

WINNEMUCCA RANCH WATER RESOURCES STUDY WASHOE COUNTY, NEVADA



Prepared for:

Washoe County Department of Public Works
Utility Division
1195-B Corporate Boulevard
Reno, Nevada 89520



Harding Lawson Associates
961 Matley Lane, Suite 110
Reno, Nevada 89502

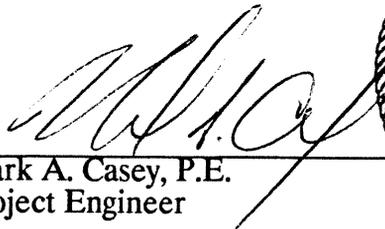
A Report Prepared for

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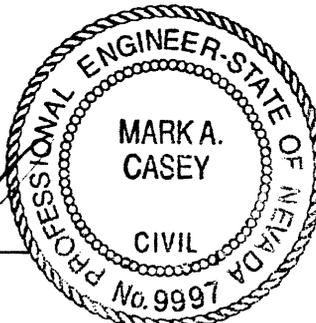
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RESOURCES STUDY
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HLA Job No. 23108

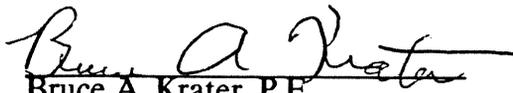
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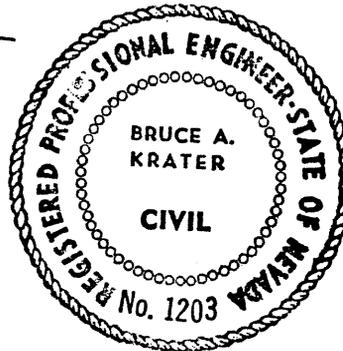
Mark A. Casey, P.E.
Project Engineer



10-20-93



Bruce A. Krater, P.E.
Consulting Principal Engineer



10/20/93

Harding Lawson Associates
961 Matley Lane, Suite 110
Reno, Nevada 89502
(702) 329-6123

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1.0 INTRODUCTION

Harding Lawson Associates (HLA) has been retained by the Washoe County Department of Public Works Utility Division to conduct an engineering study of the water resources of the Winnemucca Ranch and Upper Dry Valley Watershed. The purpose of the study was to evaluate methods and costs associated with collecting, storing and conveying water to the county service areas from existing springs within the Winnemucca Ranch and surface flows from the Upper Dry Valley Watershed. The scope of the study did not include an analysis of the environmental issues that may be associated with this project.

The results of this study are presented in this report and the attached conceptual drawings. Cost data for all alternatives are presented within Appendix A of this report.

1.1 Location

Upper Dry Valley is located in northern Washoe County, approximately 34 miles north of Sparks, Nevada and 9 miles southeast of Pyramid Lake. Upper Dry Valley can be found on Dogskin Mountain, Nev. Quadrangle within Township 24 and 25 North and Range 19 East. The majority of Upper Dry Valley is located on private property on the Winnemucca Ranch at the end of Winnemucca Ranch Road off State Route 445. The average elevation of Upper Dry Valley is 5200 feet mean sea level (MSL).

Upper Dry Valley along with its many contributory springs currently flows down Dry Valley Creek to Dry Valley north of Red Rock and Seven Lakes Mountain. The water then continues west to the California/Nevada state line.

Spanish Flat Reservoir is located approximately 2 miles northeast of Upper Dry Valley on the Winnemucca Ranch, in the southwest 1/4, northwest 1/4, Section

30 of Township 25 North, Range 20 East. The reservoir is located at an elevation of approximately 6686 feet MSL. The embankment has a crest length of 568 feet, a drainage basin of about 6.8 square miles and a water surface of about 0.7 square mile.

Refer to the HLA report dated June 29, 1992, entitled "Preliminary Evaluation, Spanish Flat Dam, Winnemucca Ranch" to Washoe County Department of Public Works for additional information regarding Spanish Flat Dam.

The Winnemucca Ranch Springs are located to the east of Winnemucca Ranch within the existing pasture land. These springs consist of four spring locations named Sugarcane, Suzie, APD, and Upper and Lower Spring de Casa. All of these locations are within Sections 12 and 13 of Township 24N and Range 19E. Currently, the springs drain through the ranch pasture land serving as irrigation water.

1.2 Scope of Work

The original scope of work, as outlined in HLA's proposal dated December 11, 1992, included an evaluation of the methods and cost for collecting, storing and conveying the spring and surface flows by pipeline to points of use in Spanish Springs Valley and/or Lemmon Valley. The transmission to Lemmon Valley included the alternates of connection to the proposed Truckee Meadows pipeline or via a separate pipeline.

The study was to include the evaluation of four (4) possible schemes, as requested by the Washoe County Utility Division, for the collection, storage and conveyance of the Winnemucca Ranch water rights. The four proposed schemes are the following:

- **Winnemucca Ranch Spring Flows**

Develop four (4) springs, Suzie, Sugarcane, APD and de Casas on the Winnemucca Ranch. Collect the flow and convey by pipeline to Spanish Springs Valley and/or Lemmon Valley along the most favorable topographic and geologic alignment. Annual possible flows of 900, 1,000 and 1,100 acre feet were to be evaluated.

- **Surface Flows from Dry Valley Watershed**

Develop storage facilities to collect and store surface flows. Two possible storage sites were anticipated and referred to as the Dry Creek site and the Black Canyon site. It was anticipated that storage would be provided by constructing low earth fill dams, sized to impound flows of 500, 1,000, or 1,500 acre feet annually. Conveyance of water from the storage reservoirs would be to Spanish Springs Valley and/or Lemmon Valley by pipeline and would include combining with flows from the Winnemucca Ranch Springs.

Water treatment (filtration) of surface water would be necessary prior to introduction in a domestic distribution system and would be provided at the storage facility.

- **Surface Flows from Dry Valley Watershed Conveyed to the Truckee Meadows Pipeline**

Storage facilities and treatment are the same as in No. 2 above, but conveyance would be by pipeline down Dry Valley to tie into the proposed Truckee Meadows pipeline.

- **Surface Flows from Dry Valley Watershed Combined with Winnemucca Ranch Spring Flows and Conveyed to the Proposed Truckee Meadows Pipeline**

Spring development and collection are the same as in No. 1 above, with water conveyed by a pumping facility and pipeline to storage and treatment facilities described in No. 2 above and then conveyed to the proposed Truckee Meadows pipeline.

Eight tasks were proposed to accomplish the engineering evaluation for the above alternatives.

Task No. 1 -- Initial site reconnaissance and identification of potential reservoir sites and pipeline routes.

The work items for this task included the following:

- initial map study of existing USGS Quads to identify preliminary storage sites and pipeline routes;

- field reconnaissance of study area to verify preliminary storage and routing selections; and
- brief narrative report of site conditions.

Task No. 2 -- Geologic reconnaissance of reservoir sites and pipeline routes.

The work items for this task included the following:

- geologic literature review;
- field geologic study; and
- preliminary geologic report.

Task No. 3 -- Mapping of reservoir sites.

The work items for this task included the following:

- set photo identified control points (utilizing existing aerial photography) at each reservoir site; and
- compile topographic mapping with 5 foot contour interval for each reservoir site (Autocad format).

Task No. 4 -- Winnemucca Ranch springs collection and conveyance to Spanish Springs Valley and/or Lemmon Valley.

The work items for this task included the following:

- details of spring development and collection;
- pipeline routing, details, plan and profiles;
- pipeline hydraulics;
- pump station details and hydraulics; and
- quantities and cost estimate.

Task No. 5 -- Dry Valley Reservoirs (two sites) and treatment facilities.

Combine with Winnemucca Ranch spring water and convey to Spanish Springs Valley and/or Lemmon Valley. Reservoirs of 500, 1,000, 1,500 acre foot capacity.

The work items for this task included the following:

- storage depth determinations;
- dam embankment and spillway;

- probable maximum flood design events;
- embankment and spillway sizing by flood routing;
- embankment and spillway details;
- water treatment facility (industry reference);
- pipeline routing to Winnemucca Ranch springs, details, plan and profile;
- pipeline hydraulics;
- pump station details and hydraulics;
- hydraulic and sizing adjustments to Spanish Springs Valley and/or Lemmon Valley pipeline and pump station; and
- quantities and cost estimates.

Task No. 6 -- Convey Dry Valley Reservoir water to Truckee Meadows pipeline

The work items for this task included the following:

- pipeline routing to Truckee Meadows pipeline;
- pipeline details, plan and profile;
- pipeline hydraulics; and
- quantities and cost estimates.

Task No. 7 -- Convey Dry Valley Reservoir water and Winnemucca Ranch spring water to Truckee Meadows pipeline.

The work items for this task included the following:

- pipeline routing from Winnemucca Ranch springs to Dry Valley reservoirs, details, plan and profiles;
- pipeline hydraulics;
- hydraulic and sizing adjustments of pipeline to the Truckee Meadows pipeline; and
- quantities and cost estimates.

Task No. 8 -- Engineering Report

The work items for this task included the following:

- data compilation;
- geologic Reconnaissance Summary; and
- description of Project Schemes:
 - conceptual drawings
 - photographs
 - design assumptions
 - hydraulic data
 - cost data

In addition to the above scope of work HLA was requested by the Utility Division to provide engineering analysis on two additional alternatives. These alternatives were to analyze the conveyance of water from the Spanish Flat Dam to the head of Cottonwood Creek or to Winnemucca Ranch Springs. The latter would then be routed to Spanish Springs Valley or Lemmon Valley. This work was outlined in HLA's supplemental proposal dated July 6, 1993.

The work items associated with these additional alternatives included the following:

- geologic reconnaissance of possible alternative pipeline routes;
- preparation of a brief narrative report of site conditions;
- prepare topographic strip map (from USGS Quad Maps, Autocad format) along the identified pipeline corridor;
- prepare preliminary details and hydraulics of pump station located at Spanish Flat Dam;
- prepare preliminary pipeline details, plan and profile from Spanish Flat Reservoir to Cottonwood Creek and from Spanish Flat Reservoir to Winnemucca Ranch Springs; and

- prepare an engineering report:
 - summary of data
 - geologic reconnaissance summary
 - description of project
 1. conceptual drawings
 2. photographs
 3. design assumptions
 4. cost data

2.0 SPANISH SPRINGS VALLEY IMPORTATION ANALYSIS

2.1 Alternatives

The Spanish Springs Valley importation alternatives consist of collecting and conveying waters from existing Winnemucca Ranch Springs and/or the waters from Upper Dry Valley to the Spanish Springs Valley. The term Winnemucca Ranch Springs for purposes of this report include Suzie, Sugarcane, APD and de Casas springs. All of these springs reside on the Winnemucca Ranch east of the ranch house (see conceptual drawings, sheet C3 of 36, for the approximate spring locations). The springs will be collected via a collection system similar to that shown on sheet C36 of 36 of the drawings. Possible flows from this group of springs is estimated by the Washoe County Utility Division at a total of 900, 1,000, or 1,100 acre - feet per year. The waters from Upper Dry Valley will be collected at either a dam in Upper Dry valley or the existing Spanish Flat Reservoir on the Winnemucca Ranch. The possible flows analyzed from the Upper Dry Valley were 500, 1,000, or 1,100 acre - feet per year. The flow from Spanish Flat Reservoir is approximately 3225 acre - feet per year. All discharge flows were provided to HLA by the Utility Division.

The Spanish Springs alternative uses existing roads for the entire pipeline route excepting that portion from Winnemucca Ranch Road to the spring locations above the ranch and from Black Canyon Reservoir to the springs. The pipe trenching will be at a depth of 3 to 5 feet in generally sandy soil. See section 7.0 of this report for the geologic summary. Using existing roads will reduce the costs of trenching and minimize environmental impacts.

2.2 Winnemucca Ranch Springs

Three flows were analyzed including 900, 1,000 and 1,100 acre feet per year all from the Winnemucca Ranch Springs. The springs are high enough in elevation

to allow gravity flow from the springs to Spanish Springs Valley without the use of a pump station. The pipe selected for all three flows was a 10 inch ductile iron pipe. The maximum working pressure of the pipe was calculated to be 290 pounds per square inch (psi). Class 50 pipe was used for this alternative allowing for approximately 100 psi operational allowance for water hammer and other phenomenon. This pipe was sized on the basis of water flowing 24 hours per day, and 365 days per year. The springs probably flow heavier during the spring months than the fall and winter months. However, the flows at different periods of the year were not available at the time of this report. This indicates that additional information is needed on the spring flow characteristics. The additional spring flow information might suggest a slightly larger pipe size based on the peak flows from the springs.

2.3 Black Canyon Reservoir and Winnemucca Ranch Springs

The flows analyzed included 900, 1,000 and 1,100 acre feet per year from the Winnemucca Ranch Springs and 500, 1,000, and 1,500 acre-feet per year from Black Canyon Reservoir. The reservoir water will have to be pumped to the spring location where gravity will carry the water on into Spanish Springs Valley. Additionally, the water from the reservoir will have to be treated prior to introduction to the potable water supply system from the springs. This treatment will be done at the dam where the pump station will be located. Electric power for the pump stations and water treatment plants would be provided by constructing an electrical transmission line from the Route 445/Winnemucca Ranch Road intersection to the pump station and treatment facility locations.

The pipe selected for flow combinations of 1,400, 1,500, 1,600 and 1,900 acre-feet per year from Spanish Springs Valley to Winnemucca Ranch Springs is a 12 inch class 50 ductile iron pipe. The pipe selected for flow combinations of 2,000

2,100, 2,400, 2,500 and 2,600 acre-feet per year from Spanish Springs Valley to Winnemucca Ranch Springs is a 14 inch class 50 ductile iron pipe. The pipe selected from Winnemucca Ranch Springs to Black Canyon Dam for a flow of 500, 1,000 and 1,100 acre-feet per year is 8, 10 and 10 inch class 50 ductile iron respectively. The maximum working pressure of the pipe for all these flows was calculated to be approximately 310 psi. These pipe sizes were based on the water flowing 24 hours per day, and 365 days per year from all sources. As mentioned above, the springs probably flow heavier during the spring months than the fall and winter months. Also the reservoir was assumed to discharge at a constant rate through the year assuming sufficient storage inflow during the year. Pipe sizes identified in this study are subject to revisions as additional data is obtained regarding expected flow rates into the reservoir and the refinement of the flows from the springs.

2.4 Spanish Flat Reservoir and Winnemucca Ranch Springs

The flows analyzed were 3,225 acre-feet per year from the Spanish Flat Reservoir and 900, 1,000, or 1,100 acre-feet per year from the Winnemucca Ranch Springs. The reservoir water will flow down the existing channel to a man made diversion ditch as shown on the drawings. The water will be piped from the diversion ditch to the springs. This will eliminate infiltration loss from the diversion ditch to the springs. The channel from Spanish Flat Reservoir to the diversion ditch is very sandy and subject to infiltration loss; however, the channel is also extremely rocky, making pipeline construction difficult and expensive. Additional data is needed to determine the amount of water to be expected to infiltrate into the ground in this existing channel.

The water from the reservoir will have to be treated prior to introduction to the potable water supply system. This treatment will be done after piping to the

springs and before combination with the spring water. This will reduce the cost of electrical line installation for the treatment facility. Electricity will again be supplied by constructing a transmission line from the Route 445/Winnemucca Ranch Road intersection to the treatment facility at Winnemucca Ranch Springs. The pipe selected for the flow combination of 4,125, 4,225, and 4,335 acre-feet per year from Spanish Springs Valley to Winnemucca Ranch Springs is an 18 inch class 50 ductile iron pipe. The pipe selected from Winnemucca Ranch Springs to the top of the diversion structure for a flow of 3,225 acre-feet per year is also an 18 inch class 50 ductile iron pipe. The maximum working pressure of the pipe for all these flows was calculated to be approximately 250 psi. As before, these pipe sizes were based on the water flowing 24 hours per day, and 365 days per year from all sources. Pipe and hydraulic grade line profiles were not prepared for the combination of flows from the Spanish Flat Reservoir and the Winnemucca Ranch Springs. These profiles would be similar to those prepared for the combination of flows from the Black Canyon Reservoir and Winnemucca Ranch Springs.

3.0 LEMMON VALLEY IMPORTATION ANALYSIS

3.1 Alternatives

The Lemmon Valley importation alternatives consist of collecting and conveying the waters from the Winnemucca Ranch Springs and/or the waters from Upper Dry Valley or Spanish Flat Reservoir to Lemmon Valley. The pipe route for the alternatives initially follows the same route to Spanish Springs Valley, but then is routed up to Bedell Flat from Winnemucca Ranch Road. From Bedell Flat the pipeline ties into the Truckee Meadows Pipeline. This pipeline would then continue on to Lemmon Valley. The pressure head was assumed to be approximately 100 psi in the Truckee Meadows Pipeline at the point of connection to the Winnemucca Ranch Pipeline. The flows considered are the same as those analyzed for the Spanish Springs Valley pipelines.

3.2 Winnemucca Ranch Springs

The flows include 900, 1,000 and 1,100 acre-feet per year, all from Winnemucca Ranch Springs. Unlike the Spanish Springs Valley alternative, the springs are not high enough to produce enough pressure to push the water up into Bedell Flat, north of Lemmon Valley. To provide enough pressure to Lemmon Valley, a pump station will be provided at Winnemucca Ranch Springs. This location reduces the pumping costs due to its high elevation. The maximum working pressure in the pipeline is approximately 600 psi for the three flows analyzed for this alternative. The pipe selected for all three flows was class 50 and 51 ductile iron pipe, with class 51 being used only within high pressure areas. The pipe class was varied to reduce the pipeline costs.

3.3 Black Canyon Reservoir and Winnemucca Ranch Springs

The flows analyzed included 900, 1,000 and 1,100 acre-feet per year from the Winnemucca Ranch Springs and 500, 1,000 and 1,500 acre-feet per year from Black

Canyon Reservoir. The reservoir water will be pumped to the spring location where the water will be combined with the spring water. The reservoir water will also be treated at the dam site prior to mixing with spring water.

This alternative will require the spring water as well as the reservoir water to be pumped to a pressure sufficient to allow the water to flow up to Bedell Flat to connect to the Truckee Meadows Pipeline.

The pipe selected for flow combinations of 1,400, 1,500 and 1,600 acre-feet per year was 12" diameter class 50 and 52 ductile iron pipe. The pipe selected for flow combinations of 1,900, 2,000, 2,100, 2,400, 2,500 and 2,600 acre-feet per year was 14" diameter class 50 and 53 ductile iron pipe. The pipe selected from Black Canyon Reservoir to Winnemucca Ranch Springs for flows of 500, 1,000 and 1,500 acre-feet per year was 10", 12" and 12" class 50 ductile iron pipe.

Electricity will again be supplied by constructing a transmission line from the Route 445/Winnemucca Ranch Road intersection to the pump stations and treatment facility for this option.

3.4 Spanish Flat Reservoir and Winnemucca Ranch Springs

The flows analyzed for are the same as in Section 2.4 above, 3,225 acre-feet per year from Spanish Flat Reservoir and 900, 1,000, or 1,100 acre-feet per year from Winnemucca Ranch Springs. The reservoir water will flow down the existing channel to a man made diversion ditch as shown on the plans. The water will be piped from the existing diversion ditch to the springs. As mentioned previously, this will eliminate infiltration loss from the ditch to Winnemucca Ranch Springs. The water from the reservoir will be treated prior to introduction to the potable water supply system at the springs location. This will reduce the cost of electrical line installation for the treatment facility. Electricity will again be supplied by the

construction of a transmission line from the Route 445/Winnemucca Ranch Road intersection to the treatment facility at Winnemucca Ranch Springs.

The pipe selected for this route is 18" class 50 ductile iron pipe from Spanish Flat Reservoir to the Springs and 18" class 54 ductile iron pipe from Winnemucca Ranch Springs to Bedell Flat. As before, all pipe sizes are based on continuous flow year round. Pipe and hydraulic grade line profiles are similar to those prepared for the combination of flows from the Black Canyon Reservoir and Winnemucca Ranch Springs.

4.0 DRY VALLEY ROUTE TO LEMMON VALLEY IMPORTATION ANALYSIS

4.1 Alternatives

The Dry Valley alternatives consists of collecting and conveying the waters from existing Winnemucca Ranch Springs and/or the waters from Upper Dry Valley through Dry Valley to connect to the Truckee Meadows Pipeline. A reservoir located at the base of Upper Dry Valley at the head of Dry Valley Canyon would be constructed to collect and retain the runoff from Upper Dry Valley. From this reservoir, a pipeline will be constructed down Dry Valley Canyon to Dry Valley. At this point the pipeline will connect to the Truckee Meadows Pipeline. The Truckee Meadows Pipeline would then continue on to Lemmon Valley. The pressure head was assumed to be approximately 350 psi at the point of connection to the Dry Valley Pipeline.

The flows considered for this alternate were the same as for the previous alternates with the exception of Spanish Flat Reservoir. Spanish Flat Reservoir was not considered as part of this route. Also, the reservoir containing the runoff from Dry Valley was moved from Black Canyon to the downstream end of Upper Dry Valley.

Although this report does not address environmental issues, site visits indicate a possible archaeological restraint with this pipeline route. Additionally, the valley floor within this canyon contains an incised meandering streambed. At points this streambed has scoured the valley floor to a depth of 10 to 15 feet. This will increase the cost of the pipeline through the canyon. There is an existing concrete dam approximately 4 feet thick and 20 to 30 feet tall completely blocking the canyon. The bedrock on both the right and left abutment of the dam make it difficult and expensive to pass the pipeline through the canyon.

4.2 Winnemucca Ranch Springs

The flows for this alternative include 900, 1,000 and 1,100 acre-feet per year, all from Winnemucca Ranch Springs. Similar to the Lemmon Valley Alternate the springs are not high enough to provide enough pressure to match the pressure in the Truckee Meadows Pipeline in Dry Valley. A pump station will be installed at Winnemucca Ranch Springs to boost the pressure approximately 150-170 psi to match the pipeline pressures. The maximum working pressure in the pipeline is approximately 350 psi at the Truckee Meadows Pipeline. The pipe selected for the flow of 500 acre-feet per year was a 10" class 50 ductile iron. The pipe selected for the flows of 1,000 and 1,500 acre-feet per year was a 12" class 50 ductile iron pipe.

4.3 Dry Valley Reservoir and Winnemucca Ranch Springs

The flows analyzed for this alternative included 900, 1,000 and 1,100 acre feet per year from the Winnemucca Ranch Springs and 500, 1,000 and 1,500 acre feet per year from Dry Valley Reservoir. The reservoir and spring water will be pumped to the base of Dry Valley Canyon where the pipeline will connect to the Truckee Meadows Pipeline. The reservoir water will be treated at the dam prior to combining with the spring water.

The pipe selected for flows of 900, 1,000 and 1,100 acre feet per year from Winnemucca Ranch Springs to the Dry Valley Reservoir was a 12" diameter class 50 ductile iron pipe. The flows of 500 acre feet per year from the reservoir and 900 acre feet per year from the springs to the Truckee Meadows Pipeline received a 10" diameter class 50 ductile iron pipe. Flows of 1,000, 1,100, 1,400 and 1,500 acre feet per year received a 12" diameter class 50 ductile iron pipe. While flows of 1,600, 1,900, 2,000, 2,100, 2,400, 2,500 and 2,600 all received pipe sizes of 14" diameter class 50 ductile iron pipe. The maximum working pressure in the pipeline is at the Truckee Meadows Pipeline at 350 psi.

6.0 HYDROLOGIC MODELING OF RESERVOIRS

The flood flows into the reservoirs were analyzed using the U.S. Army Corps of Engineers computer program HEC-1. Within this program, the SCS dimensional unit hydrograph was used to determine runoff hydrographs. In addition, two routing methods were used within the program: the modified Puls method for routing through reservoirs and the Muskingum method for channel routing. The HEC-1 SCS model is designed to represent a given drainage basin as it is subject to various intensities of precipitation. The model is set up using mathematical parameters which represent various surface conditions of the given basin. This model computes stream flow hydrographs at key locations within the site. The major parameters represented by the SCS model are drainage area, precipitation, SCS curve number, and SCS watershed lag time (reference Table 1 in Appendix A for the hydrologic design parameters used for this analysis).

Hydrology is a complex system with many uncertain variables. This model takes into account hydrologic variables using basin average assumptions. It is HLA's best judgment that these assumptions are conservative enough to account for hydrologic inconsistencies. The hydrology process is not an exact science, however, and is very judgmental in nature; therefore, all runoff values contained herein are approximate.

6.1 Drainage Basins

Analysis points for Black Canyon and Dry Valley Reservoirs were picked at the base of the reservoir for each watershed boundary.

The topographic boundaries of each watershed drainage basin were approximated by outlining the watershed boundaries on a 1 inch = 2000 feet USGS Quadrangle.

6.2 Precipitation

As specified by the US Army Corps of Engineers, the 1/2 and full probable maximum floods (PMF) were analyzed for each basin. The Design Event was determined to be the 1/2 PMF for both the Black Canyon Reservoir and the Dry Valley reservoir (reference Appendices B and C for the analysis printouts).

Precipitation values for the two PMF storms were determined from the procedures outlined within Hydrometeorological report (HMR) No. 49, prepared by the National Weather Service.

Due to the relatively small size of the drainage basins included in this analysis, no areal reduction factors were used to allow for storm distribution. The precipitation distribution was taken from the standard SCS Type II distribution. This is the standard rainfall distribution developed by the Soil Conservation Service for this area of the country. HMR No. 5 distributions were used to distribute the PMF storms (reference Appendix A for the PMF calculations and distributions).

6.3 SCS Curve Number

An SCS curve number was calculated for each basin with the following four considerations in mind:

1. Soil Type - Soils are classified according to their hydrologic behavior. The four classes in the SCS analysis are A, B, C, and D, with A being the most pervious and D being the least. The soil classifications of A, B, C, and D were encountered for the runoff basin for both dams. A weighted soil type was used for both basins based on the amount of area for each soil type.
2. Vegetative Type - The type of vegetation will influence runoff and SCS has broken the type of vegetation into multiple classes (open spaces, grass, forest, etc.). The vegetation at this site varies from sparse sagebrush with a grass understory to short grass pasture land.
3. Cover - The curve number is influenced by the amount of protective cover on the ground surface of the watershed. Cover is usually defined as the percentage of ground covered with vegetation. SCS has broken this down into categories such as good, fair, and poor. The cover on this site is generally considered poor to fair due to the lack of dense vegetation.

4. **Soil Moisture** - Soil moisture is expressed in antecedent soil moisture condition (AMC). AMC is classified as I, II, or III, with AMC III being the wettest condition and AMC II as the reference point on which curve numbers are based. The curve number can be adjusted depending on the anticipated AMC. Generally, peak runoff figures are calculated using an antecedent moisture condition of II due to the approximate nature of the AMC. This analysis uses the standard antecedent moisture condition of II.

The curve number for each area can vary according to each of these variables from a low of 0 (a completely pervious watershed with no possibility of runoff) to a high of 100 (a completely impervious watershed with runoff equaling rainfall). After considering all of the above parameters, a curve number of 69 for both basins was chosen. This reflects the runoff potential and vegetation characteristics of the site.

6.4 SCS Watershed Lag Time

The lag time for each basin was calculated using the velocity method. The velocity method breaks up the hydraulic length of each basin into varying slopes and land types. Each segment's length is divided by its corresponding runoff velocity to obtain a time of concentration for each reach. The SCS lag time is 0.6 times the computed time of concentration. The lag time must then be adjusted according to the actual field conditions of the given channel. Field conditions that may affect the channel's efficiency are bank and bottom soil conditions, vegetation, debris, etc. The lag time is used to estimate the delay time from initial precipitation to actual runoff at some reference point within the basin. It is of extreme importance that the lag time closely approximate the actual field conditions due to its significant impact on the peak runoff values at each analysis point. As mentioned in Section 7.0 of this report, site reconnaissance was performed to evaluate channel conditions for each basin. The types and amount of vegetation, channel condition and slope were all verified to best determine the channel velocities. Table 1 in Appendix A lists the calculated lag times for each basin.

6.5 Dam Height / Reservoir Volume Evaluations

Both dams were analyzed for the full PMP and the 1/2 PMP storms. The PMP for both sites is approximately 13.3 inches within a 6 hour period. The 1/2 PMP is simply calculated by halving the initial precipitation to a depth of 6.65 inches.

Both dams were analyzed using an initial condition set at 1,500 acre-feet of storage, then the storms were run through each reservoir with differing spillway configurations to minimize the height of each dam. This analysis is conservative due to the fact that the reservoirs probably will never have a volume this high. All pipelines were sized assuming continuous flow from the reservoirs throughout the year. During the spring months the reservoirs will fill to some height and slowly drain throughout the year. At the time of this report there was not enough data to fully analyze the maximum pool elevation that would be obtained during the spring runoff period. This information is being obtained by Washoe County by monitoring a network of rain and stream gages installed within the area. Both dams are probably over designed at this time. Costs for both dams may reduce after final design.

6.5.1 Black Canyon Reservoir

The spillway for this reservoir is located off of a finger in the reservoir pool to the north. The spillway will be in rock cut and will need no slope protection due to its location away from the dam face. The cut from the spillway will be used for shell material during the dam construction.

The dam core materials are planned to be taken from the pool and surrounding area. This material will have to be processed on-site before placement.

6.5.2 Upper Dry Valley Reservoir

This reservoir location is in a confined area at the base of Upper Dry Valley. The spillway is located on the left abutment of the dam in a rock cut. Due to the close proximity to the dam face, this spillway was estimated to need full concrete lining along with energy dissipaters at the base of the dam to reduce erosion. The spillway excavation will produce shell material usable on the upstream and downstream dam face. The core materials for the dam are planned to be taken from the pool and surrounding area. This material will have to be processed on-site before placement.

7.0 GEOLOGIC RECONNAISSANCE AND LITERATURE REVIEW

A literature review was performed as part of the Winnemucca Ranch Water Resources Study. The review focused on available geotechnical, topographical, and orthological data from existing published and unpublished sources. A list of references reviewed is provided in the Bibliography.

In addition to the literature search, site reconnaissances of proposed pipeline routes and reservoir sites were conducted. A site reconnaissance was conducted to field confirm surface conditions and to verify findings of the literature review. The geologic factors studied included: rock and soil conditions including; near or surface bedrock; liquefaction potential; high groundwater; access for construction equipment.

Geologic data and assessments summarized below were based on the literature review and site reconnaissance only. Rippability of bedrock, subsurface conditions, liquefaction potential and other geotechnical and excavation considerations should be better defined during a design geotechnical investigation.

7.1 General Observations

Data obtained during the literature review did not indicate the presence of active faults crossing any of the proposed pipeline alignments, proposed reservoir sites, or the existing Spanish Flat Reservoir. A Holocene Age (younger than 11,000 years) fault is present in Warm Springs Valley near the Pyramid Lake Highway. Holocene faults are considered by the United State Geological Survey (USGS) to be active faults. The fault trace is approximately two miles in length. Several active faults are present near the Ollinghouse Mine that have the potential to generate large earthquakes and may cause liquefaction of granular soils.

Two subsurface factors must be present in a seismically active area to have a significant potential for liquefaction: high ground water and loose, fine grained

cohesionless soils. Published data and site reconnaissance indicate high groundwater at locations along the proposed pipeline alignment and reservoir sites. Additionally, sandy soils are present in some areas. To determine if there is a potential for liquefaction in these areas, additional studies including subsurface exploration would be required.

7.2 Upper Dry Valley Reservoir Site

Abutments at the Upper Dry Valley site are composed of Tertiary Hartford Hill Rhyolite bedrock, predominantly consisting of propylitically altered, variable welded ashflow tuff with minor beds of ashflow tuff and lenses of clastic sediments. The ashflow tuff is composed of quartz latite or rhyolite in composition. The bedrock is moderately to highly fractured and covered by a layer of colluvium. The bedrock, although fractured, is competent. Prior to construction, the colluvial material should be removed to expose competent bedrock. Seepage may occur through the bedrock fractures at the abutments.

