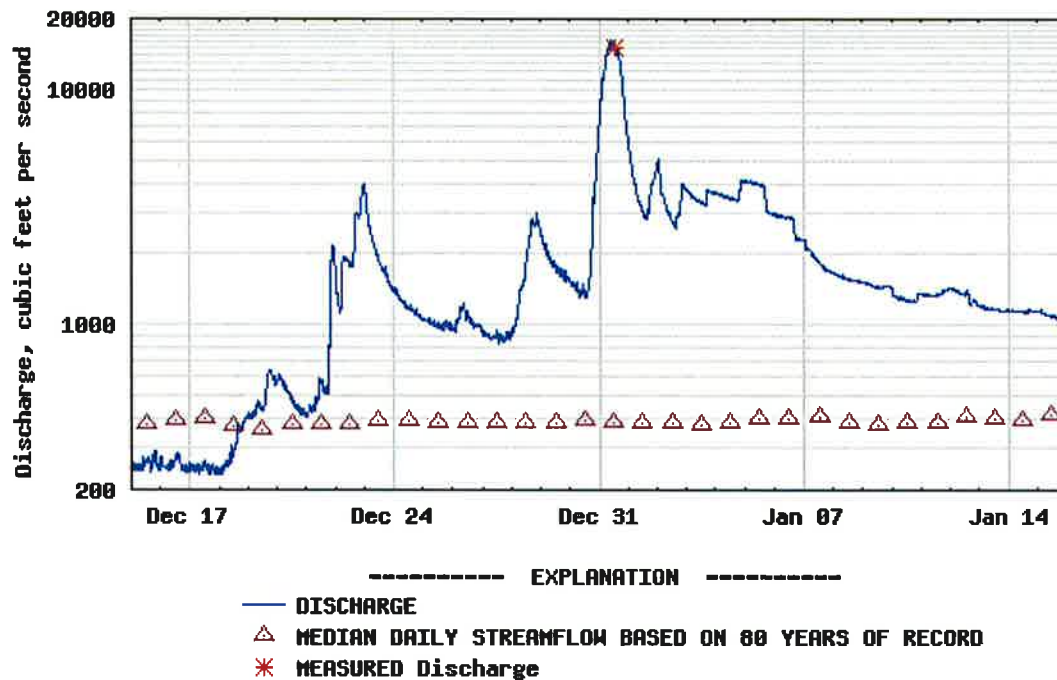
----- EXPLANATION -----
— DISCHARGE
△ MEDIAN DAILY STREAMFLOW BASED ON 10 YEARS OF RECORD

