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Truckee River Sediment Removal and Capacity Assessment

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Prepared for

Washoe County
Department of Water Resources
4930 Energy Way
Reno, Nevada 89502

K/J Project No. 0595010

Table of Contents

List of Tables

List of Figures

List of Appendices

Executive Summary

The Truckee River flows through the Truckee Meadows and provide a focus for community interest, recreation, and the environment. The river also provides for our water supply and our waste removal. Citizens of the Truckee Meadows are inherently tied to the Truckee River.

The Reno/Sparks community has depended on the river for its development and has witnessed how development can be reclaimed by the river during flood events. The Truckee River is a highly managed system, but is by no means a totally controlled system. The occurrence of flooding reminds us that the system is a harnessed part of nature and will always have the potential to break free and take its own course. Since the development of the Truckee Meadows began, efforts have been made to control flooding induced damages. The historic engineering approach to flood conveyance was to create a wider deeper channel with higher levees and greater channel entrenchment. This approach works well for smaller flood events but containment of the river is a recipe for disaster during a record flood event such as in January 1997.

Current flood control planning efforts have adopted the engineering and planning approach of "reconnecting" the river with its floodplain. This concept is proving successful in many communities but requires significant planning, land acquisition, engineering and administrative efforts, and time.

Under increasing pressure Washoe County is exploring means of providing enhanced flood conveyance in a timely, project specific manner. This report presents the results of a visual survey of the Truckee River through the Central Truckee Meadows and details the five sites that could provide flood conveyance benefits through channel excavation and sediment removal.

The results of this effort suggest that while channel capacity enhancement projects will benefit flood control efforts during smaller flood events, the amount of conveyance improvements are hardly noticeable during larger over-bank flood events.

Section 1: Background

Historically the Truckee Meadows has been prone to regular flooding. The flood of 1997 highlighted the limitation of the existing Truckee River channel to convey a large flood event. The Truckee River, within the Truckee Meadows, can convey approximately 8,700 CFS (cubic feet per second) in a bank full condition. This is approximately the flow rate anticipated for the 10-year flood event. The flood of 1997 produced a peak flow within the downtown reach of approximately 18,200 CFS. This means that approximately 9,500 CFS was being conveyed through the Truckee Meadows as overbank flow. This 9,500 CFS was the cause of the property damage during the 1997 Flood.

The Community Flood Coalition was formed after the 1997 flood to address the issue of inadequate flood conveyance through the downtown Reno corridor. Recommendations of this group have widely reflected the community's desire to embrace the Truckee River as an asset and to enhance the natural ecological processes required for sustainable function. These goals are being achieved through land acquisitions that allow for floodplain terracing and through restoration efforts allowing access of the river channel to the historic floodplain. These efforts are greatly complicated in the downtown Reno reach where channel encroachment is greater and overbank flows less manageable and more destructive.

Local, State and Federal agencies all have obligations to maintain conveyance within the Truckee River channel . However the specific duties of these agencies are loosely defined and capacity maintenance projects have been undertaken primarily as a response to a specific problem or event, such as the 1997 flood. To date, the majority of the capacity maintenance efforts have not been based on a prediction of improved capacity, but rather have focused on maintaining existing channel capacity.

One of the regulatory entities on the upper reach of the Truckee Meadows is the Carson-Truckee Water Conservancy District. The Carson-Truckee Water Conservancy District (CTWCD) was formed in 1958 to secure the storage of the municipal water supply for the Truckee Meadows. Since its inception the duties and authority of the CTWCD have changed. One of their current obligations is to enforce the 1973 Martis Lake Operating and Maintenance Agreement (Martis Agreement). The CTWCD has this authority as a co-permittee with the U.S. Army Corps of Engineers. The channel capacity maintenance obligation of the CTWCD extends to the 14,000 cfs channel section. Encroachments to flows greater than the 14,000 cfs are not reviewed by the CTWCD. The geographical limit of the CTWCD regulatory authority extends from the California-Nevada state line to the Glendale Bridge in the central Truckee Meadows.

Channel capacity maintenance obligations below the Glendale Bridge are the responsibility of the State of Nevada, Division of State Lands. There does not appear to be any standardized review and permitting of channel encroachments within the lower river reaches. However, many of the potentially adverse affects of river projects are addressed by the other agency review processes in lower river reaches. This may include reviews by the City of Sparks, Washoe County, Storey County, or the U.S. Army Corps of Engineers.

As mentioned above, the existing obligation for channel capacity maintenance vested in these agencies is limited to maintenance activities and does not to address the conveyance capacity improvements sought by proponents of improved flood conveyance projects.

Section 2: Project Purpose

The Washoe County Department of Water Resources has been under increased pressure to address flood control proposals voiced to the Washoe County Commissioners. The various proposals, recommendations and opinions for flood conveyance improvement projects have not been supported by data demonstrating the anticipated flood flow conveyance benefits.

Through discussions with Washoe County Department of Water Resources the need for a preliminary assessment of channel conveyance capacity was identified. The need for a common understanding and framework for discussions regarding the river and the identification of areas that may warrant further investigation with respect to conveyance capacity and sediment removal activities are to be addressed in the preliminary assessment.

Kennedy/Jenks Consultants was asked to prepare a preliminary assessment of the downtown reach of the Truckee River. As part of the assessment, Kennedy/Jenks conducted a visual survey of the Truckee River corridor through the central Truckee Meadows and assessed the need for in-channel sediment removal for the enhancement of channel conveyance capacity.

The intended level of effort of the preliminary assessment was limited to non-hydraulic modeling estimations of channel modifications. This approach was undertaken to provide a large scale assessment of the central Truckee Meadows reach without requiring the time or budget of a hydraulic modeling effort. The assessment focused on the central Truckee Meadows reach because the lower reach, downstream of Rock Blvd. Bridge is currently undergoing flood control, recreation, and channel modification planning efforts.

2.1 River Terms and Definitions

The following section provides terms and definitions that are commonly used to discuss river conditions, flood control, and channel restoration efforts. An understanding of these terms will aid in fostering informed and comprehensive discussions regarding river channel conveyance capacity.

Slope and Gradient - The longitudinal slope of a river refers to the elevation change of a channel segment over a given distance and is designated as a foot vertical change per foot horizontal distance. The upper Truckee River can be considered to have a high gradient while the Lower Truckee River has a low gradient, or low slope. The boundary between the high gradient flow characteristics of the upper river and the lower river is located approximately at the Glendale water treatment plant diversion.

Higher gradient reaches of the Truckee River will generally have larger size substrate materials, higher flow velocities, less sinuosity, less in-channel vegetation, and often exhibit improved water quality related to temperature and dissolved oxygen.

Lower gradient reaches of the Truckee River within the Truckee Meadows have a longitudinal slope of approximately 0.13% (S=0.0013 ft/ft). These reaches are characterized by silt and sand substrate materials, lower velocities due to decreased slope and larger channel size, a greater

average river depth than upstream reaches, wide channels with greater floodplain access, increased sinuosity and these reaches often show degraded water quality.

Distinct river reach geomorphologies create significantly different aquatic habitats. These habitats respond differently to disturbances and influence conditions for sediment removal and channel capacity projects.

Sinuosity – This is a ratio of the amount of curvature in a river system. Sinuosity is calculated by dividing the river centerline (or Thalwag) distance by the strait line distance. The upper and lower reaches of the Truckee River within the Truckee Meadows have little sinuosity due to past projects that have straightened reaches of the river. The lower river tends to have a higher sinuosity than the upper river; however sinuosity can be site specific. Figure 1 shows the loss of sinuosity in the Ferrari Ranch reach north of the airport between 1948 and 2004.

Embeddedness –The term embeddedness refers to the degree of anchoring of the channel substrate material. Embeddedness is a function of the substrate material size, gradation and composition. In-channel vegetation also affects the embeddedness of the river channel. The embeddedness of a river reach dictates the amount and degree of substrate material moved as a function of flow velocity.