The foundation for the proposed dam consists of a Quaternary alluvial cover consisting of stream, elonian (wind), talus and slope wash and alluvial fan deposits overlying bedrock. The Quaternary alluvial deposits range in thickness. For preliminary engineering design cost purposes, the thickness was assumed not to exceed 30 feet. The thickness of alluvial cover must be verified during a geotechnical investigation prior to final design. Bedrock is the Hartford Hill Rhyolite described above. Due to the close spacing of fractures and propylitic alteration, seepage may occur under the dam through the bedrock foundation.

The spillway will be located in the rhyolite bedrock. Material to be excavated will be primarily the fractured bedrock. A large quantity of rock excavation will be generated during construction of the spillway and could be suitable for use in a dam embankment.

Based on the literature review, soils comprising the flat portion of the impoundment area consist of sandy, silty clays and silty sands. However, during the site reconnaissance, only silty fine sands were observed in surface exposures. The colluvium covering the slopes in the impoundment area consist of silty and clayey sands with gravel and cobbles. Generally, these soils have a moderately low permeability depending on their gradation. At the time of the reconnaissance, there were a number of phreatites and an organic layer in the upper 6 to 8 inches of soil. However, grass and sagebrush roots may extend deeper. This area may be considered a wetlands area. This wetlands area may be mitigated with the construction and subsequent flooding of the impoundment area. This will require additional study to confirm.

7.3 Black Canyon Reservoir Site

The abutments at the Black Canyon Reservoir site are bedrock comprised of andesitic and dacitic flows, of the Pyramid Sequence. The bedrock is overlain by colluvial soils. The colluvial soils contain a moderate percentage of clay material. The andesite and dacite bedrock is highly fractured and is slightly to moderately weathered, with minor alteration. The bedrock is competent, however, seepage may occur through the abutment. The colluvial material would be removed prior to construction.

The foundation for the proposed dam consists of a Quaternary alluvial soil cover over the Pyramid Sequence andesitic and dacitic bedrock. For preliminary design purposes, the foundation is similar to the Upper Dry Valley Foundation and a depth of 30 feet of alluvial cover to be removed was assumed. Seepage may occur through the foundation and abutment bedrock due to the fracturing.

The spillway will be located in the andesitic and dacitic bedrock after the removal of colluvial material. Spillway construction should generate a large quantity of rock excavation suitable for use in a dam embankment.

Based on the site reconnaissance, the soils within the impoundment area consist of silty fine sands. Generally, these soils have moderate permeability, however, if the soils are well graded, permeability rates may be lower than expected when compacted. Phreatites, willows and an upper organic soil layer are present within the impoundment area. This area may be considered a wetlands. The wetland area at the Black Canyon site may be mitigated with the construction and subsequent flooding of the impoundment area. This will require additional study to confirm.

7.4 Spanish Flat Reservoir Site

A preliminary evaluation for the Spanish Flat Reservoir site was conducted by HLA and is summarized in a report dated June 29, 1992. Potential concerns are as follows:

1. The upstream slope has been severely eroded by wave action which has reduced the effective crest width to about 6 feet.
2. Seepage appears to be passing along the low-level conduit and exits under the conduit at the downstream end. Seepage volumes are small and no piping of the soils is evident.
3. Seepage also appears along the downstream toe of the embankment at various places at about 50 to 100 feet on each side of the outlet.
4. The spillway on the left abutment has experienced some side slope sloughing and there is considerable sagebrush in the control section. These obstructions may not allow the structure to operate to the required design level.
5. The condition of the low-level outlet conduit is unknown. The conduit has not been inspected. Some minor seepage appears to be exiting from around the conduit.

The low-level conduit is pressurized at all times due to the way it is operated. This potential concern could be mitigated by simply changing the operation procedure to use the upstream control gate.

The HLA report concludes that a geotechnical investigation will be required to determine the most effective method for upgrading the reservoir.

7.5 Spanish Springs Importation Alternative

The three routes described below eventually transport water to Spanish Springs via a pipeline along Winnemucca Ranch Road to Route 445. The following paragraph describes geologic conditions expected to be encountered along that portion common to the three routes.

The majority of the Winnemucca Ranch Road route is underlain by alluvial soil deposits that should present no significant excavation problems. The alluvium includes the Pleistocene Winnemucca Ranch lake deposits of clays, silts, sands, gravel and calcareous tufa, and Quaternary stream talus, slope wash alluvial fan and elonian deposits. Shallow bedrock may be encountered along the alignment; however, the majority of bedrock encountered would be the Pyramid Sequence (described below) and is potentially rippable. Rippability of bedrock, subsurface conditions and other excavation considerations should be determined by a geotechnical investigation.

- **Winnemucca Ranch Springs Alternative**

The Winnemucca Ranch Springs alternate pipeline route crosses pre-lake Lahontan Deposits consisting of deeply weathered terrace, alluvial fan and pediment gravels.

- **Black Canyon Reservoir and Winnemucca Ranch Springs Alternative**

Black Canyon Reservoir water would be piped from the reservoir to the Winnemucca Ranch Springs. The pipeline route crosses the Hartford Hill Rhyolite bedrock (described in Section 7.2) and Quaternary alluvial soil consisting of stream, elonian, talus, slopewash and alluvial fan deposits. The first 2.5 miles of the alignment is in the

bedrock. Although shallow bedrock is probable for this portion, it may be rippable due to the close fracture spacing, moderate weathering and propylitic alteration.

- **Spanish Flat Reservoir and Winnemucca Ranch Springs Alternative**

The proposed alignment to convey water to the Winnemucca Ranch spring from the Spanish Flat Reservoir is described in Section 2.3. The reservoir water will flow down an existing channel to an existing diversion. The flow will be piped from the existing diversion to the Winnemucca Ranch Springs. The existing channel is a creek bed in the Tertiary Pyramid Sequence bedrock. Bedrock is composed of the andesite and dacitic flows described above and andesitic and dacitic breccias, lahars, agglomerates, tuffs and associated intrusives. The pipeline portion of the alignment is generally in Quaternary alluvium and colluvium soils. Construction of the pipeline would be straight forward. Infiltration losses in the upper open channel portion of this alignment may be high.

7.6 Lemmon Valley Importation Alternative

The pipeline route for this alternative initially follows the same route as the Spanish Springs importation alternative with the exception that the pipe is routed up to Bedell Flat from Winnemucca Ranch Road. From Bedell Flat, it is assumed the pipeline will tie into the Truckee Meadows Pipeline. The pipeline alternatives (Winnemucca Ranch Spring, Black Canyon Reservoir and Winnemucca Ranch Springs and the Spanish Flat Reservoir and Winnemucca Springs) are described in Section 7.5. The route to Bedell Flat, once it leaves Winnemucca Ranch Road, will traverse Quaternary alluvial soils and medium to coarse grained, weathered granodiorite bedrock. Generally the route follows an existing road and will be easy to excavate. Soils encountered will be granular. If the granodiorite bedrock is encountered, excavation should not be too difficult; however, shallow groundwater may be encountered in Bedell Flat.

7.7 Dry Valley Route to Lemmon Valley Importation Alternative

The Dry Valley Route to Lemmon Valley, as described in Section 4.0, would convey water from the Upper Dry Valley Reservoir or Winnemucca Ranch Springs to the Truckee Meadow Pipeline.

- **Dry Valley Reservoir and Winnemucca Springs Alternative**

Dry Valley cuts through the Hartford Hill Rhyolite bedrock, predominantly composed of ashflow tuff (see section 7.2). Constructability concerns were addressed in Section 4.0. Additionally, there is a potential for shallow groundwater and very difficult access for construction equipment.

- **Winnemucca Ranch Springs Alternative**

The Winnemucca Ranch Springs pipeline route would transfer water from the spring to the Truckee Meadows Pipeline. From the Winnemucca Ranch Springs, the route would encounter similar conditions as the Black Canyon Reservoir and Winnemucca Ranch Spring Alternate and the same problems as described above in Section 7.5.

7.8 Cottonwood Creek Infiltration Alternative

The Cottonwood Creek Infiltration route would initially parallel the impoundment area at the Spanish Flat Reservoir. Based on published information, soils in the impoundment area, consist of Quaternary alluvial deposits. These soils are most likely saturated and may pose a dewatering and trench stabilization problem during excavation. The portion of the alignment from the north end of the Spanish Flat Reservoir to the top of the Virginia Mountains, the outlet at East Cottonwood Creek, is underlain by alluvial soil and highly fractured bedrock. This alignment will only be used if the Spanish Flat Reservoir alternative is selected. Heavy construction equipment access to the reservoir would be moderately difficult. From the reservoir, heavy equipment access is not a problem.

7.9 Conceptual Embankment

A conceptual embankment section for the Upper Dry Valley and Black Canyon Reservoir sites is presented on sheet C35 of 36 of the accompanying drawings. It is based on HLA's literature review, site reconnaissance, and experience in northern Nevada, especially with the recently constructed South Truckee Meadows Reservoir. Zone 4 is a rock fill and will be constructed from the rock excavation for the spillways. Zone 1 is a core and will be constructed from

overexcavation of overburden soils within the impoundment area. The effectiveness of this core to retard seepage through the embankment will depend on the gradation and presence of clay in these soils. Zones 2 and 3 are specified soil that will be designed to meet the filter criteria for the embankment.

In order to control seepage under the embankment, the existing alluvial soils will be excavated to expose competent bedrock. These soils may be used as borrow for Zones 1, 2 and 3. A three stage grout curtain and concrete cap will most likely be required beneath the Zone 1 core to mitigate seepage through the fractured bedrock under the embankment in the foundation and abutments.

A preliminary followed by a final geotechnical investigation will be required to confirm the material property and foundation assumptions the conceptual design is based on.

Embankment improvements required for the Spanish Flat Dam are presented in Section III of HLA's June 29, 1992 report.

BIBLIOGRAPHY

Bell, John W. *Quaternary Fault Map of Nevada Reno Sheet, Map 79, 1984*. Nevada Bureau of Mines and Geology, Mackay School of Mines, University of Nevada, Reno.

Bonham, Harold F. *Geology and Mineral Deposits of Washoe and Storey Counties, Nevada Bulletin 70, 1969*. Nevada Bureau of Mines and Geology, Mackay School of Mines, University of Nevada, Reno.

Division of Water Resources, State Engineer's Office. *Static Ground Water Levels of Nevada* (prepared as part of the Nevada State Water Plan, scale 1:750,000), 1974.

Gimlett, James I. *Gravity Study of Warm Springs Valley, Washoe County, Nevada, 1967*. Nevada Bureau of Mines, Mackay School of Mines, University of Nevada, Reno.

Harding Lawson Associates. *Preliminary Evaluation, Spanish Flat Dam, Winnemucca Ranch, June 29, 1992*.

United States Department of Agriculture, Soil Conservation Service, U.S. Government Printing Office. *Soil Survey of Washoe County, South Part, August, 1983*.

APPENDIX A

This appendix contains cost data for all alternatives.

SPANISH SPRINGS ALTERNATIVES

Preliminary Engineers Estimate Summary Sheet

Spanish Springs Importation Alternate Alternates in Order of Cost per Ac-Ft

Q=1100	\$9,300	Dollars/Ac-Ft (Winnemucca Ranch Springs)
Q=1000	\$10,200	Dollars/Ac-Ft (Winnemucca Ranch Springs)
Q=900	\$11,400	Dollars/Ac-Ft (Winnemucca Ranch Springs)
Q=2600	\$11,600	Dollars/Ac-Ft (Black Canyon Reservoir & Winnemucca Ranch Springs)
Q=2500	\$12,100	Dollars/Ac-Ft (Black Canyon Reservoir & Winnemucca Ranch Springs)
Q=2400	\$12,600	Dollars/Ac-Ft (Black Canyon Reservoir & Winnemucca Ranch Springs)
Q=2100	\$14,100	Dollars/Ac-Ft (Black Canyon Reservoir & Winnemucca Ranch Springs)
Q=1900	\$14,300	Dollars/Ac-Ft (Black Canyon Reservoir & Winnemucca Ranch Springs)
Q=2000	\$14,800	Dollars/Ac-Ft (Black Canyon Reservoir & Winnemucca Ranch Springs)
Q=1600	\$16,100	Dollars/Ac-Ft (Black Canyon Reservoir & Winnemucca Ranch Springs)
Q=1500	\$17,200	Dollars/Ac-Ft (Black Canyon Reservoir & Winnemucca Ranch Springs)
Q=1400	\$18,400	Dollars/Ac-Ft (Black Canyon Reservoir & Winnemucca Ranch Springs)

Winnemucca Ranch Springs				
to Spanish Springs				
Q=900 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Pipeline to Spanish Springs	\$7,055,150
			Contingency (25%)	\$1,763,788
			Subtotal	\$8,818,938
			Geotechnical & Surveys (2%)	\$176,379
			Engineering Design (6%)	\$529,136
			Construction Management (8%)	\$705,515
			Total	\$10,229,968
			Rounded Total	\$10,230,000
			Dollars/AC-FT	\$11,400
Note:				
All Costs are preliminary and do not include				
any environmental planning and permitting costs				

Winnemucca Ranch Springs				
to Spanish Springs				
Q=1000 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Pipeline to Spanish Springs	\$7,055,150
			Contingency (25%)	\$1,763,788
			Subtotal	\$8,818,938
			Geotechnical & Surveys (2%)	\$176,379
			Engineering Design (6%)	\$529,136
			Construction Management (8%)	\$705,515
			Total	\$10,229,968
			Rounded Total	\$10,230,000
			Dollars/AC-FT	\$10,200
Note:				
All Costs are preliminary and do not include				
any environmental planning and permitting costs				

Winnemucca Ranch Springs				
to Spanish Springs				
Q=1100 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Pipeline to Spanish Springs	\$7,055,150
			Contingency (25%)	\$1,763,788
			Subtotal	\$8,818,938
			Geotechnical & Surveys (2%)	\$176,379
			Engineering Design (6%)	\$529,136
			Construction Management (8%)	\$705,515
			Total	\$10,229,968
			Rounded Total	\$10,230,000
			Dollars/AC-FT	\$9,300
Note:				
All Costs are preliminary and do not include				
any environmental planning and permitting costs				

Black Canyon Reservoir and Winnemucca Ranch Springs				
to Spanish Springs				
Q=1400 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Black Canyon Dam	\$7,840,485
2	1	LS	Pipeline to Spanish Springs	\$9,949,800
			Subtotal	\$17,790,285
			Contingency (25%)	\$4,447,571
			Subtotal	\$22,237,856
			Geotechnical & Surveys (2%)	\$444,757
			Engineering Design (5.8%)	\$1,289,796
			Construction Management (8%)	\$1,779,029
			Total	\$25,751,438
			Rounded Total	\$25,751,000
			Dollars/AC-FT	\$18,400
Note:				
All Costs are preliminary and do not include				
any environmental planning and permitting costs				

Black Canyon Reservoir and Winnemucca Ranch Springs				
to Spanish Springs				
Q=1500 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Black Canyon Dam	\$7,840,485
2	1	LS	Pipeline to Spanish Springs	\$9,949,800
			Subtotal	\$17,790,285
			Contingency (25%)	\$4,447,571
			Subtotal	\$22,237,856
			Geotechnical & Surveys (2%)	\$444,757
			Engineering Design (5.8%)	\$1,289,796
			Construction Management (8%)	\$1,779,029
			Total	\$25,751,438
			Rounded Total	\$25,751,000
			Dollars/AC-FT	\$17,200
Note:				
All Costs are preliminary and do not include				
any environmental planning and permitting costs				

Black Canyon Reservoir and Winnemucca Ranch Springs				
to Spanish Springs				
Q=1600 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Black Canyon Dam	\$7,840,485
2	1	LS	Pipeline to Spanish Springs	\$9,961,300
			Subtotal	\$17,801,785
			Contingency (25%)	\$4,450,446
			Subtotal	\$22,252,231
			Geotechnical & Surveys (2%)	\$445,045
			Engineering Design (5.8%)	\$1,290,629
			Construction Management (8%)	\$1,780,179
			Total	\$25,768,084
			Rounded Total	\$25,768,000
			Dollars/AC-FT	\$16,100
Note:				
All Costs are preliminary and do not include				
any environmental planning and permitting costs				

Black Canyon Reservoir and Winnemucca Ranch Springs				
to Spanish Springs				
Q=1900 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Black Canyon Dam	\$7,840,485
2	1	LS	Pipeline to Spanish Springs	\$10,882,400
			Subtotal	\$18,722,885
			Contingency (25%)	\$4,680,721
			Subtotal	\$23,403,606
			Geotechnical & Surveys (2%)	\$468,072
			Engineering Design (5.8%)	\$1,357,409
			Construction Management (8%)	\$1,872,289
			Total	\$27,101,376
			Rounded Total	\$27,101,000
			Dollars/AC-FT/YR	\$14,300
Note:				
All Costs are preliminary and do not include				
any environmental costs (i.e. EIS, 401 Permits, etc.)				

Black Canyon Reservoir and Winnemucca Ranch Springs				
to Spanish Springs				
Q=2000 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Black Canyon Dam	\$7,840,485
2	1	LS	Pipeline to Spanish Springs	\$12,582,325
			Subtotal	\$20,422,810
			Contingency (25%)	\$5,105,703
			Subtotal	\$25,528,513
			Geotechnical & Surveys (2%)	\$510,570
			Engineering Design (5.8%)	\$1,480,654
			Construction Management (8%)	\$2,042,281
			Total	\$29,562,018
			Rounded Total	\$29,562,000
			Dollars/AC-FT	\$14,800
Note:				
All Costs are preliminary and do not include				
any environmental planning and permitting costs				

Black Canyon Reservoir and Winnemucca Ranch Springs				
to Spanish Springs				
Q=2100 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Black Canyon Dam	\$7,840,485
2	1	LS	Pipeline to Spanish Springs	\$12,582,325
			Subtotal	\$20,422,810
			Contingency (25%)	\$5,105,703
			Subtotal	\$25,528,513
			Geotechnical & Surveys (2%)	\$510,570
			Engineering Design (5.8%)	\$1,480,654
			Construction Management (8%)	\$2,042,281
			Total	\$29,562,018
			Rounded Total	\$29,562,000
			Dollars/AC-FT	\$14,100
Note:				
All Costs are preliminary and do not include				
any environmental planning and permitting costs				

Black Canyon Reservoir and Winnemucca Ranch Springs				
to Spanish Springs				
Q=2400 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Black Canyon Dam	\$7,840,485
2	1	LS	Pipeline to Spanish Springs	\$13,027,325
			Subtotal	\$20,867,810
			Contingency (25%)	\$5,216,953
			Subtotal	\$26,084,763
			Geotechnical & Surveys (2%)	\$521,695
			Engineering Design (5.8%)	\$1,512,916
			Construction Management (8%)	\$2,086,781
			Total	\$30,206,155
			Rounded Total	\$30,206,000
			Dollars/AC-FT	\$12,600
Note:				
All Costs are preliminary and do not include				
any environmental planning and permitting costs				

Black Canyon Reservoir and Winnemucca Ranch Springs				
to Spanish Springs				
Q=2500 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Black Canyon Dam	\$7,840,485
2	1	LS	Pipeline to Spanish Springs	\$13,027,325
			Subtotal	\$20,867,810
			Contingency (25%)	\$5,216,953
			Subtotal	\$26,084,763
			Geotechnical & Surveys (2%)	\$521,695
			Engineering Design (5.8%)	\$1,512,916
			Construction Management (8%)	\$2,086,781
			Total	\$30,206,155
			Rounded Total	\$30,206,000
			Dollars/AC-FT	\$12,100
Note:				
All Costs are preliminary and do not include				
any environmental planning and permitting costs				

Black Canyon Reservoir and Winnemucca Ranch Springs				
to Spanish Springs				
Q=2600 ac-ft/yr				
				Approx.
Item	Quantity	Unit	Description	Price
1	1	LS	Black Canyon Dam	\$7,840,485
2	1	LS	Pipeline to Spanish Springs	\$13,027,325
			Subtotal	\$20,867,810
			Contingency (25%)	\$5,216,953
			Subtotal	\$26,084,763
			Geotechnical & Surveys (2%)	\$521,695
			Engineering Design (5.8%)	\$1,512,916
			Construction Management (8%)	\$2,086,781
			Total	\$30,206,155
			Rounded Total	\$30,206,000
			Dollars/AC-FT	\$11,600
Note:				
All Costs are preliminary and do not include				
any environmental planning and permitting costs				

Preliminary Engineers Estimate					
Winnemucca Ranch Springs to Spanish Springs					
Q = 900, 1000, or 1100 AC-FT/YR from Winnemucca Ranch Springs					
				Unit	Total
Item	Quantity	Unit	Description	Price	Price
1	126,725	LF	10" Class 50 Restrained Joint Ductile Iron	\$30.00	\$3,801,750
2	126,725	LF	Trenching	\$20.00	\$2,534,500
3	9	EA	6" Butterfly Valve	\$3,500.00	\$31,500
4	10	EA	10" Butterfly Valve	\$6,500.00	\$65,000
5	9	EA	6" Check Valve	\$2,000.00	\$18,000
6	33	EA	Air/Vacuum Valve 1" - 410 psi	\$350.00	\$11,550
7	3	EA	Air Release Valve 1" - 410 psi	\$350.00	\$1,050
8	16	EA	Combination Valve 1" - 410 psi	\$550.00	\$8,800
9	54	EA	Valve Vaults	\$3,000.00	\$162,000
10	18	EA	Reducer 10" x 6"	\$1,000.00	\$18,000
11	4	EA	Spring Collection	\$100,000.00	\$400,000
12	1	EA	1000 Gal Steel Tank	\$3,000.00	\$3,000
				Total	\$7,055,150

Preliminary Engineers Estimate					
Black Canyon Reservoir and Winnemucca Ranch Springs to Spanish Springs					
Q = 500 AC-FT/YR from Black Canyon Reservoir					
Q = 900 or 1000 AC-FT/YR from Winnemucca Ranch Springs					
Total Q = 1400 or 1500 AC-FT/YR					
Item	Quantity	Units	Description	Unit Price	Total Price
1	126,725	LF	12" Class 50 Restrained Joint Ductile Iron	\$30.00	\$3,801,750
2	18,050	LF	8" Class 50 Restrained Joint Ductile Iron	\$23.00	\$415,150
3	144,775	LF	Trenching	\$20.00	\$2,895,500
4	12	EA	Butterfly Valve 12"	\$9,000.00	\$108,000
5	8	EA	Butterfly Valve 6"	\$3,500.00	\$28,000
6	1	EA	Butterfly Valve 4"	\$2,500.00	\$2,500
7	8	EA	Check Valve 6"	\$2,000.00	\$16,000
8	1	EA	Check Valve 4"	\$700.00	\$700
9	36	EA	Air/Vacuum Valve 1"-410psi	\$350.00	\$12,600
10	5	EA	Air Release Valve 1"-410psi	\$350.00	\$1,750
11	18	EA	Combination Valve 1"-410 psi	\$550.00	\$9,900
12	63	EA	Valve Vaults	\$3,000.00	\$189,000
13	14	EA	Reducer (12" x 6")	\$1,200.00	\$16,800
14	1	EA	Reducer (12" x 8")	\$1,500.00	\$1,500
15	2	EA	Reducer (8" x4")	\$800.00	\$1,600
16	2	EA	4" Pressure Release Valve	\$2,500.00	\$5,000
17	2	EA	Pump 4x6-11, 3560rpm, 15hp	\$9,000.00	\$18,000
18	1	EA	Pump Station (excluding pumps)	\$115,000.00	\$115,000
19	4	EA	Spring Collection	\$100,000.00	\$400,000
20	1	EA	Treatment Plant	\$330,000.00	\$330,000
21	1	EA	Chlorination System	\$10,000.00	\$10,000
22	91,700	LF	Power (Three-Phase)	\$16.50	\$1,513,050
23	1	EA	Line Regulator	\$58,000.00	\$58,000
				Total	\$9,949,800

Preliminary Engineers Estimate					
Black Canyon Reservoir and Winnemucca Ranch Springs to Spanish Springs					
Q = 500 AC-FT/YR from Black Canyon Reservoir					
Q = 1100 AC-FT/YR from Winnemucca Ranch Springs					
Total Q = 1600 AC-FT/YR					
Item	Quantity	Units	Description	Unit Price	Total Price
1	126,725	LF	12" Class 50 Restrained Joint Ductile Iron	\$30.00	\$3,801,750
2	18,050	LF	8" Class 50 Restrained Joint Ductile Iron	\$23.00	\$415,150
3	144,775	LF	Trenching	\$20.00	\$2,895,500
4	12	EA	Butterfly Valve 12"	\$9,000.00	\$108,000
5	8	EA	Butterfly Valve 6"	\$3,500.00	\$28,000
6	1	EA	Butterfly Valve 4"	\$2,500.00	\$2,500
7	8	EA	Check Valve 6"	\$2,000.00	\$16,000
8	1	EA	Check Valve 4"	\$700.00	\$700
9	33	EA	Air/Vacuum Valve 2"-410psi	\$550.00	\$18,150
10	3	EA	Air Release Valve 2"-410psi	\$650.00	\$1,950
11	16	EA	Combination Valve 2"-410 psi	\$800.00	\$12,800
12	3	EA	Air/Vacuum Valve 1"-410psi	\$350.00	\$1,050
13	2	EA	Air Release Valve 1"-410psi	\$350.00	\$700
14	2	EA	Combination Valve 1"-410 psi	\$550.00	\$1,100
15	63	EA	Valve Vaults	\$3,000.00	\$189,000
16	14	EA	Reducer (12" x 6")	\$1,200.00	\$16,800
17	1	EA	Reducer (12" x8")	\$1,500.00	\$1,500
18	2	EA	Reducer (8" x 4")	\$800.00	\$1,600
19	2	EA	4" Pressure Reducing Valve	\$2,500.00	\$5,000
20	2	EA	Pump 4x6-11, 3560rpm, 15hp	\$9,000.00	\$18,000
21	1	EA	Pump Station (excluding pumps)	\$115,000.00	\$115,000
22	1	EA	Treatment Plant	\$330,000.00	\$330,000
23	1	EA	Chlorination System	\$10,000.00	\$10,000
24	91,700	LF	Power (Three-Phase)	\$16.50	\$1,513,050
25	1	EA	Line Regulator	\$58,000.00	\$58,000
26	4	EA	Spring Collection	\$100,000.00	\$400,000
				Total	\$9,961,300

Preliminary Engineers Estimate					
Black Canyon Reservoir and Winnemucca Ranch Springs to Spanish Springs					
Q = 1000 AC-FT/YR from Black Canyon Reservoir					
Q = 900 AC-FT/YR from Winnemucca Ranch Springs					
Total Q = 1900 AC-FT/YR					
Item	Quantity	Units	Description	Unit Price	Total Price
1	126,725	LF	12" Class 50 Restrained Joint Ductile Iron	\$36.00	\$4,562,100
2	18,050	LF	10" Class 50 Restrained Joint Ductile Iron	\$30.00	\$541,500
3	144,775	LF	Trenching	\$20.00	\$2,895,500
4	12	EA	Butterfly Valve 12"	\$9,000.00	\$108,000
5	9	EA	Butterfly Valve 6"	\$3,500.00	\$31,500
6	9	EA	Check Valve 6"	\$2,000.00	\$18,000
7	33	EA	Air/Vacuum Valve 2"-410psi	\$550.00	\$18,150
8	3	EA	Air Release Valve 2"-410psi	\$650.00	\$1,950
9	16	EA	Combination Valve 2"-410 psi	\$800.00	\$12,800
10	3	EA	Air/Vacuum Valve 1"-410psi	\$350.00	\$1,050
11	2	EA	Air Release Valve 1"-410psi	\$350.00	\$700
12	2	EA	Combination Valve 1"-410 psi	\$550.00	\$1,100
13	63	EA	Valve Vaults	\$3,000.00	\$189,000
14	15	EA	Reducer (12" x 6")	\$1,200.00	\$18,000
15	2	EA	Reducer (10" x 6")	\$1,000.00	\$2,000
16	2	EA	Pump 4x6-11, 3560rpm, 15hp	\$9,000.00	\$18,000
17	2	EA	6" Pressure Release Valve	\$3,500.00	\$7,000
18	1	EA	Pump Station (excluding pumps)	\$115,000.00	\$115,000
19	4	EA	Spring Collection	\$100,000.00	\$400,000
20	1	EA	Treatment Plant	\$360,000.00	\$360,000
21	1	EA	Chlorination System	\$10,000.00	\$10,000
22	91,700	LF	Power (Three-Phase)	\$16.50	\$1,513,050
23	1	EA	Line Regulator	\$58,000.00	\$58,000
				Total	\$10,882,400

Preliminary Engineers Estimate					
Black Canyon Reservoir and Winnemucca Ranch Springs to Spanish Springs					
Q = 1000 AC-FT/YR from Black Canyon Reservoir					
Q = 1000, 1100 AC-FT/YR from Winnemucca Ranch Springs					
Total Q = 2000 or 2100 AC-FT/YR					
Item	Quantity	Units	Description	Unit Price	Total Price
1	126,725	LF	14" Class 50 Restrained Joint Ductile Iron	\$49.00	\$6,209,525
2	18,050	LF	10" Class 50 Restrained Joint Ductile Iron	\$30.00	\$541,500
3	144,775	LF	Trenching	\$20.00	\$2,895,500
4	12	EA	Butterfly Valve 14"	\$13,000.00	\$156,000
5	9	EA	Butterfly Valve 6"	\$3,500.00	\$31,500
6	9	EA	Check Valve 6"	\$2,000.00	\$18,000
7	33	EA	Air/Vacuum Valve 2"-410psi	\$550.00	\$18,150
8	3	EA	Air Release Valve 2"-410psi	\$650.00	\$1,950
9	16	EA	Combination Valve 2"-410 psi	\$800.00	\$12,800
10	3	EA	Air/Vacuum Valve 1"-410psi	\$350.00	\$1,050
11	2	EA	Air Release Valve 1"-410psi	\$350.00	\$700
12	2	EA	Combination Valve 1"-410 psi	\$550.00	\$1,100
13	63	EA	Valve Vaults	\$3,000.00	\$189,000
14	15	EA	Reducer (14" x 6")	\$1,500.00	\$22,500
15	2	EA	Reducer (10" x 6")	\$1,000.00	\$2,000
16	2	EA	Pump 4x6-11, 3560rpm, 15hp	\$9,000.00	\$18,000
17	2	EA	6" Pressure Release Valve	\$3,500.00	\$7,000
18	1	EA	Pump Station (excluding pumps)	\$115,000.00	\$115,000
19	4	EA	Spring Collection	\$100,000.00	\$400,000
20	1	EA	Treatment Plant	\$360,000.00	\$360,000
21	1	EA	Chlorination System	\$10,000.00	\$10,000
22	91,700	LF	Power (Three-Phase)	\$16.50	\$1,513,050
23	1	EA	Line Regulator	\$58,000.00	\$58,000
				Total	\$12,582,325