USGS 10347460 TRUCKEE RIVER NR MOGUL, NV

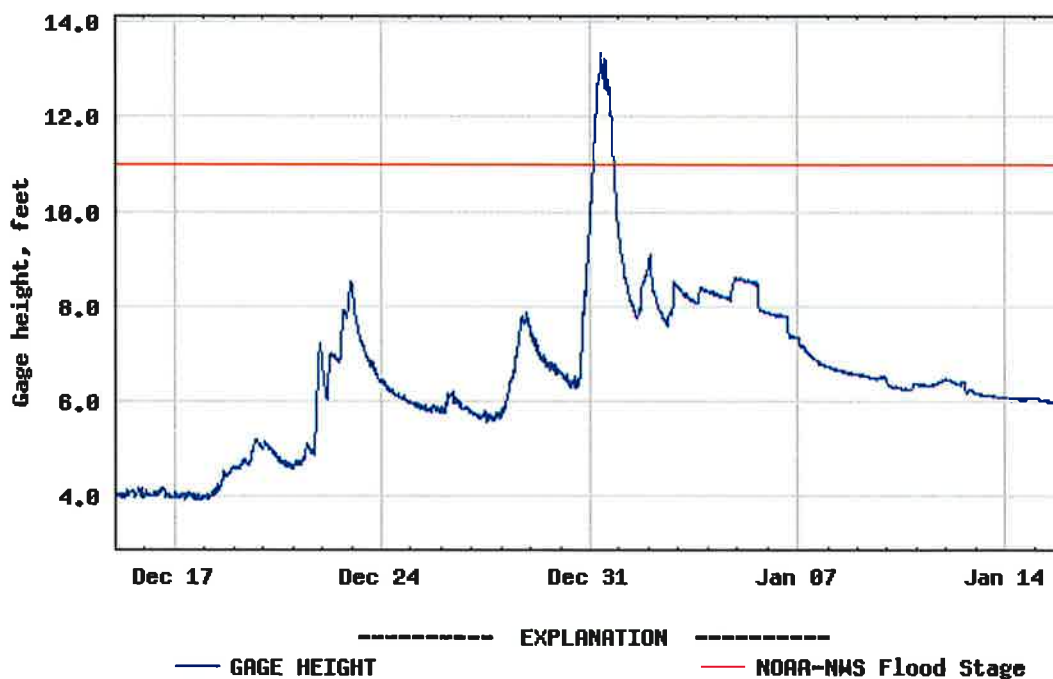


Truckee River at Reno, Nevada

USGS 10348000 TRUCKEE R AT RENO,NV

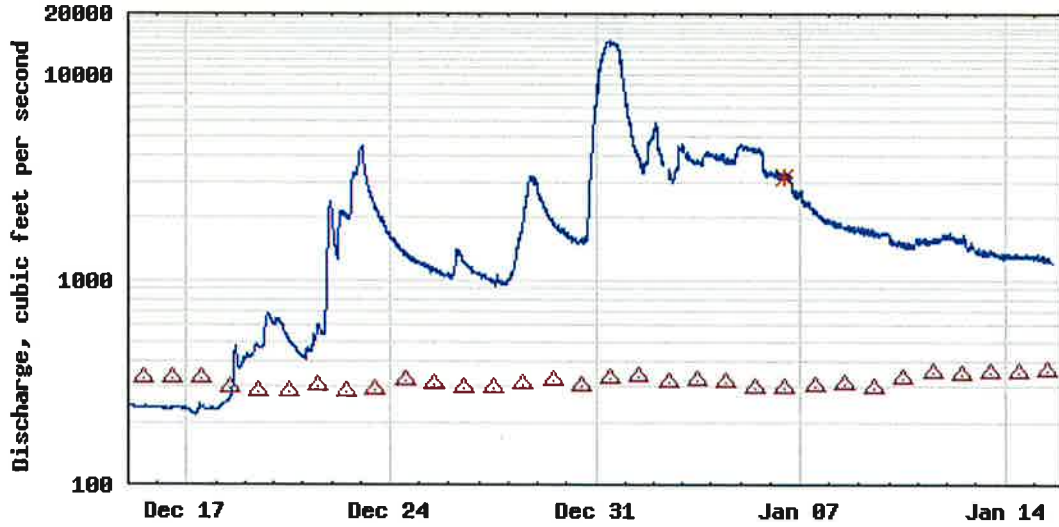


USGS 10348000 TRUCKEE R AT RENO,NV



Truckee River Near Sparks, Nevada

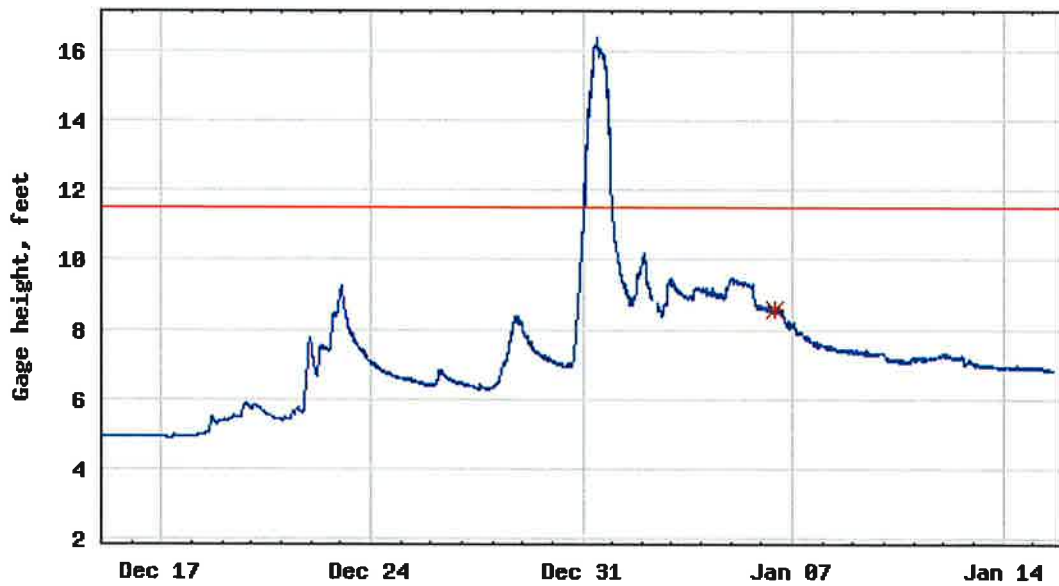
USGS 10348200 TRUCKEE R NR SPARKS, NV



----- EXPLANATION -----

- DISCHARGE
- △ MEDIAN DAILY STREAMFLOW BASED ON 27 YEARS OF RECORD
