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*Final Report*

# TRAction Visioning Project

Prepared for  
**City of Reno**

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DRAFT



# Executive Summary

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The City of Reno TRAction Visioning Project is an element of the Truckee River Flood Management Project's (TRFMP) master plan to provide improved safety along the Truckee River Corridor through the Truckee Meadows region in Washoe County. The reach of the river that runs through downtown Reno has unique land use, transportation needs, and is experiencing a significant amount of redevelopment. The City of Reno has taken a leadership role in working with the TRFMP to determine the best solutions for improved flood protection in downtown Reno. This study is one step in defining the City's needs, opportunities, and the constraints that exist for implementing any improvements.

A initial assumption from the outset of this study is that the downtown bridges serve as a physical barriers during high river flow events and will need to be replaced with structures that pass significant high river flows and prevent flooding in downtown Reno.

The initial objective of this study was to determine the City's and community's vision for the "look and feel" of the replacement bridge structures along the reach of the Truckee River Corridor through downtown Reno, Nevada. In order to address what options the City would have for architectural and aesthetic treatments for the new bridges, the City and the Study Team agreed that some core design criteria would need to be determined in order to guide the "look and feel" of the bridges as they each become ready for replacement. The City directed the Study Team to create a technically accurate and updated hydraulic model of the downtown reach of the corridor in order to inform decisions on the best design criteria for flood protection. With updated survey and flood data from the 1997 and 2005 flood events, a revised model was built and used to determine the effects of various bridge and roadway designs and their impacts to the surrounding built environment and the viewsheds along the river corridor..

Negative community response to the more conservative criteria used in the U.S. Army Corps of Engineers (COE) of 100-year flood protection with 4 feet of freeboard (clearance between the bottom of the bridge deck and the highest point of the water surface elevation), led the City to develop local design criteria. This locally-preferred criteria better reflected the community values and were more acceptable based on the reduced physical impacts to the surrounding built environment, reduced visual impacts along the river corridor. Lower elevations in roadway approaches and bridge decks create less impact to surrounding businesses, pedestrian and bicycle pathways, and viewsheds upstream and downstream along the river corridor.

Understanding the community appetite to maintain existing access to, from, and across the river along the downtown corridor, while still improving flood protection in downtown Reno, provided the direction required to develop the recommended design criteria.

Through the hydraulic analysis, roadway and bridge design, and community input, the Study Team arrived at the following conclusions and recommendations:

1. 100-year flood design, with 2 feet of freeboard, will provide for adequate protection through the downtown reach of the river corridor.

2. A bridge structure that is supported by foundations beneath the bridge deck will provide a safe travel way, less expensive replacement costs, and an opportunity for pedestrian and bicycle pathways on the north and south sides of the river; will maintain existing viewsheds upstream and downstream of the river corridor; and will allow for architectural design and artistic influences to be reflected in each of the replaced structures.
3. Any other options, such as channel widening, dredging, or use of moveable bridge structures, are not low-risk, feasible options to maintain adequate flood protection in the long term and would be at risk of being higher cost solutions for the long term as well as the potential for causing/creating other reasons for flooding in the downtown during large flow events.
4. Community input on the “look and feel” of the structures can be accommodated under these design and replacement parameters.

While the conclusions presented in this study provide some baseline design criteria and assumptions, as each bridge is under consideration for replacement, unique challenges will need to be resolved. Each bridge location has a unique set of constraints and opportunities and will require individual considerations to make the implementation of these design criteria and assumptions acceptable to the community.

The body of this report presents the basis and justification for the Study Team’s conclusions and recommendations.

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# Acronyms and Abbreviations

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AASHTO	American Association of State Highway and Transportation Officials
cfs	cubic feet per second
City	the City of Reno
COE	U.S. Army Corps of Engineers
DTM	digital terrain model
MCACES	Micro-Computer Aided Cost Engineering System
USGS	United States Geologic Survey
WSEL	water surface elevation
yr	year

# 1.0 Study Process and Methodology

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The initial scope of work for this study was defined to identify the aesthetic and architectural themes and treatments for the four downtown bridges—Sierra, Virginia, Center and Lake Street crossings—plus two upstream bridges at Arlington Avenue and Booth Streets.

The primary assumptions for this study were to consider the following design criteria for the bridge structure type:

- Clear-span bridges
- 100-year flood protection
- 4 feet of freeboard (following the U.S. Army Corps of Engineers [COE] base criteria)

An early task in the study, not directly related to the contract scope of services, was direction by the City to prepare a COE -formatted MCACES (Micro-Computer Aided Cost Engineering System) Cost Estimate for the replacement of the four downtown bridges. The purpose of this activity was to provide the COE with a detailed cost analysis for the Environmental Impact Statement as part of the entire Truckee River Flood Control Project. As the Team completed this task, using the above design assumptions, the main objectives of the study were initiated.

The Team first presented the concept to the City and the public to consider this reach of the Truckee River Corridor (from Booth Street downstream to Lake Street) as three distinct “zones” that would each lend themselves to different opportunities for aesthetic, architectural, and access features (see Figure 1-1). The concept of Zones A, B, and C were developed and defined as follows:

- **Zone A: Residential Zone.** This zone extends along Riverside Drive from Booth Street to west of Arlington Avenue. Primarily residential with pedestrian and bicycle use along the north side of the river corridor.
- **Zone B: Wingfield Park Zone.** This zone extends considers the area around Arlington Avenue. Primarily recreational with Whitewater Park and river access for recreational uses. Bicycle and pedestrian use along the north side of the river.
- **Zone C: Downtown Zone.** This zone extends from Sierra Street to Lake Street. Mixed land uses with residential, commercial, and recreational uses. Pedestrian and bicycle use along the north and south sides of the river corridor. Parking along Sierra, Virginia and Lake Street Bridges. Downtown redevelopment activity with projects such as the Post Office Plaza, and the 101 Virginia Plaza, the new ball park stadium, with commerce and mobility on surface streets the primary focus.

However, as the City received feedback from the community that the “Zone concept” was an acceptable method for considering aesthetic and architectural features, a significant premise of the initial design assumptions was challenged and the design approach headed in a new direction, as discussed below. The focus for the balance of the study became the

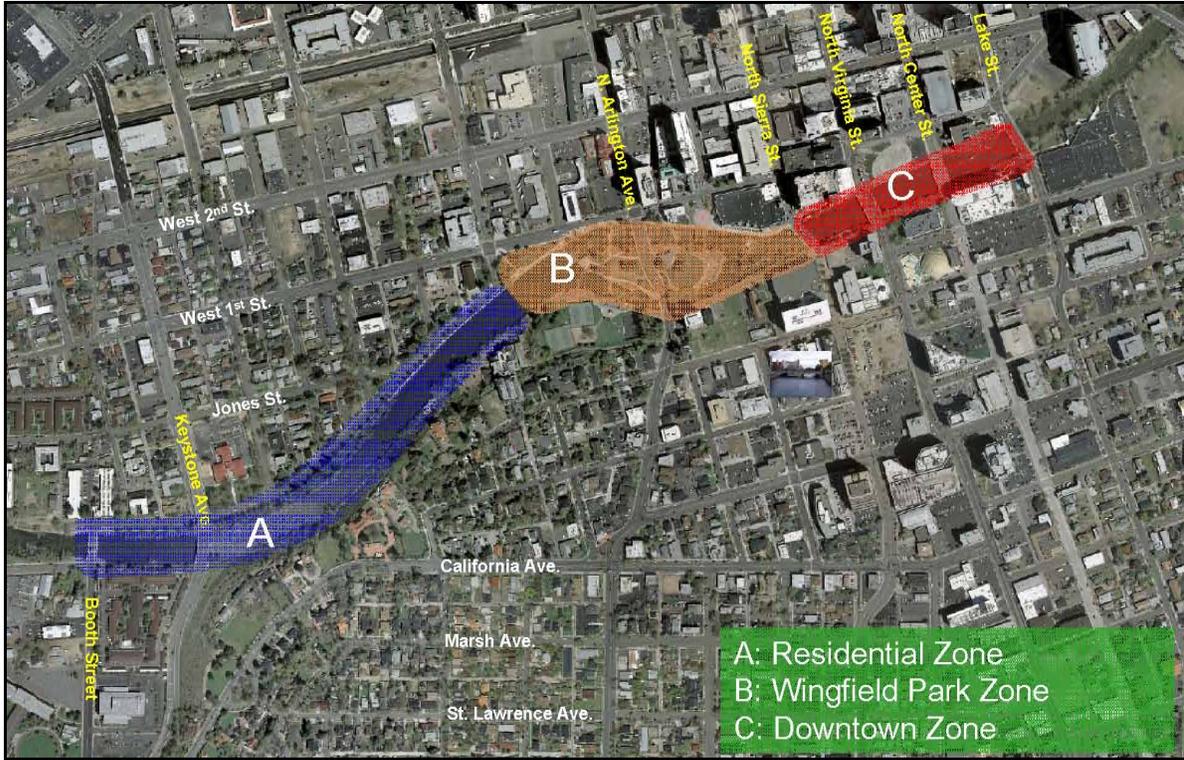


FIGURE 1-1  
Truckee River Corridor "Zones" Concept

Downtown Zone. Further discussion on unique architectural and aesthetic treatments by Zone will occur on a project by project basis.

## 1.1 Re-Directing Design Assumptions

Following the debut of the project at Workshop #1 in three different locations around Reno, the consensus of the public feedback was that the height of the bridge structures designed to meet the 100-year flood protection with 4 feet of freeboard resulted in unacceptable impacts, both physically and visually, particularly in the downtown reach of the river corridor.

The City then directed the Study Team to consider other levels of flood protection and freeboard criteria that would provide increased levels of flood protection along the river corridor, and also reduce the physical and visual impacts of the bridge structures.

## 1.2 Study Process Steps Forward

The methodology discussed with the City for moving forward with the study followed this process:

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- Conduct a topographic field survey to produce a more accurate and detailed hydraulic model of the downtown reach of the river corridor (east of Arlington Avenue to the Second Street and Kunzeli Bridges).
  - Assume 2 feet of freeboard for design and modeling analyses.
  - Calibrate the new hydraulic model using existing flood data from the 1997 and 2005 events.
  - Determine flood protection scenarios that would be reasonable to develop conceptual level designs for bridge replacements.
  - Provide conceptual level roadway and structure designs for each of the flood protection scenarios.
  - Assume continuous pathways on both the north and south sides of the river between Sierra and Lake, with the exception of the south side access between Center and Lake Streets so as not to assume the Siena Property would be interested in an all-access pathway.
  - Present conceptual designs and flood protection effects to public for Workshop #2.

Following the outcome and feedback of Workshop #2 the following methodology was defined along with the City staff to move the study towards a final recommendation:

- Present choices of bridge structure types.
- Prepare and present planning-level cost estimates for bridge types and approach roadway reconstruction.
- Prepare visual simulations comparing the 74-year (design year determined based on the water surface elevation of the 2005 flood event in Reno, NV) and 100-year designs.
- Present to City Council the 74- and 100-year design scenarios for two different bridge types.
- Prepare for Workshop #3 to have final public input opportunity on design year and structure type.
- Reach agreement with the City that the aesthetic and architectural treatments for each bridge would be determined at the time of planning and design for each bridge project as it moved forward.
- Reach agreement that this study would present the recommended design year and general structure type.

Following the City Council Presentation, several questions arose regarding other methods of flood protection. The City asked for the Team to summarize previous studies and conduct some new analysis on the following flood protection scenarios:

- Upstream Detention
- Deepening or Widening the River Channel
- Moveable/Lift Bridges

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The intent for this step in the process was to evaluate these additional scenarios and provide enough justification to substantiate the need for conventional bridge replacement at the four downtown locations.

Workshop # 3 was then conducted to present physical and visual impacts of the 74- and 100-year flood design choices and the bridge types. The City asked the public for their preference of these choices and gave them a chance to learn more about the alternative methods of flood protection.

Finally, the City's direction was to provide a final report to document the study process, the analysis, and the public feedback, and to present a recommendation to the City of the best and most feasible flood protection solutions for the river corridor.

This study process was dynamic and used the Workshops as milestones to make decisions about how to proceed and where to focus the analysis, design, and simulation efforts. It was an incremental methodology building consensus along the way with the City and the Truckee River Flood Management Project in order to meet the final desired outcome of a flood protection design year and bridge type.

The rest of this report will summarize the details of each of these steps in the process and draw conclusions building on the results of each step.

## 2.0 History of Hydraulic Modeling in the Truckee River Downtown Reach

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The Truckee River channel modeling work described in this report was built on previous hydraulic modeling efforts, which have been underway for nearly two decades. The known previous modeling conducted by several entities is briefly described in this section.