Preliminary Engineers Estimate					
Black Canyon Reservoir and Winnemucca Ranch Springs to Spanish Springs					
Q = 1500 AC-FT/YR from Black Canyon Reservoir					
Q = 900,1000,1100 AC-FT/YR from Winnemucca Ranch Springs					
Total Q = 2400, 2500, 2600 AC-FT/YR					
Item	Quantity	Units	Description	Unit Price	Total Price
1	126,725	LF	14" Class 50 Restrained Joint Ductile Iron	\$49.00	\$6,209,525
2	18,050	LF	10" Class 50 Restrained Joint Ductile Iron	\$30.00	\$541,500
3	144,775	LF	Trenching	\$20.00	\$2,895,500
4	12	EA	Butterfly Valve 14"	\$13,000.00	\$156,000
5	9	EA	Butterfly Valve 6"	\$3,500.00	\$31,500
6	9	EA	Check Valve 6"	\$2,000.00	\$18,000
7	2	EA	8" Pressure Reducing Valve	\$5,500.00	\$11,000
8	33	EA	Air/Vacuum Valve 2"-410psi	\$550.00	\$18,150
9	3	EA	Air Release Valve 2"-410psi	\$650.00	\$1,950
10	16	EA	Combination Valve 2"-410 psi	\$800.00	\$12,800
11	15	EA	Reducer (14" x 6")	\$1,500.00	\$22,500
12	3	EA	Reducer (10" x 6")	\$1,000.00	\$3,000
13	3	EA	Air/Vacuum Valve 1"-410psi	\$350.00	\$1,050
14	2	EA	Air Release Valve 1"-410psi	\$350.00	\$700
15	2	EA	Combination Valve 1"-410 psi	\$550.00	\$1,100
16	63	EA	Valve Vaults	\$3,000.00	\$189,000
17	2	EA	Pump 4x6-11, 3560rpm, 15hp	\$9,000.00	\$18,000
18	1	EA	Pump Station (excluding pumps)	\$115,000.00	\$115,000
19	4	EA	Spring Collection	\$100,000.00	\$400,000
20	1	EA	Treatment Plant	\$800,000.00	\$800,000
21	1	EA	Chlorination System	\$10,000.00	\$10,000
22	91,700	LF	Power (Three-Phase)	\$16.50	\$1,513,050
23	1	EA	Line Regulator	\$58,000.00	\$58,000
				Total	\$13,027,325

Black Canyon Reservoir					
Preliminary Engineers Estimate					
Item	Quantity	Unit	Description	Unit Price	Total Price
1	98,500	CY	Foundation Excavation	\$4.00	\$394,000
2	228,300	CY	Spillway Excavation	\$5.50	\$1,255,650
3	140,000	CY	Zone 1 Embankment	\$25.00	\$3,500,000
4	44,800	CY	Zone 2 Embankment	\$18.50	\$828,800
5	36,600	CY	Zone 3 Embankment	\$14.00	\$512,400
6	271,700	CY	Zone 4 Embankment	\$2.00	\$543,400
7	1,530	SY	Grout Cap Surface Prep		
			(10' Min. 12' Max.)	\$17.50	\$26,775
8	190	EA	Pipe for Grout Holes	\$50.00	\$9,500
9	650	CY	Grout Cap Concrete	\$300.00	\$195,000
10	10,450	LF	Drilling Rotary Percussion		
			Grout Holes	\$8.00	\$83,600
11	8,360	LF	Redrilling of Grout Holes	\$8.00	\$66,880
12	18,530	Bag	Portland Cement in Grout	\$13.00	\$240,890
13	361	Bag	Bentonite in Grout	\$6.15	\$2,220
14	570	EA	Connection to Grout Holes	\$55.00	\$31,350
15	400	LF	Grout Cap Linear Foot of		
			Joints or Faults to 4" Wide	\$24.00	\$9,600
16	40	CY	Grout Cap (Concrete placed		
			in joints or Faults > 4" Wide)	\$500.00	\$20,000
17	480	EA	Grout Cap Anchor Bars	\$69.00	\$33,120
18	5	EA	Pneumatic Piezometer	\$2,500.00	\$12,500
19	200	LF	Piezometer Bore Holes	\$34.00	\$6,800
20	4	EA	Relief Well	\$17,000.00	\$68,000
			Total		\$7,840,485

LEMMON VALLEY ALTERNATIVES

Preliminary Engineers Estimate Summary Sheet

Lemmon Valley Importation Alternate Alternates in order of Cost per Ac-Ft

Q=1100	\$8,400	Dollars/AC-FT (Winnemucca Ranch Springs)
Q=1000	\$9,200	Dollars/AC-FT (Winnemucca Ranch Springs)
Q=900	\$10,200	Dollars/AC-FT (Winnemucca Ranch Springs)
Q=2600	\$10,200	Dollars/AC-FT (Black Canyon Reservoir and Winnemucca Ranch Springs)
Q=2500	\$10,600	Dollars/AC-FT (Black Canyon Reservoir and Winnemucca Ranch Springs)
Q=2400	\$11,100	Dollars/AC-FT (Black Canyon Reservoir and Winnemucca Ranch Springs)
Q=2100	\$12,300	Dollars/AC-FT (Black Canyon Reservoir and Winnemucca Ranch Springs)
Q=2000	\$12,900	Dollars/AC-FT (Black Canyon Reservoir and Winnemucca Ranch Springs)
Q=1900	\$13,600	Dollars/AC-FT (Black Canyon Reservoir and Winnemucca Ranch Springs)
Q=1600	\$15,000	Dollars/AC-FT (Black Canyon Reservoir and Winnemucca Ranch Springs)
Q=1500	\$16,000	Dollars/AC-FT (Black Canyon Reservoir and Winnemucca Ranch Springs)
Q=1400	\$17,100	Dollars/AC-FT (Black Canyon Reservoir and Winnemucca Ranch Springs)

Winnemucca Ranch Springs				
to Lemmon Valley (Tie to TMPP)				
Q=900 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Pipeline to Lemmon Valley	\$6,269,286
			Contingency (25%)	\$1,567,322
			Subtotal	\$7,836,608
			Geotechnical & Surveys (3%)	\$235,098
			Engineering Design (6.3%)	\$493,706
			Construction Management (8%)	\$626,929
			Total	\$9,192,341
			Rounded Total	\$9,192,000
			Dollars/AC-FT	\$10,200
Note:				
All Costs are preliminary and do not include				
any environmental planning or permitting costs				

Winnemucca Ranch Springs				
to Lemmon Valley (Tie to TMPP)				
Q=1000 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Pipeline to Lemmon Valley	\$6,269,286
			Contingency (25%)	\$1,567,322
			Subtotal	\$7,836,608
			Geotechnical & Surveys (3%)	\$235,098
			Engineering Design (6.3%)	\$493,706
			Construction Management (8%)	\$626,929
			Total	\$9,192,341
			Rounded Total	\$9,192,000
			Dollars/AC-FT	\$9,200
Note:				
All Costs are preliminary and do not include				
any environmental planning or permitting costs				

Winnemucca Ranch Springs				
to Lemmon Valley (Tie to TMPP)				
Q=1100 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Pipeline to Lemmon Valley	\$6,269,286
			Contingency (25%)	\$1,567,322
			Subtotal	\$7,836,608
			Geotechnical & Surveys (3%)	\$235,098
			Engineering Design (6.3%)	\$493,706
			Construction Management (8%)	\$626,929
			Total	\$9,192,341
			Rounded Total	\$9,192,000
			Dollars/AC-FT	\$8,400
Note:				
All Costs are preliminary and do not include				
any environmental planning or permitting costs				

Black Canyon Reservoir and Winnemucca Ranch Springs to Lemmon Valley (Tie to TMPP)				
Q=1400 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Black Canyon Dam	\$7,840,485
2	1	LS	Pipeline to Lemmon Valley	\$8,735,375
			Subtotal	\$16,575,860
			Contingency (25%)	\$4,143,965
			Subtotal	\$20,719,825
			Geotechnical & Surveys (2%)	\$414,397
			Engineering Design (5.8%)	\$1,201,750
			Construction Management (8%)	\$1,657,586
			Total	\$23,993,558
			Rounded Total	\$23,994,000
			Dollars/AC-FT	\$17,100
Note:				
All Costs are preliminary and do not include				
any environmental planning or permitting costs				

Black Canyon Reservoir and Winnemucca Ranch Springs to Lemmon Valley (Tie to TMPP)				
Q=1500 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Black Canyon Dam	\$7,840,485
2	1	LS	Pipeline to Lemmon Valley	\$8,735,375
			Subtotal	\$16,575,860
			Contingency (25%)	\$4,143,965
			Subtotal	\$20,719,825
			Geotechnical & Surveys (2%)	\$414,397
			Engineering Design (5.8%)	\$1,201,750
			Construction Management (8%)	\$1,657,586
			Total	\$23,993,558
			Rounded Total	\$23,994,000
			Dollars/AC-FT	\$16,000
Note:				
All Costs are preliminary and do not include any environmental planning or permitting costs				

Black Canyon Reservoir and Winnemucca Ranch Springs to Lemmon Valley (Tie to TMPP)				
Q=1600 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Black Canyon Dam	\$7,840,485
2	1	LS	Pipeline to Lemmon Valley	\$8,743,925
			Subtotal	\$16,584,410
			Contingency (25%)	\$4,146,103
			Subtotal	\$20,730,513
			Geotechnical & Surveys (2%)	\$414,610
			Engineering Design (5.8%)	\$1,202,370
			Construction Management (8%)	\$1,658,441
			Total	\$24,005,934
			Rounded Total	\$24,006,000
			Dollars/AC-FT	\$15,000
Note:				
All Costs are preliminary and do not include				
any environmental planning or permitting costs				

Black Canyon Reservoir and Winnemucca Ranch Springs to Lemmon Valley (Tie to TMPP)				
Q=1900 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Black Canyon Dam	\$7,840,485
2	1	LS	Pipeline to Lemmon Valley	\$10,048,775
			Subtotal	\$17,889,260
			Contingency (25%)	\$4,472,315
			Subtotal	\$22,361,575
			Geotechnical & Surveys (2%)	\$447,232
			Engineering Design (5.8%)	\$1,296,971
			Construction Management (8%)	\$1,788,926
			Total	\$25,894,704
			Rounded Total	\$25,895,000
			Dollars/AC-FT	\$13,600
Note:				
All Costs are preliminary and do not include				
any environmental planning or permitting costs				

Black Canyon Reservoir and Winnemucca Ranch Springs to Lemmon Valley (Tie to TMPP)				
Q=2000 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Black Canyon Dam	\$7,840,485
2	1	LS	Pipeline to Lemmon Valley	\$10,048,775
			Subtotal	\$17,889,260
			Contingency (25%)	\$4,472,315
			Subtotal	\$22,361,575
			Geotechnical & Surveys (2%)	\$447,232
			Engineering Design (5.8%)	\$1,296,971
			Construction Management (8%)	\$1,788,926
			Total	\$25,894,704
			Rounded Total	\$25,895,000
			Dollars/AC-FT	\$12,900
Note:				
All Costs are preliminary and do not include				
any environmental planning or permitting costs				

Black Canyon Reservoir and Winnemucca Ranch Springs to Lemmon Valley (Tie to TMPP)				
Q=2100 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Black Canyon Dam	\$7,840,485
2	1	LS	Pipeline to Lemmon Valley	\$10,048,775
			Subtotal	\$17,889,260
			Contingency (25%)	\$4,472,315
			Subtotal	\$22,361,575
			Geotechnical & Surveys (2%)	\$447,232
			Engineering Design (5.8%)	\$1,296,971
			Construction Management (8%)	\$1,788,926
			Total	\$25,894,704
			Rounded Total	\$25,895,000
			Dollars/AC-FT	\$12,300
Note:				
All Costs are preliminary and do not include				
any environmental planning or permitting costs				

Black Canyon Reservoir and Winnemucca Ranch Springs to Lemmon Valley (Tie to TMPP)				
Q=2400 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Black Canyon Dam	\$7,840,485
2	1	LS	Pipeline to Lemmon Valley	\$10,488,775
			Subtotal	\$18,329,260
			Contingency (25%)	\$4,582,315
			Subtotal	\$22,911,575
			Geotechnical & Surveys (2%)	\$458,232
			Engineering Design (5.8%)	\$1,328,871
			Construction Management (8%)	\$1,832,926
			Total	\$26,531,604
			Rounded Total	\$26,532,000
			Dollars/AC-FT	\$11,100
Note:				
All Costs are preliminary and do not include				
any environmental planning or permitting costs				

Black Canyon Reservoir and Winnemucca Ranch Springs				
to Lemmon Valley (Tie to TMPP)				
Q=2500 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Black Canyon Dam	\$7,840,485
2	1	LS	Pipeline to Lemmon Valley	\$10,488,775
			Subtotal	\$18,329,260
			Contingency (25%)	\$4,582,315
			Subtotal	\$22,911,575
			Geotechnical & Surveys (2%)	\$458,232
			Engineering Design (5.8%)	\$1,328,871
			Construction Management (8%)	\$1,832,926
			Total	\$26,531,604
			Rounded Total	\$26,532,000
			Dollars/AC-FT	\$10,600
Note:				
All Costs are preliminary and do not include				
any environmental planning or permitting costs				

Black Canyon Reservoir and Winnemucca Ranch Springs				
to Lemmon Valley (Tie to TMPP)				
Q=2600 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Black Canyon Dam	\$7,840,485
2	1	LS	Pipeline to Lemmon Valley	\$10,488,775
			Subtotal	\$18,329,260
			Contingency (25%)	\$4,582,315
			Subtotal	\$22,911,575
			Geotechnical & Surveys (2%)	\$458,232
			Engineering Design (5.8%)	\$1,328,871
			Construction Management (8%)	\$1,832,926
			Total	\$26,531,604
			Rounded Total	\$26,532,000
			Dollars/AC-FT	\$10,200
Note:				
All Costs are preliminary and do not include				
any environmental planning or permitting costs				

Preliminary Engineers Estimate					
Winnemucca Ranch Springs to Lemmon Valley					
900,1000 and 1100 AC-FT/YR from Winnemucca Ranch Springs					
Item	Quantity	Units	Description	Unit Price	Total Price
1	21,000	LF	10" Class 50 Restrained Joint Ductile Iron	\$30.00	\$630,000
2	54,100	LF	10" Class 51 Restrained Joint Ductile Iron	\$32.00	\$1,731,200
3	75,100	LF	Trenching	\$25.00	\$1,877,500
4	5	EA	Butterfly Valve 10"	\$6,500.00	\$32,500
5	5	EA	Butterfly Valve 6"	\$3,500.00	\$17,500
6	5	EA	Check Valve 6"	\$2,000.00	\$10,000
7	23	EA	Air/Vacuum Valve 1"-700psi	\$500.00	\$11,500
8	3	EA	Air Release Valve 1"-700psi	\$550.00	\$1,650
9	30	EA	Valve Vaults	\$3,000.00	\$90,000
10	4	EA	Combination Valve 1"-700psi	\$900.00	\$3,600
11	9	EA	Reducer (10" x 6")	\$2,500.00	\$22,500
12	2	EA	Pump 4x6-9, 3560rpm, 50hp	\$5,518.00	\$11,036
13	4	EA	Spring Collection	\$100,000.00	\$400,000
14	1	EA	Pump Station (excluding pumps)	\$115,000.00	\$115,000
15	76,200	LF	Power (Three Phase)	\$16.50	\$1,257,300
16	1	EA	Line Regulator	\$58,000.00	\$58,000
				Total	\$6,269,286

Preliminary Engineers Estimate					
Black Canyon Reservoir and Winnemucca Ranch Springs to Lemmon Valley					
900, 1000 AC-FT/YR from Winnemucca Ranch Springs and					
500 AC-FT/YR from Black Canyon Reservoir					
Q = 1400, 1500 AC-FT/YR					
Item	Quantity	Unit	Description	Price	Price
1	54,100	LF	12" Class 52 Restrained Joint Ductile Iron	\$42.00	\$2,272,200
2	21,000	LF	12" Class 50 Restrained Joint Ductile Iron	\$36.00	\$756,000
3	18,075	LF	10" Class 50 Restrained Joint Ductile Iron	\$30.00	\$542,250
4	93,175	LF	Trenching	\$25.00	\$2,329,375
5	5	EA	Butterfly Valve 12"	\$9,000.00	\$45,000
6	5	EA	Butterfly Valve 6"	\$3,500.00	\$17,500
7	5	EA	Check Valve 6"	\$2,000.00	\$10,000
8	1	EA	Butterfly Valve 4"	\$2,500.00	\$2,500
9	1	EA	Check Valve 4"	\$700.00	\$700
10	27	EA	Air/Vacuum Valve 1"-700psi	\$500.00	\$13,500
11	4	EA	Air Release Valve 1"-700psi	\$550.00	\$2,200
12	6	EA	Combination Valve 1"-700psi	\$900.00	\$5,400
13	37	EA	Valve Vaults	\$3,000.00	\$111,000
14	8	EA	Reducer (12" x 6")	\$2,700.00	\$21,600
15	1	EA	Reducer (10" x 6")	\$2,500.00	\$2,500
16	2	EA	Reducer (10" x 4")	\$2,300.00	\$4,600
17	4	EA	Pump 3x4-10, 1750rpm, 15hp	\$8,000.00	\$32,000
18	2	EA	Pump 4x6-9, 3560rpm, 75hp	\$13,000.00	\$26,000
19	4	EA	Spring Collection	\$100,000.00	\$400,000
20	1	EA	Treatment Plant	\$330,000.00	\$330,000
21	1	EA	Chlorination System	\$10,000.00	\$10,000
22	2	EA	Pump Station (excluding pumps)	\$115,000.00	\$230,000
23	91,700	LF	Power (Three-Phase)	\$16.50	\$1,513,050
24	1	EA	Line Regulator	\$58,000.00	\$58,000
				Total	\$8,735,375

Preliminary Engineers Estimate					
Black Canyon Reservoir and Winnemucca Ranch Springs to Lemmon Valley					
1100 AC-FT/YR from Winnemucca Ranch Springs and					
500 AC-FT/YR from Black Canyon Reservoir					
Q = 1600 AC-FT/YR					
Item	Quantity	Unit	Description	Price	Price
1	54,100	LF	12" Class 52 Restrained Joint Ductile Iron	\$42.00	\$2,272,200
2	21,000	LF	12" Class 50 Restrained Joint Ductile Iron	\$36.00	\$756,000
3	18,075	LF	10" Class 50 Restrained Joint Ductile Iron	\$30.00	\$542,250
4	93,175	LF	Trenching	\$25.00	\$2,329,375
5	5	EA	Butterfly Valve 12"	\$9,000.00	\$45,000
6	5	EA	Butterfly Valve 6"	\$3,500.00	\$17,500
7	5	EA	Check Valve 6"	\$2,000.00	\$10,000
8	1	EA	Butterfly Valve 4"	\$2,500.00	\$2,500
9	1	EA	Check Valve 4"	\$700.00	\$700
10	3	EA	Air/Vacuum Valve 1"-410psi	\$350.00	\$1,050
11	2	EA	Air Release Valve 1"-410psi	\$350.00	\$700
12	2	EA	Combination Valve 1"-410psi	\$550.00	\$1,100
13	24	EA	Air/Vacuum Valve 2"-700psi	\$900.00	\$21,600
14	4	EA	Combination Valve 2"-700psi	\$1,300.00	\$5,200
15	37	EA	Valve Vaults	\$3,000.00	\$111,000
16	8	EA	Reducer (12" x 6")	\$2,700.00	\$21,600
17	1	EA	Reducer (10" x 6")	\$2,500.00	\$2,500
18	2	EA	Reducer (10" x 4")	\$2,300.00	\$4,600
19	4	EA	Pump 3x4-10, 1750rpm, 15hp	\$8,000.00	\$32,000
20	2	EA	Pump 4x6-9, 3560rpm, 75hp	\$13,000.00	\$26,000
21	4	EA	Spring Collection	\$100,000.00	\$400,000
22	1	EA	Treatment Plant	\$330,000.00	\$330,000
23	1	EA	Chlorination System	\$10,000.00	\$10,000
24	2	EA	Pump Station (excluding pumps)	\$115,000.00	\$230,000
25	91,700	LF	Power (Three-Phase)	\$16.50	\$1,513,050
26	1	EA	Line Regulator	\$58,000.00	\$58,000
				Total	\$8,743,925

Preliminary Engineers Estimate					
Black Canyon Reservoir and Winnemucca Ranch Springs to Lemmon Valley					
900,1000,1100 AC-FT/YR from Winnemucca Ranch Springs and					
1000 AC-FT/YR from Black Canyon Reservoir					
Q = 1900, 2000, 2100 AC-FT/YR					
Item	Quantity	Unit	Description	Price	Price
1	54,100	LF	14" Class 53 Restrained Joint Ductile Iron	\$58.00	\$3,137,800
2	21,000	LF	14" Class 50 Restrained Joint Ductile Iron	\$49.00	\$1,029,000
3	18,075	LF	12" Class 50 Restrained Joint Ductile Iron	\$36.00	\$650,700
4	93,175	LF	Trenching	\$25.00	\$2,329,375
5	5	EA	Butterfly Valve 14"	\$13,000.00	\$65,000
6	6	EA	Butterfly Valve 6"	\$3,500.00	\$21,000
7	6	EA	Check Valve 6" (740 psi)	\$2,000.00	\$12,000
8	3	EA	Air/Vacuum Valve 1"-410psi	\$350.00	\$1,050
9	2	EA	Air Release Valve 1"-410psi	\$350.00	\$700
10	2	EA	Combination Valve 1"-410psi	\$550.00	\$1,100
11	23	EA	Air/Vacuum Valve 2"-700psi	\$900.00	\$20,700
12	3	EA	Air Release Valve 2"-700psi	\$1,000.00	\$3,000
13	4	EA	Combination Valve 2"-700psi	\$1,300.00	\$5,200
14	37	EA	Valve Vaults	\$3,000.00	\$111,000
15	8	EA	Reducer (14" x 6")	\$3,000.00	\$24,000
16	3	EA	Reducer (12" x 6")	\$2,700.00	\$8,100
17	4	EA	Pump 3x4-10, 1750rpm, 15hp	\$8,000.00	\$32,000
18	2	EA	Pump 4x6-9, 3560rpm, 75hp	\$13,000.00	\$26,000
19	4	EA	Spring Collection	\$100,000.00	\$400,000
20	1	EA	Treatment Plant	\$360,000.00	\$360,000
21	1	EA	Chlorination System	\$10,000.00	\$10,000
22	2	EA	Pump Station (excluding pumps)	\$115,000.00	\$230,000
23	91,700	LF	Power (Three-Phase)	\$16.50	\$1,513,050
24	1	EA	Line Regulator	\$58,000.00	\$58,000
				Total	\$10,048,775

Preliminary Engineers Estimate					
Black Canyon Reservoir and Winnemucca Ranch Springs to Lemmon Valley					
900, 1000, 1100 AC-FT/YR from Winnemucca Ranch Springs and					
1500 AC-FT/YR from Black Canyon Reservoir					
Q = 2400, 2500, 2600 AC-FT/YR					
Item	Quantity	Unit	Description	Price	Price
1	54,100	LF	14" Class 53 Restrained Joint Ductile Iron	\$58.00	\$3,137,800
2	21,000	LF	14" Class 50 Restrained Joint Ductile Iron	\$49.00	\$1,029,000
3	18,075	LF	12" Class 50 Restrained Joint Ductile Iron	\$36.00	\$650,700
4	93,175	LF	Trenching	\$25.00	\$2,329,375
5	5	EA	Butterfly Valve 14"	\$13,000.00	\$65,000
6	6	EA	Butterfly Valve 6"	\$3,500.00	\$21,000
7	6	EA	Check Valve 6" (740 psi)	\$2,000.00	\$12,000
8	3	EA	Air/Vacuum Valve 1"-410psi	\$350.00	\$1,050
9	2	EA	Air Release Valve 1"-410psi	\$350.00	\$700
10	2	EA	Combination Valve 1"-410psi	\$550.00	\$1,100
11	23	EA	Air/Vacuum Valve 2"-700psi	\$900.00	\$20,700
12	3	EA	Air Release Valve 2"-700psi	\$1,000.00	\$3,000
13	4	EA	Combination Valve 2"-700psi	\$1,300.00	\$5,200
14	37	EA	Valve Vaults	\$3,000.00	\$111,000
15	8	EA	Reducer (14" x 6")	\$3,000.00	\$24,000
16	3	EA	Reducer (12" x 6")	\$2,700.00	\$8,100
17	4	EA	Pump 3x4-10, 1750rpm, 15hp	\$8,000.00	\$32,000
18	2	EA	Pump 4x6-9, 3560rpm, 75hp	\$13,000.00	\$26,000
19	4	EA	Spring Collection	\$100,000.00	\$400,000
20	1	EA	Treatment Plant	\$800,000.00	\$800,000
21	1	EA	Chlorination System	\$10,000.00	\$10,000
22	2	EA	Pump Station (excluding pumps)	\$115,000.00	\$230,000
23	91,700	LF	Power (Three-Phase)	\$16.50	\$1,513,050
24	1	EA	Line Regulator	\$58,000.00	\$58,000
				Total	\$10,488,775

DRY VALLEY ALTERNATIVES

Preliminary Engineers Estimate Summary Sheet

Dry Valley Importation Alternate Alternates in order of Cost per Ac-Ft

Q=1100	\$6,000	Dollars/Ac-Ft
Q=1000	\$6,600	Dollars/Ac-Ft
Q=900	\$6,900	Dollars/Ac-Ft
Q=2600	\$8,300	Dollars/Ac-Ft
Q=2500	\$8,700	Dollars/Ac-Ft
Q=2400	\$9,000	Dollars/Ac-Ft
Q=2100	\$10,300	Dollars/Ac-Ft
Q=2000	\$10,800	Dollars/Ac-Ft
Q=1900	\$11,400	Dollars/Ac-Ft
Q=1500 (res)	\$11,900	Dollars/Ac-Ft
Q=1600	\$13,700	Dollars/Ac-Ft
Q=1500	\$14,300	Dollars/Ac-Ft
Q=1400	\$15,400	Dollars/Ac-Ft
Q=1000 (res)	\$17,900	Dollars/Ac-Ft
Q=500 (res)	\$35,500	Dollars/Ac-Ft

Dry Valley Reservoir				
To Dry Valley (Tie To TMPP)				
Q=500 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Dry Valley Dam	\$9,207,358
2	1	LS	Pipeline to Dry Valley	\$3,059,750
			Subtotal	\$12,267,108
			Contingency (25%)	\$3,066,777
			Subtotal	\$15,333,885
			Geotechnical & Surveys (2%)	\$306,678
			Engineering Design (5.8%)	\$889,365
			Construction Management (8%)	\$1,226,711
			Total	\$17,756,639
			Rounded Total	\$17,757,000
Note:			Dollars/AC-FT	\$35,500
All Costs are preliminary and do not include any environmental planning or permitting costs				

Dry Valley Reservoir				
To Dry Valley (Tie To TMPP)				
Q=1000 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Dry Valley Dam	\$9,207,358
2	1	LS	Pipeline to Dry Valley	\$3,158,250
			Subtotal	\$12,365,608
			Contingency (25%)	\$3,091,402
			Subtotal	\$15,457,010
			Geotechnical & Surveys (2%)	\$309,140
			Engineering Design (5.8%)	\$896,507
			Construction Management (8%)	\$1,236,561
			Total	\$17,899,218
			Rounded Total	\$17,899,000
Note:			Dollars/AC-FT	\$17,900
All Costs are preliminary and do not include				
any environmental planning or permitting costs				

Dry Valley Reservoir				
To Dry Valley (Tie To TMPP)				
Q=1500 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Dry Valley Dam	\$9,207,358
2	1	LS	Pipeline to Dry Valley	\$3,158,250
			Subtotal	\$12,365,608
			Contingency (25%)	\$3,091,402
			Subtotal	\$15,457,010
			Geotechnical & Surveys (2%)	\$309,140
			Engineering Design (5.8%)	\$896,507
			Construction Management (8%)	\$1,236,561
			Total	\$17,899,218
			Rounded Total	\$17,899,000
Note:			Dollars/AC-FT	\$11,900
All Costs are preliminary and do not include any environmental planning or permitting costs				

Winnemucca Ranch Springs				
To Dry Valley (Tie To TMPP)				
Q=900 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Pipeline to Dry Valley	\$4,231,650
			Contingency (25%)	\$1,057,913
			Subtotal	\$5,289,563
			Geotechnical & Surveys (3%)	\$158,687
			Engineering Design (6.4%)	\$338,532
			Construction Management (8%)	\$423,165
			Total	\$6,209,947
			Rounded Total	\$6,210,000
Note:			Dollars/AC-FT	\$6,900
All Costs are preliminary and do not include any environmental planning and permitting costs				

Winnemucca Ranch Springs				
To Dry Valley (Tie To TMPP)				
Q=1000 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Pipeline to Dry Valley	\$4,465,520
			Contingency (25%)	\$1,116,380
			Subtotal	\$5,581,900
			Geotechnical & Surveys (3%)	\$167,457
			Engineering Design (6.4%)	\$357,242
			Construction Management (8%)	\$446,552
			Total	\$6,553,151
			Rounded Total	\$6,553,000
Note:			Dollars/AC-FT	\$6,600
All Costs are preliminary and do not include				
any environmental planning and permitting costs				

Winnemucca Ranch Springs				
To Dry Valley (Tie To TMPP)				
Q=1100 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Pipeline to Dry Valley	\$4,465,520
			Contingency (25%)	\$1,116,380
			Subtotal	\$5,581,900
			Geotechnical & Surveys (3%)	\$167,457
			Engineering Design (6.4%)	\$357,242
			Construction Management (8%)	\$446,552
			Total	\$6,553,151
			Rounded Total	\$6,553,000
			Dollars/AC-FT	\$6,000
Note:				
All Costs are preliminary and do not include				
any environmental planning and permitting costs				

Dry Valley Reservoir and Winnemucca Ranch Springs				
To Dry Valley (Tie To TMPP)				
Q=1400 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Dry Valley Dam	\$9,207,358
2	1	LS	Pipeline to Dry Valley	\$5,655,170
			Subtotal	\$14,862,528
			Contingency (25%)	\$3,715,632
			Subtotal	\$18,578,160
			Geotechnical & Surveys (2%)	\$371,563
			Engineering Design (5.8%)	\$1,077,533
			Construction Management (8%)	\$1,486,253
			Total	\$21,513,509
			Rounded Total	\$21,514,000
			Dollars/AC-FT	\$15,400
Note:				
All Costs are preliminary and do not include				
any environmental planning and permitting costs				

Dry Valley Reservoir and Winnemucca Ranch Springs				
To Dry Valley (Tie To TMPP)				
Q=1500 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Dry Valley Dam	\$9,207,358
2	1	LS	Pipeline to Dry Valley	\$5,655,170
			Subtotal	\$14,862,528
			Contingency (25%)	\$3,715,632
			Subtotal	\$18,578,160
			Geotechnical & Surveys (2%)	\$371,563
			Engineering Design (5.8%)	\$1,077,533
			Construction Management (8%)	\$1,486,253
			Total	\$21,513,509
			Rounded Total	\$21,514,000
			Dollars/AC-FT	\$14,300
Note:				
All Costs are preliminary and do not include				
any environmental planning and permitting costs				

Dry Valley Reservoir and Winnemucca Ranch Springs				
To Dry Valley (Tie To TMPP)				
Q=1600 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Dry Valley Dam	\$9,207,358
2	1	LS	Pipeline to Dry Valley	\$5,883,870
			Subtotal	\$15,091,228
			Contingency (25%)	\$3,772,807
			Subtotal	\$18,864,035
			Geotechnical & Surveys (2%)	\$377,281
			Engineering Design (5.8%)	\$1,094,114
			Construction Management (8%)	\$1,509,123
			Total	\$21,844,553
			Rounded Total	\$21,845,000
			Dollars/AC-FT	\$13,700
Note:				
All Costs are preliminary and do not include				
any environmental planning and permitting costs				

Dry Valley Reservoir and Winnemucca Ranch Springs				
To Dry Valley (Tie To TMPP)				
Q=1900 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Dry Valley Dam	\$9,207,358
2	1	LS	Pipeline to Dry Valley	\$5,770,270
			Subtotal	\$14,977,628
			Contingency (25%)	\$3,744,407
			Subtotal	\$18,722,035
			Geotechnical & Surveys (2%)	\$374,441
			Engineering Design (5.8%)	\$1,085,878
			Construction Management (8%)	\$1,497,763
			Total	\$21,680,117
			Rounded Total	\$21,680,000
			Dollars/AC-FT	\$11,400
Note:				
All Costs are preliminary and do not include				
any environmental planning and permitting costs				