- * MEASURED Discharge

USGS 10348200 TRUCKEE R NR SPARKS, NV

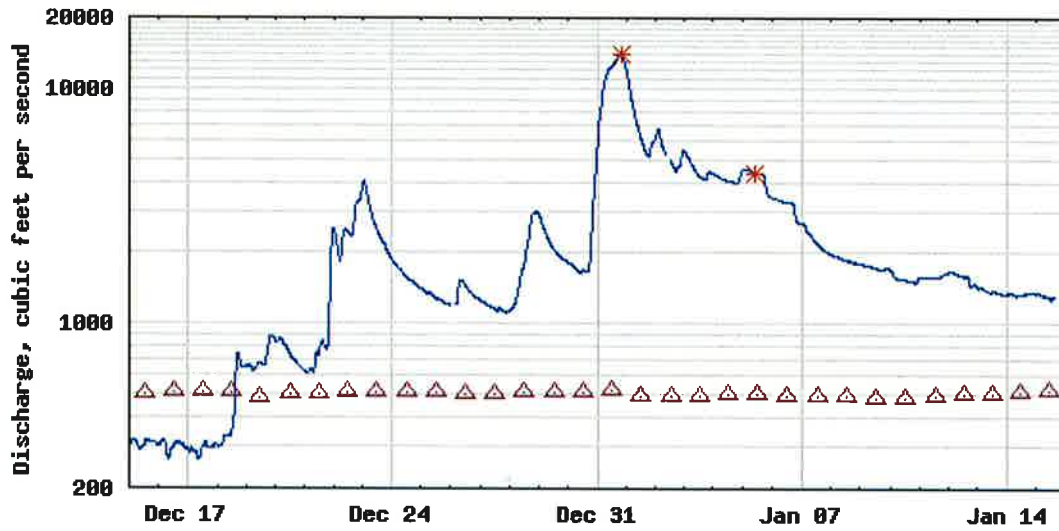


----- EXPLANATION -----

- GAGE HEIGHT
- * MEASURED Gage height
- NOAA-NMS Flood Stage

Truckee River at Vista

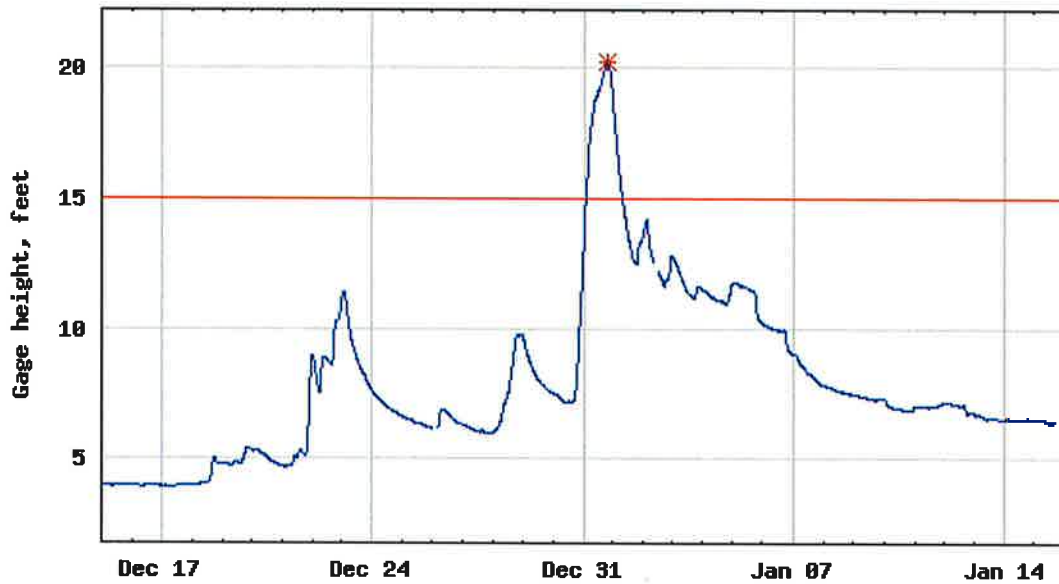
USGS 10350000 TRUCKEE R AT VISTA, NV



----- EXPLANATION -----

- DISCHARGE
- △ MEDIAN DAILY STREAMFLOW BASED ON 77 YEARS OF RECORD
- * MEASURED Discharge