Entrenchment – This term can be defined as the measure to which a stream or river channel is incised into its floodplain.

Past flood control efforts have focused on deepening and straightening river courses through the urban center. This actions have resulted in widespread channel entrenchment. As flood waters increase, the river velocity and areas of concentrated flow increase thereby making the energy management aspects of flood flow conveyance very difficult. Entrenchment along the Truckee River through downtown Reno eliminates the ability of the river to access an extended floodplain where sediment deposition and energy absorption occur. The downtown Reno reach functions as a funnel providing high velocity flows to downstream sections and provides the potential for a significant amount of bed load material to be moved. During the past several large floods, a significant bed load mobilization through this reach did not appear to occur. The lack of bed load mobilization may have occurred due to excessive embeddedness and armoring of the channel bottom.

Natural Flow – The Truckee River is a highly regulated watershed. Normal flows in the Truckee River are a combination of natural flows and reservoir releases. The reservoirs of the Truckee River system are managed for municipal and environmental water supply, recreation and flood protection. Without this reservoir system the Truckee River would contain minimal flows throughout much of the year with large and unregulated flooding.

Reservoir Operations – The Truckee River system is a large and complex network of storage reservoirs and complex water management agreements. Specific questions and issues regarding how reservoir operations benefit flood protection operations should be directed toward the U.S. Army Corps of Engineers, the U.S. Federal Water Master, and the language of the Truckee River Operating Agreement (TROA).

Section 3: Scope of Sediment and Conveyance Assessment

3.1 GIS and Aerial Photographic Data

Kennedy/Jenks Consultants gathered available aerial photographic data from Washoe County. The 0.5' pixel resolution 2002 aerial photography was adequate for identifying large boulders, vegetation and channel features. These photos were used in conjunction with historic photos of the downtown Reno reach of the Truckee River to assess channel changes over the past several decades. Variations in photographic resolution and dates make direct computational comparisons difficult but still provide an informative history of channel activity within the central Truckee Meadows.

The aerial photography provided by Washoe County was also used to determine site access areas and property ownership along the river. This data supported the site feasibility and cost estimation work for the five proposed project sites.

3.1.1 Truckee River Map Atlas

A Map Atlas was developed from the 0.5' pixel resolution 2002 aerial photography for the project study reach using ArcGIS. The Map Atlas was created as an aid for the visual survey of the river channel and will act as a reference book for future river discussions. The Map Atlas is provided in Appendix B in the form of a CD-ROM containing PDF's of each of the map plates in a 11x17 format.

3.2 Visual Assessment

In late April 2005, Kennedy/Jenks performed a visual assessment of the river environment from the active river channel. Photographs looking upstream and downstream from various points along the study reach were archived to create a photo log. Sediment size, condition of the river banks, presence of debris, and flow characteristics were noted.

3.3 Site Prioritization

River channel characteristics obtained from the visual assessment were utilized to prioritize the study reach into sites that deserved additional consideration. The factors considered when prioritizing the sites include size and volume of sediment accumulation, backwater development during flooding, resistance of the materials to transport during flooding, and impact of the accumulated materials on flood conveyance.

Through the site prioritization process, Kennedy/Jenks identified five sites for further analysis. These sites extend from Wingfield Park to the Ferrari Ranch downstream of Rock Blvd.

3.4 Site Survey

Cross section elevation surveys were conducted at each of the five sites. Approximately five cross sections were surveyed at each site. These data were used to determine the total volume of excavation required as well as to estimate the cross sectional area improvement. The cross section data was tied to the elevation of the adjacent river trail but did not reflect a standard geodetic elevation. Each of the five sites were surveyed relative to itself but not tied together. The survey was done in this manner to reduce costs while still obtaining all of the volume data required for the excavation estimation.

3.5 Removal Quantity Estimation

Based upon the elevation data gathered during the site surveys, an estimation of the total volume of material to be removed for each site was determined. The volumes were determined by calculating a channel invert slope greater than the existing, and a channel cross section lower than the original throughout the subject reach.

The survey data and the estimated cross section and profile of the proposed channel removal was input into CAD software to aid in the development of 3D surfaces. These surfaces where compared to determine the total volume of material at each site to be removed.

3.6 Estimation of Hydraulic Effect

To estimate the hydraulic effect resulting from channel modification activities several data sets were utilized. The channel conveyance improvement data set was generated though efforts discussed in Section 3.5. A mean cross sectional area improvement was determined for each of the five sites. This improved area was multiplied by the mean water velocity as a function of flow. The velocity data was obtained from the WRC and MWH HEC-RAS models of the Truckee River. By multiplying the mean channel velocity by the improved cross sectional area the increased flow conveyance can be determined. The models also provide a cross section width as a function of flow for each cross section. This width was used to calculate the expected reduction in water surface elevation resulting from sediment removal at the site.

3.7 Opinion of Probable Removal Cost

An opinion of probable cost was prepared for each of the five study sites in order to provide a method for weighing the financial costs of sediment removal against anticipated flood hazard mitigation benefits.

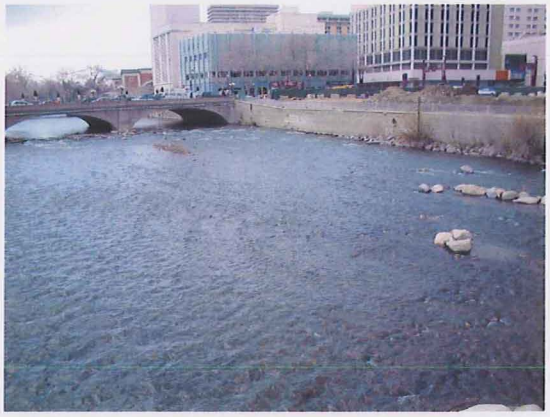
The cost estimate provided in Appendix A illustrates both the standardized estimation methodology provided by RS Means© as well as costs provided by local contractors with in-river sediment removal experience. All costs are provided as a comparative means of looking at projects of similar scale and complexity. All costs should be considered as estimates and they do not reflect specific issues of permitting, mitigation, or contingency planning. Issues of permitting and monitoring have been presented as fixed costs and are not scale dependent like the engineering and construction costs.

Section 4: The Truckee River in Downtown Reno

The Truckee River is confined by encroachment walls from Arlington Avenue to Lake Street in downtown Reno. This reach is further confined by several bridges. Past analysis by the U.S. Army Corps of Engineers has looked at channel excavation and potential bridge scour through this reach. Available engineering data indicates that a deepening of the river channel through this reach will require a significant structural engineering effort to ensure the protection of the existing bridge abutments and the encroachment walls.

To provide an example of the project scale necessary to affect flood flow conveyance in this reach several assumptions have be made. These assumptions are:

- Excavation of 5 feet of river sediments will be required to affect flow in this reach.
- Bridge footings and wall footings can be protected from potential scour effects of high flows after sediments have been removed.
- Only the area from Virginia Street to Lake Street is required to affect conveyance capacity through this reach.



Although these assumptions appear to limit the project, the intent of the assumptions is to provide a concept of the quantity of materials and effort required for excavation in a manner that can be visualized.

The distance from the Virginia Street Bridge to the Lake Street Bridge is approximately 850 feet and the channel is about 150 feet wide through this reach. If this area were to be excavated down 5 feet the total material production would be 24,580 cubic yards. This volume of material will require 1,200 20-yard end-dumps for removal. The impact of sediment removal activities on traffic, river ecology, downtown redevelopment efforts, and water quality would be significant. An effort of this magnitude would require time to engineer, permit and execute and would need to be scheduled during low flow periods.

Section 5: Evaluation of Potential Channel Capacity Improvement Sites within the Central Truckee Meadows

The five sites selected for sediment removal are discussed in detail below. Each of these sites has unique characteristics that influence the type and extent of excavation. During the aforementioned river surveys, each site was described in terms of channel embeddedness, vegetative cover, and substrate material size. When considering channel excavation it is important to consider substrate material composition due its impact on the ease of removal.