A physical, 1:30-scale model of the Truckee River was developed in September 1992 to determine the adequacy of the COE's proposed channel improvements. The model reproduced approximately 3,200 ft of the Truckee River running through downtown Reno, NV. Tests conducted with these proposed channel improvements (assuming a design flow at 18,500 cubic feet per second [cfs]) indicated areas within the modeled reach would need modifications to improve flow conditions (Stockstill, 1992). Documentation from this study was archived in the mid 1990s and later was lost. (Forest, 2008).

An unsteady, two-dimensional, finite difference model (FLO-2D) was then constructed by Tetra-Tech in 2000. This model was used to replicate the January 1997 flood event and is discussed in the COE report *Unsteady HEC-RAS Model of the Downtown Reach of the Truckee River* (COE, 2005).

The COE determined that the 2000 FLO-2D model should be replaced with a HEC-RAS unsteady flow model in 2001. The COE created a calibrated, georeferenced, unsteady HEC-RAS model of the downtown reach, using the older steady-state model as much as possible. This study was documented in the abovementioned 2005 COE report. An important observation was made in this report relating to debris assumptions and simulation. The report stated that debris was simulated as 4-foot-thick floating debris associated with each pier at widths that extended 6 feet beyond the pier on both sides. If, however, the energy grade line reached the bridge soffit, the assumption was made that debris would accumulate along the entire low chord of the bridge at a thickness of 4 feet. A similar approach was taken in the current modeling effort discussed in this report (see Section 2.2, Modeling Approach and Methods).

A steady-state HEC-RAS model was created in 2001 based on the unsteady HEC-RAS model by the COE model. This model was calibrated to the 1997 flood event. This model begins at about 2 miles upstream of Mayberry Drive (east of downtown) and ends at the US 395 crossing.

### 2.1 Bridge Modeling of the Downtown Reach

As part of this study effort, a new, steady-state hydraulic model of the Truckee River in downtown Reno has been developed using HEC-RAS version 4.0. The objective of this work was to create an updated hydraulic model for the Truckee River in the area between Arlington Avenue upstream and East 2<sup>nd</sup> Street downstream using updated field survey, geometry and calibration data. This model includes simulations of water surface profiles

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resulting from 50-year, 74-year, and 100-year return period flood flows, under both existing conditions and proposed new bridge configurations. Geometry data for this model came from two sources including a topographic field survey and an existing electronic digital terrain model (DTM) file for the overbanks. The field survey provided river channel geometry and bridge geometry data. This model was calibrated using photos taken of the river during actual flood events where flow rates were known and recorded. This model is intended to supplement the COE model that was developed through the earlier modeling efforts.

## 2.2 Modeling Approach and Methods

This section describes the approach and methods used to develop the existing conditions base model and future conditions models of the Truckee River, downtown reach.

### 2.2.1 Model Input Data

A contour file was developed from a DTM to represent the topography of the overbank areas along the channel. The original DTM (with one-foot contours) came from Washoe County. A topographic survey was conducted to accurately characterize the stream channel and bridges. These survey points were incorporated into the DTM to create a single geometric model of the channel, structures, and overbanks. Cross-sections were cut for the channel and channel overbanks using this data and entered into HEC-RAS. The mapping information for this project is based on the 1988 vertical datum and the Nevada State Plane Grid horizontal datum. A map showing locations of the surveyed cross sections and a contour map are included in Appendix A of this report.

As-Built drawings of the Arlington, Sierra, Virginia, Center and Lake bridges were obtained and evaluated to ensure accuracy of bridge modeling. Information from these drawings (such as curvature of the bridge piers) was incorporated into the HEC-RAS model.

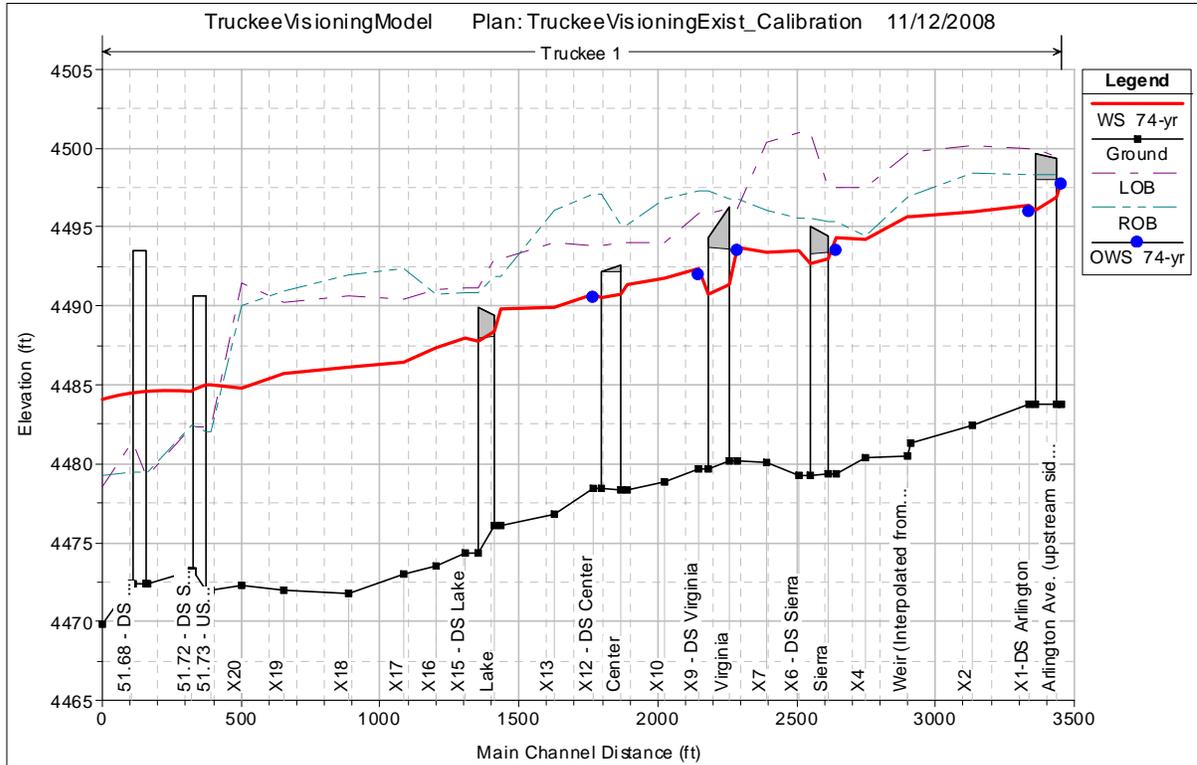
Photos taken during the 2005 flood event were obtained from various sources (mostly from the internet) and evaluated to help link the 2005 flood flow rate to the water surface elevation (WSEL) at some of the bridges in the downtown reach. The 2005 photos used for this analysis (including photos from other flood events) are shown in Appendix B.

### 2.2.2 Model Calibration

An existing conditions HEC-RAS model simulating the 2005 flood flow through the channel, bridges, and overbanks was developed using the input data described above. The estimated peak flow rate through the downtown reach during this flood event as recorded at the Reno United States Geologic Survey (USGS) gage was 16,400 cfs. The existing conditions model was calibrated by adjusting Manning's  $n$  values and other loss factors used in HEC-RAS to adjust WSEL. These factors were adjusted until the WSEL at bridges matched to within relative accuracy of what the 2005 flood photos portrayed.

The City of Reno positioned a trackhoe on the Virginia Street Bridge that removed floating debris from the upstream face of the bridge during the flood event. Removal of the debris allowed for better calibration of the hydraulic model by removing the highly variable debris component from this bridge.

Figure 2-1 shows the comparison of the simulated water surface profile compared to the flood elevations as they appeared in the bridge photos taken during the 2005 flood. In this figure, the solid dots refer to calibration points (taken from photos) and the bold line refers to the simulated 2005 flood water surface profile.



**FIGURE 2-1**  
 Hydraulic Profile Truckee River Downtown, 2005 Flood Event Calibration  
 \*LOB = Left Overbank, ROB = Right Overbank, OWS = Observed Water Surface

Tables of the Manning’s n values and other loss factors used for the model calibration are included in Appendix C of this report.

### 2.2.3 Flows Used in Modeling Existing and Proposed Bridge Structures

For the bridge modeling efforts, three different flood flows were analyzed. Table 2-1 summarizes the flows corresponding to the return period of the events. The 2005 flood flow is assumed to be approximately equivalent to a 74-year flood event.

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TABLE 2-1  
Flood Flows

Recurrence Interval	Flow Rate (cfs)
50-year	13,684
74-year <sup>1</sup>	16,400
100-year	20,676

**Note:**

<sup>1</sup> The 2005 flood flow is assumed to be approximately equivalent to a 74-year flood event.

## 2.2.4 Methods for Modeling Bridges

The energy flow method is used to calculate WSEL at the bridges during low flow regimes. For high flow (flow over the bridge), the pressure and weir method is used with a submerged inlet and outlet coefficient of 0.8.

All proposed new bridges in the HEC-RAS model were assumed to have a single center pier. A sensitivity analysis conducted on the effect of the bridge pier found that the WSEL rises less than 0.2 feet with the pier. To be conservative, this modeling work assumes piers will be used even though the proposed bridges may not require this center pier. For all new bridges, debris on the piers was modeled by multiplying the bridge pier width by 2.

Debris buildup on the low chords of the bridges was modeled and is considered a significant factor in flooding at the bridges in the downtown reach. Simulation of debris buildup is based on earlier work and studies by the COE. Debris buildup consists of 4 feet of blocked flow just below the low chord of the bridge, which is modeled by dropping the low chord geometry by 4 feet in the HEC-RAS geometry editor. The low chord of the bridge is only dropped by 4 feet if it is determined that the WSEL without debris on the low chord exceeds an elevation that is 2 feet below the average low chord of the bridge. If the WSEL is found to be more than 2 feet below the average low chord of the bridge, then no debris blockage is used. It was typically found that once the debris blockage is used in the model, simulated flood waters back up behind the bridge and overtop the bridge deck.

Debris buildup was not used in the 2005 calibration model because during this flood event, the debris was removed by City workers and was not allowed to accumulate. It is assumed that this equipment may not be readily available during every major flood event; therefore, debris accumulation should be considered in assessing flood protection provided by the various scenarios.

## 2.3 Bridge Replacement Analysis and Results

Four scenarios were analyzed as part of the bridge replacement study and are described below. Each scenario was developed in HEC-RAS starting with the calibration model of existing conditions as a foundation. All scenarios shown below included changes only to bridges and not to the channel itself. The results of these scenarios are represented as inundation flood maps showing the extents of flooding and areas where the flood flows are

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contained in the channel. Inundation maps for each of these scenarios are included in Appendix D of this report. Hydraulic profiles are also included in Appendix D.

**Scenario #1 - 50-year Flood Protection** - This scenario is known as a 50-year flood protection for downtown Reno because flows would be contained in the channel for flows up to the 50-year event. This design requires reconstruction of the Sierra, Virginia, and Lake Street Bridges. The existing Center Street Bridge remains in place. In this scenario, the low chords of bridges are at least 2 feet above the 50-year flood WSEL.

**Scenario #2 - 74-year Flood Protection** - This scenario is known as a 74-year flood protection for downtown Reno because flows would be contained in the channel for flows up to the 74-year event. This design requires reconstruction of the four bridges at Sierra, Virginia, Center, and Lake Streets. In this scenario, the low chords of bridges are at least 2 feet above the 74-year flood.

**Scenario #3 - 100-year Flood Protection** - This scenario is known as a 100-year flood protection for downtown Reno because flows are contained in the channel for flows up to the 100-year event. This design requires reconstruction of the four bridges at Sierra, Virginia, Center, and Lake Streets. In this scenario, the bottoms of bridges are at least 2 feet above the 100-year flood. The WSEL along portions of the channel around Sierra Street are very near to over-topping the banks on both the north and south sides of the river.

**Scenario #4 - 100-year Corps' Flood Protection** - This scenario is a 100-year flood design corresponding to the highest level of flood protection and has a corresponding flow of 20,700 cfs. All four downtown bridges require replacement to accommodate the 100-Year flood design with 4 feet of freeboard (2 additional feet about Scenario #3) complies with COE requirements.

The Study Team also summarized previous analysis to support to replacement of the Virginia Street Bridge. These conclusions are supported by the analysis conducted as part of this study and were brought to the community as a reminder for previous decisions made by the City.

**Virginia Street Bridge Impacts** -The justification for replacing the Virginia Street Bridge was included to demonstrate the reasoning behind the City's decision to replace this bridge. Replacing the Virginia Street Bridge is necessary with any level of flood protection to avoid flooding in downtown Reno.

Tabular results of the hydraulic models listed above are included in Appendix E.