USGS 10350000 TRUCKEE R AT VISTA, NV

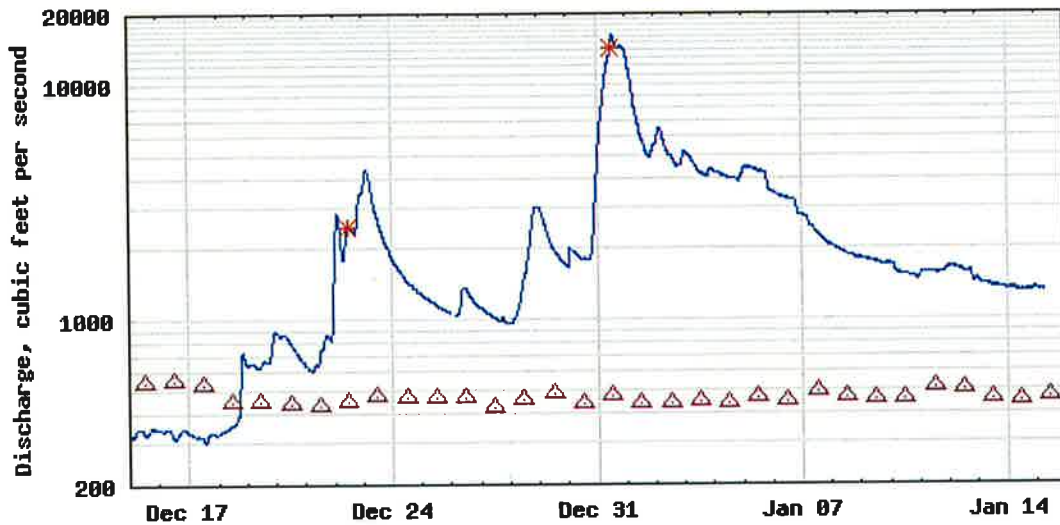


----- EXPLANATION -----

- GAGE HEIGHT
- * MEASURED Gage height
- NOAA-NWS Flood Stage

Truckee River Near Tracy, Nevada

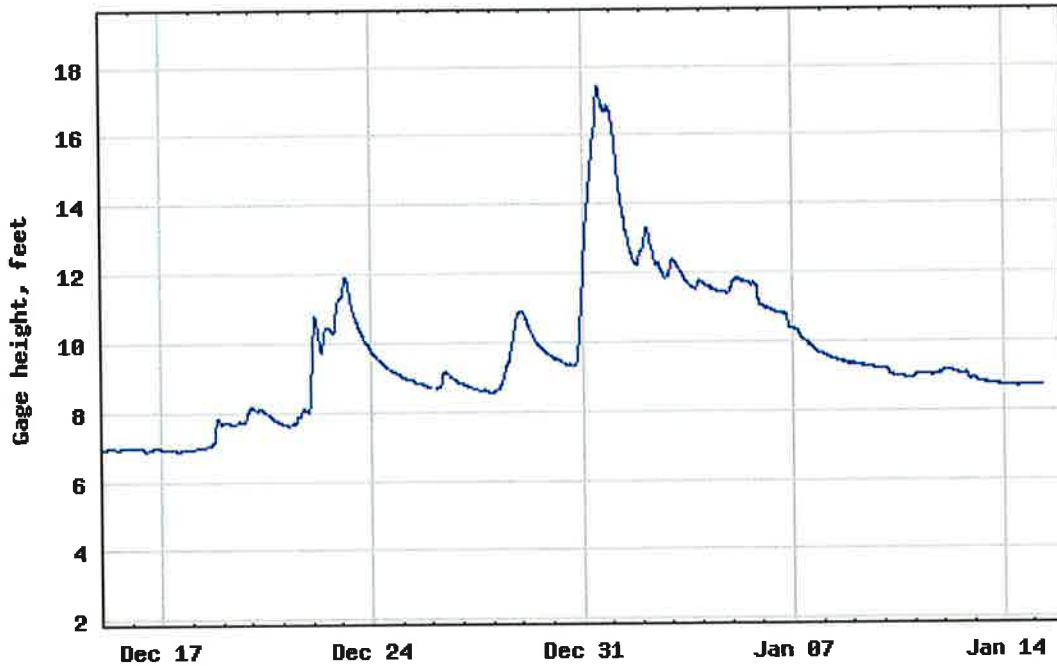
USGS 10350340 TRUCKEE RIVER NR TRACY, NV



----- EXPLANATION -----

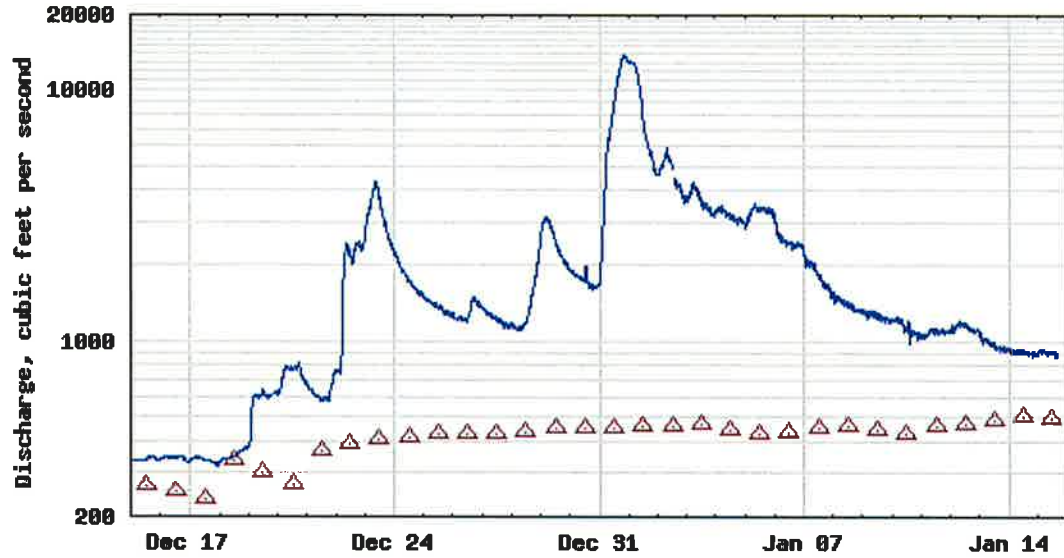
- DISCHARGE
- △ MEDIAN DAILY STREAMFLOW BASED ON 7 YEARS OF RECORD
- * MEASURED Discharge