5.1 Site 1: Wingfield Park Reach

The Wingfield Park Reach lies immediately upstream of the Wingfield Whitewater Park in downtown Reno. Figure 2 shows the site in 2002 as the vegetation in the shallow, southern half of the channel becomes established.

Site Characteristics

- Excavation footprint: 35,700 ft^2 (0.82 acres)
- Excavation Volume: 1,983 cubic yards
- Average depth of excavation: 2 feet
- Cross Sectional Area Improvement: 316 ft^2

The majority of the excavation at this site can be accomplished with front-end loaders; however a portion of the substrate material at the downstream end of the project site will likely require a track excavator. Most of the removal material is less than 12"-18" in diameter with a substantial portion in the 2" to 6" diameter size range.

The river immediately upstream of Wingfield Park is characteristically wide and uniform. The downstream section of the photograph in Figure 2 was greatly modified during construction of the Whitewater Park however survey data indicates the channel elevation at the downstream end of the study site is similar to the channel section prior to the park development.

Table 1 below presents the hydraulic data for various flood events. The columns on the right indicate the benefit in conveyance and reduction in water surface elevation anticipated from the described volume of sediment removal. Note that the proportionate improvement is reduced as the flood event increases.

Table 1. Wingfield Park

Model: 01 Truckee River u/s 395 Recal 7/01							
	Flow, Q (cfs)	**Velocity (ft/s)**	**Flow area (ft^2)**	**Top width (ft)**	**Modified Q (cfs)**	**Flow area (ft^2)**	**▲ in WS (ft)**
2-Year	2,621	3.83	685	225	3,833	1,001	-1.41
5-Year	5,742	5.21	1,103	229	7,393	1,419	-1.38
10-Year	8,708	6.38	1,370	277	10,758	1,686	-1.14
25-Year	13,640	7.93	1,925	533	17,767	2,241	-0.59
50-Year	18,280	6.68	3,474	629	25,316	3,790	-0.50
100-Year	23,840	7.04	4,437	643	33,462	4,753	-0.49
200-Year	30,430	7.29	5,565	651	42,871	5,881	-0.49
500-Year	41,000	7.59	7,280	663	57,654	7,596	-0.48

These data indicate that a sediment removal operation of this scale (approximately 2,000 cubic yards) will likely have a water surface elevation improvement during a 2-year event of approximately 18 inches, whereas the water surface reduction during a 100-year event would be less than six inches.

Site Access

The Wingfield Park site is surrounded by City of Reno property which would simplify site access issues when compared to sites bounded by private property. The presence of the stone and concrete wall along the south bank of the river will increase project costs due to site accessibility. The wall would need to be breached to allow heavy equipment access to the river channel. Due to the proximity of this site to downtown Reno and its location adjacent to a heavily used park, traffic control will be somewhat problematic (Figure 2).

No close disposal sites exist for the excavated material from this site. Therefore, all excavate must be hauled over-highway which would require street legal haul trucks and would have a significant impact on project costs and complexity. For the purposes of this comparative assessment, it has been assumed that all material will require over-highway haul trucks and offsite material disposal.

Offsite hauling of excavate material will require the use of 20-yard end-dump trucks. At a reasonable rate of four trucks per hour (one per 15 minutes) a minimum of 3 working days would be required to complete the 100 loads of off-haul material. Site restoration and project cleanup efforts will require another week of truck usage.

Costs

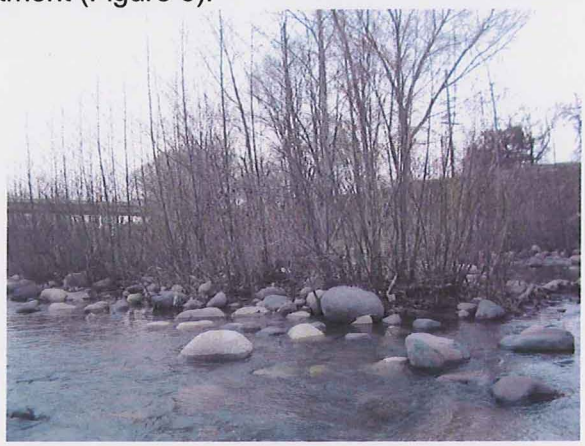
The opinion of probable cost for the removal of approximately 1,980 cubic yards of excavated material is $103,000. This estimate was prepared using a combination of RS Means and conversations with local excavation and hauling contractors. This estimate is conceptual in nature and does not contain an established contingency. This estimate also assumes that the Nevada Department of Environmental Protection (NDEP) will permit this project based on construction drawings and that the general costs as presented in Appendix A are fixed costs.

5.2 Site 2: 2nd Street to Wells Avenue

This site is located just upstream of the Wells Avenue Bridge along the south bank of the river and immediately north of the Reno Police Department (Figure 3).

Site Characteristics

- Excavation footprint: 15,700 ft^2 (0.36 acres)
- Excavation Volume: 1,160 cubic yards
- Average depth of excavation: 2 feet
- Cross Sectional Area Improvement: 162 ft^2



Since the 1997 flood a shallow point bar extending out from the south bank of the river has developed. This point bar has a variety of vegetation to aid in anchoring the substrate during higher flows. In May of 2005 flows exceeding 1,400 cfs did not appear to effect the vegetation or the extent of the point bar. Observation of these flows indicates that the river is attempting to regain some sinuosity in this reach and the submerged portions of the channel lacking vegetation appear to be primarily comprised of 4" to 8" cobbles with minimal anchoring by finer grade materials.

The point bar holds a fair gradation of material sizes with adequate soil to support dense riverine vegetation. This site accumulates woody debris at a greater density that elsewhere in the downtown reach. However, the accumulation of material does not appear to present a channel encroachment at flows greater than 2,000 or 3,000 cfs. River flows greater than this should flush the majority of the unanchored debris downriver.

Excavation of this site will eliminate the vegetation within the channel and remove the finer sediment which support in-channel vegetation. Due to the upstream geomorphic constraints of the river channel, this site will likely try to reestablish any excavated materials within the next few years.

Material removal at this site will reduce the water surface elevation approximately one foot during the 2-year and 5-year flood flows. Larger flood events should expect to see a water surface reduction of approximately one-half foot as a result of this excavation. Table 2 presents the results of the MWH HEC-RAS model run for this reach using the standard USGS flood event intensities.

Table 2. 2nd Street to Wells Avenue

Model: 01 Truckee River u/s 395 Recal							
	Flow, Q (cfs)	Velocity (ft/s)	Flow area (ft^2)	Top width (ft)	Modified Q (cfs)	Flow area (ft^2)	▲ in WS (ft)
2-Year	2,621	6.19	423	162	3,623	585	-1.00
5-Year	5,742	7.54	761	174	6,963	923	-0.93
10-Year	8,708	8.54	1,020	180	10,092	1,182	-0.90
25-Year	13,640	9.47	1,440	189	15,171	1,602	-0.86
50-Year	18,280	10.04	1,821	197	19,908	1,983	-0.82
100-Year	23,840	9.91	2,412	229	25,513	2,574	-0.71
200-Year	30,430	10.66	2,890	294	32,532	3,052	-0.55
500-Year	41,000	11.98	3,505	334	43,927	3,667	-0.48

Similar to the first site, the proportionate benefit of channel excavation diminishes with the size of the flood event. Note that at this site the flow velocities are very high, and the channel is confined (~334'); therefore in-channel excavation efforts have a measurable, although, less of an affect in large flood events. A river section to this one that contains the majority of the larger flood events will display a greater change in water surface elevation as a result of excavation than sections where a substantial portion of the flow is out of the channel.

Site Access

Site access will be provided from Kuensli Avenue located on the south bank of the river between Park Street and High Street. Haul trucks will have limited impact on residential and heavy traffic urban streets. The south bank of the river in this reach has been protected by riprap and boulders. The riprap material will need to be removed to allow adequate equipment access into the river channel and must be replaced at the end of the project.