## 2.4 Dredging Analysis

During the course of the study, members of the community and City staff had questions regarding alternative channel dredging options in lieu of replacing bridges in the downtown reach of the Truckee River. The HEC-RAS model was modified to analyze the effects of dredging on the hydraulic profile. For a river that is currently in equilibrium, such as the Truckee River, dredging cannot be considered a long-term solution. The channel would need dredging on a regular basis. Dredging will alter the slope of the river and change the sediment transport at the bridges and along river channel walls. To determine potential effects of dredging, it would be useful to look at how dredging could affect the

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energy, slope, velocity, and stream power of the river. This analysis has not yet been conducted.

Scour resulting from the channel dredging could undermine the retaining walls lining the banks within the downtown reach and increase the scour at the bridges. The end of the Whitewater Park structure (where dredging would begin) may get undermined unless channel protection is installed. The dredging operation would have adverse environmental impacts. It could be difficult to get an environmental permit to operate an ongoing dredging program in this high profile and environmentally sensitive area of the Truckee River.

A sedimentation study was conducted by Wood Rodgers earlier this year (Wood Rodgers, 2008), which complements some of the conclusions made from the HEC-RAS analysis. The results of that study are outlined in the following section.

### 2.4.1 Wingfield Whitewater Park Sedimentation Study

In May 2008, Wood Rodgers Engineering conducted a reconnaissance level fluvial sediment study of Truckee River in Reno, to determine the approximate frequency and magnitude of sedimentation anticipated to occur within the Wingfield Whitewater Park. Sediment delivery in the stream channel is related to the flood hydrograph, channel geometry, and sediment characteristics, etc. To account for these factors, the FLUVIAL-12 model was used to simulate the hydraulics of stream flow, sediment transport and stream channel changes, using three floods representative of major, moderate and small events. The analysis provides general information on trends which are useful in evaluation of dredging options within the downtown reach of the Truckee River. The following conclusions are made in the Wood Rodgers report:

1. Sediment deposition is likely to occur within the downtown reach during flood events on the order of 10-year and greater flows.
2. Deposition will occur during the highest flows. Therefore, an excavated channel may appear to have adequate capacity prior to a major event, with deposition occurring at the worst possible time during the peak of the flood resulting in loss of the anticipated flood protection benefits.
3. No analysis of "what-if" scenarios, such as the contemplated channel excavation, was included in the Wood Rodgers analysis. However, based upon basic fluvial principals, it is anticipated that depositional trends would be exacerbated by channel excavation in this reach. Sediment-transporting rivers tend toward fluvial processes which result in a linear water surface profile (to the extent possible with consideration of hardened constraints). Thus, deposition within the deepened area would likely occur along with potential degradation upstream as the river strives to achieve a linear water surface profile.
4. Should a more rigorous analysis of the channel deepening concept be desired, the Wood Rodgers model could be adjusted to include this feature.

The Wood Rodgers study depicts the river channel geometry by the longitudinal profiles of the water surface and channel bed together with the cross-sectional profiles. Changes in river channel geometry were modeled using three floods. The modeled results indicate that

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the channel bed through Whitewater Park is subject to sediment deposition during major floods as well as small events. Since the channel banks are armored along the river reach, the channel bed through the Park area tends to be built up by sediment deposition.

The amount of sediment deposition or erosion along the river channel reach through the Park has been determined based on the spatial variations of sediment delivery along the river channel. The river channel reach through the Whitewater Park area is subject to sediment deposition during moderate and major floods. The amount of sediment deposition is in direct relation to the flood magnitude. Computed volumes of sediment deposition along the river reach in the park are as follows:

- Flood 1 (close to a 100-yr flood): 11,100 cubic yards
- Flood 2 (close to a 25-yr flood): 6,800 cubic yards
- Flood 3 (2,000 cfs for 30 hours): 2,360 cubic yards

Joe Coudriet, of Flood and Drainage at Reno Public Works, recommends a fund of \$29,000 per year for maintenance of the Park to remove sediment. If the channel dredging were extended downstream for flood protection, the cost would likely increase substantially.

## 2.4.2 Dredging Analysis in HEC-RAS

Two different dredging scenarios were evaluated by the Study Team to determine how much the channel capacity could be increased. The first scenario evaluated was dredging the channel an average of 5 feet through the downtown reach. The second scenario is extending this dredging from downstream of the Whitewater Park just downstream of Arlington Avenue, to Wells Street to the east.

### 2.4.2.1 Five-foot Dredging Scenario in the Downtown Area

In response to questions from the City, the Team evaluated a 5-foot deep dredging scenario starting at 2<sup>nd</sup> Street and extending upstream to between Arlington and Sierra. This analysis was conducted while making broad assumptions in order to produce preliminary results in a timely manner. The HEC-RAS software allows the modeler to quickly sketch dredging scenarios by specifying a channel template and interpolating between two points. This method was used for this analysis. Note that this method could result in depths that vary from 5 feet of depth from the existing channel bottom. A conservative approach was taken by dredging slightly deeper than 5 feet in some areas.

Dredging the channel bottom by 5 feet will impact the geomorphology of the channel in ways that cannot be predicted without a full fluvial study. The dredged area will become a sediment trap during high flows in the future and will require frequent dredging. The bridge and channel retaining wall foundation designs in this area would need to be reviewed before finalizing this proposed dredge depth. Dredging at this depth could adversely impact the structural integrity of bridge and/or wall foundations in and adjacent to the river.

It was assumed that after dredging, the channel would be rectangular in shape and 140 feet wide. It was assumed that all the bridges would remain the same as they are today. The results of this analysis show that the water surface could be reduced slightly under the 100-year flood and more significantly under the 50-year flood. Figures 2-2, 2-3, and 2-4 show

the resulting hydraulic profiles from the 5-foot dredging scenario for the 100-, 74-, and 50-year flood events, respectively. The pink line is the existing channel bottom, the black line is the channel bottom after dredging (~5 feet lower), the red line is the WSEL after dredging, and the blue line represents existing conditions.

Note that the transitions into the dredged area show an abrupt and relatively steep section representing a drop structure or short heavily armored drop. This drop could be incorporated into the future Whitewater Park extension. A 5-foot drop in the river will produce flow conditions that will require extensive protection against scour.

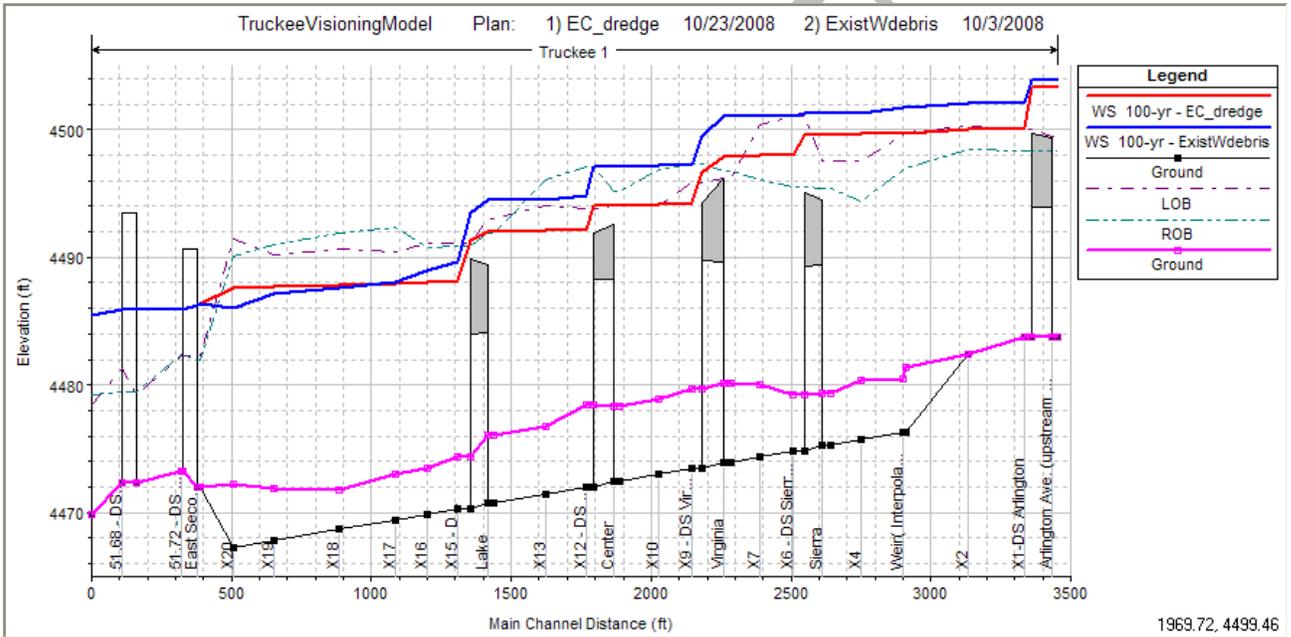


FIGURE 2-2  
Dredging Scenario, 100-year Flood Event Hydraulic Profile  
\*WS = Water surface, EC = Existing Channel

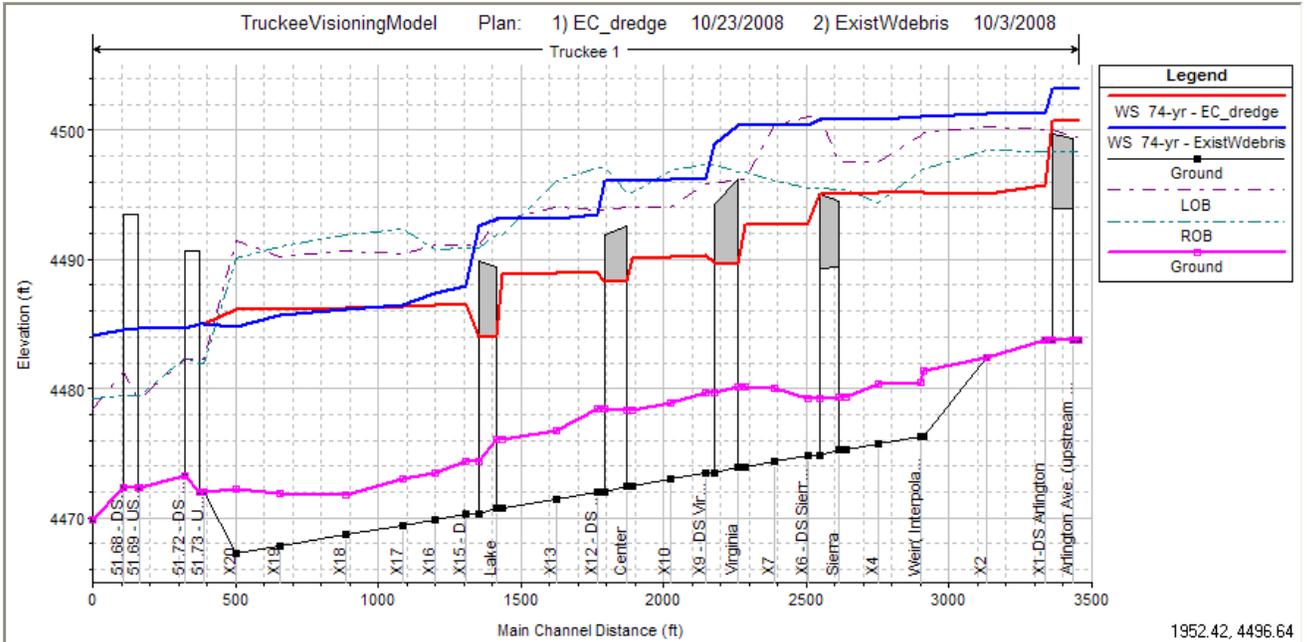


FIGURE 2-3  
Dredging Scenario, 74-year Flood Event Hydraulic Profile

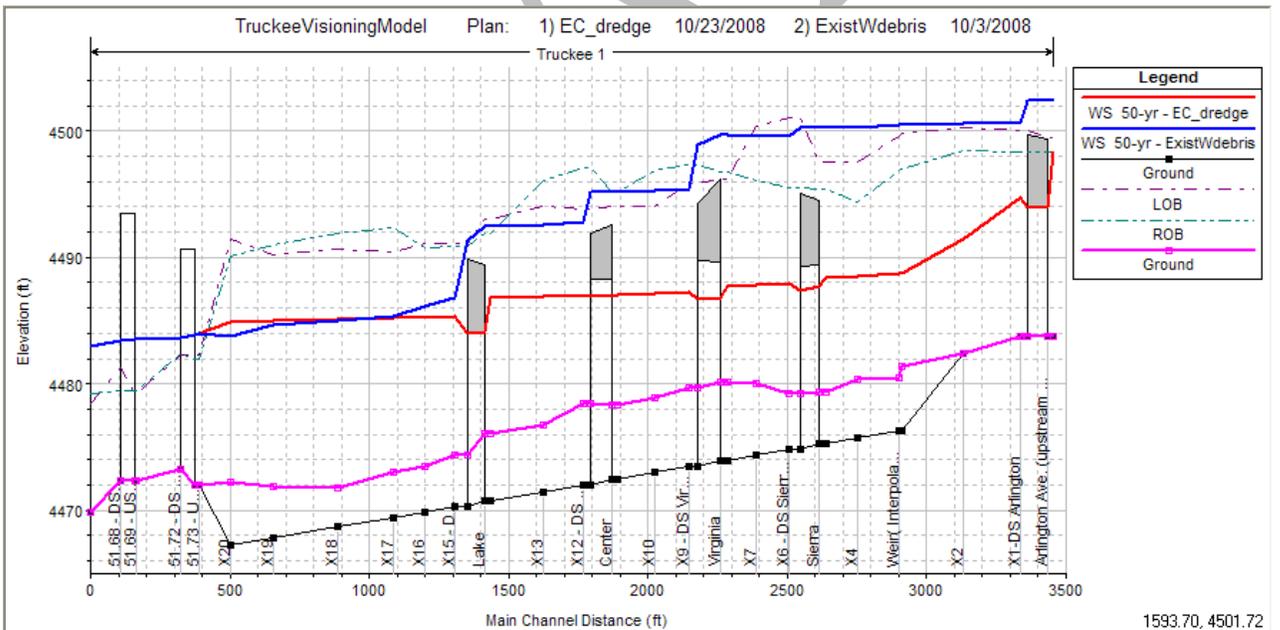


FIGURE 2-4  
Dredging Scenario, 50-year Flood Event Hydraulic Profile

The hydraulic analyses indicate that the dredging would reduce flooding; however, the hydraulic analyses do not account for the sedimentation that would occur prior to the peak discharge, thereby nullifying most of the dredging benefit.