USGS 10350340 TRUCKEE RIVER NR TRACY, NV



Truckee River at Wadsworth, Nevada

USGS 10351650 TRUCKEE R AT WADSWORTH, NV

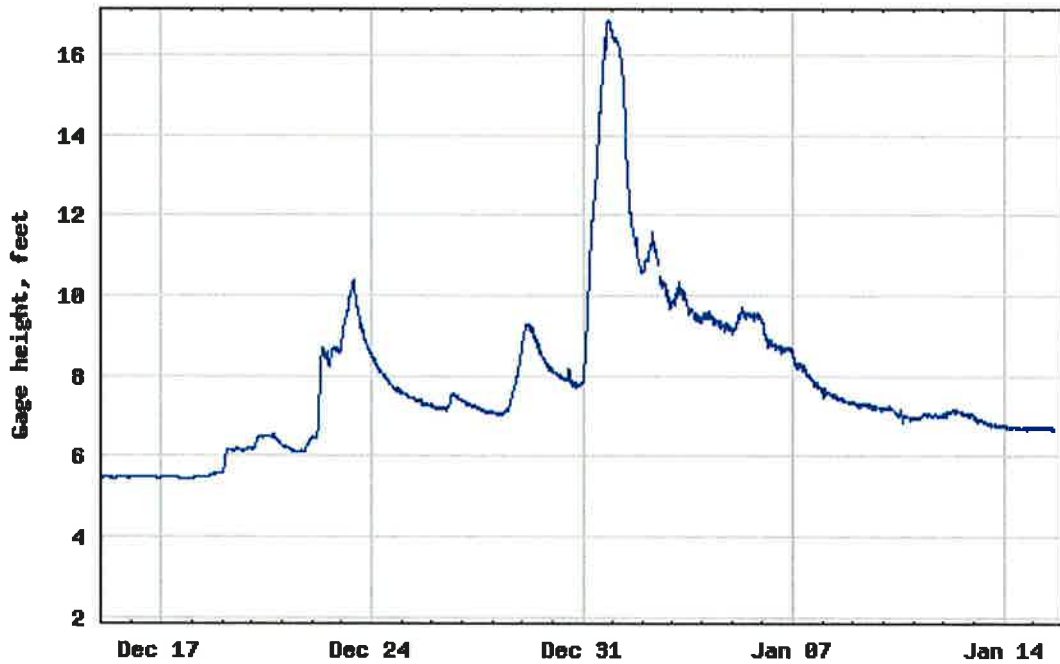


----- EXPLANATION -----

— DISCHARGE

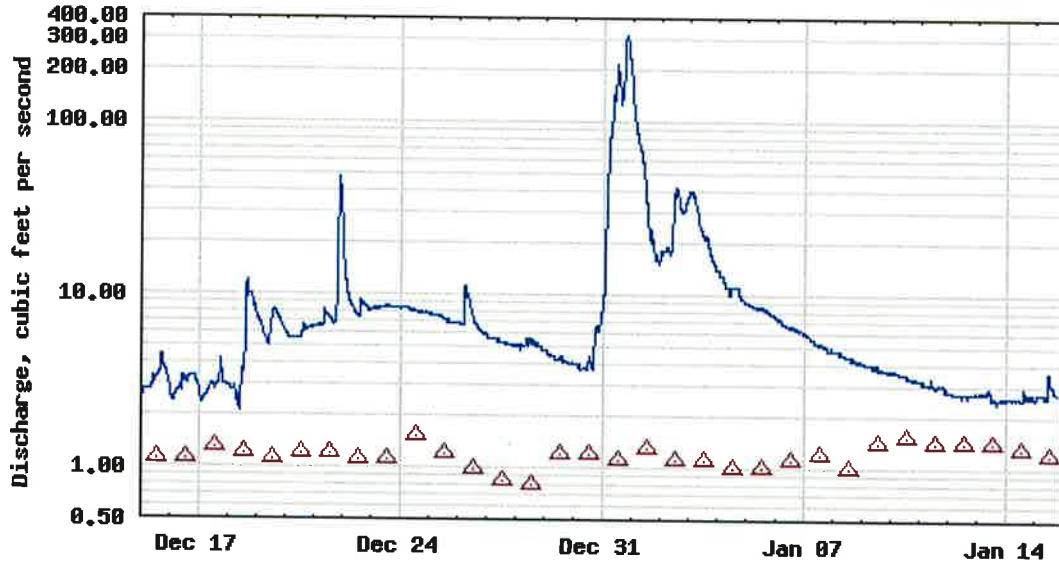
△ MEDIAN DAILY STREAMFLOW BASED ON 32 YEARS OF RECORD

USGS 10351650 TRUCKEE R AT WADSWORTH, NV



North Truckee Drain at Spanish Springs Road

USGS 10348245 N TRUCKEE DRAIN AT SPANISH SPRINGS RD NR SPARKS NV

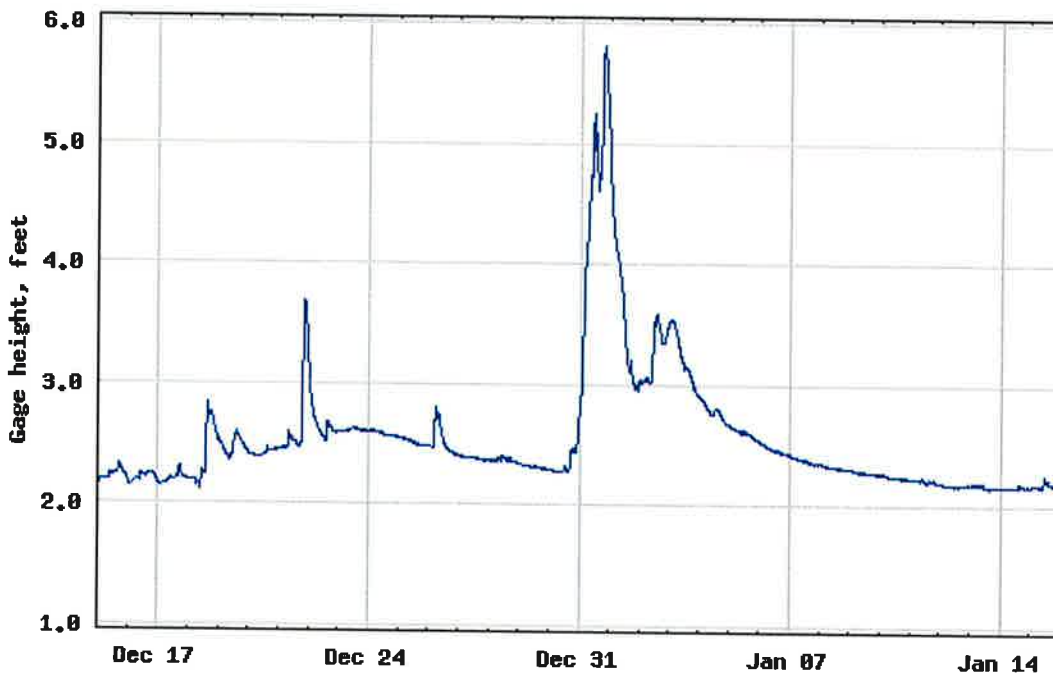


----- EXPLANATION -----

— DISCHARGE

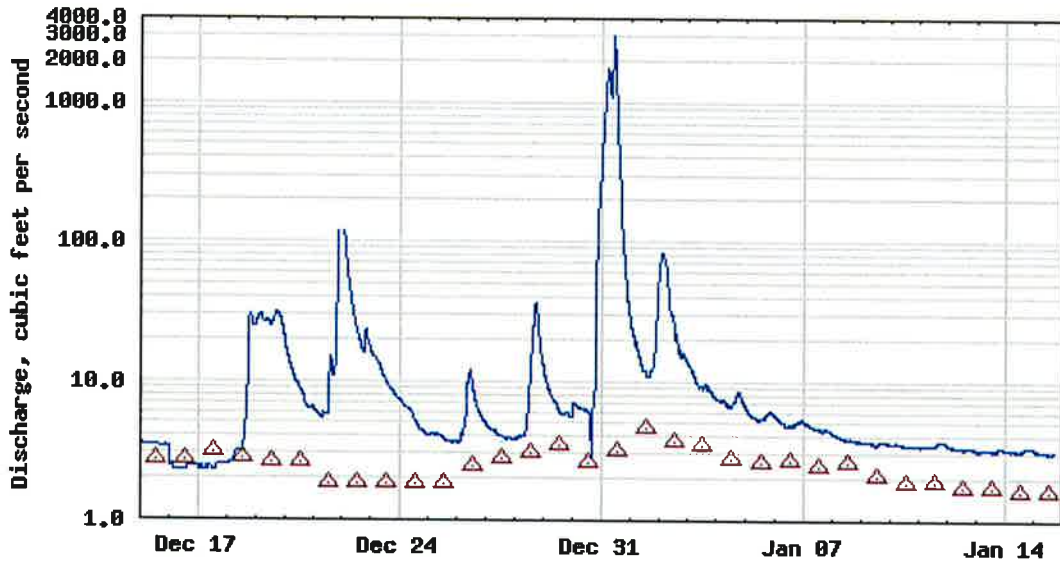