Costs

The costs presented as general requirements in the Engineers Opinion of Probable Costs (Appendix A) are applicable to all five sites. The general costs are a combination of the design and engineering, permitting and associated monitoring, and administrative costs totaling $42,000. In addition to the general costs, site modification costs total approximately $46,000 for a project total of $88,000.

5.3 Site 3: Upstream of Kietzke Street Bridge

The third site is located on the north bank of the river immediately upstream of the Kietzke Street Bridge. This area is adjacent to the bike path and is bounded on the downstream end by an elevated sewer line crossing.

Site Characteristics

This reach is characterized by a long smooth glide entering a deeply channelized steeped section that has formed as a result of sediment deposition on both the upstream south side and along the north half of the channel. The channelized section has formed an abrupt drop which directs all of the flow to the south bank and a poor alignment for passing under Kietzke Street Bridge.

The large sediment deposit located in the northern half of the channel is comprised of loosely consolidated sands and gravels, inter-mixed 12" diameter cobbles and scattered large boulders. This well mixed substrate has allowed for significant growth of willow, alder and cottonwood. The vegetation appears to be well anchored and would not likely wash out in a small (< 5-year) event; however the lack of well embedded substrate material may destabilize the vegetation at flows greater than 5,000 cfs.

- Excavation footprint: 38,700 ft^2 (0.89 acres)
- Excavation Volume: 5,750 cubic yards
- Average depth of excavation: 4 feet
- Cross Sectional Area Improvement: 518 ft^2

The depth of excavation at this site varies greatly due to the variable topography of the vegetated and braided north half of the channel. Quantities for excavation were developed using the proposed cross sectional area presented in Figure 4. This cross section represents the improved area after removal of approximately 5,750 cubic yards of substrate material plus all of the vegetation within the channel. The channel is steep and confined through this reach; therefore an improvement in cross sectional conveyance area reflects a significant improvement in the water surface elevations during in-bank flood events such as the 25-year or lesser event.

Table 3. Upstream of Kietzke Street Bridge

Model:	01 Truckee River u/s 395 Recal						
	Flow, Q (cfs)	**Velocity (ft/s)**	**Flow area (ft^2)**	**Top width (ft)**	**Modified Q (cfs)**	**Flow area (ft^2)**	**▲ in WS (ft)**
2-Year	2,621	5.78	453	155	5,613	971	-3.35
5-Year	5,742	6.00	957	197	8,849	1,475	-2.63
10-Year	8,708	6.20	1,404	224	11,915	1,922	-2.31
25-Year	13,640	6.63	2,057	268	17,075	2,575	-1.93
50-Year	18,280	6.85	2,667	297	21,816	3,185	-1.75
100-Year	23,840	6.17	3,863	533	27,031	4,381	-0.97
200-Year	30,430	6.72	4,531	657	33,930	5,049	-0.79
500-Year	41,000	7.88	5,201	663	45,065	5,719	-0.78

Site 3's location immediately upstream of the Kietzke Street Bridge may produce a backwater effect during higher flows. If hydraulic modeling shows the presence of a backwater effect then conveyance improvements at this site will have a negligible effect on that size event.

Site Access

Even though site access will affect the park landscaping and bike path, the Fisherman's Park II near the City of Reno maintenance yard (Corp Yard) would be a logical access point,. Material composition at this site dictates the majority of the excavation will need to be accomplished with a track excavator (hoe), and a front end loader. Because this site is located at a public park a riparian and/or recreation enhancement project could be undertaken in addition to channel conveyance improvements.

Costs

The bulk of the costs associated with this project site is material hauling, (Appendix A). The excavation costs reflect some level of dewatering and river management, although the majority of the excavation will be done outside of the active (low flow) channel. The total estimated project cost for 5,750 cubic yards of material removal and disposal, associated permits and environmental monitoring and restoration is $173,000. This effort does not include a significant amount of site or park enhancement beyond the replacement of damaged items, i.e. bike path, sidewalk.

5.4 Site 4: Pioneer Ditch Diversion

The removal of the Pioneer Ditch Diversion has been discussed many times by flood control, river restoration, fishery and public safety interest groups. This site is located directly south of the Glendale water treatment plant and upstream of the Greg Street Bridge. This is the only site discussed in this report that is a man-made river feature. This structure has been rebuilt after flood events to continue to serve Orr Ditch Decree water rights to irrigated lands. To continue the support of the agricultural water right diversions an alternative this diversion structure will need to be developed if this structure were to be removed. Examples of alternative diversion structure are available on the Truckee River at the Olinghouse Pumps 1 and 2 located on the river between Wadsworth and Nixon. The Olinghouse Pumps 1 and 2 are vertical turbine pumps driven by electricity which provide irrigation for a similar acreage of land as the Pioneer Ditch. The quantity analysis conducted on the Pioneer Ditch Diversion Structure assumed the removal of the entire structure and did not include the replacement of that water diversion with a suitable alternative.

Site Characteristics

The Pioneer Ditch Diversion acts as an in-stream dam to impound water for diversion. This structure artificially increases the water surface through this reach. The diversion dam ranges in height from 3 to 6 feet. By the removal of approximately 950 cubic yards of material and debris that compose the dam, the post project water surface will fall almost 4 feet in a 2–year event.

- Excavation footprint: 8,500 ft^2 (0.2 acres)
- Excavation Volume: 950 cubic yards
- Average depth of excavation: 3 feet (6'max)
- Cross Sectional Area Improvement: 520 ft^2

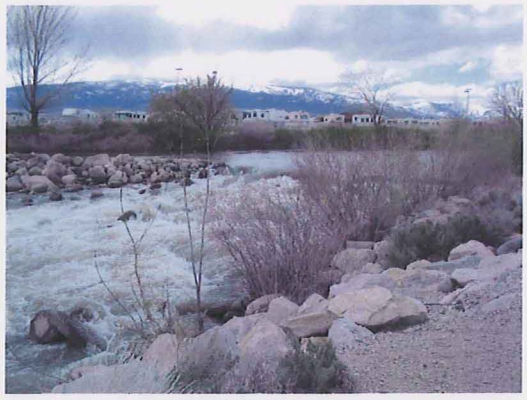


Table 4 shows that at the 50-year event the channel is exceeded in this reach and the water spreads onto the floodplain. Therefore, the prediction of a -0.9 foot water surface reduction in a large event is probably unrealistic because of the indefinite floodplain at the location. The water surface computation indicates that the in channel conveyance capacity increase approximately 60% to 80% for the same water surface elevation.

Table 4. Pioneer Ditch Diversion

Model:	01 Truckee River u/s 395 Recal						
	Flow, Q (cfs)	Velocity (ft/s)	Flow area (ft^2)	Top width (ft)	Modified Q (cfs)	Flow area (ft^2)	▲ in WS (ft)
2-Year	2621	4.53	578.43	133.41	4,976	1,098	-3.90
5-Year	5742	5.82	986.69	153.27	8,769	1,507	-3.39
10-Year	8708	6.66	1307.86	175.55	12,174	1,828	-2.96
25-Year	13640	8.42	1922.41	548.91	20,565	2,442	-0.95
50-Year	18280	9.58	2514.71	573.77	29,073	3,035	-0.91
100-Year	23840	10.55	3172.21	578.2	38,953	3,692	-0.90
200-Year	30430	9.47	4789.93	578.2	50,285	5,310	-0.90
500-Year	41000	10.1	6141.13	578.2	67,277	6,661	-0.90

Site Access

Access to Site 4 would be obtained through either the City of Reno property located downstream and accessed from Greg Street, or access could be developed through the Glendale Treatment Plant owned by the Truckee Meadows Water Authority. Either route provides good site access and a short distance to paved roads. Material hauling will occur in heavy traffic area and the cost estimate reflects these conditions.