### 2.4.2.2 Extended Dredging Scenario

The rough hydraulic evaluation shows that extending the dredging at 5 feet of depth further downstream from 2<sup>nd</sup> Street would further reduce the modeled flood levels. This assumed dredging begins downstream of Wells Avenue and continues upstream to Whitewater Park between Arlington Avenue and Sierra Streets. This dredging scenario represents a major change to the river morphology and would likely have a significant impact on sediment transport. It is unknown whether this option is feasible due to possible negative impacts on structural foundations within the channel.

An attempt was made to simulate another dredging scenario for this reach using the original COE HEC-RAS model that uses an unsteady flow regime. The transition from the existing channel to the dredged channel caused instabilities in the model and reasonable results could not be obtained within a timely manner. An attempt was made to estimate an approximate order of magnitude benefit from dredging this reach by extrapolating a WSEL by hand and without doing any backwater or normal depth calculations. The drop in WSEL from the previous example was used as a basis for extrapolating the estimated benefit further downstream. It was assumed that where backwater from bridges does not affect the WSEL profile, normal depth slope would follow parallel to the channel bottom. Figure 2-5 below shows an estimated representation of a possible WSEL profile under the 100-year flood event using engineering judgment and the assumptions that were stated previously.

Note that the existing conditions geometry data used in this COE model is different than the newly updated model being used for this TRAction Study analysis. Also note that the debris conditions were not removed from any of these dredging scenarios. Debris is simulated by artificially dropping the low chord of the bridge 4 feet if the WSEL comes within 2 feet of the actual low chord. As shown in Figure 3-5, this kind of dredging scenario could lower the WSEL profile during a 100-year flood event. However, as seen in the Figure 2-5, it is likely that the existing bridges could still have a significant impact on flooding in downtown.

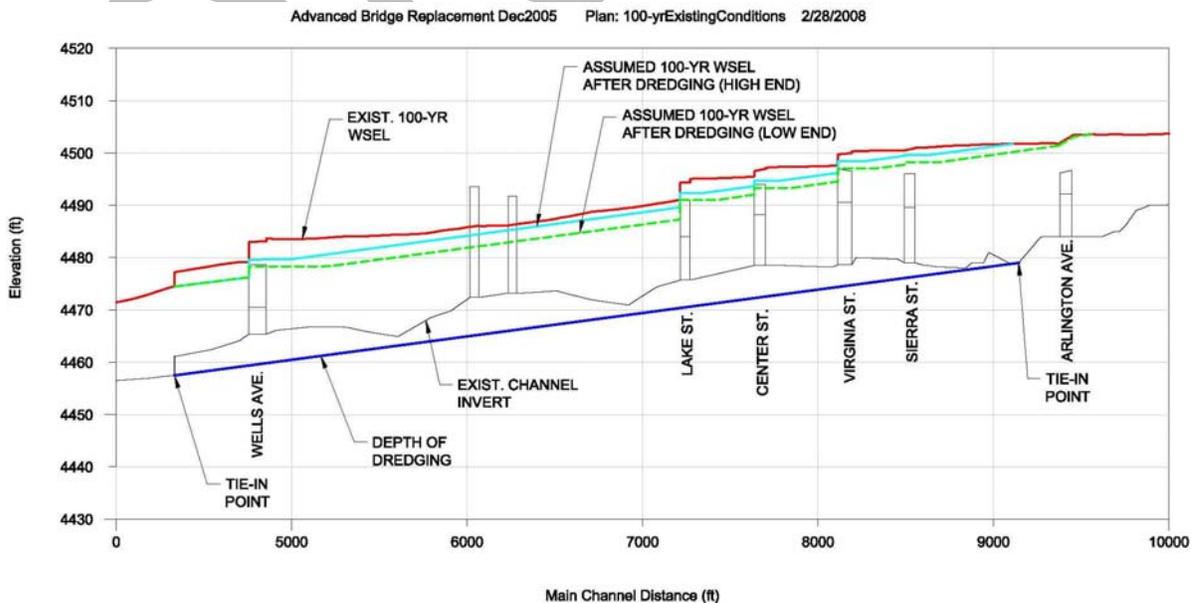


FIGURE 2-5  
Extended Dredging Scenario, Assumed 100-year Hydraulic Profile

The potential reduction in flooding is purely hypothetical and based on this very limited analysis. To develop a more accurate accounting of the impacts and any potential benefits resulting from dredging of the Truckee River would require a detailed fluvial study. However, the result from the Wood Rodgers analysis for Whitewater Park provides information that can be extrapolated to the dredging further downstream. This previous work indicates that dredging the channel may not be effective in reducing flooding due to sediment filling in the channel and would require periodic maintenance.

## 2.5 Widening Analysis

The Team evaluated widening the channel by 50 feet on each bank between Lake Street and 2<sup>nd</sup> Street to determine how widening may improve the conveyance capacity through the downtown reach based on a 50-year flood event. Results of this analysis show that widening this reach of the channel will not increase the hydraulic capacity for flood flows. Figure 2-6 is an example cross-section showing what the channel will look like after widening. The pink line represents existing channel conditions.

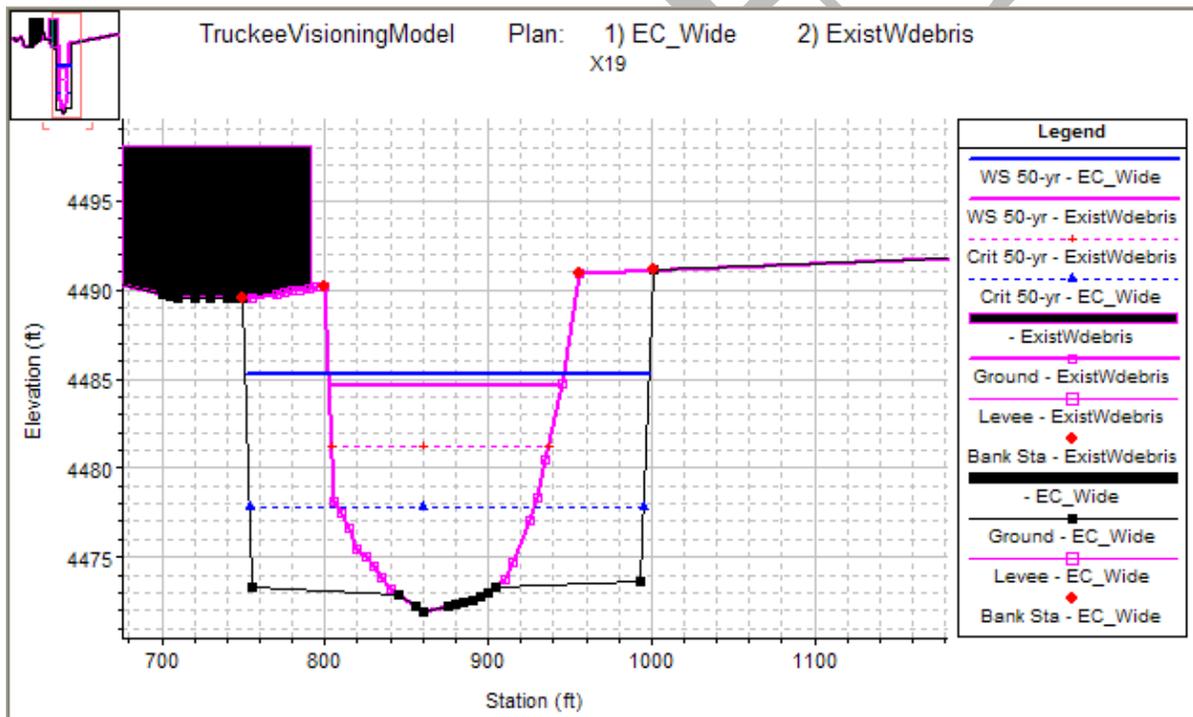


FIGURE 2-6  
Widening Scenario, 50-year Flood Event—Cross-Section  
\*Crit = Critical, Bank Sta = Bank Station

Figure 2-7 is a plot of the resulting hydraulic profile showing the effects of widening the channel by 50 feet on each side. The results from the 74-year and 100-year events are impacted in a similar fashion compared to the existing conditions.

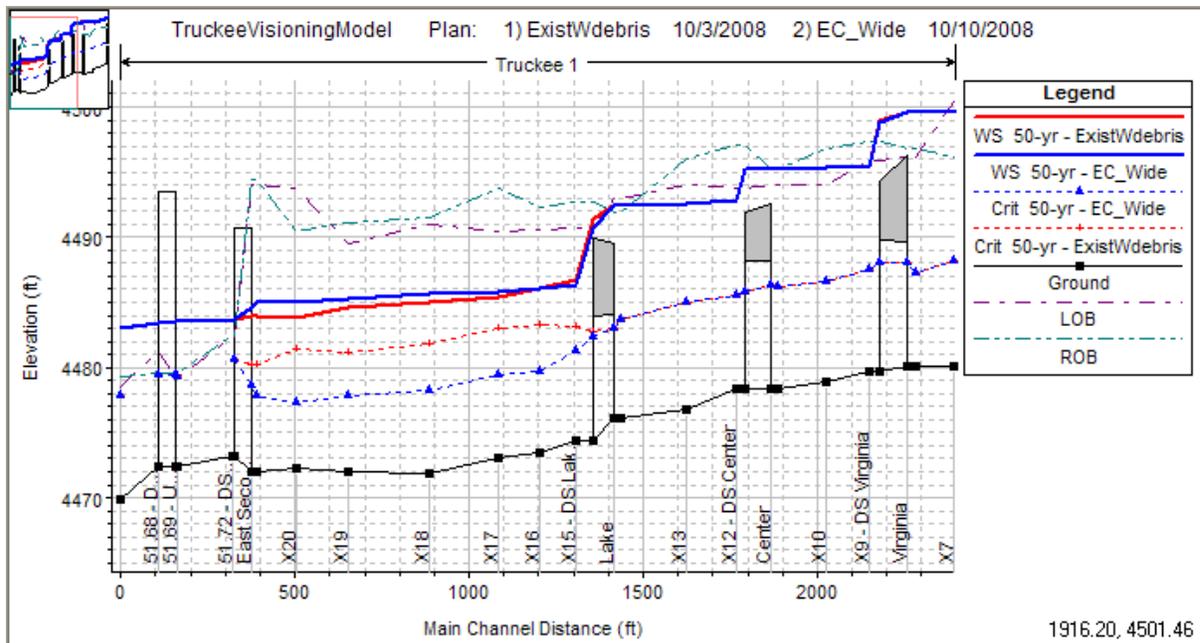


FIGURE 2-7  
Widening Scenario, 50-year Flood Event—Hydraulic Profile

The blue line in Figure 2-7 represents the water surface during a 50-year flood with a widened channel, and the red line is existing conditions. Widening the channel significantly slowed velocities in this reach and is the reason the water surface increases at 2<sup>nd</sup> Street. Decrease in velocity is the only benefit found from widening this reach. However, slower velocities in this reach may also result in sediment collecting, creating additional decrease in capacity. The important areas to focus on in the downtown section are the areas with significant headloss. The focus should be on those areas to reduce flooding, and those areas are the bridges. Notice the 6-foot drop at Lake Street compared to an only 2.5-foot drop in the channel reach below Lake Street.