△ MEDIAN DAILY STREAMFLOW BASED ON 7 YEARS OF RECORD

USGS 10348245 N TRUCKEE DRAIN AT SPANISH SPRINGS RD NR SPARKS NV



Steamboat Creek at Geiger Grade

USGS 10349495 STEAMBOAT CK AT GEIGER GD NR STEAMBOAT, NV

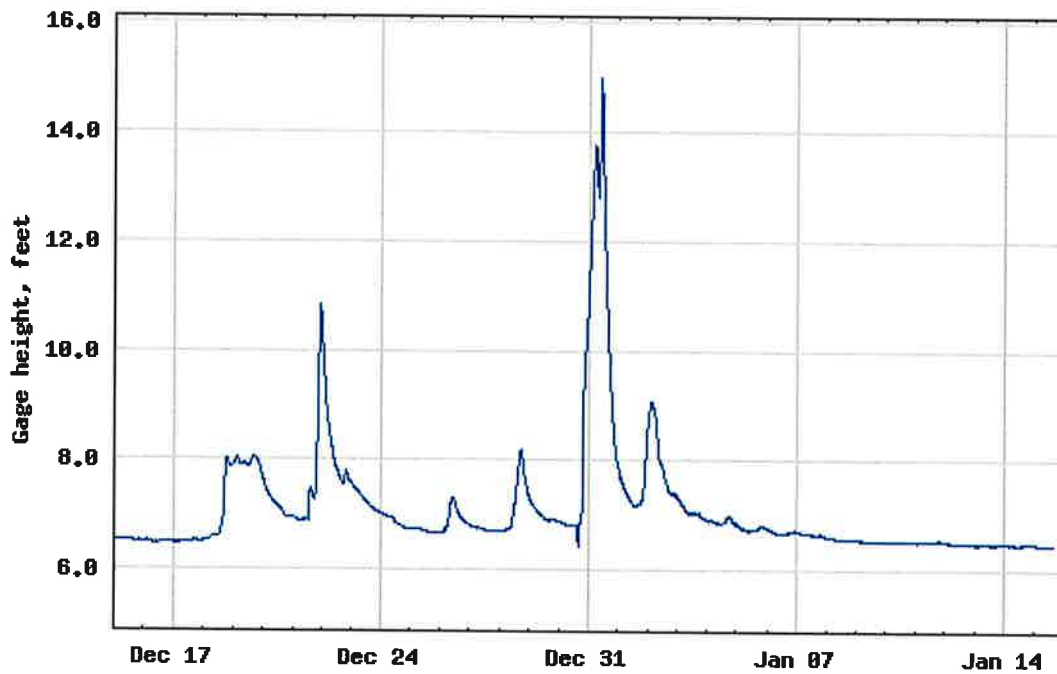


----- EXPLANATION -----

— DISCHARGE

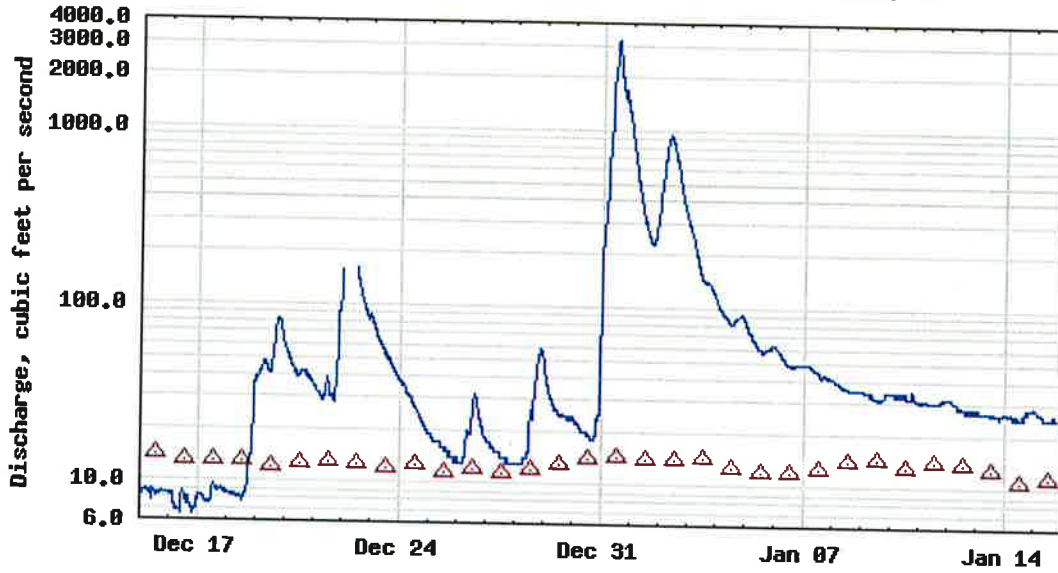
△ MEDIAN DAILY STREAMFLOW BASED ON 3 YEARS OF RECORD

USGS 10349495 STEAMBOAT CK AT GEIGER GD NR STEAMBOAT, NV



Steamboat Creek at Short Lane

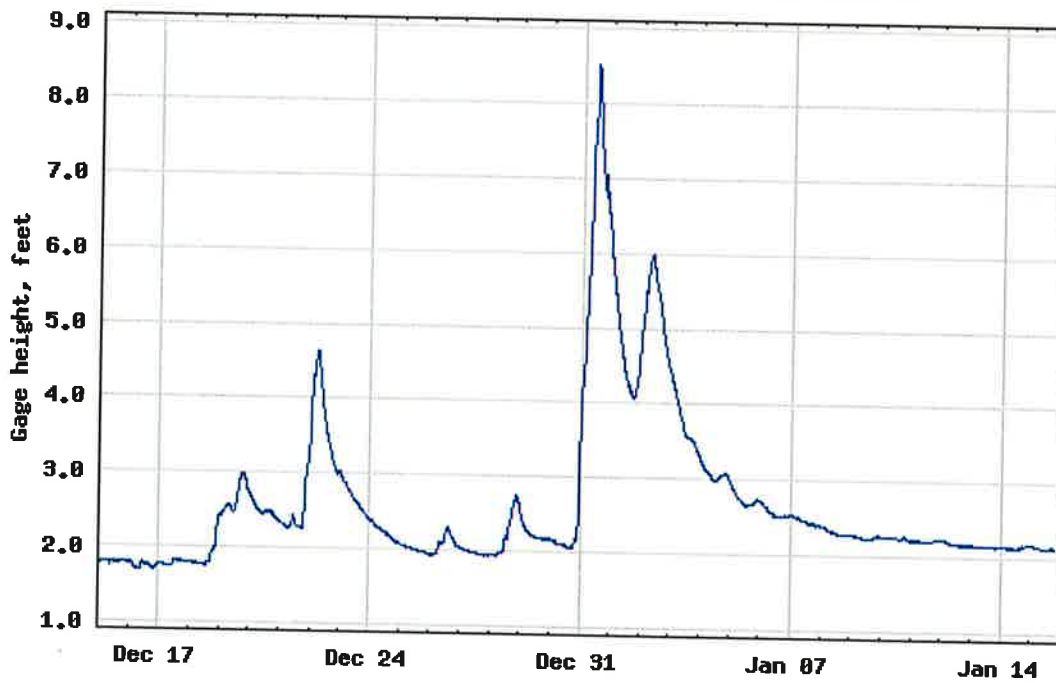
USGS 10349849 STEAMBOAT CK AT SHORT LN AT RENO, NV