If an associated project could receive the material without on-highway hauling a substantial savings could be realized. However, this may only be possible if an agreement to stockpile material near the site for use by other projects could be signed.

Costs

River management will play a significant role at this site. The Pioneer Ditch Diversion Dam impounds 6 to 8 feet of water which will need to be lowered for material removal. Because the active river channel will be impacted by work efforts greater requirements for BMPs and water quality monitoring will be required. All other assumptions regarding the project costs remain the same as those of other sites.

A total project cost for the removal of the Pioneer Ditch Diversion is $100,000. As mentioned above this cost could be trimmed if these efforts are incorporated into an adjacent project. However, most of the costs associated with flow management and BMP's are somewhat unique to this site due to the presence of impounded water behind the diversion dam.

5.5 Site 5: Ferrari Farm

The Ferrari Farm is located between Mill Street and the Truckee River downstream of the Rock Blvd. Bridge (Figure 6). The southern bank of the river channel is composed of an elevated point bar that is actively forming a bend in the river. The river channel is relatively shallow in this section of the lower Truckee Meadow reach and thus the 10-year event would be barely contained within the river channel. Removal of sediments at this site would enhance conveyance capacity during 10-year and lesser flood events but would not have much of an affect on larger events due to the floodplain access of larger events combined with potential backwater conditions developing in lower reaches of the Truckee River.

This stretch of river is trying very hard to regain some of the historic sinuosity that has been lost to encroachment and other channel modifications. Figure 1 shows the project site in 1948 and in 2002. The most noticeable part off this comparison is the loss of the braided channel present in the 1948 photograph. Encroachment of the industrial park to the north has increased damages caused during over bank events since the historic floodplain is no longer adequate to absorb overbank floods.

Site Characteristics

The Ferrari Farm site could be defined as a dry channel maintenance project. This means that most, if not all, of the material removal can occur in the dry portion of the active channel at low flows. Figure 6 shows a long shallow sand bar comprised of sands and gravels with some cobble. This sand bar is actively being colonized by willow and alder species. The adjacent banks are fairly low and do not contain the river during events greater than the 10-year flood.

The current model indicates that the river spreads beyond its banks at less than the 10-year event. Containment of the10-year event may be possible through the excavation of 4,700 cubic yards of material. However, this assumes that flood water elevations less than the 10-year event are not controlled by a downstream backwater effect.

The proposed excavation quantities and project footprint is listed below. This level of effort is predicted to have a benefit of 2.5 feet during the 2-year flood event but will provide little benefit once the river is out of its channel.

- Excavation footprint: 84,700 ft^2 (1.94 acres)
- Excavation Volume: 4,706 cubic yards
- Average depth of excavation: 2 feet
- Cross Sectional Area Improvement: 310 ft^2

Table 5 demonstrates that the river top width increases dramatically between the 10-year and 25-year event indicating that the river has exceeded bank full capacity and is spreading beyond the existing floodplain.

Table 5. Ferrari Farm

Model:	01 Truckee River u/s 395 Recal						
	Flow, Q cfs	**Velocity (ft/s)**	**Flow area (ft^2)**	**Top width (ft)**	**Modified Q (cfs)**	**Flow area (ft^2)**	**▲ in WS (ft)**
2-Year	2621	5.39	485.92	121.28	4,290	796	-2.56
5-Year	5742	6.71	855.11	140.36	7,818	1,165	-2.21
10-Year	8708	7.56	1152.76	163.28	11,058	1,463	-1.90
25-Year	13640	8.56	1693.61	222.18	17,151	2,004	-1.40
50-Year	18280	9.34	2141	222.18	22,892	2,451	-1.40
100-Year	23840	10.12	2626.05	222.18	29,713	2,936	-1.40
200-Year	30430	10.81	3182.69	222.18	37,756	3,493	-1.40
500-Year	41000	11.6	4057.85	222.18	50,667	4,368	-1.40

Site Access

Site access, material hauling and material disposal should be greatly simplified at this site when compared to the other 4 sites. The presence of a working farm adjacent to the site allows for easy access to the excavation. Low existing banks simplifies access to the river channel and restoration of the access routes at the close of the project will be less costly. The close proximity of other flood control project sites may make this a feasible effort for larger flood control projects by reducing hauling costs. However, this site does not appear to provide a significant flood conveyance improvement for the cost and effort expended.

Costs

Total project costs reflect the standard general costs presented in Appendix A and site specific costs totaling $165,000. Because this stretch of river would likely be a depositional zone during lower flows, sediment removal effort at this site may prove futile after a few years. Aerial photography shows this stretch of the river regaining a similar morphology after a significant channel alteration, i.e. 1997 flood, etc.

Section 6: Site Access and Site Remediation

6.1 Best Management Practices for Working in Rivers

Best Management Practices (BMPs) are applied to project sites to prevent the transport of pollutants, the erosion or sedimentation of waterways, and the degradation of aquatic and riparian ecosystems (Kennedy/Jenks, 2003). Work within a river system should include BMPs to prevent fine sediments stirred up during material removal from being transported down river. They should also include the protection of riparian vegetation along the river banks as well as bank erosion prevention, equipment maintenance and leak prevention, timing of activities to occur during low flow periods, and diversion of river flows away from the project site. The use of Best Management Practices is not only required by law but also demonstrate a stewardship for the river environment. Additional information on Best Management Practices for the Reno/Sparks area can be found in the Truckee Meadows Construction Site Best Management Practices Handbook.

6.2 Permitting

Permits from the following agencies would be required prior to the removal of any material from the Truckee River channel; U.S. Army Corps of Engineers, Nevada Division of Environmental Protection, U.S. Fish and Wildlife Service, Nevada Division of Wildlife, Nevada Division of State Lands, City of Reno, City of Sparks, and Washoe County. The required permits will be described and discussed in the following subsections.

6.2.1 Environmental

Protection of the river environment and ecosystem is the goal of the environmental permits necessary for working in and near the active Truckee River channel.

- **U.S. Fish and Wildlife Service (USFWS)** - Any federally permitted project that plans to modify any body or water in the U.S. is required to consult with the USFWS under the Fish and Wildlife Coordination Act. A review by the USFWS is coordinated through the USACE. Due to the local presence of Lahonton cutthroat trout and the cui-ui, which are threatened and endangered species respectively, a Section 7 consultation will be required. The Section 7 consultation prevents the destruction or adverse modifications to critical habitats for threatened and endangered species.

- **Nevada Division of Wildlife** – A consultation with the Nevada Division of Wildlife is recommended.

6.2.2 Water Quality

The following permits are concerned with water quality issues and must be obtained prior to work within the Truckee River channel.

- **Section 404 Permit (USACE)** – This permit is required under the Federal Clean Water Act (CWA) for the dredging or filling of material into any waters of the U.S. This includes material being excavated or redeposited and also includes the placement of any new materials including rip-rap or concrete structures. A Section 404 permit can be issued as an individual permit or as a Nationwide permit. Consultation with the local USACE office is recommended.

- **Section 401 Water Quality Certification (NDEP)** – This permit is required prior to the initiation of any activities that require a federal permit such as a U.S. Army Corps of Engineers' permit, pursuant to Section 404 of the CWA or National Pollutant Discharge elimination System (NPDES) permit, pursuant to Section 402 of the CWA (http://ndep.nv.gov/bwqp/bwqreg.htm). Allow 6 months to obtain this permit. The certificate will be valid for 1 year. Although there are no fees associated with this permiting process, the applicant must provide detailed information describing the project's impact to water quality as well as a written request to obtain a 401 Certification.

- **Temporary Permit Application for Working in Waterways (NDEP)** – To prevent the release of pollutants into waterbodies, the State of Nevada requires a permit for the utilization of any excavation equipment for construction, maintenance, or repair work within a stream or river. Allow at least one to two months to obtain this permit. This permit is required under the National Pollutant Discharge Elimination System (NPDES) program (http://ndep.nv.gov/bwpc/forms.htm).