It is likely that widening the channel just downstream from 2<sup>nd</sup> Street would also have minimal benefit. Widening the channel for much longer distances downstream would probably help the downtown area but would likely be cost-prohibitive. It is not known how much further downstream this would need to take place. The widening would need to be continuous, because a narrowed section would cause backwater impacts that could be significant.

## 2.6 FEMA Requirements and Mapping

The City inquired of the Team if Federal Emergency Management Agency (FEMA) regulates the freeboard at bridges. We contacted Sarah Owen ([510] 627-7050) with FEMA Region 9 and she clarified that FEMA does not regulate bridges and does not have freeboard requirements for bridges.

For FEMA to give credit for flood reduction based on a levee, the levee requires 3 feet of freeboard. Based on the survey information we have, the buildings along the downtown reach of the Truckee River will not be in the future floodplain of the downtown reach if we

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proceed with the proposal to raise the bridges 2 feet over the 100-year flood level. Therefore, no levees will be required.

The regulatory FEMA floodplain can be drawn to where the WSEL calculated by the hydraulic model intersects the ground along the Truckee River. Under current conditions, buildings outside of this floodplain will not be in the floodplain of a 100-year flood design and will not be required to purchase flood insurance. Additional surveying will be required around some buildings to verify whether they are above the base (100-year) flood elevation.

The FEMA floodplain map indicates that during a 100-year flood event with the 100-year flood design, some small areas outside of the river channel may flood. This includes an area on the south bank along Island Avenue just upstream of Sierra Street and another area just upstream of Lake Street. The results of the model do not show flooding in these areas, but low spots along the roads are lower in elevation flood profile in the river.

## 2.7 Booth and Arlington Impacts

The original COE model was used to answer the question of whether Arlington Avenue and Booth Street bridges would affect potential flooding. As no additional survey and geometry data were obtained upstream of Arlington Avenue under the current scope of work, the Study Team relied on previous analysis to provide a preliminary evaluation of these potential effects to the river system.

Figure 2-8 is a profile plot showing the WSEL from Booth Street down to Arlington Avenue under the 100-year flood condition. The water level at Arlington Avenue was manually set at the elevation calculated from the calibration HEC-RAS model completed by CH2M HILL. As seen in Figure 2-8, a fairly flat backwater curve continues upstream from Arlington Avenue for about 700 feet (refer to the red line labeled 'PF 1'). This backwater is due to a constriction in flow at Arlington Avenue. Another scenario was analyzed where the water surface at Arlington Avenue was dropped by 6 feet (see the blue dashed line labeled 'PF 2').

No matter where the water surface starts at Arlington Avenue, the WSEL is identical starting about 700 feet upstream of this point. The WSEL of either scenario matches at this point because the flow in the channel has returned to normal depth and the profile is no longer affected by the backwater from Arlington Avenue.

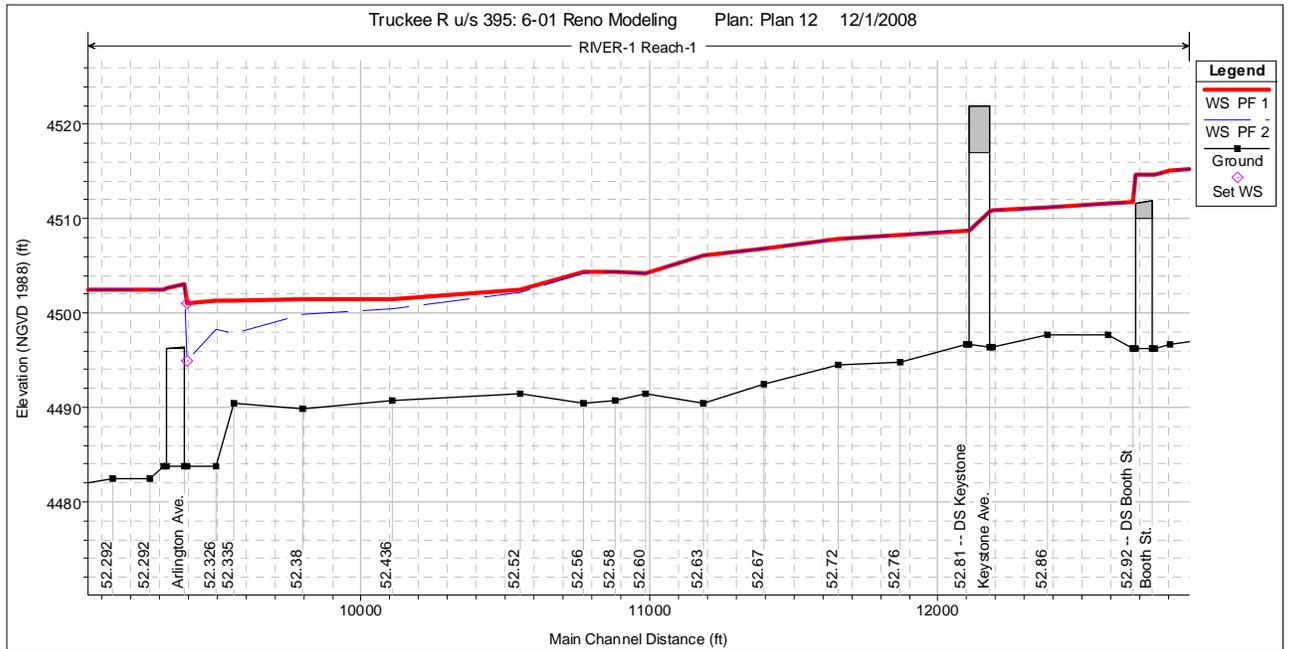


FIGURE 2-8  
Effects of WSEL Changes at Arlington Ave. on WSEL at Booth Street

## 2.8 Conclusions

The following conclusions are based on the results from the hydraulic modeling, bridge analysis, dredging, and widening studies:

1. Raising bridges in the downtown reach:
  - Would increase the flow capacity of the channel.
  - Would reduce the chance of debris collecting on the bridges.
  - Depending on the bridges that are replaced, would provide up to a 100-year level of protection.
2. Dredging just the downtown reach by 5 feet would likely have the following impacts:
  - Would increase the amount of sediment deposited in the downtown reach and thus increase required maintenance.
  - May provide up to a 50-year level of protection without changing the bridges assuming the channel does not refill with sediment prior to the peak discharge.
  - Would likely result in flooding under 74-year event due to debris blockage at Lake Street.
  - Would reduce flooding under 100-year event if the channel remains free of sediment, but only slightly.

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3. Extended dredging by 5 feet from Wells Avenue to Arlington Avenue would likely have the following impacts:

- Would increase the amount of sediment deposited in the downtown reach and thus increase required maintenance – high flow events increase sediment deposits and can counter any benefits of dredging.
- May provide up to a 50-year level of protection without changing the bridges, assuming the channel does not refill with sediment prior to the peak discharge.
- Would likely provide a 74-year level of protection with a lower WSEL at Lake Street, assuming the channel does not refill with sediment prior to the peak discharge.
- Under the 100-year event, it is likely that flooding would be reduced, assuming the channel does not refill with sediment prior to the peak discharge.

4. Widening the channel in the downtown reach:

- Would increase the amount of sediment deposited in the downtown reach and thus increase required maintenance.
- Would not increase flood capacity in the downtown area.
- Would not prevent the Lake Street bridge from causing a 5-foot rise in WSEL and causing flooding upstream.

5. Center bridge piers:

Removing center piers would have little impact on WSEL.

Raising the bridge deck (of any structure type) would have a significant impact on WSEL.

Raising the bridges will provide a practical solution to minimize flooding in the downtown area without increasing required maintenance. Dredging the channel on a large scale could slightly increase the capacity of the channel if it does not refill with sediment, but there are many effects of dredging that are not currently understood, many of which are known to increase the cost of maintenance significantly. Even a very ambitious (and possibly risky) dredging project may not provide 100-year or 74-year flood protection if the bridges are not raised.



# 3.0 Roadway and Bridge Design

To develop an accurate analysis of physical and visual impacts to the downtown river corridor, and to understand the relative costs of mitigating these impacts, a conceptual level design was prepared for replacing the four downtown bridges and adjacent roadway sections on the north and south sides of the river. Following are the design criteria, assumptions and results of this conceptual level engineering effort.

## 3.1 Design Criteria

The horizontal alignment for the roadways is based on existing geometry. We assumed the future roadways will retain the path and width of existing roadways, although the existing horizontal curvature does not meet current standards based on the American Association of State Highway and Transportation Officials' *Policy on Geometric Design of Highways and Streets* (AASHTO, 2001). Roadway profiles are based on results from the hydraulic modeling analysis shown in Table 3-1. We used the water surface elevation for each flood event and added height for required freeboard (2 feet as the City criterion) and an estimated depth of bridge structure to calculate the minimum bridge surface elevation. The depth of the bridge structure varies based on the type of structure, the width of the bridge, and the number of spans as discussed later in this section of the report.

TABLE 3-1  
Water Surface Elevations from Hydraulic Models

Flood Event	Elevation at Sierra Street (ft)	Elevation at Virginia Street (ft)	Elevation at Center Street (ft)	Elevation at Lake Street (ft)
50-year	4,490.56	4,490.57	4,488.88	4,487.24
74-year	4,491.67	4,491.79	4,490.10	4,488.52
100-year	4,493.16	4,493.58	4,491.83	4,490.29

Roadway profiles were designed based on criteria from three sources: calculated minimum bridge surface elevations, AASHTO policy, and the desire for as little impact as possible. The impact of the design is measured both by visual impact and length of roadway approach reconstruction required. The criteria from AASHTO policy are listed in Table 3-2. The drivers' sight distance is particularly important due to the amount of pedestrian traffic in the area.

TABLE 3-2  
AASHTO Roadway Design Criteria

Criterion	Minimum Value	AASHTO Exhibit Referenced
Design Speed	30 mph	N/A
Stopping Sight Distance	200 ft	3-1
K <sub>crest</sub>	19	3-75
K <sub>sag</sub>	37	3-78

Source: AASHTO

## 3.2 Flood Designs and Approach Impacts

Reconstruction of the bridges in downtown Reno will require raising the approach roads to pass the 74-year and 100-year flood designs. The bridges will be set at an elevation high enough over the flood design to have a freeboard clearance and accommodate the depth of the bridge superstructure. Reconstructing the approach roads to match the new bridge elevations will impact the properties and public facilities adjacent to the roads.

Freeboard clearance is the distance between the flood design's water surface elevation and the bottom of bridge superstructure. The freeboard clearance allows debris to pass under the bridge without obstructing flows.

The depth of bridge is dependent upon many factors. For this project, two bridge types were identified that provided the thinnest bridge section while minimizing the number of supports in the river. The bridge types are discussed in more detail in the Section 3.3, Discussion of Bridge Types.

### 3.2.1 Flood Designs

The capacity of the existing Truckee River channel is restricted by the existing bridge crossings, and is dependent on the amount of debris that accumulates on the structures. As flows increase and the water surface elevation begins to reach the bottom of the existing bridge decks, there is a tendency for debris to catch on the bridge decks and block the flow. With its low profile, the Lake Street Bridge is very susceptible to collecting debris and ultimately causes flow to back up throughout the downtown reach of the river. With debris assumed to partially block flows at Lake Street, the channel has a capacity of about 10,000 cfs before the flow overtops the bank just upstream of the Lake Street Bridge. This flow volume represents a flood with a return period of between 10 and 50 years. The project evaluated four flood designs, all of which provide an increased flood protection for downtown Reno. The four flood designs are described below:

- **Scenario #1 - 50-Year flood design with 2 feet of freeboard.** The 50-year flood design is considered the lowest level of flood protection and has a corresponding flow of 13,700 cfs. The area of flooding outside the Truckee River channel associated with the

50-year flood is shown in the inundation maps located in Appendix D. Three of the four downtown bridges require replacement to accommodate the 50-year flood design. The Center Street Bridge will not be replaced for this flood design.

- **Scenario #2 - 74-Year flood design with 2 feet of freeboard.** The 74-year flood design corresponds approximately to the historical flood event of 2005 and has a flow of 16,400 cfs. This flood design is considered an intermediate level of flood protection. The area of flooding outside the Truckee River channel associated with the 74-year flood is shown in the inundation maps located in Appendix D. All four downtown bridges require replacement to accommodate the 74-year flood design.
- **Scenario #3 - 100-Year flood design with 2 feet of freeboard.** The 100-year flood design corresponds to the highest level of flood protection and has a corresponding flow of 20,700 cfs. The area of flooding outside the Truckee River channel associated with the 100-Year Flood is shown in the inundation maps located in Appendix D. All four downtown bridges require replacement to accommodate the 100-year flood design.
- **Scenario #4 - 100-Year Corps' Flood design with 4 feet of freeboard.** The 100-year flood design corresponds to the highest level of flood protection and has a corresponding flow of 20,700 cfs. The area of flooding outside the Truckee River channel associated with the 100-year flood is shown in the inundation maps located in Appendix D. All four downtown bridges require replacement to accommodate the 100-year flood design. A freeboard clearance of 4 feet complies with COE requirements.