----- EXPLANATION -----

- DISCHARGE
- △ MEDIAN DAILY STREAMFLOW BASED ON 4 YEARS OF RECORD

USGS 10349849 STEAMBOAT CK AT SHORT LN AT RENO, NV



Appendix B



USGS Provisional Rainfall Data

Truckee River at Farad, California

USGS 10346000 TRUCKEE R A FARAD CA



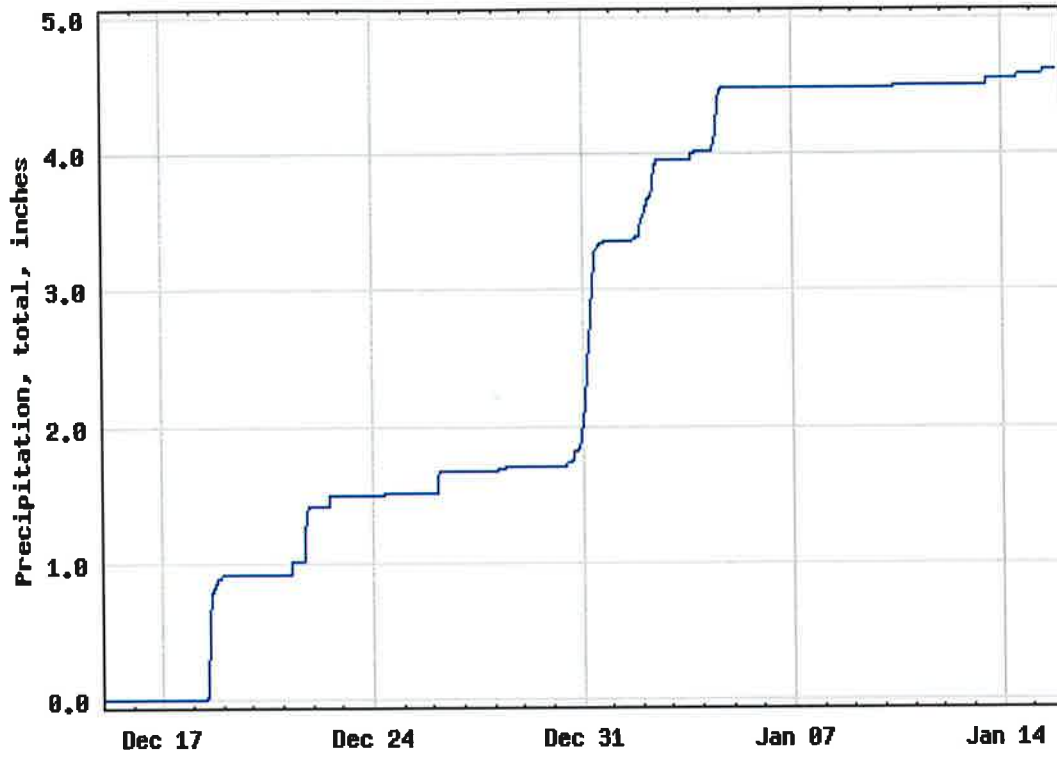
Truckee River at Mogul, Nevada

USGS 10347460 TRUCKEE RIVER NR MOGUL, NV



North Truckee Drain at Spanish Springs Road

USGS 10348245 N TRUCKEE DRAIN AT SPANISH SPRINGS RD NR SPARKS NV

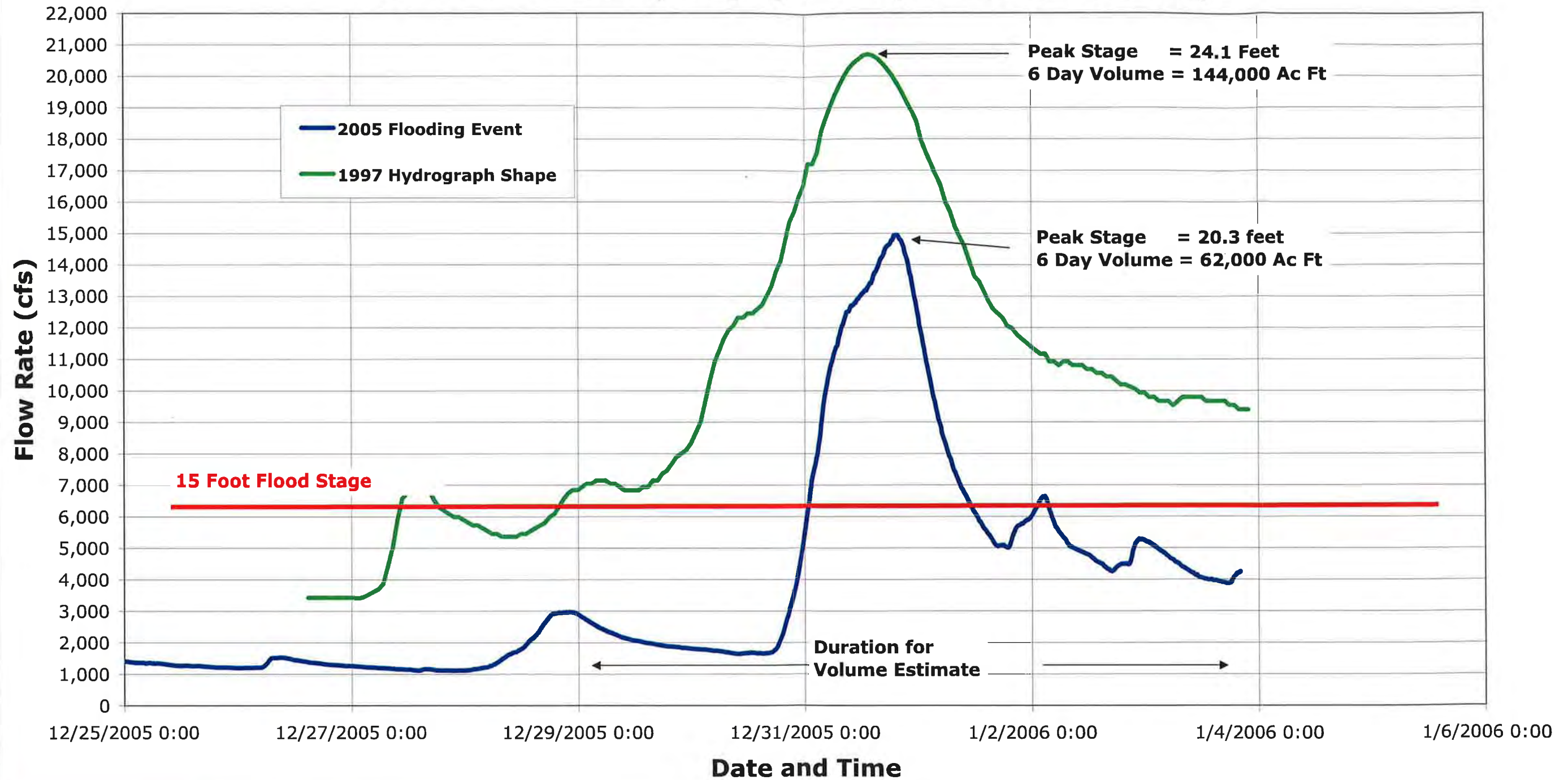


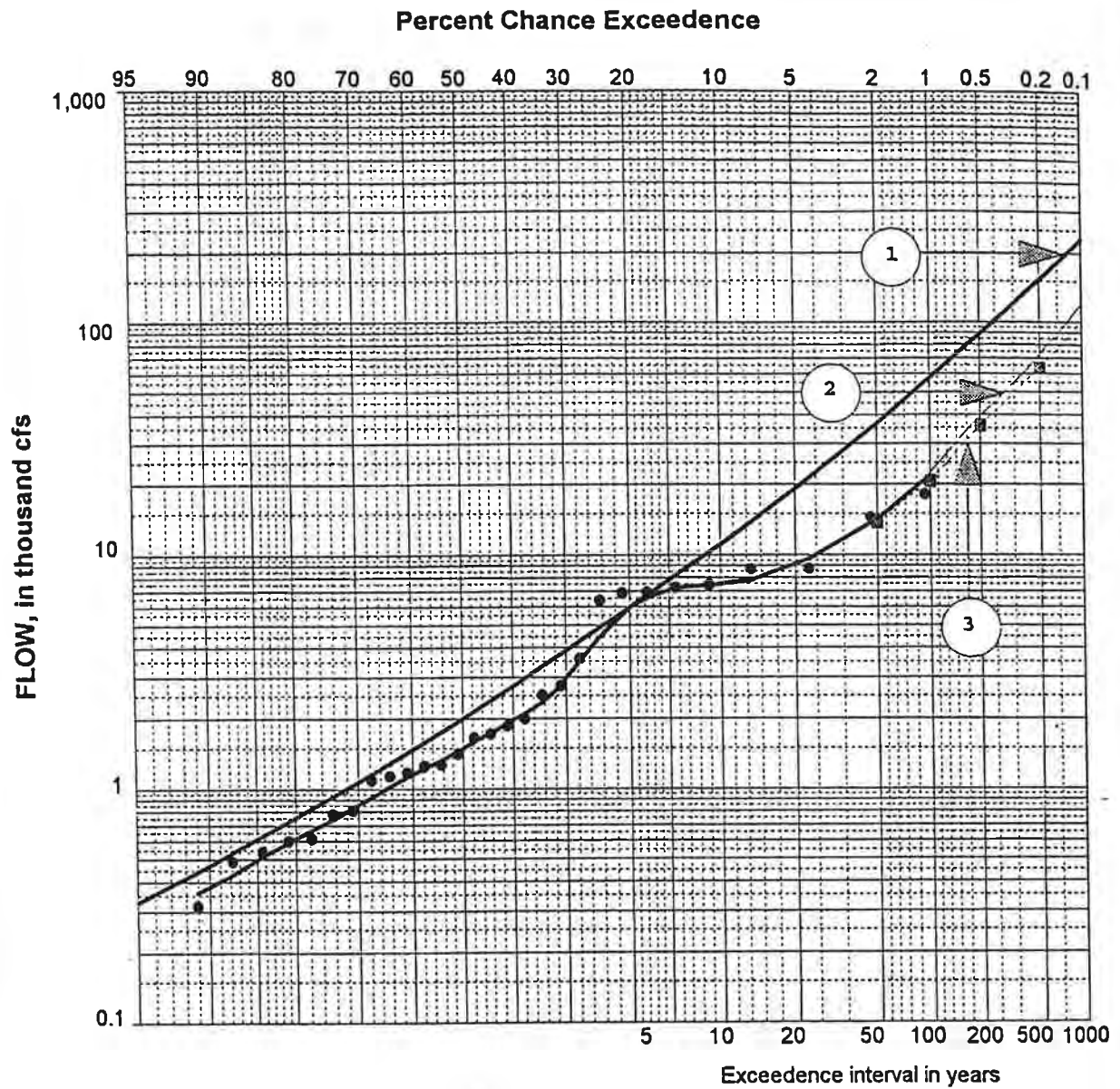
Appendix C



Comparison Between 1997 and 2006 Event Hydrographs
(note that time scale is for 2006 Event, 1997 Event timing adjusted to allow comparison)

Dec 2005 Event Hydrograph Comparison at Vista Gage





CURVE: 1. Unregulated with expected probability.

2. Regulated - expected probability.