- **Temporary Authorization to Discharge (NDEP)** – This is a permit required by the State of Nevada to control any water pollution that may result from equipment working in/near a stream or river. Allow at least one to two months to obtain this permit. This permit may be required if a significant volume of dewatering is necessary in the excavation of the channel sediments.

- **Stormwater Permit (NDEP)** – A stormwater permit will be required on construction sites that disturb more than 1 acre of land as designated under Category X of 40 CFR §122.26(b)(14) (http://ndep.nv.gov/bwpc/storm_cont03.htm). In addition, a Notice of Intent and a Stormwater Pollution Prevention Plan must be submitted to the State of Nevada as required under the NPDES permit process.

- **Nevada Division of State Lands** – The Nevada Division of State Lands holds title for the land underlying the Truckee River channel extending to the high water mark. Since a permit is required to perform any bank stabilization, dredging, or sand and gravel bar removal type of activity on State lands, a permit will be required for any sediment removal project on the Truckee River.

- **Special Use Permit (Washoe County)** – A special use permit is required if restoration activities will require more than 1,000 cubic yards of fill will be imported and placed as fill below the flood hazard area, if more than 1,000 cubic yards of fill will be excavated from the property, or if more than 5,000 cubic yards of fill will be imported.

- **Grading and Excavation Plan (Washoe County)** – Washoe County requires a grading and excavation plan if more than 50 cubic yards of material will be graded. A grading plan must be submitted to the County.

6.3 Site Remediation Techniques and Requirements

Access to the Truckee River channel for sediment removal activities will impact both public and private lands adjacent to the river. These impacts to the channel banks, adjacent floodplain, and other structures will need to be mitigated for upon completion of sediment removal. Mitigation may take the form of bank stabilization techniques, repaving of streets and bike paths, replacement of stone/brick walls, replacement of fencing material, and revegetation of the banks and floodplain. These mitigation activities will add additional expenses to the project costs depending on the extent of site disturbance.

Section 7: Reservoir Management and River Ecology

This section is provided to assist in the discussion of river management and flood conveyance design objectives and liabilities along the Truckee River. The content of this section is based on observations of flood control discussions at the Washoe County Commission and other planning board meetings.

Section 7.1 provides historic and operational information of the Truckee River and its associated reservoirs while Section 7.2 discusses ecological habitats.

7.1 Flood Conveyance and River Management

The flow of the Truckee River is regulated by seven reservoirs. Although these facilities are operated by several entities, reservoir release rates are governed by the Federal Water Master in Reno, Nevada. The Water Master is an appointee of the U.S. District Court and administers reservoir operations in accordance with specific operation criteria, principally the 1944 Orr Ditch Decree and the incorporated 1935 Truckee River Agreement. Portions of the Truckee River Operating Agreement (TROA) are being developed and tested through incorporation into the Water Master's reservoir operation plans.

The acronyms for the various agencies are:

USBOR – Bureau of Reclamation, US Dept. of Interior
USCOE – Corp of Engineers, US Dept. of Defense, Army
USFWS – Fish and Wildlife Service, US Dept. of Interior
TCID – Truckee-Carson Irrigation District
TMWA – Truckee Meadows Water Authority
WCWCD – Washoe County Water Conservation District

When considering the events surrounding the 1997 Flood, it becomes clear that flood control operations of the reservoirs work effectively. Policy makers and the public must realize that a storm greater than the 100-year event is always possible and that the issue becomes one of balancing economics and ecology. Floods will happen and the system in place is effective at dealing with them. Is it worth building a river that keeps our community dry if we destroy the river function in the process?

7.2 Ecologically Sustainable River Management

This section presents information and opinions regarding the ecological feasibility of channel dredging and flood control actions that will affect the riparian ecology of the Truckee River.

The riparian ecology of the Truckee River system has been influenced by the development of upstream storage reservoirs. Without active reservoir management, the Truckee River system would function similar to the periodically ephemeral Carson River system. Due to the elimination of the ephemeral nature of the river through the development of the reservoir system, two Threatened and Endangered fish and several amphibian and avian species have a wider range of habitat along the Truckee River. These species rely on the macroinvertebrates, which colonize the river bed, as a food source. Full channel dredging and excavation projects for flood control purposes will disturb the local benthic invertebrate communities as well as the terrestrial and aquatic habitats of numerous species.

The Truckee Meadows has invested significant resources into infrastructure design for community enjoyment of the Truckee River. The community has expressed an interest in activities occurring within the riparian corridor. The trail system along the river as well as the numerous parks scattered along the banks of the Truckee River allow community access for rafting, kayaking, fly fishing, and birding. A personal association with the ecology of the Truckee Meadows and a desire to enhance and restore the riparian corridor is being fostered through the development of these facilities and features. To protect the access to and aesthetics of this community asset, limited application of sediment clearing operations should be encouraged.

Although periodic sediment management activities must occur within an urban river setting, these activities should not proceed without a basic understanding of riverine ecology and the associated effects of the operations on species of concern. Channel conveyance projects must be weighed against ecological and economic impacts. Although several projects on the Truckee River promise flood protection through ecological restoration, it should be recognized that these projects will have similar effects as dredging activities on the ecology of the river over the short term. The difference between these types of projects is the intent and anticipated effects of the design. The goal and intent of ecological restoration is to enhance the long term stability of riparian habitats, whereas the focus of channel conveyance projects neglects river function and project impacts on aquatic species of concern.

The answer to the competing arguments of flood conveyance and ecological enhancement and protection reside in hydraulic modeling and geomorphic analysis. Both improved flood conveyance and ecological enhancement can be possible in a project but not without an understanding of the acceptable impacts of this type of undertaking. A balance of these competing interests is imperative to successful project efforts along the Truckee River.

References

Kennedy/Jenks Consultants, 2003, Truckee Meadows Construction Site Best Management Practices Handbook.

Kennedy/Jenks Consultants, 2004, Preliminary Design Report for the Hidden Meadows Appraisal Study.

MWH, HEC-RAS Model of the Truckee River through Downtown Reno.

Nevada Division of Water Planning, 1997, The Flood of 1997, Final Report: An Analysis of Snowpack Water Content and Precipitation Changes in the Waterbasins of Western Nevada and the Effect on Runoff and Stream Flows, December 16, 1996- January 6, 1997.

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State of Nevada, Division of Environmental Protection, Bureau of Water Pollution Control, Permit Forms and Fee Schedules. http://ndep.nv.gov/bwpc/forms.htm

State of Nevada, Division of Environmental Protection, Bureau of Water Pollution Control, Stormwater Discharge Permits, http://ndep.nv.gov/bwpc/storm_cont03.htm

Washoe-Storey Conservation District, 2000, Steamboat Creek Restoration Plan.

WRC, HEC-RAS Model of the Lower Truckee Meadows.