### 3.2.2 Approach Impacts

The level of impact associated with the reconstruction of the approach roads is directly related to how high the bridges must be raised. The length of roadway approach reconstruction increases as the bridge elevation increases. Appendix F shows new road profiles for each roadway and associated flood design. The level of impacts to adjacent property and public facilities increases as the flood protection levels increases. The following subsections present a summary of the impacts.

#### 3.2.2.1 Sierra Street

Table 3-3 shows the approximate amount of increase in the elevation of Sierra Street at the north side and south sides of the river necessary to accommodate the various flood designs.

TABLE 3-3  
Sierra Street Elevation Increases Required to Accommodate Flood Designs

Flood Design	North Side of River	South Side of River
50-Year + 2 feet Freeboard	0.25 feet	1.0 feet
74-Year + 2 feet Freeboard	1.25 feet	2.75 feet
100-Year + 2 feet Freeboard	2.5 feet	4.0 feet
100-Year + 4 feet Freeboard (COE)	4.5 feet	5.5 feet

**Note:**

Table presents approximate increases in street elevation needed to accommodate the flood designs. Assumes Above-Supported Bridges; Below-Supported Bridges require 0.5 feet more on the north and south sides.

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### **Northeast Corner**

- Truckee River Lane runs along the north edge of the river from Sierra Street to the east. Each of the flood designs requires some reconstruction of Truckee River Lane. The 50-year flood design requires little reconstruction while the 100-year plus 4 feet of freeboard flood design requires reconstruction from Sierra Street to about halfway to Virginia Street.
- The Palladio condominium complex is located along the north edge of Truckee River Lane and along the east side of Sierra Street from Truckee River Lane to First Street. The 50-year flood design has little to no impact on the Palladio. However, the 100-year plus 4 feet of freeboard flood design requires modification to many of the steps on the south side of the building along with construction of a retaining wall and modification to entrances along the west side of the building.

### **Northwest Corner**

- Truckee River Lane runs along the north edge of the river from Sierra Street to the west. Each of the flood designs requires some reconstruction of Truckee River Lane. The 50-year flood design requires little reconstruction of Sierra Street while the 100-year plus 4 feet of freeboard flood design requires about 200 feet of reconstruction.
- The Century Theaters complex is located along the north edge of Truckee River Lane and along the west side of Sierra Street from Truckee River Lane to First Street. The 50-year flood design has little to no impact on the Century Theaters. However, the 100-year plus 4 feet of freeboard flood design requires modification to many of the steps on the south side of the building along with construction of a retaining wall and modification to entrances along the east side of the building.

### **Southeast Corner**

- The Riverwalk runs along the south edge of the river from Sierra Street to the east. Each of the flood designs requires some reconstruction of the Riverwalk with the 50-year flood design requiring about 50 feet of reconstruction and the 100-year plus 4 feet of freeboard requiring reconstruction halfway to Virginia Street.
- A vacant lot sits south of the Riverwalk with the County Courthouse south of the vacant lot. Construction of a retaining between the Riverwalk and vacant lot is required for all flood designs except the 50-year flood design. There are two approaches along the east side of Sierra Street south of the bridge that will require some reconstruction for the 100-year flood design.

### **Southwest Corner**

- The Riverwalk runs along the south edge of the river from Sierra Street to the west. Each of the flood designs requires some reconstruction of the Riverwalk with the 50-year flood design requiring approximately 50 feet of reconstruction and the 100-year plus 4 feet of freeboard requiring approximately 275 feet of reconstruction.
- Island Avenue Drive runs from Sierra Street to the west and is located between the Riverwalk and Reno City Municipal Court. Reconstruction of Island Avenue Drive is required for the 50-year and 74-year flood designs. The 100-year flood designs may

require closure of Island Avenue at Sierra Street. Access will be maintained to the entrance of the Reno City Municipal Court parking lot on Island Avenue.

- The Reno City Municipal Court is located along the south side of Island Avenue and the west side of Sierra Street. The 50-year flood design will have little to no impact on the Court. However, the 74-year and 100-year flood designs require construction of retaining walls along the edge of building on both Sierra Street and Island Avenue.

### 3.2.2.2 Virginia Street

Table 3-4 shows the approximate amount of increase required on Virginia Street at the north side and south side of the river to accommodate the flood design.

TABLE 3-4  
Virginia Street Elevation Increases Required to Accommodate Flood Designs

Flood Design	North Side of River	South Side of River
50-Year + 2 feet Freeboard	0 feet	0.75 feet
74-Year + 2 feet Freeboard	1.75 feet	2.25 feet
100-Year + 2 feet Freeboard	3.0 feet	2.75 feet
100-Year + 4 feet Freeboard (COE)	5.0 feet	4.75 feet

**Note:**

Table presents approximate increases in street elevation needed to accommodate the flood designs. Assumes Above-Supported Bridges; Below-Supported Bridges require 0.5 feet more on the north and south sides.

#### Northeast Corner

- The 10 North Virginia Street Plaza is located along the north edge of the river and along the east side of Virginia Street. The 50-year flood design has no effect on the 10 North Virginia Street Plaza. The 100-year plus 4 feet of freeboard flood design requires reconstruction of the walkway along the river for about 250 feet to the east from Virginia Street. Retaining walls are required along the existing planters up to the intersection of First Street.

#### Northwest Corner

- Truckee River Lane runs along the north edge of the river from Virginia Street to the west. The 50-year flood design requires no reconstruction of Truckee River Lane while the 100-year plus 4 feet of freeboard flood design requires reconstruction half way to Sierra Street.
- The Masonic Building is located along the north edge of Truckee River Lane and along the west side of Virginia Street from Truckee River Lane to First Street. The 50-year flood design has no impact on the Masonic Building. The 100-year plus 4 feet of freeboard flood design requires construction of retaining walls along the south edge of the building and in the sidewalk along Virginia Street to allow access into the Masonic Building.

#### Southeast Corner

- The Post Office parking lot runs along the south edge of river from Virginia Street to the east. Reconstruction of the parking lot is under consideration and would turn this area

into a pedestrian plaza. The 50-year flood design will have little impact on the pedestrian plaza design. The 100-year plus 4 feet of freeboard flood design requires construction of taller retaining walls in the pedestrian plaza and increased ramp slopes within the Plaza.

### Southwest Corner

- The Riverwalk runs along the south edge of the river from Virginia Street to the west. The 50-year flood design requires little reconstruction of the Riverwalk. The 100-year plus 4 feet for freeboard flood design requires reconstruction of the Riverwalk half way to Sierra Street.
- The Riverside Artist Lofts is located along the south edge of the Riverwalk and west side of Virginia Street. The 50-year flood design has no impact on the Riverside. The 100-year plus 4 feet of freeboard clearance flood design requires construction of a retaining wall in the sidewalk and Riverwalk to allow access into the Riverside.

### 3.2.2.3 Center Street

Table 3-5 shows the approximate amount of increase required on Center Street at the north side and south side of the river for each flood design. The Center Street Bridge is not replaced for the 50-year flood design.

TABLE 3-5  
Center Street Elevation Increases Required to Accommodate Flood Designs

Flood Design	North Side of River	South Side of River
50-Year + 2 feet Freeboard	N/A	N/A
74-Year + 2 feet Freeboard	4.0 feet	1.0 feet
100-Year + 2 feet Freeboard	4.0 feet	2.5 feet
100-Year + 4 feet Freeboard (COE)	5.75 feet	4.5 feet

**Note:**

Table presents approximate increases in street elevation needed to accommodate the flood designs. Assumes Above-Supported Bridges; Below-Supported Bridges require 0.5 feet more on the north and south sides.

### Northeast Corner

- A pedestrian path is located along the north edge of river and runs to the east. All flood designs require reconstruction of the sidewalk from the edge of bridge to the ATT building.
- A park is located north of the sidewalk and east of Center Street. A retaining wall around the park will be required for all flood designs.

### Northwest Corner

- The 10 North Virginia Street Plaza is located along the north edge of the river and along the west side of Center Street. All flood designs require reconstruction of the walkway along the river for at least 200 feet to the west. Retaining walls are required along the edge of sidewalk to the intersection of First Street.

### Southeast Corner

- The Siena Hotel is located along the south edge of river and along the east side of Center Street. The 74-year flood design will have little effect on the Siena Hotel. The 100-year flood designs will require reconstruction of the exit steps located at the edge of bridge. A retaining wall is required along the edge of sidewalk adjacent to the Siena. The 100-year plus 4 feet of freeboard flood design requires reconstruction of the entrance.

### Southwest Corner

- The Post Office parking lot runs along the south edge of river from Center Street to the west. Reconstruction of the parking lot is under consideration and would turn this area into a pedestrian plaza. The 74-year flood design has only a slight effect on the new plaza design while the 100-year flood designs require construction of taller retaining walls and increased ramp slopes in the pedestrian plaza.

### 3.2.2.4 Lake Street

Table 3-6 shows the approximate amount of increase required on Lake Street at the north side and south side of the river for each flood design.

TABLE 3-6  
Lake Street Elevation Increases Required to Accommodate Flood Designs

Flood Design	North Side of River	South Side of River
50-Year + 2 feet Freeboard	2.25 feet	1.75 feet
74-Year + 2 feet Freeboard	4.5 feet	4.0 feet
100-Year + 2 feet Freeboard	5.25 feet	4.5 feet
100-Year + 4 feet Freeboard (COE)	7.25 feet	6.5 feet

**Note:**

Table presents approximate increases in street elevation needed to accommodate the flood designs. Assumes Above-Supported Bridges; Below-Supported Bridges require 0.5 feet more on the north and south sides.

### Northeast Corner

- A vacant property exists along the north edge of river and runs along the east side of Lake Street. This property is planned for improvements in the future. All flood designs require a retaining wall between the sidewalk and vacant property, varying from 100 to 300 feet in length.

### Northwest Corner

- A sidewalk runs along the north side of the river to the west. The 50-year flood design will have little effect on the sidewalk. The sidewalk will require reconstruction up to the ATT building for all other flood designs.
- The La Famiglia Restaurant is located north of the sidewalk and west of Lake Street. A retaining wall is required between the Lake Street sidewalk and restaurant. The length of the retaining wall for the 50-year flood design will not adversely impact the restaurant. The length of retaining wall for the other flood designs must wrap around the First Street intersection and continue to the west. It is probable the restaurant will be adversely affected by these flood designs.

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- First Street runs to the west just north of the La Famiglia Restaurant. All flood designs except for the 50-year flood design require reconstruction of a portion of First Street and its sidewalks.
  - The ATT building is located on the north side of First Street and along the west side of Lake Street. Construction of a retaining wall adjacent to the building and modification to the building access is required for all flood designs except the 50-year flood design.

#### Southeast Corner

- A pedestrian path is located along the south side of the river and extends to the east. All flood designs require reconstruction of the pedestrian path. The extent of reconstruction varies from about 75 to 300 feet in length depending upon the flood design.
- The National Auto Museum is located south of the pedestrian path and east of Lake Street. An entrance with sidewalk is located near the end of bridge. Reconstruction of the sidewalk along with construction of retaining walls is required for all flood designs. An additional retaining wall is required between the Lake Street sidewalk and museum planter that extends up to the Mill Street intersection.

#### Southwest Corner

- The Siena Hotel is located along the south edge of river and along the west side of Lake Street. The hotel's main exit is located on the south end of the bridge. The exit requires moderate reconstruction for the 50-year flood design. The 74-year and 100-year plus 2 feet of freeboard flood designs require extensive reconstruction of the exit. The 100-year plus 4 feet of freeboard flood design may require the exit be closed. A retaining wall between the Lake Street sidewalk and hotel planter can extend as far as the Mill Street intersection.

### 3.3 Discussion of Bridge Types

Improving flood capacity requires replacement of the bridges in downtown Reno. The bridges must be set at a higher elevation to allow the flood design to pass under the bridge without the accumulation of debris on the superstructure. The approach roads must be reconstructed to match the increased bridge elevation. The urban landscape is highly developed with the existing approach roads being fairly flat. To reduce impacts to adjacent properties, the increased bridge and roadway elevation must be minimized as much as possible.

Three factors influence how high the bridge elevation is set:

- **Flood design.** Four flood designs are being considered in this study, see above. Each flood design has a different water surface elevation. The water surface elevation increases with level of flood protection.
- **Freeboard clearance.** The freeboard clearance is the distance from the top of flood design water surface to the bottom of the lowest point on the bridge superstructure. It provides a measure of safety for accumulation of debris. Values of 2 and 4 feet are used in this study depending upon the amount of flood protection desired.

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- **Structure depth.** Structure depth or the thickness of the bridge is dependent upon the type of bridge (girder, truss, arch), materials used (structural steel, prestressed concrete, reinforced concrete) and the number of spans.