Dry Valley Reservoir and Winnemucca Ranch Springs				
To Dry Valley (Tie To TMPP)				
Q=2000 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Dry Valley Dam	\$9,207,358
2	1	LS	Pipeline to Dry Valley	\$5,770,270
			Subtotal	\$14,977,628
			Contingency (25%)	\$3,744,407
			Subtotal	\$18,722,035
			Geotechnical & Surveys (2%)	\$374,441
			Engineering Design (5.8%)	\$1,085,878
			Construction Management (8%)	\$1,497,763
			Total	\$21,680,117
			Rounded Total	\$21,680,000
			Dollars/AC-FT	\$10,800
Note:				
All Costs are preliminary and do not include				
any environmental planning and permitting costs				

Dry Valley Reservoir and Winnemucca Ranch Springs				
To Dry Valley (Tie To TMPP)				
Q=2100 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Dry Valley Dam	\$9,207,358
2	1	LS	Pipeline to Dry Valley	\$5,770,270
			Subtotal	\$14,977,628
			Contingency (25%)	\$3,744,407
			Subtotal	\$18,722,035
			Geotechnical & Surveys (2%)	\$374,441
			Engineering Design (5.8%)	\$1,085,878
			Construction Management (8%)	\$1,497,763
			Total	\$21,680,117
			Rounded Total	\$21,680,000
			Dollars/AC-FT	\$10,300
Note:				
All Costs are preliminary and do not include				
any environmental planning and permitting costs				

Dry Valley Reservoir and Winnemucca Ranch Springs				
To Dry Valley (Tie To TMPP)				
Q=2400 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Dry Valley Dam	\$9,207,358
2	1	LS	Pipeline to Dry Valley	\$5,770,270
			Subtotal	\$14,977,628
			Contingency (25%)	\$3,744,407
			Subtotal	\$18,722,035
			Geotechnical & Surveys (2%)	\$374,441
			Engineering Design (5.8%)	\$1,085,878
			Construction Management (8%)	\$1,497,763
			Total	\$21,680,117
			Rounded Total	\$21,680,000
			Dollars/AC-FT	\$9,000
Note:				
All Costs are preliminary and do not include				
any environmental planning and permitting costs				

Dry Valley Reservoir and Winnemucca Ranch Springs				
To Dry Valley (Tie To TMPP)				
Q=2500 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Dry Valley Dam	\$9,207,358
2	1	LS	Pipeline to Dry Valley	\$5,770,270
			Subtotal	\$14,977,628
			Contingency (25%)	\$3,744,407
			Subtotal	\$18,722,035
			Geotechnical & Surveys (2%)	\$374,441
			Engineering Design (5.8%)	\$1,085,878
			Construction Management (8%)	\$1,497,763
			Total	\$21,680,117
			Rounded Total	\$21,680,000
			Dollars/AC-FT	\$8,700
Note:				
All Costs are preliminary and do not include				
any environmental planning and permitting costs				

Dry Valley Reservoir and Winnemucca Ranch Springs				
To Dry Valley (Tie To TMPP)				
Q=2600 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Dry Valley Dam	\$9,207,358
2	1	LS	Pipeline to Dry Valley	\$5,770,270
			Subtotal	\$14,977,628
			Contingency (25%)	\$3,744,407
			Subtotal	\$18,722,035
			Geotechnical & Surveys (2%)	\$374,441
			Engineering Design (5.8%)	\$1,085,878
			Construction Management (8%)	\$1,497,763
			Total	\$21,680,117
			Rounded Total	\$21,680,000
			Dollars/AC-FT	\$8,300
Note:				
All Costs are preliminary and do not include				
any environmental planning and permitting costs				

Preliminary Engineers Estimate					
Dry Valley Reservoir to Dry Valley					
Q = 500 AC-FT/YR from Dry Valley Reservoir					
				Unit	Total
Item	Quantity	Unit	Description	Price	Price
1	16,000	LF	10" Class 50 Restrained Joint Ductile Iron	\$30.00	\$480,000
2	16,000	LF	Trenching	\$30.00	\$480,000
3	1	EA	Butterfly Valve 10"	\$6,500.00	\$6,500
4	6	EA	Air/Vacuum Valve 1" -410 psi	\$350.00	\$2,100
5	6	EA	Vave Vaults	\$3,000.00	\$18,000
6	2	EA	Combination Valve 1"-410psi	\$550.00	\$1,100
7	2	EA	Pump 3x4-10, 1750rpm, 15hp	\$8,000.00	\$16,000
8	1	EA	Treatment Plant	\$360,000.00	\$360,000
9	1	EA	Chlorination System	\$10,000.00	\$10,000
10	1	EA	Pump Station (excluding pumps)	\$115,000.00	\$115,000
11	91,700	LF	Power (Three-Phase)	\$16.50	\$1,513,050
12	1	EA	Line Regulator	\$58,000.00	\$58,000
				Total	\$3,059,750

Preliminary Engineers Estimate					
Dry Valley Reservoir to Dry Valley					
1000, 1500 AC-FT/YR from Dry Valley Reservoir					
				Unit	Total
Item	Quantity	Unit	Description	Price	Price
1	16,000	LF	12" Class 50 Restrained Joint Ductile Iron	\$36.00	\$576,000
2	16,000	LF	Trenching	\$30.00	\$480,000
3	1	EA	Butterfly Valve 12"	\$9,000.00	\$9,000
4	6	EA	Air/Vacuum Valve 1" -410 psi	\$350.00	\$2,100
5	6	EA	Valve Vaults	\$3,000.00	\$18,000
6	2	EA	Combination Valve 1"-410psi	\$550.00	\$1,100
7	2	EA	Pump 3x4-10, 1750rpm, 15hp	\$8,000.00	\$16,000
8	1	EA	Treatment Plant	\$360,000.00	\$360,000
9	1	EA	Chlorination System	\$10,000.00	\$10,000
10	1	EA	Pump Station (excluding pumps)	\$115,000.00	\$115,000
11	91,700	LF	Power (Three-Phase)	\$16.50	\$1,513,050
12	1	EA	Line Regulator	\$58,000.00	\$58,000
				Total	\$3,158,250

Preliminary Engineers Estimate					
Winnemucca Ranch Springs to Dry Valley					
Q = 900 AC-FT/YR from Winnemucca Ranch Springs					
				Unit	Total
Item	Quantity	Units	Description	Price	Price
1	38,145	LF	10" Class 50 Ductile Iron	\$30.00	\$1,144,350
2	38,145	LF	Trenching	\$30.00	\$1,144,350
3	2	EA	Butterfly Valve 10"	\$6,500.00	\$13,000
4	16	EA	Air/Vacuum Valve 1"-410psi	\$350.00	\$5,600
5	3	EA	Combination Valve 1"-410psi	\$550.00	\$1,650
6	4	EA	Air Release Valve 1" -410psi	\$350.00	\$1,400
7	2	EA	Pump 4x6-11, 3560rpm, 20hp	\$9,500.00	\$19,000
8	4	EA	Spring Collection	\$100,000.00	\$400,000
9	1	EA	Pump Station (excluding pumps)	\$115,000.00	\$115,000
10	76,200	EA	Power (Three-Phase)	\$16.50	\$1,257,300
11	24	EA	Valve Vaults	\$3,000.00	\$72,000
12	1	EA	Line Regulator	\$58,000.00	\$58,000
				Total	\$4,231,650

Preliminary Engineers Estimate					
Winnemucca Ranch Springs to Dry Valley					
Q = 1000, 1100 AC-FT/YR from Winnemucca Ranch Springs					
Item	Quantity	Units	Description	Unit Price	Total Price
1	38,145	LF	12" Class 50 Ductile Iron	\$36.00	\$1,373,220
2	38,145	LF	Trenching	\$30.00	\$1,144,350
3	2	EA	Butterfly Valve 12"	\$9,000.00	\$18,000
4	16	EA	Air/Vacuum Valve 1"-410psi	\$350.00	\$5,600
5	3	EA	Combination Valve 1"-410psi	\$550.00	\$1,650
6	4	EA	Air Release Valve 1" -410psi	\$350.00	\$1,400
7	24	EA	Valve Vaults	\$3,000.00	\$72,000
8	2	EA	Pump 4x6-11, 3560rpm, 20hp	\$9,500.00	\$19,000
9	4	EA	Spring Collection	\$100,000.00	\$400,000
10	1	EA	Pump Station (excluding pumps)	\$115,000.00	\$115,000
11	76,200	EA	Power (Three-Phase)	\$16.50	\$1,257,300
12	1	EA	Line Regulator	\$58,000.00	\$58,000
				Total	\$4,465,520

Preliminary Engineers Estimate					
Winnemucca Ranch Springs and Dry Valley Reservoir to Dry Valley					
900, 1000 AC-FT/YR from Winnemucca Ranch Springs and					
500 AC-FT/YR from Dry Valley Reservoir					
Q=1400, 1500 AC-FT/YR					
Item	Quantity	Unit	Description	Price	Price
1	38,145	LF	12" Class 50 Restrained Joint Ductile Iron	\$36.00	\$1,373,220
2	38,145	LF	Trenching	\$30.00	\$1,144,350
3	1	EA	Butterfly Valve 12"	\$9,000.00	\$9,000
4	16	EA	Air/Vacuum Valve 1"-410psi	\$350.00	\$5,600
5	4	EA	Air Release Valve 1"-410psi	\$350.00	\$1,400
6	1	EA	6" Check Valve	\$2,000.00	\$2,000
7	1	EA	6" Butterfly Valve	\$3,500.00	\$3,500
8	22	EA	Valve Vaults	\$3,000.00	\$66,000
9	2	EA	Reducer (12x6)	\$1,200.00	\$2,400
10	3	EA	Combination Valve 1"-410psi	\$550.00	\$1,650
11	2	EA	Pump 3x4-10, 1750rpm, 15hp	\$8,000.00	\$16,000
12	2	EA	Pump 4x6-11, 3560rpm, 20hp	\$9,500.00	\$19,000
13	4	EA	Spring Collection	\$100,000.00	\$400,000
14	1	EA	Treatment Plant	\$800,000.00	\$800,000
15	1	EA	Chlorination System	\$10,000.00	\$10,000
16	2	EA	Pump Station (excluding pumps)	\$115,000.00	\$230,000
17	91,700	LF	Power (Three-Phase)	\$16.50	\$1,513,050
18	1	EA	Line Regulator	\$58,000.00	\$58,000
				Total	\$5,655,170

Preliminary Engineers Estimate					
Winnemucca Ranch Springs and Dry Valley Reservoir to Dry Valley					
1100 AC-FT/YR from Winnemucca Ranch Springs and					
500 AC-FT/YR from Dry Valley Reservoir					
Q=1600 AC-FT/YR					
Item	Quantity	Unit	Description	Price	Price
1	16,000	LF	14" Class 50 Restrained Joint Ductile Iron	\$49.00	\$784,000
2	22,145	LF	12" Class 50 Restrained Joint Ductile Iron	\$36.00	\$797,220
3	38,145	LF	Trenching	\$30.00	\$1,144,350
4	1	EA	6" Check Valve	\$2,000.00	\$2,000
5	1	EA	6" Butterfly Valve	\$3,500.00	\$3,500
6	2	EA	Reducer (12x6)	\$1,200.00	\$2,400
7	22	EA	Valve Vaults	\$3,000.00	\$66,000
8	2	EA	Butterfly Valve 14"	\$13,000.00	\$26,000
9	9	EA	Air/Vacuum Valve 2"-410psi	\$550.00	\$4,950
10	4	EA	Air Release Valve 2"-410psi	\$700.00	\$2,800
11	2	EA	Combination Valve 2"-410psi	\$800.00	\$1,600
12	7	EA	Air/Vacuum Valve 1"-410psi	\$350.00	\$2,450
13	1	EA	Combination Valve 1"-410psi	\$550.00	\$550
14	2	EA	Pump 3x4-10, 1750rpm, 15hp	\$8,000.00	\$16,000
15	2	EA	Pump 4x6-11, 3560rpm, 20hp	\$9,500.00	\$19,000
16	4	EA	Spring Collection	\$100,000.00	\$400,000
17	1	EA	Treatment Plant	\$800,000.00	\$800,000
18	1	EA	Chlorination System	\$10,000.00	\$10,000
19	2	EA	Pump Station (excluding pumps)	\$115,000.00	\$230,000
20	91,700	LF	Power (Three-Phase)	\$16.50	\$1,513,050
21	1	EA	Line Regulator	\$58,000.00	\$58,000
				Total	\$5,883,870

Preliminary Engineers Estimate					
Dry Valley Reservoir and Winnemucca Ranch Springs to Dry Valley					
Q = 900, 1000, 1100 AC-FT/YR from Winnemucca Ranch Springs					
Q = 1000 AC-FT/YR from Dry Valley Reservoir					
Q = 1900, 2000, 2100 AC-FT/YR					
Item	Quantity	Units	Description	Unit Price	Total Price
1	16,000	LF	14" Class 50 Ductile Iron	\$49.00	\$784,000
2	22,145	LF	12" Class 50 Ductile Iron	\$36.00	\$797,220
3	38,145	LF	Trenching	\$30.00	\$1,144,350
4	2	EA	Pump, 3x4-10, 1750 rpm, 15hp	\$8,000.00	\$16,000
5	1	EA	6" Check Valve	\$2,000.00	\$2,000
6	1	EA	6" Butterfly Valve	\$3,500.00	\$3,500
7	2	EA	Reducer (12x6)	\$1,200.00	\$2,400
8	23	EA	Valve Vaults	\$3,000.00	\$69,000
9	2	EA	Butterfly Valve 14"	\$13,000.00	\$26,000
10	9	EA	Air/Vacuum Valve 2"-410psi	\$550.00	\$4,950
11	4	EA	Air Release Valve 2"-410psi	\$700.00	\$2,800
12	7	EA	Air/Vacuum Valve 1"-410psi	\$350.00	\$2,450
13	1	EA	Combination Valve 1" -410psi	\$550.00	\$550
14	2	EA	Pump 4x6-11, 3560rpm, 20hp	\$9,500.00	\$19,000
15	4	EA	Spring Collection	\$100,000.00	\$400,000
16	1	EA	Treatment Plant	\$800,000.00	\$800,000
17	1	EA	Chlorination System	\$10,000.00	\$10,000
18	1	EA	Pump Station (excluding pumps)	\$115,000.00	\$115,000
19	91,700	LF	Power (Three-Phase)	\$16.50	\$1,513,050
20	1	EA	Line Regulator	\$58,000.00	\$58,000
				Total	\$5,770,270

Preliminary Engineers Estimate					
Dry Valley Reservoir and Winnemucca Ranch Springs to Dry Valley					
Q = 900, 1000, 1100 AC-FT/YR from Winnemucca Ranch Springs					
Q = 1500 AC-FT/YR from Dry Valley Reservoir					
Q = 2400, 2500, 2600 AC-FT/YR					
Item	Quantity	Units	Description	Unit Price	Total Price
1	16,000	LF	14" Class 50 Ductile Iron	\$49.00	\$784,000
2	22,145	LF	12" Class 50 Ductile Iron	\$36.00	\$797,220
3	38,145	LF	Trenching	\$30.00	\$1,144,350
4	2	EA	Pump, 3x4-10, 1750 rpm, 15hp	\$8,000.00	\$16,000
5	1	EA	6" Check Valve	\$2,000.00	\$2,000
6	1	EA	6" Butterfly Valve	\$3,500.00	\$3,500
7	2	EA	Reducer (12x6)	\$1,200.00	\$2,400
8	23	EA	Valve Vaults	\$3,000.00	\$69,000
9	2	EA	Butterfly Valve 14"	\$13,000.00	\$26,000
10	9	EA	Air/Vacuum Valve 2"-410psi	\$550.00	\$4,950
11	4	EA	Air Release Valve 2"-410psi	\$700.00	\$2,800
12	7	EA	Air/Vacuum Valve 1"-410psi	\$350.00	\$2,450
13	1	EA	Combination Valve 1" -410psi	\$550.00	\$550
14	2	EA	Pump 4x6-11, 3560rpm, 20hp	\$9,500.00	\$19,000
15	4	EA	Spring Collection	\$100,000.00	\$400,000
16	1	EA	Treatment Plant	\$800,000.00	\$800,000
17	1	EA	Chlorination System	\$10,000.00	\$10,000
18	1	EA	Pump Station (excluding pumps)	\$115,000.00	\$115,000
19	91,700	LF	Power (Three-Phase)	\$16.50	\$1,513,050
20	1	EA	Line Regulator	\$58,000.00	\$58,000
				Total	\$5,770,270

Dry Valley Reservoir					
Preliminary Engineers Estimate					
Item	Quantity	Unit	Description	Unit Price	Total Price
1	147,600	CY	Foundation Excavation	\$4.00	\$590,400
2	117,200	CY	Zone 1 Embankment	\$25.00	\$2,930,000
3	41,900	CY	Zone 2 Embankment	\$18.50	\$775,150
4	34,200	CY	Zone 3 Embankment	\$14.00	\$478,800
5	183,400	CY	Zone 4 Embankment	\$2.00	\$366,800
6	1,410	SY	Grout Cap Surface Prep		
			(10' Min. 12' Max.)	\$17.50	\$24,675
7	176	EA	Pipe for Grout Holes	\$50.00	\$8,800
8	590	CY	Grout Cap Concrete	\$300.00	\$177,000
9	9,680	LF	Drilling Rotary Percussion		
			Grout Holes	\$8.00	\$77,440
10	7,744	LF	Redrilling of Grout Holes	\$8.00	\$61,952
11	17,160	Bag	Portland Cement in Grout	\$13.00	\$223,080
12	334	Bag	Bentonite in Grout	\$6.15	\$2,054
13	528	EA	Connection to Grout Holes	\$55.00	\$29,040
14	400	LF	Grout Cap Linear Foot of		
			Joints or Faults to 4" Wide	\$24.00	\$9,600
15	40	CY	Grout Cap (Concrete placed		
			in joints or Faults > 4" Wide)	\$500.00	\$20,000
16	443	EA	Grout Cap Anchor Bars	\$69.00	\$30,567
17	5	EA	Pneumatic Piezometer	\$2,500.00	\$12,500
18	200	LF	Piezometer Bore Holes	\$34.00	\$6,800
19	4	EA	Relief Well	\$17,000.00	\$68,000
			Subtotal		\$5,892,658
Spillway Construction					
20	92,200	CY	Spillway Excavation	\$6.00	\$553,200
21	6,200	CY	Concrete Spillway	\$400.00	\$2,480,000
22	300	CY	Spillway End Section	\$400.00	\$120,000
23	11,000	SF	Rip Rap	\$6.00	\$66,000
24	3,800	CY	Drainage Layer	\$10.00	\$38,000
25	115	EA	Weep Holes and Drainage Piping	\$500.00	\$57,500
			Subtotal		\$3,314,700
			Total		\$9,207,358

SPANISH FLAT RESERVOIR ALTERNATIVES

Preliminary Engineers Estimate Summary Sheet

Spanish Flat Reservoir Alternate Alternates in order of Cost per Ac-Ft

Q=3225	\$2,000	Dollars/AC-FT (Cottonwood Creek)
Q=4325	\$4,300	Dollars/AC-FT (Lemmon Valley)
Q=4225	\$4,400	Dollars/AC-FT (Lemmon Valley)
Q=4125	\$4,500	Dollars/AC-FT (Lemmon Valley)
Q=4325	\$5,500	Dollars/AC-FT (Spanish Springs)
Q=4225	\$5,600	Dollars/AC-FT (Spanish Springs)
Q=4125	\$5,700	Dollars/AC-FT (Spanish Springs)

Spanish Flat Reservoir and Winnemucca Ranch Springs				
to Spanish Springs				
Q=4125, 4225, 4325 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Pipeline to Lemmon Valley (inc. Reservoir)	\$16,157,600
			Contingency (25%)	\$4,039,400
			Subtotal	\$20,197,000
			Geotechnical & Surveys (3%)	\$605,910
			Engineering Design (5.8%)	\$1,171,426
			Construction Management (8%)	\$1,615,760
			Total	\$23,590,096
			Rounded Total	\$23,590,000
			Dollars/AC-FT (4,125 ac-ft/yr)	\$5,700
			Dollars/AC-FT (4,225 ac-ft/yr)	\$5,600
			Dollars/AC-FT (4,325 ac-ft/yr)	\$5,500
Note:				
All Costs are preliminary and do not include				
any environmental planning or permitting costs				

Spanish Flat Reservoir and Winnemucca Ranch Springs				
to Lemmon Valley				
Q=4125, 4225, 4325 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Pipeline to Lemmon Valley (inc. Reservoir)	\$12,748,636
			Contingency (25%)	\$3,187,159
			Subtotal	\$15,935,795
			Geotechnical & Surveys (3%)	\$478,074
			Engineering Design (5.8%)	\$924,276
			Construction Management (8%)	\$1,274,864
			Total	\$18,613,009
			Rounded Total	\$18,613,000
			Dollars/AC-FT (4,125 ac-ft/yr)	\$4,500
			Dollars/AC-FT (4,225 ac-ft/yr)	\$4,400
			Dollars/AC-FT (4,325 ac-ft/yr)	\$4,300
Note:				
All Costs are preliminary and do not include				
any environmental planning or permitting costs				

Spanish Flat Reservoir to Cottonwood Creek				
Q=3225 ac-ft/yr				
Item	Quantity	Unit	Description	Approx. Price
1	1	LS	Pipeline to Cottonwood Creek	\$4,391,850
			Contingency (25%)	\$1,097,963
			Subtotal	\$5,489,813
			Geotechnical & Surveys (3%)	\$164,694
			Engineering Design (6.3%)	\$345,858
			Construction Management (8%)	\$439,185
			Total	\$6,439,550
			Rounded Total	\$6,440,000
			Dollars/AC-FT	\$2,000
Note:				
All Costs are preliminary and do not include				
any environmental planning or permitting costs				

Preliminary Engineers Estimate					
Spanish Flat and Winnemucca Ranch Springs to Spanish Springs					
900, 1000, or 1100 AC-FT/YR from Winnemucca Ranch Springs					
3225 AC-FT/YR from Spanish Flat Reservoir					
Q= 4125,4225,4325 AC-FT/YR					
Item	Quantity	Unit	Description	Price	Price
1	137,675	LF	18" Class 50 Restrained Joint Ductile Iron	\$70.00	\$9,637,250
2	137,675	LF	Trenching	\$20.00	\$2,753,500
3	9	EA	6" Butterfly Valve	\$3,500.00	\$31,500
4	11	EA	18" Butterfly Valve	\$9,500.00	\$104,500
5	9	EA	6" Check Valve	\$2,000.00	\$18,000
6	38	EA	Air/Vacuum Valve 2" - 410 psi	\$350.00	\$13,300
7	5	EA	Air Release Valve 1" - 410 psi	\$350.00	\$1,750
8	16	EA	Combination Valve 2" - 410 psi	\$550.00	\$8,800
9	62	EA	Valve Vaults	\$3,000.00	\$186,000
10	1	EA	Treatment Plant	\$800,000.00	\$800,000
11	1	EA	Chlorination System	\$10,000.00	\$10,000
12	4	EA	Spring Collection	\$100,000.00	\$400,000
13	18	EA	Reducer 10"x6"	\$1,000.00	\$18,000
14	1	LS	Spanish Flat Dam Rehabilitation	\$500,000.00	\$500,000
15	98,000	LF	Power (Three-Phase)	\$16.50	\$1,617,000
16	1	EA	Line Regulator	\$58,000.00	\$58,000
				Total	\$16,157,600

Preliminary Engineers Estimate					
Spanish Flat Reservoir and Winnemucca Ranch Springs to Lemmon Valley					
900, 1000, or 1100 AC-FT/YR from Winnemucca Ranch Springs and					
3225 AC-FT/YR from Spanish Flat Reservoir					
Q= 4125,4225,4325 AC-FT/YR					
1	31,950	LF	18" Class 50 Restrained Joint Ductile Iron	\$70.00	\$2,236,500
2	54,100	LF	18" Class 54 Restrained Joint Ductile Iron	\$85.00	\$4,598,500
3	86,050	LF	Trenching	\$25.00	\$2,151,250
4	6	EA	Butterfly Valve 18"	\$9,500.00	\$57,000
5	5	EA	Butterfly Valve 6"	\$3,500.00	\$17,500
6	5	EA	Check Valve 6"	\$2,000.00	\$10,000
7	28	EA	Air/Vacuum Valve 2"-700psi	\$500.00	\$14,000
8	5	EA	Air Release Valve 1"-700psi	\$550.00	\$2,750
9	38	EA	Valve Vaults	\$3,000.00	\$114,000
10	4	EA	Combination Valve 2"-700psi	\$900.00	\$3,600
11	9	EA	Reducer (10" x 6")	\$2,500.00	\$22,500
12	2	EA	Pump 4x6-9, 3560rpm, 50hp	\$5,518.00	\$11,036
13	1	EA	Treatment Plant	\$800,000.00	\$800,000
14	1	EA	Chlorination System	\$10,000.00	\$10,000
15	1	EA	Inlet Structure	\$10,000.00	\$10,000
16	1	LS	Spanish Flat Dam Rehabilitation	\$500,000.00	\$500,000
17	4	EA	Spring Collection	\$100,000.00	\$400,000
18	1	EA	Pump Station (excluding pumps)	\$115,000.00	\$115,000
19	98,000	LF	Power (Three Phase)	\$16.50	\$1,617,000
20	1	EA	Line Regulator	\$58,000.00	\$58,000
				Total	\$12,748,636

Preliminary Engineers Estimate					
Spanish Flat Reservoir to Cottonwood Creek					
Q= 3225 AC-FT/YR from Spanish Flat Reservoir					
Item	Quantity	Units	Description	Unit Price	Total Price
1	21,550	LF	18" Class 50 Restrained Joint Ductile Iron	\$70.00	\$1,508,500
3	21,550	LF	Trenching	\$20.00	\$431,000
4	3	EA	Butterfly Valve 18"	\$9,500.00	\$28,500
4	3	EA	Butterfly Valve 8"	\$7,500.00	\$22,500
6	1	EA	Pressure Reducer Valve 8"	\$5,500.00	\$5,500
6	1	EA	Check Valve 8"	\$3,000.00	\$3,000
7	7	EA	Air/Vacuum Valve 2"-700psi	\$500.00	\$3,500
8	3	EA	Air Release Valve 1"-700psi	\$550.00	\$1,650
9	16	EA	Valve Vaults	\$3,000.00	\$48,000
10	5	EA	Combination Valve 2"-700psi	\$900.00	\$4,500
11	6	EA	Reducer (18" x 8")	\$1,700.00	\$10,200
12	2	EA	Pump 6x8-22,1780rpm,350hp	\$15,000.00	\$30,000
15	1	EA	Outlet Structure	\$5,000.00	\$5,000
16	1	LS	Spanish Flat Dam Rehabilitation	\$500,000.00	\$500,000
18	1	EA	Pump Station (excluding pumps)	\$115,000.00	\$115,000
19	98,000	LF	Power (Three Phase)	\$16.50	\$1,617,000
20	1	EA	Line Regulator	\$58,000.00	\$58,000
				Total	\$4,391,850

APPENDIX B

This appendix contains miscellaneous hydrology calculations performed during the course of the project.

TABLE 1
HYDROLOGIC DESIGN PARAMETERS

<u>Basin or Station</u>	<u>Area (Mi²)</u>	<u>SCS Curve Number</u>	<u>Lag Time (hrs.)</u>
Upper Dry Valley Reservoir	21.45	69	2.724
Black Canyon Reservoir	15.19	69	2.257

TABLE 2
SITE DISCHARGE SUMMARY

<u>Basin</u>	<u>Peak Discharge (cfs)</u>	<u>Discharge Description</u>
Upper Dry Valley Reservoir	27,981	PMP Storm Discharge
Upper Dry Valley Reservoir	8,683	1/2 PMP Storm Discharge
Black Canyon Reservoir	22,813	PMP Storm Discharge
Black Canyon Reservoir	7,141	1/2 PMP Storm Discharge

Table 6.1.—General-storm PMP computations for the Colorado River and Great basin

Drainage Black Canyon Reservoir Area 15.19 mi² (km²)

Latitude 119° 46' 50", Longitude 40° 00' 38" of basin center

Month JAN

<u>Step</u>	<u>Duration (hrs)</u>				
	6	12	18	24	48

A. Convergence PMP

1. Drainage average value from one of figures 2.5 to 2.16 8.7 in. (~~mm~~)
2. Reduction for barrier-elevation [fig. 2.18] 55%
3. Barrier-elevation reduced PMP [step 1 X step 2] 4.8 in. (~~mm~~)
4. Durational variation [figs. 2.25 to 2.27 and table 2.7]. 51 77 90 100 128 148 %
5. Convergence PMP for indicated durations [steps 3 X 4] 2.45 3.7 4.3 4.8 6.1 7.1 in. (~~mm~~)
6. Incremental 10 mi² (26 km²) PMP [successive subtraction in step 5] 2.45 1.25 0.6 0.5 1.3 1.0 in. (~~mm~~)
7. Areal reduction [select from figs. 2.28 and 2.29] 100 → %
8. Arealy reduced PMP [step 6 X step 7] 2.45 1.25 0.6 0.5 1.3 1.0 in. (~~mm~~)
9. Drainage average PMP [accumulated values of step 8] 2.45 3.7 4.3 4.8 6.1 7.1 in. (~~mm~~)

B. Orographic PMP

1. Drainage average orographic index from figure 3.11a to d. 2.5 in. (~~mm~~)
2. Areal reduction [figure 3.20] 98%
3. Adjustment for month [one of figs. 3.12 to 3.17] 100%
4. Areally and seasonally adjusted PMP [steps 1 X 2 X 3] 2.6 in. (~~mm~~)
5. Durational variation [table 3.5] 30 57 80 100 159 167%
6. Orographic PMP for given durations [steps 4 X 5] 0.78 1.46 2.1 2.6 4.1 4.9 in. (~~mm~~)

C. Total PMP

1. Add steps A9 and B6 3.23 5.16 6.4 7.4 10.2 12 in. (~~mm~~)
2. PMP for other durations from smooth curve fitted to plot of computed data.
3. Comparison with local-storm PMP (see sec. 6.3).

Table 6.1.—General-storm PMP computations for the Colorado River and Great basin

Drainage Black Canyon Reservoir Area 15.19 mi² (km²)
 Latitude 15°46'50", Longitude 10°00'30" of basin center
 Month FEB

Step	Duration (hrs)				
	6	12	18	24	48

A. Convergence PMP

- Drainage average value from one of figures 2.5 to 2.16 8.7 in. (mm)
- Reduction for barrier-elevation [fig. 2.18] 55%
- Barrier-elevation reduced PMP [step 1 X step 2] 4.8 in. (mm)
- Durational variation [figs. 2.25 to 2.27 and table 2.7].
51 77 90 100 128 148%
- Convergence PMP for indicated durations [steps 3 X 4] 2.45 3.7 4.3 4.8 6.1 7.1 in. (mm)
- Incremental 10 mi² (26 km²) PMP [successive subtraction in step 5] 2.45 1.25 0.6 0.5 1.3 1.0 in. (mm)
- Areal reduction [select from figs. 2.28 and 2.29] 100 → %
- Areally reduced PMP [step 6 X step 7] 2.45 1.25 0.6 0.5 1.3 1.0 in. (mm)
- Drainage average PMP [accumulated values of step 8] 2.45 3.7 4.3 4.8 6.1 7.1 in. (mm)

B. Orographic PMP

- Drainage average orographic index from figure 3.11a to d. 25 in. (mm)
- Areal reduction [figure 3.20] 98%
- Adjustment for month [one of figs. 3.12 to 3.17] 105%
- Areally and seasonally adjusted PMP [steps 1 X 2 X 3] 26 in. (mm)
- Durational variation [table 3.6] 30 57 80 100 159 187%
- Orographic PMP for given durations [steps 4 X 5] 0.78 1.46 2.08 2.6 4.1 4.9 in. (mm)

C. Total PMP

- Add steps A9 and B6 3.2 5.2 6.4 7.4 10.2 12 in. (mm)
- PMP for other durations from smooth curve fitted to plot of computed data.
- Comparison with local-storm PMP (see sec. 6.3).