0 1000 2000 4000 6000

1"=2000'

N

Kennedy/Jenks Consultants

Washoe County Department of Water Resources

Truckee River Sediment Removal and Capacity Improvement Assessment

K/J 0595013
June 2005

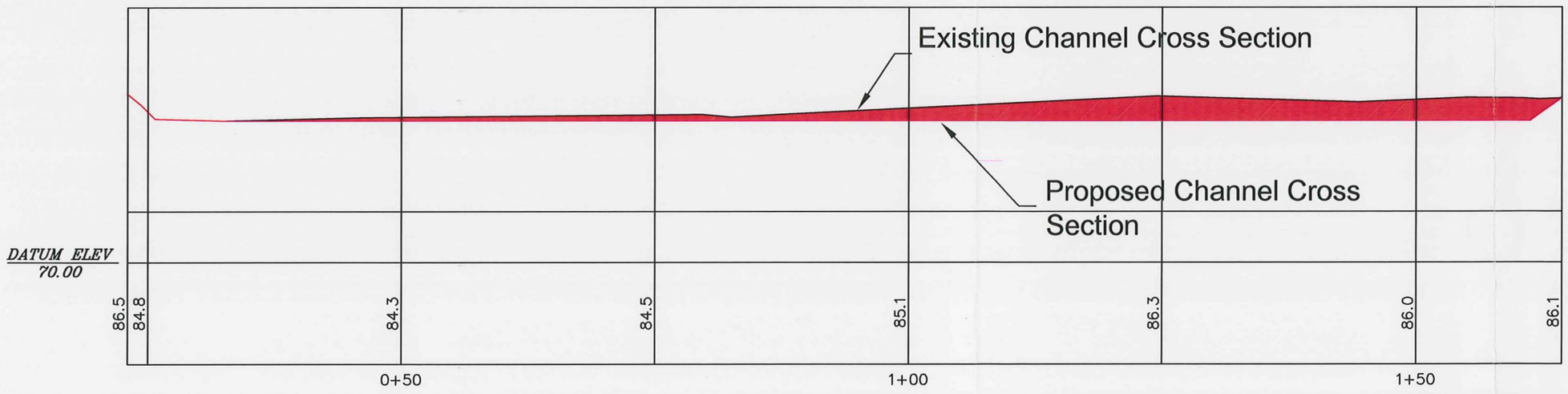
FIGURE 1

T:\0595010_TR_Sediment_Survey\10\Engineering and Design\1004 Design Notes and Calculations\Sediment Figs

0 30 60 120 180

1"=60'

Site 2: 2nd Street to Wells Avenue



Not to Scale

N

Kennedy/Jenks Consultants

Washoe County Department of Water Resources

Truckee River Sediment Removal and Capacity Improvement Assessment

K/J 0595013
June 2005

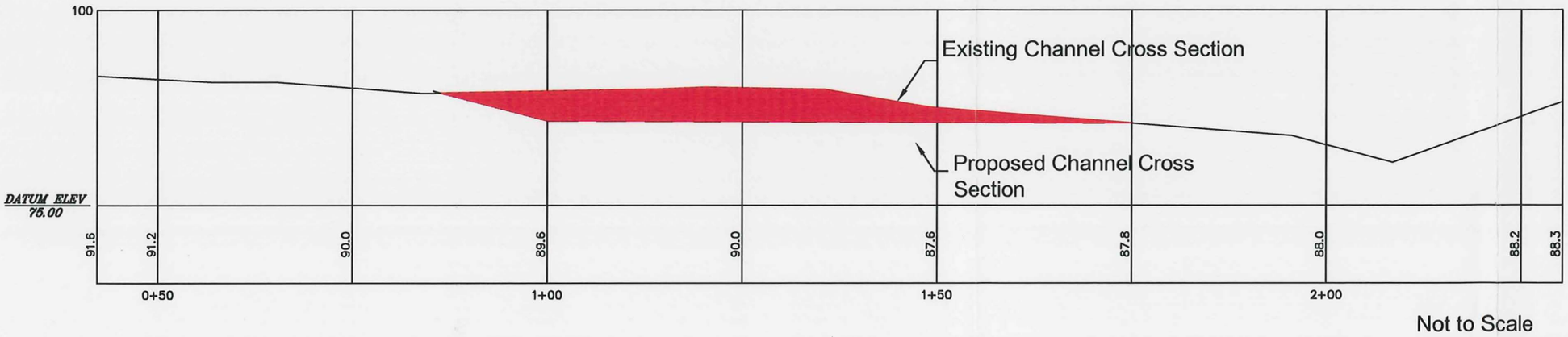
FIGURE 3

T:\0595010_TR_Sediment_Survey\10\Engineering and Design\10.04\Design Notes and Calculations\Sediment Calcs

Site 3: Upstream of Kietzke Street Bridge

0 40 80 160 240

1"=80'



Not to Scale

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Kennedy/Jenks Consultants

Washoe County Department of Water Resources

Truckee River Sediment Removal and Capacity Assessment

K/J 0595013
June 2005

FIGURE 4

T:\0595013_TR_Sediment_Survey\10Engineering and Design\1004\Design Notes and Calculations\Sediment Calcs

Site 4: Pioneer Ditch Diversion

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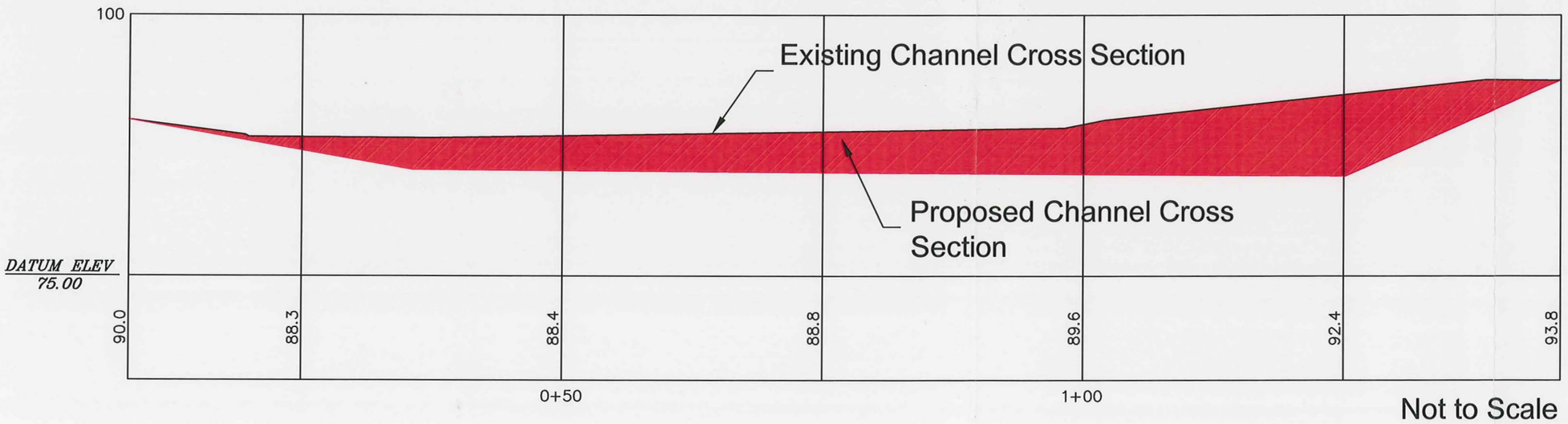
1"=60'



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Washoe County Department of Water Resources

Truckee River Sediment Removal and Capacity Improvement Assessment

K/J 0595013
June 2005

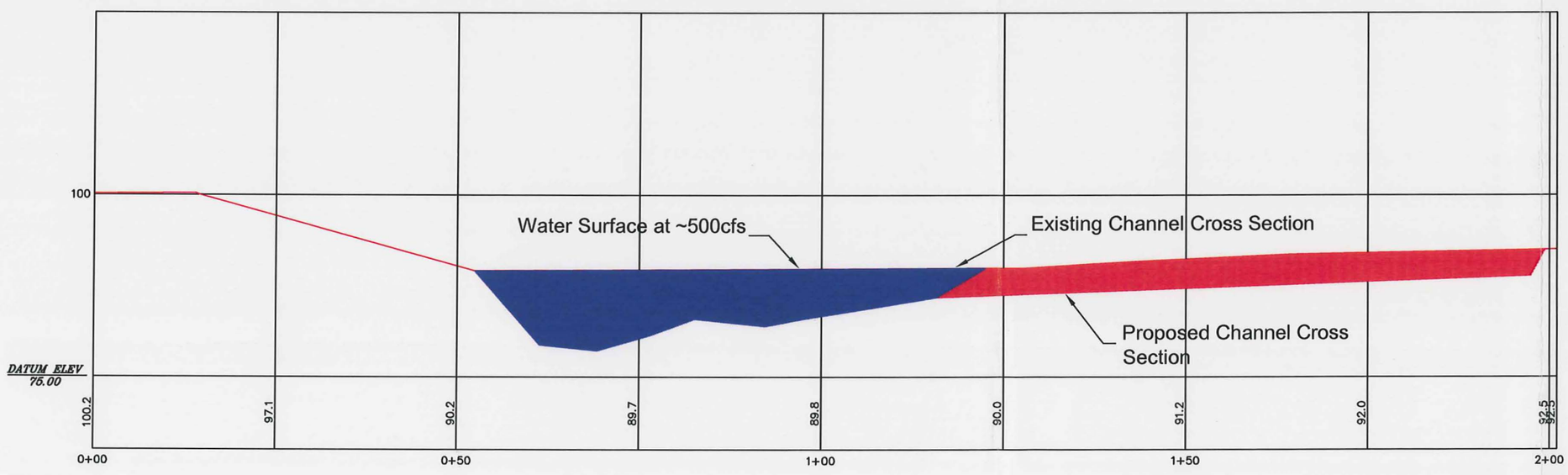
FIGURE 5

T:\0595013_TR_Sediment_Survey\10Engineering and Design\1004\Design Notes and Calculations\Sediment Calcs