3. Regulated - computed probability.

NOTE: 1. Weibull plotting positions.

2. Systemic record length: 29 years
Historic record length: 91 years

3. Drainage Area: 1,067 sq. mi.

TRUCKEE MEADOWS, NEVADA
FEASIBILITY STUDY

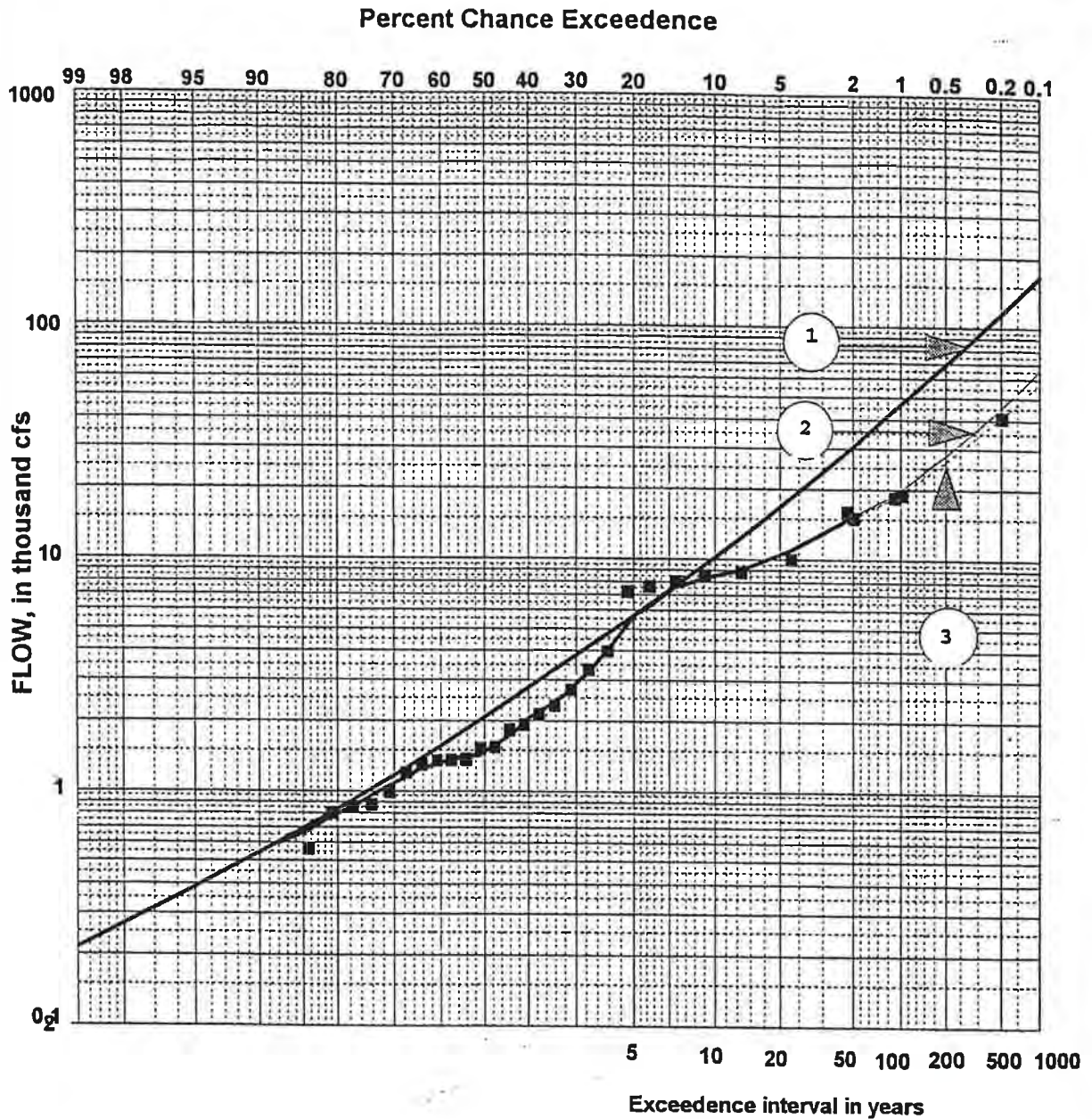
PEAK RAIN FLOOD FREQUENCY CURVES
(EXISTING CONDITION)
TRUCKEE RIVER AT RENO

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Prepared by MVB

Jun 99

FIGURE 4



CURVE: 1. Unregulated with expected probability.

2. Regulated - expected probability.

3. Regulated - computed probability.

NOTE: 1. Weibull plotting positions.

2. Systemic record length: 29 years
Historic record length: 90 years

3. Drainage Area: 1,431 sq. mi.

Prepared by MVB

TRUCKEE RIVER BASIN NEVADA AND CALIFORNIA
PEAK RAIN FLOOD FREQUENCY CURVES (EXISTING CONDITION) TRUCKEE RIVER AT VISTA
U.S. ARMY CORPS OF ENGINEERS SACRAMENTO DISTRICT

Jun 99

FIGURE 5