Table 6.1.—General-storm PMP computations for the Colorado River and Great basin

Drainage Black Canyon Reservoir Area 15.19 mi² (39 km²)
 Latitude 19°46'00", Longitude 40°00'30" of basin center
 Month MAY

<u>Step</u>	<u>Duration (hrs)</u>					
	6	12	18	24	48	72

A. Convergence PMP

1. Drainage average value from one of figures 2.5 to 2.16 8.5 in. (mm)
2. Reduction for barrier-elevation [fig. 2.18] 55%
3. Barrier-elevation reduced PMP [step 1 X step 2] 4.7 in. (mm)
4. Durational variation [figs. 2.25 to 2.27 and table 2.7].
54 78 91 100 126 142 %
5. Convergence PMP for indicated durations [steps 3 X 4] 2.54 3.67 4.28 4.7 5.9 6.67 in. (mm)
6. Incremental 10 mi² (26 km²) PMP [successive subtraction in step 5] 2.54 1.13 0.61 0.42 0.2 0.77 in. (mm)
7. Areal reduction [select from figs. 2.28 and 2.29] 100 %
8. Areal reduced PMP [step 6 X step 7] 2.54 1.13 0.61 0.42 0.2 0.77 in. (mm)
9. Drainage average PMP [accumulated values of step 8] 2.54 3.67 4.28 4.7 5.9 6.67 in. (mm)

B. Orographic PMP

1. Drainage average orographic index from figure 3.11a to d. 2.5 in. (mm)
2. Areal reduction [figure 3.20] 98%
3. Adjustment for month [one of figs. 3.12 to 3.17] 101%
4. Areal and seasonally adjusted PMP [steps 1 X 2 X 3] 2.5 in. (mm)
5. Durational variation [table 3.5] 30 57 80 100 159/187%
6. Orographic PMP for given durations [steps 4 X 5] 0.75 1.43 2 2.5 3.96 4.67 in. (mm)

C. Total PMP

1. Add steps A9 and B6 3.3 5.1 6.3 7.2 9.9 11.3 in. (mm)
2. PMP for other durations from smooth curve fitted to plot of computed data.
3. Comparison with local-storm PMP (see sec. 6.3).

Table 6.1.—General-storm PMP computations for the Colorado River and Great basin

Step	Duration (hrs)					
	6	12	18	24	48	72
Drainage	<u>Black Canyon Reservoir</u>					Area <u>15.19</u> mi ² (km ²)
Latitude	<u>119° 46' 50"</u> , Longitude <u>40° 00' 30"</u> of basin center					
Month	<u>APR</u>					
A. Convergence PMP						
1. Drainage average value from one of figures 2.5 to 2.16	<u>82 in.</u> (mm)					
2. Reduction for barrier-elevation [fig. 2.18]	<u>55%</u>					
3. Barrier-elevation reduced PMP [step 1 X step 2]	<u>45 in.</u> (mm)					
4. Durational variation [figs. 2.25 to 2.27 and table 2.7].	<u>56 79 91 100 124 138 %</u>					
5. Convergence PMP for indicated durations [steps 3 X 4]	<u>25.2 3.6 4.1 4.5 5.6 6.2 in.</u> (mm)					
6. Incremental 10 mi ² (26 km ²) PMP [successive subtraction in step 5]	<u>2.5 1.1 0.5 0.4 1.1 0.6 in.</u> (mm)					
7. Areal reduction [select from figs. 2.28 and 2.29]	<u>100</u> → _____ %					
8. Areally reduced PMP [step 6 X step 7]	<u>2.5 1.1 0.5 0.4 1.1 0.6 in.</u> (mm)					
9. Drainage average PMP [accumulated values of step 8]	<u>25 3.6 4.1 4.5 5.6 6.2 in.</u> (mm)					
B. Orographic PMP						
1. Drainage average orographic index from figure 3.11a to d.	<u>25 in.</u> (mm)					
2. Areal reduction [figure 3.20]	<u>98%</u>					
3. Adjustment for month [one of figs. 3.12 to 3.17]	<u>94%</u>					
4. Areally and seasonally adjusted PMP [steps 1 X 2 X 3]	<u>23 in.</u> (mm)					
5. Durational variation [table 3.6]	<u>30 57 80 100 159 167 %</u>					
6. Orographic PMP for given durations [steps 4 X 5]	<u>0.7 1.3 1.8 2.3 3.7 4.3 in.</u> (mm)					
C. Total PMP						
1. Add steps A9 and B6	<u>3.2 4.9 5.9 6.8 9.3 10.5 in.</u> (mm)					
2. PMP for other durations from smooth curve fitted to plot of computed data.						
3. Comparison with local-storm PMP (see sec. 6.3).						

Table 6.1.—General-storm PMP computations for the Colorado River and Great basin

Drainage Black Canyon Reservoir Area 15.19 mi² (40 km²)
 Latitude 119°41'50", Longitude 40°00'30" of basin center
 Month JUN

Step	Duration (hrs)				
	6	12	18	24	48

A. Convergence PMP

- Drainage average value from one of figures 2.5 to 2.16 7.9 in. (mm)
- Reduction for barrier-elevation [fig. 2.18] 55 %
- Barrier-elevation reduced PMP [step 1 X step 2] 4.3 in. (mm)
- Durational variation [figs. 2.25 to 2.27 and table 2.7]. 60 81 92 100 120 137 %
- Convergence PMP for indicated durations [steps 3 X 4] 2.6 3.5 4.0 4.3 5.2 5.7 in. (mm)
- Incremental 10 mi² (26 km²) PMP [successive subtraction in step 5] 2.6 0.9 0.5 0.3 0.9 0.5 in. (mm)
- Areal reduction [select from figs. 2.28 and 2.29] 100 %
- Areally reduced PMP [step 6 X step 7] 2.6 0.9 0.5 0.3 0.9 0.5 in. (mm)
- Drainage average PMP [accumulated values of step 8] 2.6 3.5 4.0 4.3 5.2 5.7 in. (mm)

B. Orographic PMP

- Drainage average orographic index from figure 3.11a to d. 2.5 in. (mm)
- Areal reduction [figure 3.20] 98 %
- Adjustment for month [one of figs. 3.12 to 3.17] 92 %
- Areally and seasonally adjusted PMP [steps 1 X 2 X 3] 2.3 in. (mm)
- Durational variation [table 3.5] 30 57 80 100 159 187 %
- Orographic PMP for given durations [steps 4 X 5] 0.7 1.3 1.8 2.3 3.7 4.3 in. (mm)

C. Total PMP

- Add steps A9 and B6 3.3 4.0 5.8 6.6 8.9 10.0 in. (mm)
- PMP for other durations from smooth curve fitted to plot of computed data.
- Comparison with local-storm PMP (see sec. 6.3).

Table 6.1.—General-storm PMP computations for the Colorado River and Great basin

Drainage Black Canyon ~~Basin~~ Area 15.19 mi² (km²)
 Latitude 119°41'50", Longitude 40°00'30" of basin center
 Month JUL

Step	Duration (hrs)				
	6	12	18	24	48

A. Convergence PMP

1. Drainage average value from one of figures 2.5 to 2.16 8.2 in. (mm)
2. Reduction for barrier-elevation [fig. 2.18] 55%
3. Barrier-elevation reduced PMP [step 1 X step 2] 4.5 in. (mm)
4. Durational variation [figs. 2.25 to 2.27 and table 2.7]. 64 83 93 100 117 126%
5. Convergence PMP for indicated durations [steps 3 X 4] 2.9 3.7 4.2 4.5 5.3 5.7 in. (mm)
6. Incremental 10 mi² (26 km²) PMP [successive subtraction in step 5] 2.9 0.6 0.5 0.3 0.6 0.4 in. (mm)
7. Areal reduction [select from figs. 2.28 and 2.29] 100 → %
8. Areally reduced PMP [step 6 X step 7] 2.9 0.6 0.5 0.3 0.6 0.4 in. (mm)
9. Drainage average PMP [accumulated values of step 8] 2.9 3.7 4.2 4.5 5.3 5.7 in. (mm)

B. Orographic PMP

1. Drainage average orographic index from figure 3.11a to d. 25 in. (mm)
2. Areal reduction [figure 3.20] 96%
3. Adjustment for month [one of figs. 3.12 to 3.17] 96%
4. Areally and seasonally adjusted PMP [steps 1 X 2 X 3] 2.4 in. (mm)
5. Durational variation [table 3.6] 30 57 80 100 159 167%
6. Orographic PMP for given durations [steps 4 X 5] 0.7 1.4 1.9 2.4 3.8 4.5 in. (mm)

C. Total PMP

1. Add steps A9 and B6 3.6 5.1 6.1 6.9 9.1 10.2 in. (mm)
2. PMP for other durations from smooth curve fitted to plot of computed data.
3. Comparison with local-storm PMP (see sec. 6.3).

Table 6.1.—General-storm PMP computations for the Colorado River and Great basin

Drainage Black Canyon Reservoir Area 15.19 mi² (km²)
 Latitude 119°41'50", Longitude 40°00'30" of basin center
 Month Aug

Step Duration (hrs)
6 12 18 24 48 72

A. Convergence PMP

1. Drainage average value from one of figures 2.5 to 2.16 8.2 in. (mm)
2. Reduction for barrier-elevation [fig. 2.18] 55%
3. Barrier-elevation reduced PMP [step 1 X step 2] 4.5 in. (mm)
4. Durational variation [figs. 2.25 to 2.27 and table 2.7]. 64 83 93 100 117 126%
5. Convergence PMP for indicated durations [steps 3 X 4] 2.9 3.7 4.2 4.5 5.3 5.7 in. (mm)
6. Incremental 10 mi² (26 km²) PMP [successive subtraction in step 5] 2.9 0.8 0.5 0.3 0.8 0.4 in. (mm)
7. Areal reduction [select from figs. 2.28 and 2.29] 100 %
8. Areal reduced PMP [step 6 X step 7] 2.9 0.8 0.5 0.3 0.8 0.4 in. (mm)
9. Drainage average PMP [accumulated values of step 8] 2.9 3.7 4.2 4.5 5.3 5.7 in. (mm)

B. Orographic PMP

1. Drainage average orographic index from figure 3.11a to d. 2.5 in. (mm)
2. Areal reduction [figure 3.20] 98%
3. Adjustment for month [one of figs. 3.12 to 3.17] 100%
4. Areal and seasonally adjusted PMP [steps 1 X 2 X 3] 2.5 in. (mm)
5. Durational variation [table 3.5] 30 57 80 100 159 187%
6. Orographic PMP for given durations [steps 4 X 5] 0.8 1.4 2 2.5 4.0 4.7 in. (mm)

C. Total PMP

1. Add steps A9 and B6 3.7 5.1 6.2 7 9.3 10.4 in. (mm)
2. PMP for other durations from smooth curve fitted to plot of computed data.
3. Comparison with local-storm PMP (see sec. 6.3).

Table 6.1.—General-storm PMP computations for the Colorado River and Great basin

Drainage Black Canyon Reservoir Area 15.19 mi² (km²)
 Latitude 119° 42', Longitude 40° of basin center

Month Sep

Step	Duration (hrs)					
	6	12	18	24	48	72
A. Convergence PMP						
1. Drainage average value from one of figures 2.5 to 2.16	<u>8.7</u> in. (mm)					
2. Reduction for barrier-elevation [fig. 2.18]	<u>55</u> %					
3. Barrier-elevation reduced PMP [step 1 X step 2]	<u>4.8</u> in. (mm)					
4. Durational variation [figs. 2.25 to 2.27 and table 2.7].	<u>64</u>	<u>83</u>	<u>93</u>	<u>100</u>	<u>117</u>	<u>126</u> %
5. Convergence PMP for indicated durations [steps 3 X 4]	<u>3.1</u>	<u>5.4</u>	<u>4.5</u>	<u>4.6</u>	<u>5.6</u>	<u>5.9</u> in. (mm)
6. Incremental 10 mi ² (26 km ²) PMP [successive subtraction in step 5]	<u>3.1</u>	<u>2.5</u>	<u>1.1</u>	<u>0.3</u>	<u>0.0</u>	<u>0.3</u> in. (mm)
7. Areal reduction [select from figs. 2.28 and 2.29]	<u>100</u> → _____ %					
8. Areally reduced PMP [step 6 X step 7]	<u>3.1</u>	<u>2.5</u>	<u>1.1</u>	<u>0.3</u>	<u>0.0</u>	<u>0.3</u> in. (mm)
9. Drainage average PMP [accumulated values of step 8]	<u>3.1</u>	<u>5.6</u>	<u>4.5</u>	<u>4.6</u>	<u>5.6</u>	<u>5.9</u> in. (mm)
B. Orographic PMP						
1. Drainage average orographic index from figure 3.11a to d.	<u>2.5</u> in. (mm)					
2. Areal reduction [figure 3.20]	<u>90</u> %					
3. Adjustment for month [one of figs. 3.12 to 3.17]	<u>105</u> %					
4. Areally and seasonally adjusted PMP [steps 1 X 2 X 3]	<u>2.6</u> in. (mm)					
5. Durational variation [table 3.6]	<u>30</u>	<u>57</u>	<u>80</u>	<u>100</u>	<u>159</u>	<u>187</u> %
6. Orographic PMP for given durations [steps 4 X 5]	<u>0.8</u>	<u>1.5</u>	<u>2.1</u>	<u>2.6</u>	<u>4.1</u>	<u>4.9</u> in. (mm)
C. Total PMP						
1. Add steps A9 and B6	<u>3.9</u>	<u>7.1</u>	<u>6.6</u>	<u>7.4</u>	<u>9.7</u>	<u>10.8</u> in. (mm)
2. PMP for other durations from smooth curve fitted to plot of computed data.						
3. Comparison with local-storm PMP (see sec. 6.3).						

Table 6.1.—General-storm PMP computations for the Colorado River and Great basin

Drainage Black Canyon Reservoir Area 15.19 mi² (km²)
 Latitude 119° 42', Longitude 40° of basin center

Month Oct

Step	Duration (hrs)				
	6	12	18	24	48

A. Convergence PMP

1. Drainage average value from one of figures 2.5 to 2.16 8.9 in. (mm)
2. Reduction for barrier-elevation [fig. 2.18] 55 %
3. Barrier-elevation reduced PMP [step 1 X step 2] 4.9 in. (mm)
4. Durational variation [figs. 2.25 to 2.27 and table 2.7]. 60 81 92 100 120 137 %
5. Convergence PMP for indicated durations [steps 3 X 4] 2.9 4.0 4.5 4.9 5.9 6.5 in. (mm)
6. Incremental 10 mi² (26 km²) PMP [successive subtraction in step 5] 2.9 1.1 0.5 0.4 1.0 0.6 in. (mm)
7. Areal reduction [select from figs. 2.28 and 2.29] 100 %
8. Areal reduced PMP [step 6 X step 7] 2.9 1.1 0.5 0.4 1.0 0.6 in. (mm)
9. Drainage average PMP [accumulated values of step 8] 2.9 4.0 4.5 4.9 5.9 6.5 in. (mm)

B. Orographic PMP

1. Drainage average orographic index from figure 3.11a to d. 2.5 in. (mm)
2. Areal reduction [figure 3.20] 98 %
3. Adjustment for month [one of figs. 3.12 to 3.17] 108 %
4. Areally and seasonally adjusted PMP [steps 1 X 2 X 3] 2.6 in. (mm)
5. Durational variation [table 3.6] 30 57 80 100 159 187 %
6. Orographic PMP for given durations [steps 4 X 5] 0.8 1.5 2.1 2.6 4.1 4.9 in. (mm)

C. Total PMP

1. Add steps A9 and B6 3.2 5.5 6.6 7.5 10.0 11.4 in. (mm)
2. PMP for other durations from smooth curve fitted to plot of computed data.
3. Comparison with local-storm PMP (see sec. 6.3).

Table 6.1.—General-storm PMP computations for the Colorado River and Great basin

Drainage Black Canyon Reservoir Area 15.19 mi² (km²)
 Latitude 119° 42', Longitude 40° of basin center

Month Nov

<u>Step</u>	<u>Duration (hrs)</u>				
	6	12	18	24	48

A. Convergence PMP

1. Drainage average value from one of figures 2.5 to 2.16 88 in. (mm)
2. Reduction for barrier-elevation [fig. 2.18] 95 %
3. Barrier-elevation reduced PMP [step 1 X step 2] 48 in. (mm)
4. Durational variation [figs. 2.25 to 2.27 and table 2.7].
54 70 91 100 127 144 %
5. Convergence PMP for indicated durations [steps 3 X 4] 2.6 3.7 4.4 4.8 6.1 6.9 in. (mm)
6. Incremental 10 mi² (26 km²) PMP [successive subtraction in step 5] 2.6 0.9 0.7 0.4 1.3 0.6 in. (mm)
7. Areal reduction [select from figs. 2.28 and 2.29] 100 %
8. Areal reduction PMP [step 6 X step 7] 2.6 0.9 0.7 0.4 1.3 0.6 in. (mm)
9. Drainage average PMP [accumulated values of step 8] 2.6 3.7 4.4 4.8 6.1 6.9 in. (mm)

B. Orographic PMP

1. Drainage average orographic index from figure 3.11a to d. 25 in. (mm)
2. Areal reduction [figure 3.20] 98 %
3. Adjustment for month [one of figs. 3.12 to 3.17] 109 %
4. Areal and seasonally adjusted PMP [steps 1 X 2 X 3] 2.7 in. (mm)
5. Durational variation [table 3.5] 30 57 80 100 159 187 %
6. Orographic PMP for given durations [steps 4 X 5] 0.8 1.5 2.2 2.7 4.3 5.0 in. (mm)

C. Total PMP

1. Add steps A9 and B6 2.1 5.6 6.6 7.5 10.1 11.9 in. (mm)
2. PMP for other durations from smooth curve fitted to plot of computed data.
3. Comparison with local-storm PMP (see sec. 6.3).

Table 6.1.—General-storm PMP computations for the Colorado River and Great basin

Drainage Black Canyon Reservoir Area 15.19 mi² (km²)
 Latitude 119°42', Longitude 40' of basin center

Month Dec.

Step Duration (hrs)
6 12 18 24 48 72

A. Convergence PMP

1. Drainage average value from one of figures 2.5 to 2.16 6.9 in. (mm)
2. Reduction for barrier-elevation [fig. 2.18] 55%
3. Barrier-elevation reduced PMP [step 1 X step 2] 4.9 in. (mm)
4. Durational variation [figs. 2.25 to 2.27 and table 2.7]. 51 77 90 100 128 148 %
5. Convergence PMP for indicated durations [steps 3 X 4] 2.5 3.8 4.4 4.9 6.3 7.3 in. (mm)
6. Incremental 10 mi² (26 km²) PMP [successive subtraction in step 5] 2.5 1.3 0.6 0.5 1.4 1.0 in. (mm)
7. Areal reduction [select from figs. 2.28 and 2.29] 100 — — — — %
8. Areal reduced PMP [step 6 X step 7] 2.5 1.3 0.6 0.5 1.4 1.0 in. (mm)
9. Drainage average PMP [accumulated values of step 8] 2.5 3.8 4.4 4.9 6.3 7.3 in. (mm)

B. Orographic PMP

1. Drainage average orographic index from figure 3.11a to d. 25 in. (mm)
2. Areal reduction [figure 3.20] 98%
3. Adjustment for month [one of figs. 3.12 to 3.17] 108%
4. Areal and seasonally adjusted PMP [steps 1 X 2 X 3] 2.6 in. (mm)
5. Durational variation [table 3.5] 30 57 80 100 159 187 %
6. Orographic PMP for given durations [steps 4 X 5] 0.8 1.5 2.1 2.6 4.1 4.9 in. (mm)

C. Total PMP

1. Add steps A9 and B6 3.3 5.3 6.5 7.5 10.4 12.2 in. (mm)
2. PMP for other durations from smooth curve fitted to plot of computed data.
3. Comparison with local-storm PMP (see sec. 6.3).

Table 6.3A.--Local-storm PMP computation, Colorado River, Great Basin and California drainages. For drainage average depth PMP. Go to table 6.3B if areal variation is required.

Drainage Black Canyon Reservoir Area 15.19 mi² (km²)
 Latitude 119°47' Longitude 40° Minimum Elevation 5480 ft (m)

Steps correspond to those in sec. 6.3A.

1. Average 1-hr 1-mi² (2.6-km²) PMP for drainage [fig. 4.5]. 6.5 in. (mm)
2. a. Reduction for elevation. [No adjustment for elevations up to 5,000 feet (1,524 m): 5% decrease per 1,000 feet (305 m) above 5,000 feet (1,524 m)]. 97.6 %
 b. Multiply step 1 by step 2a. 6.3 in. (mm)
3. Average 6/1-hr ratio for drainage [fig. 4.7]. 1.6
4. Durational variation for 6/1-hr ratio of step 3 [table 4.4].

	Duration (hr)								
	1/4	1/2	3/4	1	2	3	4	5	6
4. Durational variation for 6/1-hr ratio of step 3 [table 4.4].	<u>43</u>	<u>70</u>	<u>87</u>	<u>100</u>	<u>124</u>	<u>138</u>	<u>147</u>	<u>191</u>	<u>160</u>
5. 1-mi² (2.6-km²) PMP for indicated durations [step 2b X step 4].

5. 1-mi ² (2.6-km ²) PMP for indicated durations [step 2b X step 4].	<u>3.6</u>	<u>5.8</u>	<u>7.2</u>	<u>8.3</u>	<u>10.3</u>	<u>11.5</u>	<u>12.2</u>	<u>12.8</u>	<u>13.3</u>
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6. Areal reduction [fig. 4.9].

6. Areal reduction [fig. 4.9].	<u>67</u>	<u>74</u>	<u>76</u>	<u>78</u>	<u>81</u>	<u>82</u>	<u>83</u>	<u>84</u>	<u>85</u>
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7. Areal reduced PMP [steps 5 X 6].

7. Areal reduced PMP [steps 5 X 6].	<u>2.4</u>	<u>4.3</u>	<u>5.5</u>	<u>6.5</u>	<u>8.3</u>	<u>9.4</u>	<u>10.1</u>	<u>10.8</u>	<u>11.3</u>
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8. Incremental PMP [successive subtraction in step 7].

8. Incremental PMP [successive subtraction in step 7].	<u>6.5</u>	<u>1.8</u>	<u>1.1</u>	<u>0.7</u>	<u>0.7</u>	<u>0.5</u>	in. (mm)		
	<u>2.4</u>	<u>1.9</u>	<u>1.2</u>	<u>1.0</u>	} 15-min. increments				
9. Time sequence of incremental PMP according to:

Hourly increments [table 4.7].

Hourly increments [table 4.7].	<u>0.7</u>	<u>1.1</u>	<u>0.5</u>	<u>1.8</u>	<u>0.7</u>	<u>0.5</u>	in. (mm)		
	<u>0.5</u>	<u>0.7</u>	<u>1.8</u>	<u>6.5</u>	<u>1.1</u>	<u>0.7</u>	11.3 in.		

Four largest 15-min. increments [table 4.8].

Four largest 15-min. increments [table 4.8].	<u>2.4</u>	<u>1.9</u>	<u>1.2</u>	<u>1.0</u>	in. (mm)				
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Table 6.3B.--Local-storm PMP computation, Colorado River and Great Basin, and California drainages. (Giving areal distribution of PMP).

Steps correspond to those in sec. 6.3B.

1. Place idealized isohyetal pattern [fig. 4.10] over drainage adjusted to 1:500,000 scale to obtain most critical placement.
2. Note the isohyets within drainage. A9B.
3. Average 1-hr 1-mi² (2.6-km²) PMP for drainage [fig. 4.5]. 8.5 in. (mm)
4. a. Reduction for elevation. [No adjustment for elevations up to 5,000 feet (1,524 m), 5% decrease per 1,000 feet (305 m) above 5,000 feet (1,524 m)]. 92.6 %
 b. Multiply step 3 by step 4a. 8.3 in. (mm)
5. Average 6/1-hr ratio for drainage [fig. 4.7]. 1.6
6. Obtain isohyetal labels for 15-min incremental and the highest PMP from table 4.5 corresponding 6/1-hr ratio of step 5.

PMP Increment	Isohyet									
	A	B	C	D	E	F	G	H	I	J
Highest 1-hr	<u>100</u>	<u>82</u>								
Highest 15-min.	<u>43</u>	<u>31</u>								
2nd "	<u>27</u>	<u>23</u>								
3rd "	<u>17</u>	<u>16</u>								in %
4th "	<u>13</u>	<u>12</u>								

7. Obtain isohyetal labels in % of 1-hr PMP for 2nd to 6th highest hourly incremental PMP values from table 4.6 using 6/1-hr ratio of step 5.

2nd Highest										
1-hr PMP										
3rd "	<u>14</u>	<u>14</u>								
4th "	<u>8</u>	<u>8</u>								in %
5th "	<u>7</u>	<u>7</u>								
6th "	<u>6</u>	<u>6</u>								

8. Multiply steps 6 and 7 by step 4b to get incremental isohyetal labels of PMP.

Highest 15-min.	<u>3.6</u>	<u>2.6</u>								
2nd "	<u>2.2</u>	<u>1.9</u>								
3rd "	<u>1.4</u>	<u>1.3</u>								
4th "	<u>1.1</u>	<u>1.0</u>								
Highest 1-hr	<u>8.3</u>	<u>6.8</u>								in in. (mm)
2nd "	<u>2.0</u>	<u>1.9</u>								
3rd "	<u>1.2</u>	<u>1.2</u>								
4th "	<u>.7</u>	<u>.7</u>								
5th "	<u>.6</u>	<u>.6</u>								
6th "	<u>.5</u>	<u>.5</u>								

9. Arrange values of step 8 in time sequence [tables 4.7 and 4.8].

0.6 1.2 8.3 2.0 0.7 0.5 => HR2 WAS 133.1"

3.6 2.2 1.4 1.1

0.5 0.7 2.0 8.3 1.2 0.6 => BM1110-2-1411

Table 6.1.—General-storm PMP computations for the Colorado River and Great basin

Drainage Dry Valley Reservoir Area 2,145 mi² (km²)
 Latitude 119° 47', Longitude 40' of basin center

Month JAN

Step	Duration (hrs)				
	6	12	18	24	48 72

A. Convergence PMP

1. Drainage average value from one of figures 2.5 to 2.16 0.7 in. (mm)
2. Reduction for barrier-elevation [fig. 2.18] _____ %
3. Barrier-elevation reduced PMP [step 1 X step 2] _____ in. (mm)
4. Durational variation [figs. 2.25 to 2.27 and table 2.7]. _____ %
5. Convergence PMP for indicated durations [steps 3 X 4] _____ in. (mm)
6. Incremental 10 mi² (26 km²) PMP [successive subtraction in step 5] _____ in. (mm)
7. Areal reduction [select from figs. 2.28 and 2.29] _____ %
8. Areal reduced PMP [step 6 X step 7] _____ in. (mm)
9. Drainage average PMP [accumulated values of step 8] _____ in. (mm)

B. Orographic PMP

1. Drainage average orographic index from figure 3.11a to d. _____ in. (mm)
2. Areal reduction [figure 3.20] _____ %
3. Adjustment for month [one of figs. 3.12 to 3.17] _____ %
4. Areal and seasonally adjusted PMP [steps 1 X 2 X 3] _____ in. (mm)
5. Durational variation [table 3.5] _____ %
6. Orographic PMP for given durations [steps 4 X 5] _____ in. (mm)

C. Total PMP

1. Add steps A9 and B6 _____ in. (mm)
2. PMP for other durations from smooth curve fitted to plot of computed data.
3. Comparison with local-storm PMP (see sec. 6.3).

APPENDIX C

This appendix contains the hydrologic analysis printout for Black Canyon Reservoir.