Site 5: Ferrari Farm

0 150 300 450

1"=150'



Not to Scale

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Kennedy/Jenks Consultants

Washoe County Department of Water Resources

Truckee River Sediment Removal and Capacity Improvement Assessment

K/J 0595013
June 2005

FIGURE 6

T:\0595010_TR_Sediment_Survey\10.Engineering and Design\1004\Design Notes and Calculations\Sediment Calcs

Appendix A

ENGINEER'S ESTIMATE OF PROBABLE COST

KENNEDY/JENKS CONSULTANTS

Project: Truckee River Sediment and Channel Capacity Asessment

Building, Area: Channel excavation/dredging, material hauling, riparian remediation and permitting

Prepared By: MMS
Date Prepared: 16-May-05
K/J Proj. No. 595010

Current at ENR 2005
Escalated to ENR 2006

Estimate Type: [X] Conceptual [ ] Construction [ ] Preliminary (w/o plans) [ ] Change Order [ ] Design Development @ _____ % Complete

Spec. Section	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Other Total	Total	Source
DIVISION 1 - GENERAL REQUIREMENTS									
	1	Design/Engineering	1	ea.	20,000.00	20,000		20,000	Consultants estimate
	2	Permitting & SWPP, etc...	1	ea.	16,000.00	16,000		16,000	2 weeks at $100/hr
	3	Administrative	1	ea.	6,000.00	6,000		6,000	
SUBTOTAL - GENERAL						42,000		42,000	
DIVISION _1_ - ___SITE 1_____ Upstream of Wingfield Park, Downtown Reno									
	4	Mobilization	1	ea.	6,000.00	6,000		6,000	
02315-424	5	Excavation	2,000	cy	3.74	7,488		7,488	Round up from 1,983cy calc'ed
02315-490	6	Hauling	2,000	mi	8.64	17,280		17,280	10 mile RT med Traffic
	7	Grade Setter/Survey	3	day	1,000.00	3,000		3,000	RS Means; Confirm Local; 2-crew
	8	Traffic Control	4	day	650.00	2,600		2,600	2-crew
	9	Bank Remediation	100	LF	25.00	2,500		2,500	grading and revegitation
	10	BMP Installation/Maintenance	1	LS	12,000.00	12,000		12,000	LumpSum based on local contractor exp.
	11	River Management/Dewatering	1	LS	10,000.00	10,000		10,000	
	1-3	Items - General Reqirement					42,000	42,000	
SUBTOTAL - SITE 1						60,868		102,868	Roundup to '000's
DIVISION _1_ - ___SITE 2_____ 2nd Street to Wells Avenue									
	4	Mobilization	1	ea.	4,500.00	4,500		4,500	
02315-424	5	Excavation	1,200	cy	3.74	4,493		4,493	Round up from 1,160cy calc'ed
02315-490	6	Hauling	1,200	mi	8.64	10,368		10,368	10 mile RT med Traffic
	7	Grade Setter/Survey	2	day	1,000.00	2,000		2,000	RS Means; Confirm Local; 2-crew
	8	Traffic Control	3	day	650.00	1,950		1,950	2-crew
	9	Bank Remediation	100	LF	25.00	2,500		2,500	grading and revegitation
	10	BMP Installation/Maintenance	1	LS	12,000.00	12,000		12,000	LumpSum based on local contractor exp.
	11	River Management/Dewatering	1	LS	8,000.00	8,000		8,000	
	1-3	Items - General Reqirement					42,000	42,000	
SUBTOTAL - SITE 2						45,811		87,811	
DIVISION _1_ - ___SITE 3_____ Upstream of Kietzke Street Bridge									
	4	Mobilization	1	ea.		12,000		12,000	
02315-424	5	Excavation	5,750	cy	3.74	21,528		21,528	Round up from 5,750cy calc'ed
02315-490	6	Hauling	5,750	mi	8.64	49,680		49,680	10 mile RT med Traffic
	7	Grade Setter/Survey	3	day	1,000.00	3,000		3,000	RS Means; Confirm Local; 2-crew
	8	Traffic Control	4	day	650.00	2,600		2,600	2-crew
	9	Bank Remediation	900	LF	25.00	22,500		22,500	grading and revegitation
	10	BMP Installation/Maintenance	1	LS	12,000.00	12,000		12,000	LumpSum based on local contractor exp.
	11	River Management/Dewatering	1	LS	7,000.00	7,000		7,000	
	1-3	Items - General Reqirement					42,000	42,000	
SUBTOTAL - DIVISION __						130,308		172,308	
DIVISION _1_ - ___SITE 4_____ Pioneer Ditch Diversion									
	4	Mobilization	1	ea.	9,500.00	9,500		9,500	
02315-424	5	Excavation	950	cy	3.74	3,557		3,557	Round up from 950cy calc'ed
02315-490	6	Hauling	950	mi	8.64	8,208		8,208	10 mile RT med Traffic
	7	Grade Setter/Survey	2	day	1,000.00	2,000		2,000	RS Means; Confirm Local; 2-crew
	8	Traffic Control	3	day	650.00	1,950		1,950	2-crew
	9	Bank Remediation	200	LF	25.00	5,000		5,000	grading and revegitation
	10	BMP Installation/Maintenance	1	LS	12,000.00	12,000		12,000	LumpSum based on local contractor exp.
	11	River Management/Dewatering	1	LS	15,000.00	15,000		15,000	Flow management, confined river
	1-3	Items - General Reqirement					42,000	42,000	
SUBTOTAL - DIVISION __						57,215		99,215	
DIVISION _1_ - ___SITE 5_____ Ferrari Farm									
	4	Mobilization	1	ea.	10,000.00	10,000		10,000	
02315-424	5	Excavation	4,700	cy	3.74	17,597		17,597	Round dn from 4,706cy calc'ed
02315-490	6	Hauling	4,700	mi	8.64	40,608		40,608	10 mile RT med Traffic
	7	Grade Setter/Survey	3	day	1,000.00	3,000		3,000	RS Means; Confirm Local; 2-crew
	8	Traffic Control	4	day	650.00	2,600		2,600	2-crew
	9	Bank Remediation	1,200	LF	25.00	30,000		30,000	grading and revegitation
	10	BMP Installation/Maintenance	1	LS	12,000.00	12,000		12,000	LumpSum based on local contractor exp.
	11	River Management/Dewatering	1	LS	6,000.00	6,000		6,000	
	1-3	Items - General Reqirement					42,000	42,000	
SUBTOTAL - DIVISION __						121,805		163,805	

Appendix B

Kennedy/Jenks Consultants provided 20 copies of the Truckee River Sediment Removal/Capacity Improvement Assessment Map Atlas .pdf files on CD to Washoe County Department of Water Resources in May 2005. If additional copies of this CD are needed, please contact Kennedy/Jenks Consultants at (775) 827-7900.