The structure depth must be minimized without affecting the flood capacity or structural performance. It is generally undesirable to place supports in the river. The supports can allow debris to accumulate reducing the area of opening under the bridge. Ideally, a clear span bridge with no supports eliminates debris accumulation.

### 3.3.1 Conventional Highway Bridges – Below Bridges

Conventional highway bridges include steel girders, precast prestressed concrete girders, and cast-in-place prestressed concrete. The supports to these structures are below the riding surface of the bridge (Below Bridges). These types of bridges must have a structure depth of about 4 to 4.5 percent of their span length to ensure a cost effective structural performance along with minimizing flexibility and vibration characteristics that can be uncomfortable for pedestrians.

A clear-span conventional highway bridge requires a structure depth of about 7 feet for the spans in this study. This is unacceptably deep due to the profile adjustment required and adverse impacts on adjacent properties. Placing one support in the river reduces the structure depth to about 4 feet which reduces the profile adjustment to a more acceptable level. However, the river support will reduce the opening under the bridge due to debris accumulation and the bridge will not allow as much flood water to pass. To counter this, the south abutment of all four bridges was moved back to increase the total bridge length. This offsets the reduced area caused by the support and associated debris accumulation. A 2-span conventional highway bridge having a structure depth of 4 feet is an acceptable alternative for the bridges in this study.

### 3.3.2 Signature Highway Bridges – Above Bridges

Signature bridges include arches, trusses, cable-stay and suspension structures. They have the main supports above the riding surface of the bridge (Above Bridges). The structure depth below the riding surface depends upon the floor system and the span along the width of the bridge and not its length. For the road widths considered, the signature bridges in this study require a structure depth of about 3.5 feet. Signature bridges have a construction cost of from 25% to 100% more than the conventional highway bridges and may have significantly higher maintenance costs depending upon the bridge type. The advantage of the signature bridge is that it has no center pier, is thinner, and provides a unique architectural change to downtown Reno. A clear-span signature bridge with a structure depth of 3.5 feet is an acceptable alternative for the bridges in this study.

### 3.3.3 Redundancy

Redundancy in structural applications is the ability of a load to find an alternative path. This means a redundant bridge having multiple main support members will not collapse if there is a failure in one of the main support members. Redundancy has become especially important in recent years considering the collapse of the I-35W Bridge in Minneapolis and concerns nationwide on bridge security.

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There is a distinct difference in redundancy between the above and below bridge types. All below bridges are redundant having multiple main members. However, the above bridges are considered non-redundant and have the potential of collapse if there is a failure in one of the main members. Protection of the main members is necessary to reduce the potential failure.

### 3.3.4 Comparison of Maintenance Costs

The Below Bridges in this study will have lower maintenance costs compared to the Above Bridges. The main reason is all the Above Bridges will be structural steel that have their members above the riding surface. The Above Bridge members will be exposed to more of the elements compared to the Below Bridges. In addition, the bridges having main cables such as the cable-stay and suspension bridges will have even higher maintenance costs.

The bridges with the lowest maintenance costs will be Below Bridges constructed of prestressed concrete. Below Bridges constructed of structural steel will have a somewhat higher maintenance cost compared to prestressed concrete but will be lower than any of the Above Bridges.

## 3.4 Moveable Bridges

### 3.4.1 General

The impacts of raising bridge elevations and reconstructing approach roads can have a significant impact on adjacent property and public facilities depending upon the desired level of flood protection. An alternative to constructing a conventional fixed bridge with corresponding approach road reconstruction is to build a moveable bridge. A moveable bridge would not require significant approach road reconstruction. The approach road can remain at the existing elevation or require only a minimal increase.

Moveable bridges have a much higher construction and maintenance cost compared to the fixed bridges in this study. In addition, moveable bridges have an operational cost that fixed bridges do not. The additional construction, maintenance and operational costs associated with moveable bridges make them an uneconomical alternative.

### 3.4.2 Types of Moveable Bridges

Moveable bridges are used mainly where there is ship traffic, the vehicular traffic volume is low, and construction of a fixed bridge with enough clearance under it is not economical.

There are three basic types of movable bridges:

- **Swing Bridge:** A swing bridge pivots around a center pier to open the channel.
- **Bascule Bridge:** A bascule bridge is the conventional draw bridge. The bridge is split in into two pieces with a joint in the middle. The pieces pivot vertically at the abutments.
- **Lift Bridge:** A lift bridge spans over the river and lifts upward. Towers are located at each abutment to support the weight of the bridge during the lift.

The swing bridge is not viable for the Truckee River. A large center pier is required for the bridge to pivot on and the bridge remains at the same elevation. The center pier creates an obstruction in the river during floods.

The bascule bridge is viable in that it can accommodate the flood design by pivoting to the vertical position to ensure all of the deck is out of the river.

The lift span bridge is also viable. It can be raised to the elevation needed to accommodate the flood design. The amount of lift will be less than is typically needed for most lift spans but could be as much as 10 feet depending upon the flood design selected for the project.

### 3.4.3 Depth of Moveable Bridge Superstructure

The bascule will cantilever from the abutment to mid-river while the lift span will span the entire river. Each will require a superstructure depth of about 7 feet. The superstructure depth for the fixed bridges is 4 feet.

If the approach roads to the movable bridges do not change elevation, the flood capacity of the channel will be less than the existing bridges due to the greater structure depth. This will require operation of the bridge for lower level floods.

### 3.4.4 Planning-Level Construction Costs

A comparison of planning-level construction costs between the fixed (Below and Above) and moveable bridges is provided in Table 3-7. The costs for the Below and Above Bridges are based on the Lake Street Bridge and the 100-year flood design with 2 feet of freeboard. Costs for the moveable bridges are derived from the Florida Department of Transportation's Bridge Costs for movable bridges.

TABLE 3-7  
Comparison of Construction Costs for Fixed (Below and Above) Bridges and Moveable Bridges

Item	Below Bridges	Above Bridges	Moveable Bridges
Approach Costs	\$3,150,000	\$3,050,000	\$150,000
Structure Costs	\$9,650,000	\$11,250,000	\$31,150,000
Utilities & R/W	\$2,200,000	\$2,200,000	\$200,000
Design Costs	\$950,000	\$1,300,000	\$2,350,000
Construction Engineering	\$1,250,000	\$1,600,000	\$2,800,000
Total	\$17,200,000	\$19,400,000	\$36,650,000

### 3.4.5 Mechanical and Electrical Equipment

Moveable bridges require mechanical and electrical equipment to operate the bridge. The mechanical equipment requires constant maintenance and has shown the need for periodic replacement of parts and major rehabilitation over time. The electrical equipment requires periodic maintenance and replacement. Proper maintenance is required for the bridge to operate when needed.

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### 3.4.6 Operation and Training

Most moveable bridges have a full time tender to open and close the bridge. A movable bridge at one or all locations on the Truckee River will have a limited number of operations to allow flood flows to pass. Periodic inspection and operation will be required to ensure the bridge is operating correctly.

A full time tender will not be required but trained personnel will be needed for the operation. Trained personnel may need to be available on a 24-hour basis.

### 3.4.7 Maintenance Costs

The mechanical and electrical equipment must be maintained to ensure proper operation. Moveable bridges have a history of high maintenance costs. In addition to normal maintenance, full replacement of the mechanical and electrical equipment can be expected at least once during the life of the bridge.

### 3.4.8 Security

The mechanical and electrical equipment will require a secure facility to ensure their operation when needed.

### 3.4.9 Conclusion

Moveable bridges can accommodate the desired level of flood protection and minimize the effect on adjacent property. However, they are not considered an acceptable alternative for this project due to their high construction, maintenance, and operations costs when compared to the fixed bridges.

## 3.5 Arlington Avenue and Booth Street Bridges

The Arlington Avenue and Booth Street Bridges were evaluated to improve their flood capacity as part of this study. The cost estimates were not to the detail afforded the bridges in the downtown reach but were looked at from an order of magnitude basis. The estimates were based on conventional highway bridges for the 74-year flood design with 2 feet of freeboard and 100-year flood design plus 2 feet of freeboard.

### 3.5.1 Arlington Avenue Bridges

Arlington Avenue is located west of the Sierra Street Bridge and is considered just outside of the downtown reach of the Truckee River. Arlington Avenue crosses over the Truckee River on two bridges. The area between the bridges is Wingfield Park. First Street is located along the north bank of the river right at the edge of the north bridge and Island Avenue is located along the south bank at the edge of the south bridge. Both First Street and Island Avenue will require reconstruction if the bridges require an increase in elevation to accommodate the flood design.

The study showed that even for the lowest flood design, 50-year flood design plus 2 feet of freeboard, water comes out of the channel and floods the area between the bridges. Reconstruction of Arlington Avenue is complicated by the high number of pedestrians

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within the park. The speed limit on Arlington Avenue is 15 mph. Any reconstruction of the bridges and Arlington Avenue requires careful consideration of pedestrian access.

Two alternatives for Arlington Avenue were identified:

- Reconstruct the Arlington Avenue bridges at the same locations to the current level of flood protection. This is the least cost alternative in that only the two existing bridges are replaced with a minimal amount of approach road reconstruction. Both existing bridges are considered deficient and eligible for replacement under the Federal Bridge Program. The bridges may require some increase in elevation to keep flood waters within the channel. The park area continues to flood for the all the flood designs.
- Reconstruct the Arlington Avenue bridges with one single bridge that extends between both banks. This results in a 6-span bridge 450 feet long that spans over both existing river channels and the park. Pedestrians using the park would pass under the bridge. The bridge would be 82 feet wide and include 4 lanes of traffic with a sidewalk on each side.

Reconstructing the bridges at their current location and elevation does not meet any of the flood designs and as such is not considered an acceptable alternative. These planning-level cost estimates provided for the Arlington Avenue Bridge are based on replacing both bridges with one new bridge 450 feet long. The one long bridge is considered the acceptable alternative.

### 3.5.2 Booth Street Bridge

Booth Street is located about a half-mile upstream of Arlington Avenue. Booth Street which runs north-south terminates into Riverside Drive which runs east-west along the north side of the river. Idlewild Drive which runs east-west terminates into Booth Street at the southwest corner of the bridge. The existing Booth Street Bridge can accommodate the 50-year flood design with 2 feet of freeboard but requires replacement to meet higher levels of flood protection.

The planning-level cost estimates for the Booth Street Bridge are based on replacing the existing bridge with a new 2-span bridge 128 feet long and 62 feet wide. It provides for 2 lanes of traffic, a center turn lane, shoulders and sidewalks.

The bridge requires increasing its elevation to meet flood design requirements with an associated reconstruction of the approach roads. All approach roads require some level of reconstruction with Riverside Drive being affected the most. Generally the total length of approach road reconstruction is about twice as much for the 100-year flood design compared to the 74-year flood design. Impacts from the approach road reconstruction include:

- **North Side of River.** There are a number of apartment complexes along the north side of Riverside Drive. The driveways accessing these complexes will be impacted by the need to raise Riverside Drive and construct retaining walls. Riverside Drive must be raised up to 5 feet to accommodate the 100-year flood design.
- **South Side of River.** The south side of the river is about 3 feet higher than the north side and the impacts to adjacent properties will not be as high. There is an apartment

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complex on the southeast corner of the bridge. Its driveway access is near the south end of the bridge and will be impacted by the 100-year flood design event.

## 3.6 Conclusions

Increasing Truckee River flood capacity through downtown Reno requires reconstruction of the four bridges for all flood designs considered except for the Center Street Bridge under the 50-year flood design with 2 feet of freeboard. Each bridge must be set at an elevation high enough to clear the flood design with freeboard clearance to minimize the potential for collecting debris. Reconstructing the approach roads to match the new bridge elevations will impact adjacent properties and public facilities. Bridge types were identified that minimize the structure depth and approach road reconstruction.

The challenge is to maximize the level of flood protection while minimizing the effect on adjacent property and keeping costs down.

### 3.6.1 Recommended Flood Design

#### 3.6.1.1 100-Year Flood Design with 2 Feet of Freeboard

The 100-year flood design with 2 feet of freeboard appears to be the best flood design based on cost, level of flood protection, and effect on adjacent property due to approach road reconstruction when compared to the other flood designs.

The reconstruction costs for this flood design are about 5% higher for Sierra Street, Virginia Street, and Center Street compared to the 74-year flood design. The reconstruction costs for Lake Street are about 10% higher. There is also no significant difference between the affect on the approach road reconstructions between these two flood designs. Compared to the 74-year flood design, the 100-year flood design with 2 feet of freeboard provides a higher level of flood protection without a significant cost increase or affect on adjacent property.

### 3.6.2 Other Flood Designs

#### 3.6.2.1 50-Year Flood Design with 2 Feet of Freeboard

The 50-year flood design provides little increase in the current level of flood protection. This flood design has the lowest cost due to low approach costs and the Center Street Bridge remaining in place. This flood design does not appear to provide the increased level of protection needed for downtown Reno.