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*****
*
* U.S. ARMY CORPS OF ENGINEERS
* HYDROLOGIC ENGINEERING CENTER
* 609 SECOND STREET
* DAVIS, CALIFORNIA 95616
* (916) 551-1748
*
*****

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*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* MAY 1991
* VERSION 4.0.1E
* Lahey F77L-EM/32 version 5.01
* Dodson & Associates, Inc.
* RUN DATE 06/15/93 TIME 07:55:59
*
*****

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X X XXXXXX XXXX X
X X X X X XX
X X X X X X
XXXXXX XXXX X XXXX X
X X X X X X
X X X X X X
X X XXXXXX XXXX XXX

```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES RRTIMP AND RRTIRR HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.

THE DEFINITION OF -AMSK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FRTRAN77 VERSION

NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1 ID BLACK CANYON RESERVOIR
 2 ID PMP AND 122 PMP STRM CALCULATIONS
 3 ID HMR NO. 49 PRECIPITATIONS
 4 ID HMR NO. 5 (U.S. WEATHER BUREAU) DISTRIBUTIONS

5 IT 10 08JUN93 1200 100
 6 I 0 2 0
 7 JR PREC 1.00 .5
 8 IN 15 08JUN93 1200
 9 PG PMP 13.3
 10 PI .15 .15 .15 .3 .3 .3 .3 3.6 2.2
 11 PI 1.4 1.1 .5 .5 .5 .175 .175 .175 .175 .175
 12 PI .125 .125 .125

13 KK 100
 14 KM *****
 15 KM TOTAL FLOW T DAM
 16 KM *****

17 BA 15.19
 18 PT PMP
 19 PW 1
 20 PR PMP
 21 PW 1
 22 LS 0 69 0
 23 UD 2.257

24 KK 150
 25 KM *****
 26 KM RESERVOIR ROUTING
 27 KM *****

28 RS 1 STRR 1500
 29 SV 11.8 28.1 53 86.9 130.2 183.6 248.7 326.6 418.9 525.9
 30 SV 649.5 788.7 942.6 1111.3 1294.7 1494 1709.4 1941.7 2191.6 2318.6
 31 SE 5429 5434 5439 5444 5449 5454 5459 5464 5469 5474
 32 SE 5479 5484 5489 5494 5499 5504 5509 5514 5519 5521.5
 33 SS 5506 50 3.8 1.5
 34 ST 5520 764 2.63 1.5
 35 ZZ

```

*****
*
* U.S. ARMY CRRPS OF ENGINEERS
* HYDROLOGIC ENGINEERING CENTER
* 609 SECOND STREET
* DAVIS, CALIFORNIA 95616
* (916) 551-1748
*
*****

```

```

*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* MAY 1991
* VERSION 4.0.1E
* Lahey F77L-EM/32 version 5.01
* Dodson & Associates, Inc.
* RUN DATE 06/15/93 TIME 07:55:59
*
*****

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BLACK CANYON RESERVOIR
PMP AND 122 PMP STRM CALCULATIONS
HMR NO. 49 PRECIPITATIONS
HMR NO. 5 (U.S. WEATHER BUREAU) DISTRIBUTIONS

```

6 I OUTPUT CONTROL VARIABLES

```

IPRNT 0 PRINT CONTROL
IPLOT 2 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE

```

8 IN TIME DATA FRR INPUT TIME SERIES

```

JXMIN 15 TIME INTERVAL IN MINUTES
JXDATE 8JUN93 STARTING DATE
JXTIME 1200 STARTING TIME

```

IT HYDROGRAPH TIME DATA

```

NNIN 10 MINUTES IN COMPUTATION INTERVAL
IDATE 8JUN93 STARTING DATE
ITIME 1200 STARTING TIME
NQ 100 NUMBER OF HYDROGRAPH RRINATES
NDDATE 9JUN93 ENDING DATE
NDTIME 0430 ENDING TIME
ICENT 19 CENTURY MARK

```

```

COMPUTATION INTERVAL 0.17 HOURS
TOTAL TIME BASE 16.50 HOURS

```

```

ENGLISH UNITS
DRAINAGE AREA SQUARE MILES
PRECIPITATION DEPTH INCHES

```

LENGTH, ELEVATION FEET
 FLOW CUBIC FEET PER SECOND
 STRRAGE VOLUME ACRE-FEET
 SURFACE AREA ACRES
 TEMPERATURE DEGREES FAHRENHEIT

JP MULTIPPLAN PPTION
 NPLAN 1 NUMBER OF PLANS

JR MULTIRRATI PPTION
 RATIOS OF PRECIPITATION
 1.00 0.50

*** **

 * *
 * 100 *
 * *

 TOTAL FLOW T DAM

SUBBASIN RUNOFF DATA

17 BA SUBBASIN CHARACTERISTICS
 TAREA 15.19 SUBBASIN AREA

PRECIPITATION DATA

18 PT TOTAL STRRM STATIONS PMP
 19 PW WEIGHTS 1.00
 20 PR RECRDRING STATIONS PMP
 21 PW WEIGHTS 1.00

22 LS SCS LOSS RATE
 STRTL 0.90 INITIAL ABSTRACTION
 CRVNR 69.00 CURVE NUMBER
 RTIMP 0.00 PERCENT IMPERVIOUS AREA

23 UD SCS DIMENSIONLESS UNITGRAPH
 TLAG 2.26 LAG

PRECIPITATION STATION DATA

STATION TOTAL AVG. ANNUAL WEIGHT
 PMP 13.30 0.00 1.00

TEMPRRAL DISTRIBUTIONS

STATION PMP, WEIGHT = 1.00

0.10	0.10	0.10	0.10	0.10	0.10	0.20	0.20	0.20	0.20	0.20	0.20	0.20
0.20	0.20	2.40	1.93	1.47	0.93	0.83	0.73	0.33	0.33	0.33	0.33	0.33
0.33	0.33	0.33	0.33	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08

UNIT HYDROGRAPH

70 END-OFPERIOD RRDINATES

67.	187.	352.	553.	807.	1109.	1466.	1889.	2275.	2613.
2859.	3019.	3113.	3135.	3114.	3030.	2893.	2737.	2564.	2370.
2146.	1881.	1637.	1422.	1266.	1126.	999.	887.	803.	722.
642.	575.	508.	448.	403.	358.	319.	286.	252.	225.
200.	176.	158.	141.	125.	112.	100.	89.	80.	71.
63.	56.	49.	44.	40.	35.	32.	30.	27.	24.
22.	19.	16.	14.	12.	9.	7.	5.	3.	0.

HYDROGRAPH AT STATION 100

DA MON	HRMN	RRD	RAIN	LOSS	EXCESS	COMP Q	*	DA MON	HRMN	RRD	RAIN	LOSS	EXCESS	COMP Q
8 JUN	1200	1	0.00	0.00	0.00	0.	*	8 JUN	2020	51	0.00	0.00	0.00	5957.
8 JUN	1210	2	0.10	0.10	0.00	0.	*	8 JUN	2030	52	0.00	0.00	0.00	5363.
8 JUN	1220	3	0.10	0.10	0.00	0.	*	8 JUN	2040	53	0.00	0.00	0.00	4817.
8 JUN	1230	4	0.10	0.10	0.00	0.	*	8 JUN	2050	54	0.00	0.00	0.00	4312.
8 JUN	1240	5	0.10	0.10	0.00	0.	*	8 JUN	2100	55	0.00	0.00	0.00	3848.
8 JUN	1250	6	0.10	0.10	0.00	0.	*	8 JUN	2110	56	0.00	0.00	0.00	3427.
8 JUN	1300	7	0.10	0.10	0.00	0.	*	8 JUN	2120	57	0.00	0.00	0.00	3045.
8 JUN	1310	8	0.20	0.20	0.00	0.	*	8 JUN	2130	58	0.00	0.00	0.00	2704.
8 JUN	1320	9	0.20	0.20	0.00	0.	*	8 JUN	2140	59	0.00	0.00	0.00	2404.

8 JUN 1330	10	0.20	0.18	0.02	2.	*	8 JUN 2150	60	0.00	0.00	0.00	0.00	2139.
8 JUN 1340	11	0.20	0.17	0.03	6.	*	8 JUN 2200	61	0.00	0.00	0.00	0.00	1906.
8 JUN 1350	12	0.20	0.16	0.04	16.	*	8 JUN 2210	62	0.00	0.00	0.00	0.00	1699.
8 JUN 1400	13	0.20	0.14	0.06	34.	*	8 JUN 2220	63	0.00	0.00	0.00	0.00	1513.
8 JUN 1410	14	2.40	1.15	1.25	143.	*	8 JUN 2230	64	0.00	0.00	0.00	0.00	1349.
8 JUN 1420	15	1.93	0.51	1.42	420.	*	8 JUN 2240	65	0.00	0.00	0.00	0.00	1203.
8 JUN 1430	16	1.47	0.27	1.19	915.	*	8 JUN 2250	66	0.00	0.00	0.00	0.00	1071.
8 JUN 1440	17	0.93	0.14	0.79	1644.	*	8 JUN 2300	67	0.00	0.00	0.00	0.00	953.
8 JUN 1450	18	0.83	0.11	0.73	2640.	*	8 JUN 2310	68	0.00	0.00	0.00	0.00	849.
8 JUN 1500	19	0.73	0.08	0.65	3936.	*	8 JUN 2320	69	0.00	0.00	0.00	0.00	756.
8 JUN 1510	20	0.33	0.04	0.30	5547.	*	8 JUN 2330	70	0.00	0.00	0.00	0.00	675.
8 JUN 1520	21	0.33	0.03	0.30	7500.	*	8 JUN 2340	71	0.00	0.00	0.00	0.00	603.
8 JUN 1530	22	0.33	0.03	0.30	9706.	*	8 JUN 2350	72	0.00	0.00	0.00	0.00	540.
8 JUN 1540	23	0.33	0.03	0.30	12039.	*	9 JUN 0000	73	0.00	0.00	0.00	0.00	484.
8 JUN 1550	24	0.33	0.03	0.30	14334.	*	9 JUN 0010	74	0.00	0.00	0.00	0.00	433.
8 JUN 1600	25	0.33	0.03	0.31	16470.	*	9 JUN 0020	75	0.00	0.00	0.00	0.00	387.
8 JUN 1610	26	0.12	0.01	0.11	18354.	*	9 JUN 0030	76	0.00	0.00	0.00	0.00	345.
8 JUN 1620	27	0.12	0.01	0.11	19918.	*	9 JUN 0040	77	0.00	0.00	0.00	0.00	306.
8 JUN 1630	28	0.12	0.01	0.11	21160.	*	9 JUN 0050	78	0.00	0.00	0.00	0.00	270.
8 JUN 1640	29	0.12	0.01	0.11	22061.	*	9 JUN 0100	79	0.00	0.00	0.00	0.00	238.
8 JUN 1650	30	0.12	0.01	0.11	22615.	*	9 JUN 0110	80	0.00	0.00	0.00	0.00	208.
8 JUN 1700	31	0.12	0.01	0.11	22852.	*	9 JUN 0120	81	0.00	0.00	0.00	0.00	179.
8 JUN 1710	32	0.08	0.01	0.08	22804.	*	9 JUN 0130	82	0.00	0.00	0.00	0.00	153.
8 JUN 1720	33	0.08	0.01	0.08	22486.	*	9 JUN 0140	83	0.00	0.00	0.00	0.00	127.
8 JUN 1730	34	0.08	0.01	0.08	21901.	*	9 JUN 0150	84	0.00	0.00	0.00	0.00	105.
8 JUN 1740	35	0.08	0.01	0.08	21042.	*	9 JUN 0200	85	0.00	0.00	0.00	0.00	87.
8 JUN 1750	36	0.08	0.01	0.08	19982.	*	9 JUN 0210	86	0.00	0.00	0.00	0.00	72.
8 JUN 1800	37	0.08	0.01	0.08	18806.	*	9 JUN 0220	87	0.00	0.00	0.00	0.00	60.
8 JUN 1810	38	0.00	0.00	0.00	17618.	*	9 JUN 0230	88	0.00	0.00	0.00	0.00	50.
8 JUN 1820	39	0.00	0.00	0.00	16452.	*	9 JUN 0240	89	0.00	0.00	0.00	0.00	42.
8 JUN 1830	40	0.00	0.00	0.00	15321.	*	9 JUN 0250	90	0.00	0.00	0.00	0.00	35.
8 JUN 1840	41	0.00	0.00	0.00	14241.	*	9 JUN 0300	91	0.00	0.00	0.00	0.00	29.
8 JUN 1850	42	0.00	0.00	0.00	13234.	*	9 JUN 0310	92	0.00	0.00	0.00	0.00	24.
8 JUN 1900	43	0.00	0.00	0.00	12286.	*	9 JUN 0320	93	0.00	0.00	0.00	0.00	20.
8 JUN 1910	44	0.00	0.00	0.00	11365.	*	9 JUN 0330	94	0.00	0.00	0.00	0.00	16.
8 JUN 1920	45	0.00	0.00	0.00	10469.	*	9 JUN 0340	95	0.00	0.00	0.00	0.00	13.
8 JUN 1930	46	0.00	0.00	0.00	9603.	*	9 JUN 0350	96	0.00	0.00	0.00	0.00	11.
8 JUN 1940	47	0.00	0.00	0.00	8777.	*	9 JUN 0400	97	0.00	0.00	0.00	0.00	9.
8 JUN 1950	48	0.00	0.00	0.00	8001.	*	9 JUN 0410	98	0.00	0.00	0.00	0.00	7.
8 JUN 2000	49	0.00	0.00	0.00	7275.	*	9 JUN 0420	99	0.00	0.00	0.00	0.00	5.
8 JUN 2010	50	0.00	0.00	0.00	6594.	*	9 JUN 0430	100	0.00	0.00	0.00	0.00	4.

TOTAL RAINFALL 13.30, TOTAL LOSS 4.20, TOTAL EXCESS 9.10

PEAK FLOW TIME MAXIMUM AVERAGE FLOW
 (CFS) (HR) 6-HR 24-HR 72-HR 16.50-HR
 22852. 5.00 13754. 5408. 5408. 5408.
 (INCHES) 8.419 9.103 9.103 9.103
 (AC-FT) 6820. 7375. 7375. 7375.

CUMULATIVE AREA 15.19 SQ MI

HYDROGRAPH AT STATION 100
 PLAN 1, RATI = 1.00

DA	MON	HRMN	RRD	RAIN	LOSS	EXCESS	COMP Q	DA	MON	HRMN	RRD	RAIN	LOSS	EXCESS	COMP Q
8 JUN		1200	1	0.00	0.00	0.00	0.	8 JUN		2020	51	0.00	0.00	0.00	5957.
8 JUN		1210	2	0.10	0.10	0.00	0.	8 JUN		2030	52	0.00	0.00	0.00	5363.
8 JUN		1220	3	0.10	0.10	0.00	0.	8 JUN		2040	53	0.00	0.00	0.00	4817.
8 JUN		1230	4	0.10	0.10	0.00	0.	8 JUN		2050	54	0.00	0.00	0.00	4312.
8 JUN		1240	5	0.10	0.10	0.00	0.	8 JUN		2100	55	0.00	0.00	0.00	3848.
8 JUN		1250	6	0.10	0.10	0.00	0.	8 JUN		2110	56	0.00	0.00	0.00	3427.
8 JUN		1300	7	0.10	0.10	0.00	0.	8 JUN		2120	57	0.00	0.00	0.00	3045.
8 JUN		1310	8	0.20	0.20	0.00	0.	8 JUN		2130	58	0.00	0.00	0.00	2704.
8 JUN		1320	9	0.20	0.20	0.00	0.	8 JUN		2140	59	0.00	0.00	0.00	2404.
8 JUN		1330	10	0.20	0.18	0.02	2.	8 JUN		2150	60	0.00	0.00	0.00	2139.
8 JUN		1340	11	0.20	0.17	0.03	6.	8 JUN		2200	61	0.00	0.00	0.00	1906.
8 JUN		1350	12	0.20	0.16	0.04	16.	8 JUN		2210	62	0.00	0.00	0.00	1699.
8 JUN		1400	13	0.20	0.14	0.06	34.	8 JUN		2220	63	0.00	0.00	0.00	1513.
8 JUN		1410	14	2.40	1.15	1.25	143.	8 JUN		2230	64	0.00	0.00	0.00	1349.
8 JUN		1420	15	1.93	0.51	1.42	420.	8 JUN		2240	65	0.00	0.00	0.00	1203.
8 JUN		1430	16	1.47	0.27	1.19	915.	8 JUN		2250	66	0.00	0.00	0.00	1071.
8 JUN		1440	17	0.93	0.14	0.79	1644.	8 JUN		2300	67	0.00	0.00	0.00	953.
8 JUN		1450	18	0.83	0.11	0.73	2640.	8 JUN		2310	68	0.00	0.00	0.00	849.
8 JUN		1500	19	0.73	0.08	0.65	3936.	8 JUN		2320	69	0.00	0.00	0.00	756.
8 JUN		1510	20	0.33	0.04	0.30	5547.	8 JUN		2330	70	0.00	0.00	0.00	675.
8 JUN		1520	21	0.33	0.03	0.30	7500.	8 JUN		2340	71	0.00	0.00	0.00	603.
8 JUN		1530	22	0.33	0.03	0.30	9706.	8 JUN		2350	72	0.00	0.00	0.00	540.
8 JUN		1540	23	0.33	0.03	0.30	12039.	9 JUN		0000	73	0.00	0.00	0.00	484.
8 JUN		1550	24	0.33	0.03	0.30	14334.	9 JUN		0010	74	0.00	0.00	0.00	433.
8 JUN		1600	25	0.33	0.03	0.31	16470.	9 JUN		0020	75	0.00	0.00	0.00	387.
8 JUN		1610	26	0.12	0.01	0.11	18354.	9 JUN		0030	76	0.00	0.00	0.00	345.

8 JUN 1620	27	0.12	0.01	0.11	19918.	*	9 JUN 0040	77	0.00	0.00	0.00	306.
8 JUN 1630	28	0.12	0.01	0.11	21160.	*	9 JUN 0050	78	0.00	0.00	0.00	270.
8 JUN 1640	29	0.12	0.01	0.11	22061.	*	9 JUN 0100	79	0.00	0.00	0.00	238.
8 JUN 1650	30	0.12	0.01	0.11	22615.	*	9 JUN 0110	80	0.00	0.00	0.00	208.
8 JUN 1700	31	0.12	0.01	0.11	22852.	*	9 JUN 0120	81	0.00	0.00	0.00	179.
8 JUN 1710	32	0.08	0.01	0.08	22804.	*	9 JUN 0130	82	0.00	0.00	0.00	153.
8 JUN 1720	33	0.08	0.01	0.08	22486.	*	9 JUN 0140	83	0.00	0.00	0.00	127.
8 JUN 1730	34	0.08	0.01	0.08	21901.	*	9 JUN 0150	84	0.00	0.00	0.00	105.
8 JUN 1740	35	0.08	0.01	0.08	21042.	*	9 JUN 0200	85	0.00	0.00	0.00	87.
8 JUN 1750	36	0.08	0.01	0.08	19982.	*	9 JUN 0210	86	0.00	0.00	0.00	72.
8 JUN 1800	37	0.08	0.01	0.08	18806.	*	9 JUN 0220	87	0.00	0.00	0.00	60.
8 JUN 1810	38	0.00	0.00	0.00	17618.	*	9 JUN 0230	88	0.00	0.00	0.00	50.
8 JUN 1820	39	0.00	0.00	0.00	16452.	*	9 JUN 0240	89	0.00	0.00	0.00	42.
8 JUN 1830	40	0.00	0.00	0.00	15321.	*	9 JUN 0250	90	0.00	0.00	0.00	35.
8 JUN 1840	41	0.00	0.00	0.00	14241.	*	9 JUN 0300	91	0.00	0.00	0.00	29.
8 JUN 1850	42	0.00	0.00	0.00	13234.	*	9 JUN 0310	92	0.00	0.00	0.00	24.
8 JUN 1900	43	0.00	0.00	0.00	12286.	*	9 JUN 0320	93	0.00	0.00	0.00	20.
8 JUN 1910	44	0.00	0.00	0.00	11365.	*	9 JUN 0330	94	0.00	0.00	0.00	16.
8 JUN 1920	45	0.00	0.00	0.00	10469.	*	9 JUN 0340	95	0.00	0.00	0.00	13.
8 JUN 1930	46	0.00	0.00	0.00	9603.	*	9 JUN 0350	96	0.00	0.00	0.00	11.
8 JUN 1940	47	0.00	0.00	0.00	8777.	*	9 JUN 0400	97	0.00	0.00	0.00	9.
8 JUN 1950	48	0.00	0.00	0.00	8001.	*	9 JUN 0410	98	0.00	0.00	0.00	7.
8 JUN 2000	49	0.00	0.00	0.00	7275.	*	9 JUN 0420	99	0.00	0.00	0.00	5.
8 JUN 2010	50	0.00	0.00	0.00	6594.	*	9 JUN 0430	100	0.00	0.00	0.00	4.

TOTAL RAINFALL 13.30, TOTAL LOSS 4.20, TOTAL EXCESS 9.10

PEAK FLOW (CFS)	22852.	5.00	TIME (HR)	5.00
	(CFS)	13754.	6-HR	13754.
	(INCHES)	8.419	72-HR	5408.
	(AC-FT)	6820.	16.50-HR	5408.
				9.103
				7375.

CUMULATIVE AREA 15.19 SQ MI

81810 38.
81820 39.
81830 40.
81840 41.
81850 42.
81900 43.
81910 44.
81920 45.
81930 46.
81940 47.
81950 48.
82000 49.
82010 50.
82020 51.0.
82030 52.
82040 53.
82050 54.
82100 55.
82110 56.0.
82120 57.
82130 58.
82140 59.
82150 60.
82200 61.0.
82210 62.
82220 63.
82230 64.
82240 65.
82250 66.
82300 67.
82310 68.
82320 69.
82330 70.
82340 71.
82350 72.
90000 73.
90010 74.
90020 75.
90030 76.
90040 77.
90050 78.
90100 79.
90110 80.
90120 81.
90130 82.

90140 83
90150 84
90200 85
90210 86
90220 87
90230 88
90240 89
90250 90
90300 91
90310 92
90320 93
90330 94
90340 95
90350 96
90400 97
90410 98
90420 99
90430 100-----

HYDROGRAPH AT STATION 100
 PLAN 1, RATI 0.50

DA	MON	HRMN	RRD	RAIN	LOSS	EXCESS	COMP Q	*	DA	MON	HRMN	RRD	RAIN	LOSS	EXCESS	COMP Q
8	JUN	1200	1	0.00	0.00	0.00	0.	*	8	JUN	2020	51	0.00	0.00	0.00	2340.
8	JUN	1210	2	0.05	0.05	0.00	0.	*	8	JUN	2030	52	0.00	0.00	0.00	2110.
8	JUN	1220	3	0.05	0.05	0.00	0.	*	8	JUN	2040	53	0.00	0.00	0.00	1897.
8	JUN	1230	4	0.05	0.05	0.00	0.	*	8	JUN	2050	54	0.00	0.00	0.00	1699.
8	JUN	1240	5	0.05	0.05	0.00	0.	*	8	JUN	2100	55	0.00	0.00	0.00	1517.
8	JUN	1250	6	0.05	0.05	0.00	0.	*	8	JUN	2110	56	0.00	0.00	0.00	1351.
8	JUN	1300	7	0.05	0.05	0.00	0.	*	8	JUN	2120	57	0.00	0.00	0.00	1200.
8	JUN	1310	8	0.10	0.10	0.00	0.	*	8	JUN	2130	58	0.00	0.00	0.00	1066.
8	JUN	1320	9	0.10	0.10	0.00	0.	*	8	JUN	2140	59	0.00	0.00	0.00	947.
8	JUN	1330	10	0.10	0.10	0.00	0.	*	8	JUN	2150	60	0.00	0.00	0.00	843.
8	JUN	1340	11	0.10	0.10	0.00	0.	*	8	JUN	2200	61	0.00	0.00	0.00	751.
8	JUN	1350	12	0.10	0.10	0.00	0.	*	8	JUN	2210	62	0.00	0.00	0.00	669.
8	JUN	1400	13	0.10	0.10	0.00	0.	*	8	JUN	2220	63	0.00	0.00	0.00	596.
8	JUN	1410	14	1.20	0.95	0.25	17.	*	8	JUN	2230	64	0.00	0.00	0.00	531.
8	JUN	1420	15	0.97	0.51	0.45	78.	*	8	JUN	2240	65	0.00	0.00	0.00	474.
8	JUN	1430	16	0.73	0.30	0.43	203.	*	8	JUN	2250	66	0.00	0.00	0.00	422.
8	JUN	1440	17	0.47	0.16	0.30	401.	*	8	JUN	2300	67	0.00	0.00	0.00	376.
8	JUN	1450	18	0.42	0.13	0.29	683.	*	8	JUN	2310	68	0.00	0.00	0.00	334.
8	JUN	1500	19	0.37	0.10	0.26	1064.	*	8	JUN	2320	69	0.00	0.00	0.00	298.
8	JUN	1510	20	0.17	0.04	0.12	1550.	*	8	JUN	2330	70	0.00	0.00	0.00	265.
8	JUN	1520	21	0.17	0.04	0.12	2151.	*	8	JUN	2340	71	0.00	0.00	0.00	237.
8	JUN	1530	22	0.17	0.04	0.13	2856.	*	8	JUN	2350	72	0.00	0.00	0.00	212.
8	JUN	1540	23	0.17	0.04	0.13	3630.	*	9	JUN	0000	73	0.00	0.00	0.00	190.
8	JUN	1550	24	0.17	0.04	0.13	4424.	*	9	JUN	0010	74	0.00	0.00	0.00	170.
8	JUN	1600	25	0.17	0.04	0.13	5194.	*	9	JUN	0020	75	0.00	0.00	0.00	152.
8	JUN	1610	26	0.06	0.01	0.05	5900.	*	9	JUN	0030	76	0.00	0.00	0.00	135.
8	JUN	1620	27	0.06	0.01	0.05	6514.	*	9	JUN	0040	77	0.00	0.00	0.00	120.
8	JUN	1630	28	0.06	0.01	0.05	7025.	*	9	JUN	0050	78	0.00	0.00	0.00	107.
8	JUN	1640	29	0.06	0.01	0.05	7429.	*	9	JUN	0100	79	0.00	0.00	0.00	95.
8	JUN	1650	30	0.06	0.01	0.05	7719.	*	9	JUN	0110	80	0.00	0.00	0.00	83.
8	JUN	1700	31	0.06	0.01	0.05	7899.	*	9	JUN	0120	81	0.00	0.00	0.00	72.
8	JUN	1710	32	0.04	0.01	0.03	7976.	*	9	JUN	0130	82	0.00	0.00	0.00	62.
8	JUN	1720	33	0.04	0.01	0.03	7954.	*	9	JUN	0140	83	0.00	0.00	0.00	53.

8 JUN 1730	34	0.04	0.01	0.03	7833.	*	9 JUN 0150	84	0.00	0.00	0.00	44.
8 JUN 1740	35	0.04	0.01	0.03	7615.	*	9 JUN 0200	85	0.00	0.00	0.00	37.
8 JUN 1750	36	0.04	0.01	0.03	7314.	*	9 JUN 0210	86	0.00	0.00	0.00	31.
8 JUN 1800	37	0.04	0.01	0.03	6956.	*	9 JUN 0220	87	0.00	0.00	0.00	26.
8 JUN 1810	38	0.00	0.00	0.00	6572.	*	9 JUN 0230	88	0.00	0.00	0.00	21.
8 JUN 1820	39	0.00	0.00	0.00	6183.	*	9 JUN 0240	89	0.00	0.00	0.00	18.
8 JUN 1830	40	0.00	0.00	0.00	5796.	*	9 JUN 0250	90	0.00	0.00	0.00	15.
8 JUN 1840	41	0.00	0.00	0.00	5419.	*	9 JUN 0300	91	0.00	0.00	0.00	12.
8 JUN 1850	42	0.00	0.00	0.00	5061.	*	9 JUN 0310	92	0.00	0.00	0.00	10.
8 JUN 1900	43	0.00	0.00	0.00	4719.	*	9 JUN 0320	93	0.00	0.00	0.00	8.
8 JUN 1910	44	0.00	0.00	0.00	4384.	*	9 JUN 0330	94	0.00	0.00	0.00	7.
8 JUN 1920	45	0.00	0.00	0.00	4054.	*	9 JUN 0340	95	0.00	0.00	0.00	6.
8 JUN 1930	46	0.00	0.00	0.00	3731.	*	9 JUN 0350	96	0.00	0.00	0.00	5.
8 JUN 1940	47	0.00	0.00	0.00	3422.	*	9 JUN 0400	97	0.00	0.00	0.00	4.
8 JUN 1950	48	0.00	0.00	0.00	3127.	*	9 JUN 0410	98	0.00	0.00	0.00	3.
8 JUN 2000	49	0.00	0.00	0.00	2849.	*	9 JUN 0420	99	0.00	0.00	0.00	2.
8 JUN 2010	50	0.00	0.00	0.00	2587.	*	9 JUN 0430	100	0.00	0.00	0.00	2.

TOTAL RAINFALL 6.65, TOTAL LOSS 3.42, TOTAL EXCESS 3.23

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW	
(CFS)	(HR)	24-HR	72-HR
7976.	5.17	1918.	1918.
	(CFS)	3.229	3.229
	(INCHES)	2.981	3.229
	(AC-FT)	2415.	2616.

CUMULATIVE AREA 15.19 SQ MI

81810 38.
81820 39.
81830 40.
81840 41.
81850 42.
81900 43.
81910 44.
81920 45.
81930 46.
81940 47.
81950 48.
82000 49.
82010 50.
82020 51. 0.
82030 52.
82040 53. 0.
82050 54.
82100 55.
82110 56.
82120 57.
82130 58.
82140 59. 0.
82150 60.
82200 61.
82210 62.
82220 63.
82230 64.
82240 65.
82250 66.
82300 67.
82310 68.
82320 69.
82330 70.
82340 71.
82350 72.
90000 73.
90010 74.
90020 75.
90030 76.
90040 77.
90050 78.
90100 79.
90110 80.
90120 81. 0.
90130 82.

90140 83
90150 84
90200 85
90210 86
90220 87
90230 88
90240 89
90250 90
90300 91
90310 92
90320 93
90330 94
90340 95
90350 96
90400 97
90410 98
90420 99
90430 1000-----

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 * 150 *
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 RESERVOIR ROUTING

HYDROGRAPH ROUTING DATA

28 RS	STRAGE ROUTING	1 NUMBER OF SUBREACHES									
	NSTPS	STRR	TYPE OF INITIAL CONDITION								
	ITYP	1500.00	INITIAL CONDITION								
	RSVRIC	X	0.00	WRKING R AND D	COEFFICIENT						
29 SV	STRAGE	11.8	28.1	53.0	86.9	130.2	183.6	248.7	326.6	418.9	525.9
		649.5	788.7	942.6	1111.3	1294.7	1494.0	1709.4	1941.7	2191.6	2318.6
31 SE	ELEVATION	5429.00	5434.00	5439.00	5444.00	5449.00	5454.00	5459.00	5464.00	5469.00	5474.00
		5479.00	5484.00	5489.00	5494.00	5499.00	5504.00	5509.00	5514.00	5519.00	5521.50

33 SS

SPILLWAY	
CREL	5506.00 SPILLWAY CREST ELEVATION
SPWID	50.00 SPILLWAY WIDTH
COGM	3.80 WEIR COEFFICIENT
EXPW	1.50 EXPONENT OF HEAD

34 ST

TPP OF DAM	
TPPEL	5520.00 ELEVATION AT TPP OF DAM
DAMWID	764.00 DAM WIDTH
COGD	2.63 WEIR COEFFICIENT
EXPD	1.50 EXPONENT OF HEAD

COMPUTED OUTFLOW-ELEVATION DATA
 (EXCLUDING FLOW OVER DAM)

OUTFLOW 0.00 0.00 1.99 15.90 53.68 127.24 248.51 429.43 681.91 1017.90
 ELEVATION 5429.00 5506.00 5506.05 5506.19 5506.43 5506.77 5507.20 5507.72 5508.34 5509.06

OUTFLOW 1449.31 1988.08 2646.13 3435.40 4367.81 5455.29 6709.76 8143.17 9767.43 11594.47
 ELEVATION 5509.88 5510.78 5511.79 5512.89 5514.08 5515.38 5516.76 5518.25 5519.83 5521.50

COMPUTED STRRAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STRRAGE 11.80 28.10 53.00 86.90 130.20 183.60 248.70 326.60 418.90 525.90
 OUTFLOW 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
 ELEVATION 5429.00 5434.00 5439.00 5444.00 5449.00 5454.00 5459.00 5464.00 5469.00 5474.00

STRRAGE 649.50 788.70 942.60 1111.30 1294.70 1494.00 1580.16 1582.22 1588.41 1598.71
 OUTFLOW 0.00 0.00 0.00 0.00 0.00 0.00 0.00 1.99 15.91 53.70
 ELEVATION 5479.00 5484.00 5489.00 5494.00 5499.00 5504.00 5506.00 5506.05 5506.19 5506.43

STRRAGE 1613.14 1631.68 1654.35 1681.15 1709.40 1712.26 1750.05 1792.29 1838.96 1890.07
 OUTFLOW 127.29 248.45 429.40 681.96 987.27 1017.79 1449.31 1988.22 2646.13 3435.24
 ELEVATION 5506.77 5507.20 5507.72 5508.34 5509.00 5509.06 5509.88 5510.78 5511.79 5512.89

STRRAGE 1941.70 1945.95 2010.50 2079.83 2153.97 2191.60 2233.54 2318.60
 OUTFLOW 4299.21 4367.88 5455.22 6709.56 8143.33 8905.71 9767.50 15285.83
 ELEVATION 5514.00 5514.08 5515.38 5516.76 5518.25 5519.00 5519.83 5521.50

HYDROGRAPH AT STATION 150
 PLAN 1, RATI 1.00

DA	MON	HRMN	RRD	STRRAGE	STAGE	* DA	MON	HRMN	RRD	OUTFLOW	STRRAGE	STAGE	* DA	MON	HRMN	RRD	OUTFLOW	STRRAGE	STAGE			
8	JUN	1200	1	0.	1500.0	5504.1	*	8	JUN	1740	35	21558.	2376.9	5522.6	*	8	JUN	2320	69	1604.	1762.6	5510.1
8	JUN	1210	2	0.	1500.0	5504.1	*	8	JUN	1750	36	20642.	2369.1	5522.5	*	8	JUN	2330	70	1466.	1751.4	5509.9
8	JUN	1220	3	0.	1500.0	5504.1	*	8	JUN	1800	37	19567.	2359.7	5522.3	*	8	JUN	2340	71	1340.	1740.9	5509.7
8	JUN	1230	4	0.	1500.0	5504.1	*	8	JUN	1810	38	18424.	2349.4	5522.1	*	8	JUN	2350	72	1227.	1731.1	5509.5
8	JUN	1240	5	0.	1500.0	5504.1	*	8	JUN	1820	39	17282.	2338.7	5521.9	*	9	JUN	0000	73	1124.	1722.0	5509.3
8	JUN	1250	6	0.	1500.0	5504.1	*	8	JUN	1830	40	16168.	2327.7	5521.7	*	9	JUN	0010	74	1031.	1713.5	5509.1
8	JUN	1300	7	0.	1500.0	5504.1	*	8	JUN	1840	41	15096.	2316.6	5521.5	*	9	JUN	0020	75	943.	1705.5	5508.9
8	JUN	1310	8	0.	1500.0	5504.1	*	8	JUN	1850	42	14088.	2305.5	5521.2	*	9	JUN	0030	76	861.	1698.1	5508.7

CUMULATIVE AREA 15.19 SQ MI

STATION 150

DAHRMIN PER	(I) INFLOW, (O) OUTFLOW					(S) STRRAGE								
	0.	4000.	8000.	12000.	16000.	20000.	24000.	0.	1600.	2000.	2400.	0.	0.	0.
81200	1I							S						
81210	2I							S						
81220	3I							S						
81230	4I							S						
81240	5I							S						
81250	6I							S						
81300	7I							S						
81310	8I							S						
81320	9I							S						
81330	10I							S						
81340	11I							S						
81350	12I							S						
81400	13I							S						
81410	14I							S						
81420	150I							S						
81430	16 I							S						
81440	17 I							S						
81450	18 I							S						
81500	19 I							S						
81510	20.							S						
81520	21.	0.		I.				S						
81530	22.			I				S						
81540	23.			I				S						
81550	24.			I				S						
81600	25.			I				S						
81610	26.			I				S						
81620	27.			I				S						
81630	28.			I				S						
81640	29.			OI				S						
81650	30.			OI				S						
81700	31.			I.				S						
81710	32.			I				S						
81720	33.			I				S						
81730	34.			I				S						
81740	35.			I				S						
81750	36.			I				S						
81800	37.			I O.				S						

81810 38. I S.
81820 39.I S
81830 40. I S
81840 41. I S
81850 42. I S
81900 43.I S
81910 44. I S
81920 45. I S
81930 46. I S
81940 47. I S
81950 48. I S
82000 49. I S
82010 50. I S
82020 51.I. S
82030 52. I O. S
82040 53. I S
82050 54.I S
82100 55. I S
82110 56. I. S
82120 57. I S
82130 58. I S
82140 59. I S
82150 60. I O. S
82200 61.I. S
82210 62. I S
82220 63. I S
82230 64. I S
82240 65. I S
82250 66. I S
82300 67. I S
82310 68. I S
82320 69. I S
82330 70. I S
82340 71. IO. S
82350 72. I S
90000 73. I S
90010 74. I S
90020 75. I S
90030 76. I S
90040 77. I S
90050 78. I S
90100 79. I S
90110 80. I S
90120 81. IO. S
90130 82. I S

90140 83I S
90150 84I S
90200 85I S
90210 86I S
90220 87I S
90230 88I S
90240 89I S
90250 90I S
90300 91I0 S
90310 92I S
90320 93I S
90330 94I S
90340 95I S
90350 96I S
90400 97I S
90410 98I S
90420 99I S
90430 100I-----S

HYDROGRAPH AT STATION 150
 PLAN 1, RATI 0.50

DA	MON	HRMN	RRD	OUTFLOW	STRARGE	STAGE	DA	MON	HRMN	RRD	OUTFLOW	STRARGE	STAGE	DA	MON	HRMN	RRD	OUTFLOW	STRARGE	STAGE		
8	JUN	1200	1	0.	1500.0	5504.1	*	8	JUN	1740	35	7043.	2097.5	5517.1	*	8	JUN	2320	69	766.	1689.3	5508.5
8	JUN	1210	2	0.	1500.0	5504.1	*	8	JUN	1750	36	7141.	2102.6	5517.2	*	8	JUN	2330	70	701.	1683.1	5508.4
8	JUN	1220	3	0.	1500.0	5504.1	*	8	JUN	1800	37	7140.	2102.6	5517.2	*	8	JUN	2340	71	643.	1677.3	5508.3
8	JUN	1230	4	0.	1500.0	5504.1	*	8	JUN	1810	38	7053.	2098.0	5517.1	*	8	JUN	2350	72	590.	1671.9	5508.1
8	JUN	1240	5	0.	1500.0	5504.1	*	8	JUN	1820	39	6897.	2089.8	5517.0	*	9	JUN	0000	73	542.	1666.8	5508.0
8	JUN	1250	6	0.	1500.0	5504.1	*	8	JUN	1830	40	6689.	2078.8	5516.7	*	9	JUN	0010	74	499.	1662.2	5507.9
8	JUN	1300	7	0.	1500.0	5504.1	*	8	JUN	1840	41	6445.	2065.6	5516.5	*	9	JUN	0020	75	460.	1657.8	5507.8
8	JUN	1310	8	0.	1500.0	5504.1	*	8	JUN	1850	42	6175.	2050.9	5516.2	*	9	JUN	0030	76	424.	1653.7	5507.7
8	JUN	1320	9	0.	1500.0	5504.1	*	8	JUN	1900	43	5892.	2035.2	5515.9	*	9	JUN	0040	77	391.	1649.8	5507.6
8	JUN	1330	10	0.	1500.0	5504.1	*	8	JUN	1910	44	5600.	2018.8	5515.5	*	9	JUN	0050	78	361.	1646.2	5507.5
8	JUN	1340	11	0.	1500.0	5504.1	*	8	JUN	1920	45	5305.	2001.8	5515.2	*	9	JUN	0100	79	333.	1642.8	5507.5
8	JUN	1350	12	0.	1500.0	5504.1	*	8	JUN	1930	46	5007.	1984.5	5514.9	*	9	JUN	0110	80	308.	1639.6	5507.4
8	JUN	1400	13	0.	1500.0	5504.1	*	8	JUN	1940	47	4711.	1966.9	5514.5	*	9	JUN	0120	81	285.	1636.6	5507.3
8	JUN	1410	14	0.	1500.1	5504.1	*	8	JUN	1950	48	4419.	1949.1	5514.1	*	9	JUN	0130	82	264.	1633.8	5507.2
8	JUN	1420	15	0.	1500.8	5504.2	*	8	JUN	2000	49	4123.	1931.5	5513.8	*	9	JUN	0140	83	244.	1631.1	5507.2
8	JUN	1430	16	0.	1502.7	5504.2	*	8	JUN	2010	50	3830.	1914.1	5513.4	*	9	JUN	0150	84	226.	1628.5	5507.1
8	JUN	1440	17	0.	1506.9	5504.3	*	8	JUN	2020	51	3552.	1897.3	5513.0	*	9	JUN	0200	85	209.	1626.1	5507.1
8	JUN	1450	18	0.	1514.3	5504.5	*	8	JUN	2030	52	3288.	1880.9	5512.7	*	9	JUN	0210	86	193.	1623.7	5507.0
8	JUN	1500	19	0.	1526.4	5504.8	*	8	JUN	2040	53	3039.	1865.0	5512.3	*	9	JUN	0220	87	179.	1621.6	5507.0
8	JUN	1510	20	0.	1544.4	5505.2	*	8	JUN	2050	54	2804.	1849.5	5512.0	*	9	JUN	0230	88	166.	1619.5	5506.9
8	JUN	1520	21	0.	1569.9	5505.8	*	8	JUN	2100	55	2583.	1834.6	5511.7	*	9	JUN	0240	89	154.	1617.6	5506.9
8	JUN	1530	22	77.	1603.8	5506.5	*	8	JUN	2110	56	2376.	1820.3	5511.4	*	9	JUN	0250	90	143.	1615.8	5506.8
8	JUN	1540	23	357.	1645.7	5507.5	*	8	JUN	2120	57	2182.	1806.5	5511.1	*	9	JUN	0300	91	133.	1614.0	5506.8
8	JUN	1550	24	809.	1693.4	5508.6	*	8	JUN	2130	58	2003.	1793.4	5510.8	*	9	JUN	0310	92	123.	1612.4	5506.7
8	JUN	1600	25	1383.	1744.5	5509.8	*	8	JUN	2140	59	1837.	1780.8	5510.5	*	9	JUN	0320	93	115.	1610.9	5506.7
8	JUN	1610	26	2057.	1797.4	5510.9	*	8	JUN	2150	60	1684.	1769.0	5510.3	*	9	JUN	0330	94	107.	1609.5	5506.7
8	JUN	1620	27	2804.	1849.6	5512.0	*	8	JUN	2200	61	1543.	1757.8	5510.0	*	9	JUN	0340	95	100.	1608.2	5506.7
8	JUN	1630	28	3579.	1898.9	5513.1	*	8	JUN	2210	62	1415.	1747.2	5509.8	*	9	JUN	0350	96	93.	1606.9	5506.6
8	JUN	1640	29	4340.	1944.2	5514.1	*	8	JUN	2220	63	1298.	1737.3	5509.6	*	9	JUN	0400	97	87.	1605.7	5506.6
8	JUN	1650	30	5003.	1984.2	5514.9	*	8	JUN	2230	64	1191.	1727.9	5509.4	*	9	JUN	0410	98	81.	1604.6	5506.6
8	JUN	1700	31	5601.	2018.8	5515.5	*	8	JUN	2240	65	1093.	1719.2	5509.2	*	9	JUN	0420	99	76.	1603.6	5506.5
8	JUN	1710	32	6113.	2047.5	5516.1	*	8	JUN	2250	66	1003.	1710.9	5509.0	*	9	JUN	0430	100	71.	1602.6	5506.5
8	JUN	1720	33	6529.	2070.1	5516.6	*	8	JUN	2300	67	917.	1703.2	5508.9	*							

8 JUN 1730 34 6840. 2086.8 5516.9 * 8 JUN 2310 68 838. 1696.0 5508.7 *
*

PEAK OUTFLOW IS 7141. AT TIME 5.83 HOURS

PEAK FLOW (CFS)	TIME (HR)	6-HR	24-HR	72-HR	16.50-HR
7141.	5.83	4532.	1845.	1845.	1845.
		(INCHES)	3.105	3.105	3.105
		(AC-FT)	2516.	2516.	2516.

PEAK STRRAGE (AC-FT)	TIME (HR)	6-HR	24-HR	72-HR	16.50-HR
2103.	5.83	1951.	1731.	1731.	1731.

PEAK STAGE (FEET)	TIME (HR)	6-HR	24-HR	72-HR	16.50-HR
5517.22	5.83	5514.12	5509.32	5509.32	5509.32

CUMULATIVE AREA 15.19 SQ MI

81810 38. I S
81820 39. I 0. S
81830 40. I S
81840 41. I S
81850 42. I S
81900 43. I 0. S
81910 44. I S
81920 45. I S
81930 46. I S
81940 47. I S
81950 48. I S
82000 49. I S
82010 50. I S
82020 51. I S
82030 52. I S
82040 53. I S
82050 54. I S
82100 55. I S
82110 56. I S
82120 57. I S
82130 58. I S
82140 59. I S
82150 60. I S
82200 61. I 0. S
82210 62. I S
82220 63. I S
82230 64. I S
82240 65. I S
82250 66. I S
82300 67. I 0. S
82310 68. I S
82320 69. I S
82330 70. I S
82340 71. I S
82350 72. I S
90000 73. I S
90010 74. I S
90020 75. I S
90030 76. I S
90040 77. I S
90050 78. I S
90100 79. I S
90110 80. I S
90120 81. I 0. S
90130 82. I S

PEAK FLOW AND STAGE (END-OFFPERIOD) SUMMARY FRR MULTIPLE PLANRATI ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
 TIME T PEAK IN HOURS

RATIOS APPLIED T PRECIPITATION

RATI 1 RATI 2
 1.00 0.50

HYDROGRAPH AT 100 15.19 1 FLOW 22852. 7976.
 TIME 5.00 5.17

ROUTED T 150 15.19 1 FLOW 22813. 7141.
 TIME 5.17 5.83

** PEAK STAGES IN FEET **

1 STAGE 5522.85 5517.22
 TIME 5.17 5.83

SUMMARY OF DAM OVERTPPPINGBREACH ANALYSIS FRR STATION 150
 (PEAKS SHOWN ARE FRR INTERNAL TIME STEP USED DURING BREACH FRMATION)

PLAN 1

ELEVATION	5504.14	INITIAL VALUE	5506.00	SPILLWAY CREST	TPP OF DAM
STRAGE	1500.		1580.		5520.00
OUTFLOW	0.		0.		2242.
					9953.

RATI OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STRAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TPP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	5522.85	2.85	2387.	22813.	3.67	5.17	0.00
0.50	5517.22	0.00	2103.	7141.	0.00	5.83	0.00

*** NRRMAL END OF HEC-1 ***

APPENDIX D

This appendix contains the hydrologic analysis printout for Upper Dry Valley Reservoir.

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*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
* MAY 1991 *
* VERSION 4.0.1E *
* Lahey F77L-EM/32 version 5.01 *
* Dodson & Associates, Inc. *
* RUN DATE 06/15/93 TIME 15:53:07 *
*****

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```

*****
*
* U.S. ARMY CORPS OF ENGINEERS *
* HYDROLOGIC ENGINEERING CENTER *
* 609 SECOND STREET *
* DAVIS, CALIFORNIA 95616 *
* (916) 551-1748 *
*
*****

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X X XXXXXX XXXX X
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X X XXXXXX XXXX XXX

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THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES RRTIMP AND RRTIRR HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.

THE DEFINITION OF -AWSKK ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FRTRAN77 VERSION

NEW PPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGRITHM


```

*****
*
* U.S. ARMY CORPS OF ENGINEERS
* HYDROLOGIC ENGINEERING CENTER
* 609 SECOND STREET
* DAVIS, CALIFORNIA 95616
* (916) 551-1748
*
*****

```

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*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* MAY 1991
* VERSION 4.0.1E
* Lahey F77L-EM/32 version 5.01
* Dodson & Associates, Inc.
* RUN DATE 06/15/93 TIME 15:53:07
*
*****

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DRY VALLEY RESERVOIR
PMP AND 122 PMP STRRM CALCULATIONS
HMR NO. 49 PRECIPITATIONS
HMR NO. 5 (U.S. WEATHER BUREAU) DISTRIBUTIONS

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6 I OUTPUT CONTROL VARIABLES
IPRNT 0 PRINT CONTROL
IPLOT 2 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE

```

```

8 IN TIME DATA FRR INPUT TIME SERIES
JXWIN 15 TIME INTERVAL IN MINUTES
JXDATE 8JUN93 STARTING DATE
JXTIME 1200 STARTING TIME

```

```

IT HYDROGRAPH TIME DATA
NMIN 10 MINUTES IN COMPUTATION INTERVAL
IDATE 8JUN93 STARTING DATE
ITIME 1200 STARTING TIME
NQ 100 NUMBER OF HYDROGRAPH RR DINATES
NDDATE 9JUN93 ENDING DATE
NDTIME 0430 ENDING TIME
ICENT 19 CENTURY MARK

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COMPUTATION INTERVAL 0.17 HOURS
TOTAL TIME BASE 16.50 HOURS

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ENGLISH UNITS
DRAINAGE AREA SQUARE MILES
PRECIPITATION DEPTH INCHES

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LENGTH, ELEVATION FEET
 FLOW CUBIC FEET PER SECOND
 STRRAGE VOLUME ACRE- FEET
 SURFACE AREA ACRES
 TEMPERATURE DEGREES FAHRENHEIT

JP MULTIPPLAN PPTION
 NPLAN 1 NUMBER OF PLANS

JR MULTIRRATI PPTION
 RATIOS OF PRECIPITATION
 1.00 0.50

*** **

 * *
 * 100 *
 * *

 TOTAL FLOW T DAM

SUBBASIN RUNOFF DATA

17 BA SUBBASIN CHARACTERISTICS
 TAREA 21.45 SUBBASIN AREA

PRECIPITATION DATA

18 PT TOTAL STRRM STATIONS PMP
 19 PW WEIGHTS 1.00
 20 PR RECRRDDING STATIONS PMP
 21 PW WEIGHTS 1.00

22 LS SCS LOSS RATE
 STRL 0.90 INITIAL ABSTRACTION
 CRVNR 69.00 CURVE NUMBER
 RTIMP 0.00 PERCENT IMPERVIOUS AREA

23 UD SCS DIMENSIONLESS UNITGRAPH
LAG 2.72 LAG

PRECIPITATION STATION DATA

STATION	TOTAL	AVG. ANNUAL	WEIGHT
PMP	13.30	0.00	1.00

TEMPRRAL DISTRIBUTIONS

STATION	PMP,	WEIGHT	1.00	0.10	0.10	0.10	0.10	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
0.20	0.20	2.40	1.93	1.47	0.93	0.93	0.83	0.83	0.73	0.73	0.33	0.33	0.33	0.33	0.33	0.33
0.33	0.33	0.33	0.33	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08

UNIT HYDROGRAPH

84 END-OFPPERIOD RRDINATES

	66.	159.	313.	494.	691.	950.	1236.	1587.	1976.	2392.
2750.	3077.	3318.	3502.	3633.	3673.	3688.	3666.	3666.	3592.	3461.
3312.	3156.	2981.	2787.	2568.	2317.	2056.	1837.	1642.	1489.	
1350.	1219.	1109.	1009.	929.	849.	769.	702.	636.	571.	
517.	474.	430.	388.	355.	322.	290.	264.	240.	216.	
195.	179.	162.	146.	134.	122.	110.	101.	92.	83.	
75.	69.	62.	55.	51.	47.	42.	39.	36.	34.	
31.	28.	26.	23.	21.	18.	16.	14.	11.	9.	
7.	5.	3.	0.							

HYDROGRAPH AT STATION 100

DA	MON	HRMN	RRD	RAIN	LOSS	EXCESS	COMP	Q	DA	MON	HRMN	RRD	RAIN	LOSS	EXCESS	COMP	Q
8	JUN	1200	1	0.00	0.00	0.00	0.	0.	8	JUN	2020	51	0.00	0.00	0.00	11678.	
8	JUN	1210	2	0.10	0.10	0.00	0.	0.	8	JUN	2030	52	0.00	0.00	0.00	10764.	
8	JUN	1220	3	0.10	0.10	0.00	0.	0.	8	JUN	2040	53	0.00	0.00	0.00	9896.	
8	JUN	1230	4	0.10	0.10	0.00	0.	0.	8	JUN	2050	54	0.00	0.00	0.00	9075.	
8	JUN	1240	5	0.10	0.10	0.00	0.	0.	8	JUN	2100	55	0.00	0.00	0.00	8306.	
8	JUN	1250	6	0.10	0.10	0.00	0.	0.	8	JUN	2110	56	0.00	0.00	0.00	7591.	
8	JUN	1300	7	0.10	0.10	0.00	0.	0.	8	JUN	2120	57	0.00	0.00	0.00	6925.	

8 JUN 1310	8	0.20	0.20	0.20	0.00	0.	*	8 JUN 2130	58	0.00	0.00	0.00	6310.
8 JUN 1320	9	0.20	0.20	0.20	0.00	0.	*	8 JUN 2140	59	0.00	0.00	0.00	5744.
8 JUN 1330	10	0.20	0.18	0.02	0.02	1.	*	8 JUN 2150	60	0.00	0.00	0.00	5215.
8 JUN 1340	11	0.20	0.17	0.03	0.03	5.	*	8 JUN 2200	61	0.00	0.00	0.00	4727.
8 JUN 1350	12	0.20	0.16	0.04	0.04	14.	*	8 JUN 2210	62	0.00	0.00	0.00	4282.
8 JUN 1400	13	0.20	0.14	0.06	0.06	30.	*	8 JUN 2220	63	0.00	0.00	0.00	3878.
8 JUN 1410	14	2.40	1.15	1.25	1.25	134.	*	8 JUN 2230	64	0.00	0.00	0.00	3512.
8 JUN 1420	15	1.93	0.51	1.42	1.42	372.	*	8 JUN 2240	65	0.00	0.00	0.00	3186.
8 JUN 1430	16	1.47	0.27	1.19	1.19	807.	*	8 JUN 2250	66	0.00	0.00	0.00	2894.
8 JUN 1440	17	0.93	0.14	0.79	1452.	*	*	8 JUN 2300	67	0.00	0.00	0.00	2627.
8 JUN 1450	18	0.83	0.11	0.73	2306.	*	*	8 JUN 2310	68	0.00	0.00	0.00	2386.
8 JUN 1500	19	0.73	0.08	0.65	3410.	*	*	8 JUN 2320	69	0.00	0.00	0.00	2169.
8 JUN 1510	20	0.33	0.04	0.30	4763.	*	*	8 JUN 2330	70	0.00	0.00	0.00	1970.
8 JUN 1520	21	0.33	0.03	0.30	6409.	*	*	8 JUN 2340	71	0.00	0.00	0.00	1790.
8 JUN 1530	22	0.33	0.03	0.30	8348.	*	*	8 JUN 2350	72	0.00	0.00	0.00	1626.
8 JUN 1540	23	0.33	0.03	0.30	10575.	*	*	9 JUN 0000	73	0.00	0.00	0.00	1477.
8 JUN 1550	24	0.33	0.03	0.30	12976.	*	*	9 JUN 0010	74	0.00	0.00	0.00	1340.
8 JUN 1600	25	0.33	0.03	0.31	15451.	*	*	9 JUN 0020	75	0.00	0.00	0.00	1216.
8 JUN 1610	26	0.12	0.01	0.11	17862.	*	*	9 JUN 0030	76	0.00	0.00	0.00	1104.
8 JUN 1620	27	0.12	0.01	0.11	20120.	*	*	9 JUN 0040	77	0.00	0.00	0.00	1002.
8 JUN 1630	28	0.12	0.01	0.11	22159.	*	*	9 JUN 0050	78	0.00	0.00	0.00	909.
8 JUN 1640	29	0.12	0.01	0.11	23896.	*	*	9 JUN 0100	79	0.00	0.00	0.00	826.
8 JUN 1650	30	0.12	0.01	0.11	25346.	*	*	9 JUN 0110	80	0.00	0.00	0.00	750.
8 JUN 1700	31	0.12	0.01	0.11	26508.	*	*	9 JUN 0120	81	0.00	0.00	0.00	682.
8 JUN 1710	32	0.08	0.01	0.08	27387.	*	*	9 JUN 0130	82	0.00	0.00	0.00	621.
8 JUN 1720	33	0.08	0.01	0.08	27940.	*	*	9 JUN 0140	83	0.00	0.00	0.00	567.
8 JUN 1730	34	0.08	0.01	0.08	28177.	*	*	9 JUN 0150	84	0.00	0.00	0.00	518.
8 JUN 1740	35	0.08	0.01	0.08	28150.	*	*	9 JUN 0200	85	0.00	0.00	0.00	474.
8 JUN 1750	36	0.08	0.01	0.08	27887.	*	*	9 JUN 0210	86	0.00	0.00	0.00	432.
8 JUN 1800	37	0.08	0.01	0.08	27395.	*	*	9 JUN 0220	87	0.00	0.00	0.00	394.
8 JUN 1810	38	0.00	0.00	0.00	26682.	*	*	9 JUN 0230	88	0.00	0.00	0.00	358.
8 JUN 1820	39	0.00	0.00	0.00	25749.	*	*	9 JUN 0240	89	0.00	0.00	0.00	325.
8 JUN 1830	40	0.00	0.00	0.00	24606.	*	*	9 JUN 0250	90	0.00	0.00	0.00	293.
8 JUN 1840	41	0.00	0.00	0.00	23338.	*	*	9 JUN 0300	91	0.00	0.00	0.00	264.
8 JUN 1850	42	0.00	0.00	0.00	22014.	*	*	9 JUN 0310	92	0.00	0.00	0.00	237.
8 JUN 1900	43	0.00	0.00	0.00	20696.	*	*	9 JUN 0320	93	0.00	0.00	0.00	211.
8 JUN 1910	44	0.00	0.00	0.00	19410.	*	*	9 JUN 0330	94	0.00	0.00	0.00	186.
8 JUN 1920	45	0.00	0.00	0.00	18167.	*	*	9 JUN 0340	95	0.00	0.00	0.00	162.
8 JUN 1930	46	0.00	0.00	0.00	16974.	*	*	9 JUN 0350	96	0.00	0.00	0.00	138.
8 JUN 1940	47	0.00	0.00	0.00	15821.	*	*	9 JUN 0400	97	0.00	0.00	0.00	116.
8 JUN 1950	48	0.00	0.00	0.00	14724.	*	*	9 JUN 0410	98	0.00	0.00	0.00	96.
8 JUN 2000	49	0.00	0.00	0.00	13666.	*	*	9 JUN 0420	99	0.00	0.00	0.00	80.
8 JUN 2010	50	0.00	0.00	0.00	12645.	*	*	9 JUN 0430	100	0.00	0.00	0.00	67.

TOTAL RAINFALL 13.30, TOTAL LOSS 4.20, TOTAL EXCESS 9.10

PEAK FLOW (CFS)	TIME (HR)	6-HR	24-HR	72-HR	16.50-HR
28177.	5.50	18573.	7634.	7634.	7634.
(CFS)		8.051	9.099	9.099	9.099
(INCHES)		9210.	10410.	10410.	10410.
(AC-FT)					

CUMULATIVE AREA 21.45 SQ MI

HYDROGRAPH AT STATION 100
PLAN 1, RATIO 1.00

DA	MON	HRMN	RRD	RAIN	LOSS	EXCESS	COMP Q	DA	MON	HRMN	RRD	RAIN	LOSS	EXCESS	COMP Q
8	JUN	1200	1	0.00	0.00	0.00	0.	8	JUN	2020	51	0.00	0.00	0.00	11678.
8	JUN	1210	2	0.10	0.10	0.00	0.	8	JUN	2030	52	0.00	0.00	0.00	10764.
8	JUN	1220	3	0.10	0.10	0.00	0.	8	JUN	2040	53	0.00	0.00	0.00	9896.
8	JUN	1230	4	0.10	0.10	0.00	0.	8	JUN	2050	54	0.00	0.00	0.00	9075.
8	JUN	1240	5	0.10	0.10	0.00	0.	8	JUN	2100	55	0.00	0.00	0.00	8306.
8	JUN	1250	6	0.10	0.10	0.00	0.	8	JUN	2110	56	0.00	0.00	0.00	7591.
8	JUN	1300	7	0.10	0.10	0.00	0.	8	JUN	2120	57	0.00	0.00	0.00	6925.
8	JUN	1310	8	0.20	0.20	0.00	0.	8	JUN	2130	58	0.00	0.00	0.00	6310.
8	JUN	1320	9	0.20	0.20	0.00	0.	8	JUN	2140	59	0.00	0.00	0.00	5744.
8	JUN	1330	10	0.20	0.18	0.02	1.	8	JUN	2150	60	0.00	0.00	0.00	5215.
8	JUN	1340	11	0.20	0.17	0.03	5.	8	JUN	2200	61	0.00	0.00	0.00	4727.
8	JUN	1350	12	0.20	0.16	0.04	14.	8	JUN	2210	62	0.00	0.00	0.00	4282.
8	JUN	1400	13	0.20	0.14	0.06	30.	8	JUN	2220	63	0.00	0.00	0.00	3878.
8	JUN	1410	14	2.40	1.15	1.25	134.	8	JUN	2230	64	0.00	0.00	0.00	3512.
8	JUN	1420	15	1.93	0.51	1.42	372.	8	JUN	2240	65	0.00	0.00	0.00	3186.
8	JUN	1430	16	1.47	0.27	1.19	807.	8	JUN	2250	66	0.00	0.00	0.00	2894.
8	JUN	1440	17	0.93	0.14	0.79	1452.	8	JUN	2300	67	0.00	0.00	0.00	2627.
8	JUN	1450	18	0.83	0.11	0.73	2306.	8	JUN	2310	68	0.00	0.00	0.00	2386.
8	JUN	1500	19	0.73	0.08	0.65	3410.	8	JUN	2320	69	0.00	0.00	0.00	2169.
8	JUN	1510	20	0.33	0.04	0.30	4763.	8	JUN	2330	70	0.00	0.00	0.00	1970.
8	JUN	1520	21	0.33	0.03	0.30	6409.	8	JUN	2340	71	0.00	0.00	0.00	1790.
8	JUN	1530	22	0.33	0.03	0.30	8348.	8	JUN	2350	72	0.00	0.00	0.00	1626.
8	JUN	1540	23	0.33	0.03	0.30	10575.	9	JUN	0000	73	0.00	0.00	0.00	1477.
8	JUN	1550	24	0.33	0.03	0.30	12976.	9	JUN	0010	74	0.00	0.00	0.00	1340.

8 JUN 1600	25	0.33	0.03	0.31	15451.	*	9 JUN 0020	75	0.00	0.00	0.00	1216.
8 JUN 1610	26	0.12	0.01	0.11	17862.	*	9 JUN 0030	76	0.00	0.00	0.00	1104.
8 JUN 1620	27	0.12	0.01	0.11	20120.	*	9 JUN 0040	77	0.00	0.00	0.00	1002.
8 JUN 1630	28	0.12	0.01	0.11	22159.	*	9 JUN 0050	78	0.00	0.00	0.00	909.
8 JUN 1640	29	0.12	0.01	0.11	23896.	*	9 JUN 0100	79	0.00	0.00	0.00	826.
8 JUN 1650	30	0.12	0.01	0.11	25346.	*	9 JUN 0110	80	0.00	0.00	0.00	750.
8 JUN 1700	31	0.12	0.01	0.11	26508.	*	9 JUN 0120	81	0.00	0.00	0.00	682.
8 JUN 1710	32	0.08	0.01	0.08	27387.	*	9 JUN 0130	82	0.00	0.00	0.00	621.
8 JUN 1720	33	0.08	0.01	0.08	27940.	*	9 JUN 0140	83	0.00	0.00	0.00	567.
8 JUN 1730	34	0.08	0.01	0.08	28177.	*	9 JUN 0150	84	0.00	0.00	0.00	518.
8 JUN 1740	35	0.08	0.01	0.08	28150.	*	9 JUN 0200	85	0.00	0.00	0.00	474.
8 JUN 1750	36	0.08	0.01	0.08	27887.	*	9 JUN 0210	86	0.00	0.00	0.00	432.
8 JUN 1800	37	0.08	0.01	0.08	27395.	*	9 JUN 0220	87	0.00	0.00	0.00	394.
8 JUN 1810	38	0.00	0.00	0.00	26682.	*	9 JUN 0230	88	0.00	0.00	0.00	358.
8 JUN 1820	39	0.00	0.00	0.00	25749.	*	9 JUN 0240	89	0.00	0.00	0.00	325.
8 JUN 1830	40	0.00	0.00	0.00	24606.	*	9 JUN 0250	90	0.00	0.00	0.00	293.
8 JUN 1840	41	0.00	0.00	0.00	23338.	*	9 JUN 0300	91	0.00	0.00	0.00	264.
8 JUN 1850	42	0.00	0.00	0.00	22014.	*	9 JUN 0310	92	0.00	0.00	0.00	237.
8 JUN 1900	43	0.00	0.00	0.00	20696.	*	9 JUN 0320	93	0.00	0.00	0.00	211.
8 JUN 1910	44	0.00	0.00	0.00	19410.	*	9 JUN 0330	94	0.00	0.00	0.00	186.
8 JUN 1920	45	0.00	0.00	0.00	18167.	*	9 JUN 0340	95	0.00	0.00	0.00	162.
8 JUN 1930	46	0.00	0.00	0.00	16974.	*	9 JUN 0350	96	0.00	0.00	0.00	138.
8 JUN 1940	47	0.00	0.00	0.00	15821.	*	9 JUN 0400	97	0.00	0.00	0.00	116.
8 JUN 1950	48	0.00	0.00	0.00	14724.	*	9 JUN 0410	98	0.00	0.00	0.00	96.
8 JUN 2000	49	0.00	0.00	0.00	13666.	*	9 JUN 0420	99	0.00	0.00	0.00	80.
8 JUN 2010	50	0.00	0.00	0.00	12645.	*	9 JUN 0430	100	0.00	0.00	0.00	67.

TOTAL RAINFALL 13.30, TOTAL LOSS 4.20, TOTAL EXCESS 9.10

PEAK FLOW (CFS)	TIME (HR)	6-HR	24-HR	72-HR	MAXIMUM AVERAGE FLOW
28177.	5.50	18573.	7634.	7634.	16.50-HR
		(CFS)	7634.	7634.	7634.
		(INCHES)	8.051	9.099	9.099
		(AC-FT)	9210.	10410.	10410.

CUMULATIVE AREA 21.45 SQ MI

81810 38.
81820 39.
81830 40.
81840 41.
81850 42.
81900 43.
81910 44.
81920 45.
81930 46.
81940 47.
81950 48.
82000 49.
82010 50.
82020 51.
82030 52.
82040 53.
82050 54.
82100 55.
82110 56.
82120 57.
82130 58.
82140 59.
82150 60.
82200 61.
82210 62.
82220 63.
82230 64.
82240 65.
82250 66.
82300 67.
82310 68.
82320 69.
82330 70.
82340 71.
82350 72.
90000 73.
90010 74.
90020 75.
90030 76.
90040 77.
90050 78.
90100 79.
90110 80.
90120 81.
90130 82.

HYDROGRAPH AT STATION 100
 PLAN 1, RATI 0.50

DA	MON	HRMN	RRD	RAIN	LOSS	EXCESS	COMP Q	*	DA	MON	HRMN	RRD	RAIN	LOSS	EXCESS	COMP Q
8	JUN	1200	1	0.00	0.00	0.00	0.	*	8	JUN	2020	51	0.00	0.00	0.00	4490.
8	JUN	1210	2	0.05	0.05	0.00	0.	*	8	JUN	2030	52	0.00	0.00	0.00	4146.
8	JUN	1220	3	0.05	0.05	0.00	0.	*	8	JUN	2040	53	0.00	0.00	0.00	3819.
8	JUN	1230	4	0.05	0.05	0.00	0.	*	8	JUN	2050	54	0.00	0.00	0.00	3507.
8	JUN	1240	5	0.05	0.05	0.00	0.	*	8	JUN	2100	55	0.00	0.00	0.00	3213.
8	JUN	1250	6	0.05	0.05	0.00	0.	*	8	JUN	2110	56	0.00	0.00	0.00	2939.
8	JUN	1300	7	0.05	0.05	0.00	0.	*	8	JUN	2120	57	0.00	0.00	0.00	2682.
8	JUN	1310	8	0.10	0.10	0.00	0.	*	8	JUN	2130	58	0.00	0.00	0.00	2445.
8	JUN	1320	9	0.10	0.10	0.00	0.	*	8	JUN	2140	59	0.00	0.00	0.00	2226.
8	JUN	1330	10	0.10	0.10	0.00	0.	*	8	JUN	2150	60	0.00	0.00	0.00	2022.
8	JUN	1340	11	0.10	0.10	0.00	0.	*	8	JUN	2200	61	0.00	0.00	0.00	1832.
8	JUN	1350	12	0.10	0.10	0.00	0.	*	8	JUN	2210	62	0.00	0.00	0.00	1659.
8	JUN	1400	13	0.10	0.10	0.00	0.	*	8	JUN	2220	63	0.00	0.00	0.00	1503.
8	JUN	1410	14	1.20	0.95	0.25	17.	*	8	JUN	2230	64	0.00	0.00	0.00	1361.
8	JUN	1420	15	0.97	0.51	0.45	70.	*	8	JUN	2240	65	0.00	0.00	0.00	1235.
8	JUN	1430	16	0.73	0.30	0.43	180.	*	8	JUN	2250	66	0.00	0.00	0.00	1122.
8	JUN	1440	17	0.47	0.16	0.30	355.	*	8	JUN	2300	67	0.00	0.00	0.00	1018.
8	JUN	1450	18	0.42	0.13	0.29	601.	*	8	JUN	2310	68	0.00	0.00	0.00	924.
8	JUN	1500	19	0.37	0.10	0.26	925.	*	8	JUN	2320	69	0.00	0.00	0.00	840.
8	JUN	1510	20	0.17	0.04	0.12	1332.	*	8	JUN	2330	70	0.00	0.00	0.00	763.
8	JUN	1520	21	0.17	0.04	0.12	1835.	*	8	JUN	2340	71	0.00	0.00	0.00	693.
8	JUN	1530	22	0.17	0.04	0.13	2438.	*	8	JUN	2350	72	0.00	0.00	0.00	630.
8	JUN	1540	23	0.17	0.04	0.13	3146.	*	9	JUN	0000	73	0.00	0.00	0.00	572.
8	JUN	1550	24	0.17	0.04	0.13	3936.	*	9	JUN	0010	74	0.00	0.00	0.00	519.
8	JUN	1600	25	0.17	0.04	0.13	4775.	*	9	JUN	0020	75	0.00	0.00	0.00	471.
8	JUN	1610	26	0.06	0.01	0.05	5620.	*	9	JUN	0030	76	0.00	0.00	0.00	428.
8	JUN	1620	27	0.06	0.01	0.05	6435.	*	9	JUN	0040	77	0.00	0.00	0.00	388.
8	JUN	1630	28	0.06	0.01	0.05	7191.	*	9	JUN	0050	78	0.00	0.00	0.00	352.
8	JUN	1640	29	0.06	0.01	0.05	7863.	*	9	JUN	0100	79	0.00	0.00	0.00	320.
8	JUN	1650	30	0.06	0.01	0.05	8444.	*	9	JUN	0110	80	0.00	0.00	0.00	290.
8	JUN	1700	31	0.06	0.01	0.05	8931.	*	9	JUN	0120	81	0.00	0.00	0.00	264.
8	JUN	1710	32	0.04	0.01	0.03	9326.	*	9	JUN	0130	82	0.00	0.00	0.00	240.
8	JUN	1720	33	0.04	0.01	0.03	9615.	*	9	JUN	0140	83	0.00	0.00	0.00	219.

8 JUN 1730	34	0.04	0.01	0.03	9792.	*	9 JUN 0150	84	0.00	0.00	0.00	200.
8 JUN 1740	35	0.04	0.01	0.03	9871.	*	9 JUN 0200	85	0.00	0.00	0.00	182.
8 JUN 1750	36	0.04	0.01	0.03	9863.	*	9 JUN 0210	86	0.00	0.00	0.00	167.
8 JUN 1800	37	0.04	0.01	0.03	9770.	*	9 JUN 0220	87	0.00	0.00	0.00	152.