#### 3.6.2.2 74-Year Flood Design with 2 Feet of Freeboard

The 74-year flood design corresponds approximately to the historical flood event of 2005. This flood design is an intermediate level of protection between the 50 and 100-year flood designs. It requires replacement of all four bridges and reconstruction of approach roads. The total reconstruction costs for each bridge are not much lower than the 100-year flood design with 2 feet of freeboard. There is also no significant difference in the approach road reconstruction requirements between the two flood designs. The 74-year flood design provides a lower level of flood protection compared to the 100-year flood design with 2 feet of freeboard but without a significant decrease in cost or affect on approach reconstruction.

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### 3.6.2.3 100-Year Flood Design with 4 Feet of Freeboard (COE)

The reconstruction costs associated with this flood design averages about 15% higher compared to the 100-year flood design with 2 feet of freeboard. The majority of the cost increase is due to approach road reconstruction. There is a significant change in the affect on adjacent property by increasing the bridge elevations by 2 feet. Two feet of freeboard provides an acceptable level of protection from debris accumulation and is standard for most highway bridge projects. The COE's 4 feet includes an uncertainty in the flood design analysis and the risk of having a high level flood. The 4-foot criteria may be acceptable for locations where an increased freeboard does not come with an adverse affect on adjacent property. This flood design does not appear appropriate for this project due to the affect on adjacent property.

### 3.6.3 Bridge Type

In addition to the Above and Below Bridge types, moveable bridges were considered for the replacement bridges on this project. Below Bridges or conventional highway bridges are recommended for this project due to their low construction and maintenance costs, and the level of structural redundancy they provide.



# 4.0 Cost Estimating

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## 4.1 MCACES Estimates

The COE is recommending a 50-year flood protection for the downtown reach of the Truckee River as part of their National Economic Development (NED). The City of Reno desires a higher level of flood protection for downtown. This higher level of flood protection is known as the Locally Preferred Plan and at the time of preparation of the MCACES it included a 100-year flood protection with 4 feet of freeboard clearance. Cost estimates were prepared for the Locally Preferred Plan under a separate Reno TRAction Project. The cost estimates were prepared using the COE MCACES (Micro-Computer Aided Cost Engineering System) requirements. The MCACES method of cost estimating was used to be consistent with the estimates prepared by the Corps for their 50-year flood protection recommendation.

The MCACES method for cost estimating uses the labor, materials, and equipment needed to construct a project. This requires a well developed design to identify items of work and to be able to calculate fairly accurate quantities. Assumptions were made on the design to develop it to a point where quantities could be calculated, these included:

- New road profiles were developed to match the elevation increases in the bridges. The extent of approach road reconstruction was estimated to identify approach road reconstruction costs. New retaining walls at most adjacent properties were included to account for differences in elevations. New approach pavement, signals, sidewalks, and drainage were also included.
- A single-span tied arch bridge was considered the only viable option at the time of the preparation of the MCACES estimate. This was consistent with the single span bridge assumed by the COE in their cost estimates. The tied arch bridge provided the thinnest bridge superstructure to reduce the effect on adjacent property due to approach road reconstruction.
- Relocation of utilities, reconstruction of approaches, and modification of adjacent property were included in the estimate.

The MCACES estimate is provided in Appendix E.

## 4.2 Downtown Bridge Estimates—74-Year and 100-Year Flood Designs with 2 Feet of Freeboard

Planning-level cost estimates were prepared for the 74-year and 100-year flood designs. Both flood designs incorporate 2 feet of freeboard clearance. The cost estimates were prepared using the unit cost method. The unit cost method is used by most public agencies to develop cost estimates at all stages of project development. It requires quantities for the major work items and includes a contingency for the minor work items and project

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unknowns. The contingency at the early stages of project development is high and will be fine-tuned as the design is refined.

Two bridge types were included in the cost estimates as follows:

- Above Bridges, also called signature bridges, are single-spans that are supported by elements above the deck. They were selected originally for the MCACES estimate to provide a clear span of the river and minimize structure depth. These bridge types include a steel tied arch, steel truss, cable-stay, and suspension. The cost estimates for above bridges are based on the tied arch bridge. The tied arch has a much lower construction and maintenance cost compared to the cable-stay and suspension alternatives. The truss bridge has comparable costs to the tied arch but is considered to have inferior aesthetics.
- Below Bridges were added to the study to try and reduce bridge costs and provide a structure type that does not have its supports above the deck. A single-span below bridge requires a structure depth that is too deep for this project. A center pier was added to reduce the superstructure depth to a depth comparable to the above bridges. Hydraulic studies indicate a two-span bridge will not adversely affect water surface elevations for either of the flood designs. Structural steel girders, precast prestressed concrete box girders, and cast-in-place prestressed concrete box girders are viable structure types for below bridges. The precast prestressed concrete box girder bridge was used for the cost estimates for the Below Bridge alternatives. They have a lower cost compared to structural steel and provide faster on-site construction compared to the cast-in-place prestressed concrete box girder. Though the cost of the precast prestressed box girders is higher than the cast-in-place prestressed concrete box girder, there is risk involved in placing falsework in the river for an extended period of time while constructing the cast-in-place alternative.

The bridge lengths used in the cost estimates are longer than the existing bridges. The south abutments for all bridges have room to be moved further south. This provides a slight increase in hydraulic capacity and allows access under the bridges from the Riverwalk and future Post Office Plaza. The overall length of existing bridges and new bridges length used in the replacement cost estimates are shown in Table 4-1.

TABLE 4-1  
Length of Existing and Replacement Bridges used in 74-Year and 100-Year Flood Designs

Location	Existing	Replacement
Sierra Street	133 feet	153 feet
Virginia Street	138 feet	158 feet
Center Street	158 feet	168 feet
Lake Street	151 feet	161 feet

The bridge widths used in the cost estimates match the existing roadway widths and include at least a 10 foot wide sidewalk.

### 4.2.1 74-Year Flood Design Estimate

The 74-year flood design cost estimates for the above and below bridges are shown in Table 4-2. The estimates include construction, design, construction engineering, utility, and right of way costs. A 20% percent contingency has been included and is considered appropriate for the conceptual level of detail that has been developed at this point in time.

TABLE 4-2  
Downtown Bridge Reconstruction Cost Estimates for the 74-Year Flood Design

Location	Above Bridge Type	Below Bridge Type
Sierra Street	\$15,070,000	\$13,080,000
Virginia Street	\$15,370,000	\$13,020,000
Center Street	\$14,850,000	\$12,510,000
Lake Street	\$17,820,000	\$15,640,000

Costs Based on 2008 Dollars

### 4.2.2 100-Year Flood Design Estimate

The 100-year flood design cost estimates for the above and below bridges are shown in Table 4-3. The estimates include construction, design, construction engineering, utility, and right of way costs. A 20% percent contingency has been included and is considered appropriate for the conceptual level of detail that has been developed at this point in time.

TABLE 4-3  
Downtown Bridge Reconstruction Cost Estimates for the 100-Year Flood Design

Location	Above Bridge Type	Below Bridge Type
Sierra Street	\$15,560,000	\$13,660,000
Virginia Street	\$16,000,000	\$13,670,000
Center Street	\$15,400,000	\$13,210,000
Lake Street	\$19,380,000	\$17,240,000

**Note:**  
Costs Based on 2008 Dollars

## 4.3 Arlington and Booth Estimates

Planning-level cost estimates for the replacement of the Arlington Avenue and Booth Street Bridges are provided only for the Below Bridge type. The Above Bridge type was not considered due to its higher cost.

The square foot area method was used to calculate the cost estimates for Arlington and Booth. This method can be used during the early stages of a project's development when quantities for the major items of work are not available and cannot be accurately identified. The square foot cost method relies solely on the accuracy of the square foot cost value assumed. Square-foot costs from other comparable projects are generally used. The cost

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estimates for Arlington Avenue and Booth Street estimates are based on the square-foot cost values from the more detailed estimates developed for the downtown bridges.

Cost estimates were developed for the 74-year and 100-year flood designs to be consistent with the downtown bridges. Both flood designs have 2 feet of freeboard clearance. The cost estimates for the Arlington Avenue and Booth Street Bridges are shown in Table 4-4.

**TABLE 4-4**  
Arlington Avenue and Booth Street Reconstruction Cost Estimates for the 74-Year and 100-Year Flood Designs

<b>Location</b>	<b>74-Year Flood Design</b>	<b>100-Year Flood Design</b>
Arlington Avenue	\$19,000,000	\$21,250,000
Booth Street	\$ 6,580,000	\$ 8,420,000

**Notes:**  
Estimates are for Below Type bridges  
Costs Based on 2008 Dollars

## 5.0 Simulations and Architectural Renderings

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Graphic simulations and architectural renderings were developed illustrating elevation and aesthetic impacts at the Sierra Street, Virginia Street, Center Street, and Lake Street crossings for both the 74-year and 100-year flood designs. These assumed below supported bridges with a single center pier.

The simulations were presented during public workshops and presentations to City staff, providing visual perspective of the projected impacts to adjacent roadways, pedestrian access, and existing structures along with potential mitigation and design options.

Aerial simulations were also developed illustrating the corridor with either cable stay or tied arch bridge types at the aforementioned crossings to provide perspective on how these designs might affect viewsheds and the aesthetic character of the corridor.

Simulations and architectural renderings developed throughout the study can be referenced in Appendix G.



# 6.0 Public Involvement and Community Outreach

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The public involvement aspects of the TRAction Visioning Project were designed to be inclusive of all interested parties within the City. These efforts were geared toward engaging the community during the evaluation of potential improvements and as the project changed focus, to consider the design year and the bridge types as choices the City of Reno gets to make. Every effort was made to provide multiple avenues by which community members could take part in the process, have their questions answered, and voice their concerns and vision for the downtown Truckee River Corridor.

## 6.1 Public Workshops

A total of three (3) public workshops were held to present information regarding the TRAction Visioning Project and solicit feedback from the community. Workshops were carefully planned with specific objectives to ensure productive and meaningful discussion and foster a spirit of collaboration between attendees and the Project Team. Various workshop formats were employed to encourage participation of individuals in attendance. Workshop formats included brainstorming sessions within various group sizes, formal presentations utilizing PowerPoint presentations and large format displays, and open house formats allowing one-on-one interaction with Project Team members.

Workshop attendees were encouraged to provide both verbal and formal written comments that were referenced during the project development and were summarized and provided to the City. Workshop and comment summaries can be referenced in Appendix H.

Table 6-1 summarizes workshop dates, locations, and notification methods.

## 6.2 Additional Presentations

In addition to the public workshops, various community groups and organizations were contacted and provided an opportunity to schedule presentations for their memberships. Presentation scheduling and materials were adapted to the extent possible to meet the needs of each organization that participated.

Table 6-2 identifies those organizations and community groups that requested presentations and the dates these presentations were conducted.

TABLE 6-1  
Workshop Details

	Location	Date/Time	Notification Methods
Workshop #1*	Reno City Hall 1 East First Street	October 4, 2007 5:00-7:30 P.M.	Reno Gazette Journal City of Reno Website Truckee River Flood Management Project Website
	Northeast Community Center 1301 Valley Road	October 9, 2007 5:00-7:30 P.M.	Email Blasts Fliers distributed to riverfront businesses
	McKinley Arts Center 925 Riverside Drive	October 11, 2007 5:00-7:30 P.M.	Mailing list
Workshop #2	McKinley Arts Center 925 Riverside Drive	February 19, 2008 5:30-7:30 P.M.	Reno Gazette Journal City of Reno Website Truckee River Flood Management Project Website Telephone Notifications Email Blasts Fliers distributed to riverfront businesses Mailing list
Workshop #3	McKinley Arts Center 925 Riverside Drive	October 2, 2008 5:30-7:30 P.M.	Reno Gazette Journal City of Reno Website Truckee River Flood Management Project Website Email Blasts Fliers distributed to riverfront businesses Mailing list

**Note:**

\* Workshop #1 was held on 3 separate dates and locations

TABLE 6-2  
Additional Presentations

Community Group/Organization	Presentation Date(s)
Nevada Historic Society	December 2007
Reno Redevelopment Agency Citizen's Advisory Board	December 4, 2007
Historic Reno Preservation Society	December 6, 2007
Downtown Improvement Association (DIA)	August 7, 2008 August 21, 2008 November 2007-January 2008
Historical Resource Commission	August 14, 2008 November 2007-January 2008
Palladio Homeowner's Association	October-November 2007

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## 6.3 Project Website

A project website was developed that included project background information, project objectives, and public workshop notifications. Workshop presentations, displays, handouts, comment forms and meeting summaries were also made available via the website for those whom were unable to attend the workshops.

Site visitors were encouraged to submit their questions and comments via contact links provided for designated City of Reno and Truckee River Flood Project representatives.

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# 7.0 References

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