8 JUN 1810	38	0.00	0.00	0.00	9597.	*	9 JUN 0230	88	0.00	0.00	0.00	138.
8 JUN 1820	39	0.00	0.00	0.00	9346.	*	9 JUN 0240	89	0.00	0.00	0.00	126.
8 JUN 1830	40	0.00	0.00	0.00	9013.	*	9 JUN 0250	90	0.00	0.00	0.00	114.
8 JUN 1840	41	0.00	0.00	0.00	8621.	*	9 JUN 0300	91	0.00	0.00	0.00	103.
8 JUN 1850	42	0.00	0.00	0.00	8193.	*	9 JUN 0310	92	0.00	0.00	0.00	93.
8 JUN 1900	43	0.00	0.00	0.00	7749.	*	9 JUN 0320	93	0.00	0.00	0.00	83.
8 JUN 1910	44	0.00	0.00	0.00	7306.	*	9 JUN 0330	94	0.00	0.00	0.00	74.
8 JUN 1920	45	0.00	0.00	0.00	6871.	*	9 JUN 0340	95	0.00	0.00	0.00	65.
8 JUN 1930	46	0.00	0.00	0.00	6446.	*	9 JUN 0350	96	0.00	0.00	0.00	56.
8 JUN 1940	47	0.00	0.00	0.00	6030.	*	9 JUN 0400	97	0.00	0.00	0.00	48.
8 JUN 1950	48	0.00	0.00	0.00	5626.	*	9 JUN 0410	98	0.00	0.00	0.00	40.
8 JUN 2000	49	0.00	0.00	0.00	5233.	*	9 JUN 0420	99	0.00	0.00	0.00	34.
8 JUN 2010	50	0.00	0.00	0.00	4853.	*	9 JUN 0430	100	0.00	0.00	0.00	28.

TOTAL RAINFALL 6.65, TOTAL LOSS 3.42, TOTAL EXCESS 3.23

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW		
(CFS)	(HR)	6-HR	24-HR	72-HR
9871.	5.67	6575.	2707.	2707.
		(CFS)	(INCHES)	(AC-FT)
		2.850	3.227	3.227
		3260.	3692.	3692.

CUMULATIVE AREA 21.45 SQ MI

81810 38.
81820 39.
81830 40.
81840 41.0.
81850 42.
81900 43.0.
81910 44.
81920 45.
81930 46.
81940 47.
81950 48.
82000 49.
82010 50.
82020 51.
82030 52.
82040 53.0.
82050 54.
82100 55.
82110 56.
82120 57.
82130 58.
82140 59.
82150 60.
82200 61.0.
82210 62.
82220 63.
82230 64.
82240 65.
82250 66.
82300 67.
82310 68.
82320 69.
82330 70.
82340 71.0.
82350 72.
90000 73.
90010 74.
90020 75.
90030 76.
90040 77.
90050 78.
90100 79.
90110 80.
90120 81.0.
90130 82.

90140 83.
90150 84.
90200 85.
90210 86.
90220 87.
90230 88.
90240 89.
90250 90.
90300 91.0.
90310 92.
90320 93.
90330 94.
90340 95.
90350 96.
90400 97.
90410 98.
90420 99.
90430 1000-----

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 * 150 *
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 RESERVOIR ROUTING

HYDROGRAPH ROUTING DATA

28 RS	STRAGE ROUTING	1 NUMBER OF SUBREACHES									
	NSTPS	STRR	TYPE OF INITIAL CONDITION								
	ITYP	1500.00	INITIAL CONDITION								
	RSVRIC	X	0.00	WRKING R AND D COEFFICIENT							
29 SV	STRAGE	0.0	0.4	3.2	14.5	40.6	81.2	139.0	220.5	334.1	489.4
		689.0	934.2	1219.4	1549.4	2056.1	2491.5	2968.6	3501.2	4098.5	4765.6
31 SE	ELEVATION	5119.00	5124.00	5129.00	5134.00	5139.00	5144.00	5149.00	5154.00	5159.00	5164.00
		5169.00	5174.00	5179.00	5184.00	5191.00	5196.00	5201.00	5206.00	5211.00	5216.00

33 SS
 SPILLWAY
 CREL 5186.00 SPILLWAY CREST ELEVATION
 SPWID 75.00 SPILLWAY WIDTH
 COGW 3.80 WEIR COEFFICIENT
 EXPW 1.50 EXPONENT OF HEAD

34 ST
 TPP OF DAM
 TPPEL 5198.00 ELEVATION AT TPP OF DAM
 DAMWID 704.00 DAM WIDTH
 COGD 2.63 WEIR COEFFICIENT
 EXPD 1.50 EXPONENT OF HEAD

COMPUTED OUTFLOW-ELEVATION DATA
 (EXCLUDING FLOW OVER DAM)

OUTFLOW 0.00 0.00 8.03 64.24 216.81 513.91 1003.74 1734.45 2754.25 4111.30
 ELEVATION 5119.00 5186.00 5186.09 5186.37 5186.83 5187.48 5188.31 5189.33 5190.54 5191.93

 OUTFLOW 5853.78 8029.88 10687.77 13875.64 17641.65 22034.00 27100.86 32890.40 39450.81 46830.26
 ELEVATION 5193.50 5195.26 5197.20 5199.33 5201.65 5204.15 5206.83 5209.70 5212.76 5216.00

COMPUTED STRRAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STRRAGE 0.00 0.40 3.20 14.50 40.60 81.20 139.00 220.50 334.10 489.40
 OUTFLOW 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
 ELEVATION 5119.00 5124.00 5129.00 5134.00 5139.00 5144.00 5149.00 5154.00 5159.00 5164.00

 STRRAGE 689.00 934.20 1219.40 1549.40 1694.17 1700.89 1721.00 1754.50 1801.41 1861.74
 OUTFLOW 0.00 0.00 0.00 0.00 0.00 8.05 64.30 216.87 513.89 1003.82
 ELEVATION 5169.00 5174.00 5179.00 5184.00 5186.00 5186.09 5186.37 5186.83 5187.48 5188.31

 STRRAGE 1935.47 2022.59 2056.10 2136.72 2273.80 2427.00 2491.50 2606.35 2809.58 2968.60
 OUTFLOW 1734.58 2754.32 3186.40 4111.15 5853.78 8029.91 9012.49 10687.65 16727.02 26177.79
 ELEVATION 5189.33 5190.54 5191.00 5191.93 5193.50 5195.26 5196.00 5197.20 5199.33 5201.00

 STRRAGE 3037.62 3303.92 3501.20 3600.77 3943.63 4098.50 4333.22 4765.60
 OUTFLOW 30541.67 50257.98 67386.30 75711.37 107022.67 122409.76 144435.56 188226.30
 ELEVATION 5201.65 5204.15 5206.00 5206.83 5209.70 5211.00 5212.76 5216.00

HYDROGRAPH AT STATION 150
PLAN 1, RATI 1.00

DA	MON	HRMN	RRD	OUTFLOW	STRRAGE	STAGE	* DA	MON	HRMN	RRD	OUTFLOW	STRRAGE	STAGE									
8	JUN	1200	1	0.	1500.0	5183.3	*	8	JUN	1740	35	27925.	2996.9	5201.3	*	8	JUN	2320	69	4063.	2132.7	5191.9
8	JUN	1210	2	0.	1500.0	5183.3	*	8	JUN	1750	36	27981.	2997.8	5201.3	*	8	JUN	2330	70	3766.	2107.4	5191.6
8	JUN	1220	3	0.	1500.0	5183.3	*	8	JUN	1800	37	27778.	2994.6	5201.2	*	8	JUN	2340	71	3490.	2083.4	5191.3
8	JUN	1230	4	0.	1500.0	5183.3	*	8	JUN	1810	38	27337.	2987.5	5201.2	*	8	JUN	2350	72	3236.	2060.6	5191.1
8	JUN	1240	5	0.	1500.0	5183.3	*	8	JUN	1820	39	26676.	2976.8	5201.1	*	9	JUN	0000	73	2968.	2039.3	5190.8
8	JUN	1250	6	0.	1500.0	5183.3	*	8	JUN	1830	40	25804.	2963.1	5200.9	*	9	JUN	0010	74	2717.	2019.6	5190.5
8	JUN	1300	7	0.	1500.0	5183.3	*	8	JUN	1840	41	24656.	2945.8	5200.8	*	9	JUN	0020	75	2492.	2001.4	5190.2
8	JUN	1310	8	0.	1500.0	5183.3	*	8	JUN	1850	42	23501.	2927.9	5200.6	*	9	JUN	0030	76	2289.	1984.5	5190.0

8 JUN 1320	9	0.	1500.0	5183.3 *	8 JUN 1900	43	22241.	2907.8	5200.4 *	9 JUN 0040	77	2105.	1968.7	5189.8
8 JUN 1330	10	0.	1500.0	5183.3 *	8 JUN 1910	44	20973.	2886.9	5200.1 *	9 JUN 0050	78	1939.	1954.1	5189.6
8 JUN 1340	11	0.	1500.0	5183.3 *	8 JUN 1920	45	19743.	2865.8	5199.9 *	9 JUN 0100	79	1788.	1940.4	5189.4
8 JUN 1350	12	0.	1500.2	5183.3 *	8 JUN 1930	46	18559.	2844.6	5199.7 *	9 JUN 0110	80	1651.	1927.6	5189.2
8 JUN 1400	13	0.	1500.5	5183.3 *	8 JUN 1940	47	17424.	2823.3	5199.5 *	9 JUN 0120	81	1525.	1915.6	5189.1
8 JUN 1410	14	0.	1501.6	5183.3 *	8 JUN 1950	48	16340.	2801.8	5199.3 *	9 JUN 0130	82	1411.	1904.4	5188.9
8 JUN 1420	15	0.	1505.1	5183.3 *	8 JUN 2000	49	15312.	2780.0	5199.0 *	9 JUN 0140	83	1307.	1893.9	5188.8
8 JUN 1430	16	0.	1513.2	5183.5 *	8 JUN 2010	50	14340.	2757.8	5198.8 *	9 JUN 0150	84	1211.	1884.1	5188.6
8 JUN 1440	17	0.	1528.8	5183.7 *	8 JUN 2020	51	13405.	2734.2	5198.5 *	9 JUN 0200	85	1124.	1874.9	5188.5
8 JUN 1450	18	0.	1554.7	5184.1 *	8 JUN 2030	52	12567.	2710.0	5198.3 *	9 JUN 0210	86	1044.	1866.2	5188.4
8 JUN 1500	19	0.	1594.0	5184.6 *	8 JUN 2040	53	11877.	2684.0	5198.0 *	9 JUN 0220	87	970.	1858.0	5188.3
8 JUN 1510	20	0.	1650.3	5185.4 *	8 JUN 2050	54	11414.	2654.2	5197.7 *	9 JUN 0230	88	903.	1850.3	5188.2
8 JUN 1520	21	86.	1726.7	5186.4 *	8 JUN 2100	55	10897.	2620.3	5197.3 *	9 JUN 0240	89	840.	1843.0	5188.1
8 JUN 1530	22	677.	1823.0	5187.8 *	8 JUN 2110	56	10347.	2583.5	5197.0 *	9 JUN 0250	90	782.	1836.1	5188.0
8 JUN 1540	23	1748.	1936.7	5189.4 *	8 JUN 2120	57	9780.	2544.9	5196.6 *	9 JUN 0300	91	729.	1829.5	5187.9
8 JUN 1550	24	3272.	2063.8	5191.1 *	8 JUN 2130	58	9210.	2505.4	5196.1 *	9 JUN 0310	92	679.	1823.2	5187.8
8 JUN 1600	25	4936.	2203.6	5192.7 *	8 JUN 2140	59	8615.	2465.7	5195.7 *	9 JUN 0320	93	632.	1817.3	5187.7
8 JUN 1610	26	6934.	2351.9	5194.4 *	8 JUN 2150	60	8024.	2426.6	5195.3 *	9 JUN 0330	94	589.	1811.6	5187.6
8 JUN 1620	27	9168.	2502.4	5196.1 *	8 JUN 2200	61	7461.	2388.5	5194.8 *	9 JUN 0340	95	549.	1806.2	5187.5
8 JUN 1630	28	11386.	2652.4	5197.7 *	8 JUN 2210	62	6929.	2351.5	5194.4 *	9 JUN 0350	96	511.	1800.9	5187.5
8 JUN 1640	29	15494.	2784.0	5199.1 *	8 JUN 2220	63	6428.	2315.8	5194.0 *	9 JUN 0400	97	475.	1795.9	5187.4
8 JUN 1650	30	20345.	2876.3	5200.0 *	8 JUN 2230	64	5958.	2281.5	5193.6 *	9 JUN 0410	98	441.	1791.1	5187.3
8 JUN 1700	31	23662.	2930.4	5200.6 *	8 JUN 2240	65	5519.	2248.7	5193.2 *	9 JUN 0420	99	410.	1786.4	5187.3
8 JUN 1710	32	25666.	2961.0	5200.9 *	8 JUN 2250	66	5112.	2217.4	5192.9 *	9 JUN 0430	100	381.	1782.0	5187.2
8 JUN 1720	33	26852.	2979.6	5201.1 *	8 JUN 2300	67	4735.	2187.7	5192.5 *					
8 JUN 1730	34	27567.	2991.2	5201.2 *	8 JUN 2310	68	4386.	2159.5	5192.2 *					

PEAK OUTFLOW IS 27981. AT TIME 5.83 HOURS

PEAK FLOW (CFS)	TIME (HR)	MAXIMUM AVERAGE FLOW		
		6-HR	24-HR	72-HR
27981.	5.83	17702.	7433.	7433.
		(CFS)	(CFS)	(CFS)
		7.673	8.860	8.860
		(INCHES)	(INCHES)	(INCHES)
		8778.	10136.	10136.
		(AC-FT)	(AC-FT)	(AC-FT)

PEAK STRAGE (AC-FT)	TIME (HR)	MAXIMUM AVERAGE STRRAGE	
		6-HR	72-HR
2998.	5.83	2772.	2172.
		(AC-FT)	(AC-FT)

PEAK STAGE (FEET)	TIME (HR)	MAXIMUM AVERAGE STAGE	
		6-HR	72-HR
5201.27	5.83	5198.93	5191.83
		(FEET)	(FEET)

CUMULATIVE AREA = 21.45 SQ MI

HYDROGRAPH AT STATION 150
PLAN 1, RATI 0.50

DA	MON	HRMN	RRD	OUTFLOW	STRARGE	STAGE	* DA	MON	HRMN	RRD	OUTFLOW	STRARGE	STAGE	* DA	MON	HRMN	RRD	OUTFLOW	STRARGE	STAGE
8 JUN	1200	1	0.	1500.0	5183.3	*	8 JUN	1740	35	7082.	2362.2	5194.5	*	8 JUN	2320	69	1763.	1938.1	5189.4	
8 JUN	1210	2	0.	1500.0	5183.3	*	8 JUN	1750	36	7587.	2397.1	5194.9	*	8 JUN	2330	70	1631.	1925.8	5189.2	
8 JUN	1220	3	0.	1500.0	5183.3	*	8 JUN	1800	37	7999.	2424.9	5195.2	*	8 JUN	2340	71	1511.	1914.2	5189.0	
8 JUN	1230	4	0.	1500.0	5183.3	*	8 JUN	1810	38	8314.	2445.9	5195.5	*	8 JUN	2350	72	1400.	1903.3	5188.9	
8 JUN	1240	5	0.	1500.0	5183.3	*	8 JUN	1820	39	8533.	2460.3	5195.6	*	9 JUN	0000	73	1298.	1893.0	5188.7	
8 JUN	1250	6	0.	1500.0	5183.3	*	8 JUN	1830	40	8653.	2468.2	5195.7	*	9 JUN	0010	74	1204.	1883.3	5188.6	
8 JUN	1300	7	0.	1500.0	5183.3	*	8 JUN	1840	41	8683.	2470.2	5195.8	*	9 JUN	0020	75	1118.	1874.2	5188.5	
8 JUN	1310	8	0.	1500.0	5183.3	*	8 JUN	1850	42	8633.	2466.9	5195.7	*	9 JUN	0030	76	1038.	1865.5	5188.4	
8 JUN	1320	9	0.	1500.0	5183.3	*	8 JUN	1900	43	8512.	2458.9	5195.6	*	9 JUN	0040	77	965.	1857.4	5188.3	
8 JUN	1330	10	0.	1500.0	5183.3	*	8 JUN	1910	44	8330.	2446.9	5195.5	*	9 JUN	0050	78	897.	1849.7	5188.1	
8 JUN	1340	11	0.	1500.0	5183.3	*	8 JUN	1920	45	8097.	2431.5	5195.3	*	9 JUN	0100	79	835.	1842.4	5188.0	
8 JUN	1350	12	0.	1500.0	5183.3	*	8 JUN	1930	46	7829.	2413.5	5195.1	*	9 JUN	0110	80	777.	1835.5	5188.0	
8 JUN	1400	13	0.	1500.0	5183.3	*	8 JUN	1940	47	7537.	2393.7	5194.9	*	9 JUN	0120	81	724.	1828.9	5187.9	
8 JUN	1410	14	0.	1500.1	5183.3	*	8 JUN	1950	48	7227.	2372.3	5194.6	*	9 JUN	0130	82	675.	1822.8	5187.8	
8 JUN	1420	15	0.	1500.7	5183.3	*	8 JUN	2000	49	6905.	2349.8	5194.4	*	9 JUN	0140	83	630.	1817.0	5187.7	
8 JUN	1430	16	0.	1502.4	5183.3	*	8 JUN	2010	50	6576.	2326.5	5194.1	*	9 JUN	0150	84	588.	1811.4	5187.6	
8 JUN	1440	17	0.	1506.1	5183.3	*	8 JUN	2020	51	6245.	2302.6	5193.8	*	9 JUN	0200	85	549.	1806.2	5187.5	
8 JUN	1450	18	0.	1512.7	5183.4	*	8 JUN	2030	52	5915.	2278.3	5193.6	*	9 JUN	0210	86	513.	1801.3	5187.5	
8 JUN	1500	19	0.	1523.2	5183.6	*	8 JUN	2040	53	5590.	2254.0	5193.3	*	9 JUN	0220	87	480.	1796.7	5187.4	
8 JUN	1510	20	0.	1538.7	5183.8	*	8 JUN	2050	54	5272.	2229.7	5193.0	*	9 JUN	0230	88	450.	1792.3	5187.4	
8 JUN	1520	21	0.	1560.5	5184.2	*	8 JUN	2100	55	4961.	2205.6	5192.7	*	9 JUN	0240	89	421.	1788.1	5187.3	
8 JUN	1530	22	0.	1590.0	5184.6	*	8 JUN	2110	56	4661.	2181.7	5192.4	*	9 JUN	0250	90	395.	1784.1	5187.2	
8 JUN	1540	23	0.	1628.4	5185.1	*	8 JUN	2120	57	4372.	2158.3	5192.2	*	9 JUN	0300	91	370.	1780.3	5187.2	
8 JUN	1550	24	0.	1677.2	5185.8	*	8 JUN	2130	58	4095.	2135.4	5191.9	*	9 JUN	0310	92	347.	1776.7	5187.1	
8 JUN	1600	25	127.	1736.3	5186.6	*	8 JUN	2140	59	3831.	2113.0	5191.7	*	9 JUN	0320	93	326.	1773.3	5187.1	
8 JUN	1610	26	530.	1803.7	5187.5	*	8 JUN	2150	60	3580.	2091.3	5191.4	*	9 JUN	0330	94	306.	1770.0	5187.0	
8 JUN	1620	27	1130.	1875.5	5188.5	*	8 JUN	2200	61	3342.	2070.2	5191.2	*	9 JUN	0340	95	287.	1766.9	5187.0	
8 JUN	1630	28	1881.	1948.9	5189.5	*	8 JUN	2210	62	3104.	2049.8	5190.9	*	9 JUN	0350	96	269.	1763.9	5187.0	
8 JUN	1640	29	2733.	2020.9	5190.5	*	8 JUN	2220	63	2855.	2030.6	5190.6	*	9 JUN	0400	97	253.	1761.0	5186.9	
8 JUN	1650	30	3564.	2089.9	5191.4	*	8 JUN	2230	64	2629.	2012.6	5190.4	*	9 JUN	0410	98	237.	1758.3	5186.9	
8 JUN	1700	31	4334.	2155.2	5192.1	*	8 JUN	2240	65	2423.	1995.7	5190.2	*	9 JUN	0420	99	223.	1755.6	5186.8	
8 JUN	1710	32	5094.	2216.0	5192.8	*	8 JUN	2250	66	2235.	1979.9	5189.9	*	9 JUN	0430	100	209.	1753.1	5186.8	
8 JUN	1720	33	5821.	2271.3	5193.5	*	8 JUN	2300	67	2064.	1965.1	5189.7	*							

8 JUN 1730 34 6489. 2320.2 5194.0 * 8 JUN 2310 68 1907. 1951.2 5189.6 *
 * * * * *

PEAK OUTFLOW IS 8683. AT TIME 6.67 HOURS

PEAK FLOW (CFS)	TIME (HR)	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	16.50-HR
8683.	6.67	5967.	2524.	2524.	2524.
(INCHES)		2.587	3.008	3.008	3.008
(AC-FT)		2959.	3442.	3442.	3442.

PEAK STRAGE (AC-FT)	TIME (HR)	MAXIMUM AVERAGE STRAGE			
		6-HR	24-HR	72-HR	16.50-HR
2470.	6.67	2274.	1923.	1923.	1923.

PEAK STAGE (FEET)	TIME (HR)	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	16.50-HR
5195.75	6.67	5193.49	5188.96	5188.96	5188.96

CUMULATIVE AREA = 21.45 SQ MI

90140 83. I S
90150 84. I S
90200 85. I S
90210 86. I S
90220 87. I S
90230 88. I S
90240 89. I S
90250 90. I S
90300 91. I S
90310 92I S
90320 93I S
90330 94I S
90340 95I S
90350 96I S
90400 97I S
90410 98I S
90420 99I S
90430 100I S

PEAK FLOW AND STAGE (END-OFFPERIOD) SUMMARY FRR MULTIPLE PLANRATI ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
 TIME T PEAK IN HOURS

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED T		PRECIPITATION
				RATI 1	RATI 2	
				1.00	0.50	

HYDROGRAPH AT	100	21.45	1	FLOW	28177.	9871.
				TIME	5.50	5.67

ROUTED T	150	21.45	1	FLOW	27981.	8683.
				TIME	5.83	6.67

** PEAK STAGES IN FEET **

1	STAGE	5201.27	5195.75
	TIME	5.83	6.67

SUMMARY OF DAM OVERTPPPINGBREACH ANALYSIS FRR STATION 150
 (PEAKS SHOWN ARE FRR INTERNAL TIME STEP USED DURING BREACH FRMATION)

PLAN 1

ELEVATION	5183.25	INITIAL VALUE	5186.00	SPILLWAY CREST	5198.00	TPP OF DAM
STRAGE	1500.		1694.		2682.	
OUTFLOW	0.		0.		11847.	

RATI OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STRAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TPP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	5201.27	3.27	2998.	27981.	4.17	5.83	0.00
0.50	5195.75	0.00	2470.	8683.	0.00	6.67	0.00

*** NRRMAL END OF HEC-1 ***

APPENDIX E

Photographs.



LA CASAS SPRING



WINNEMUCCA RANCH



**VIEW LOOKING TOWARDS
BLACK CANYON RESERVOIR SITE**



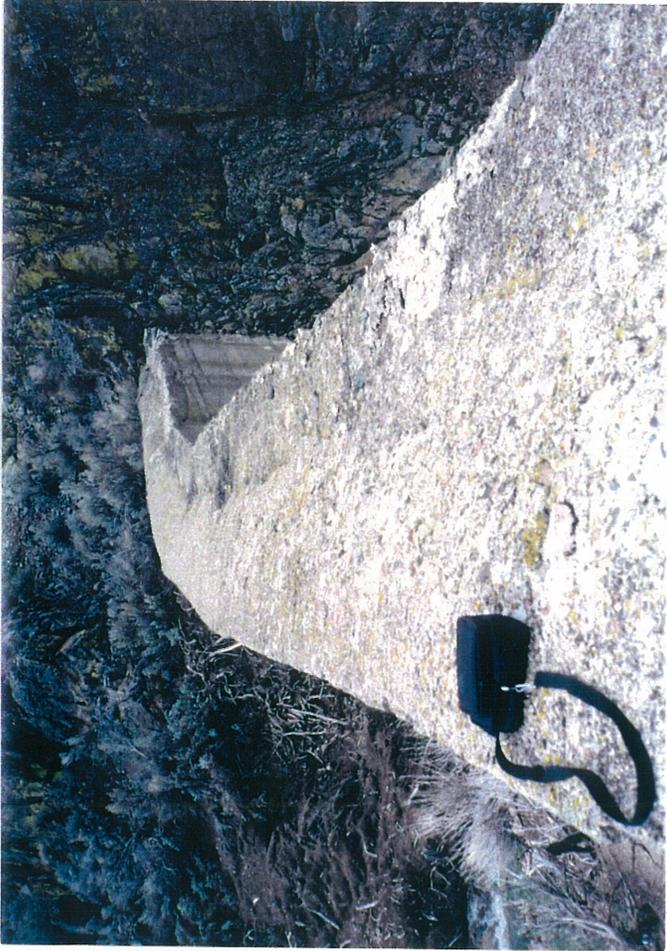
DRY VALLEY



DRY VALLEY RESERVOIR LOCATION



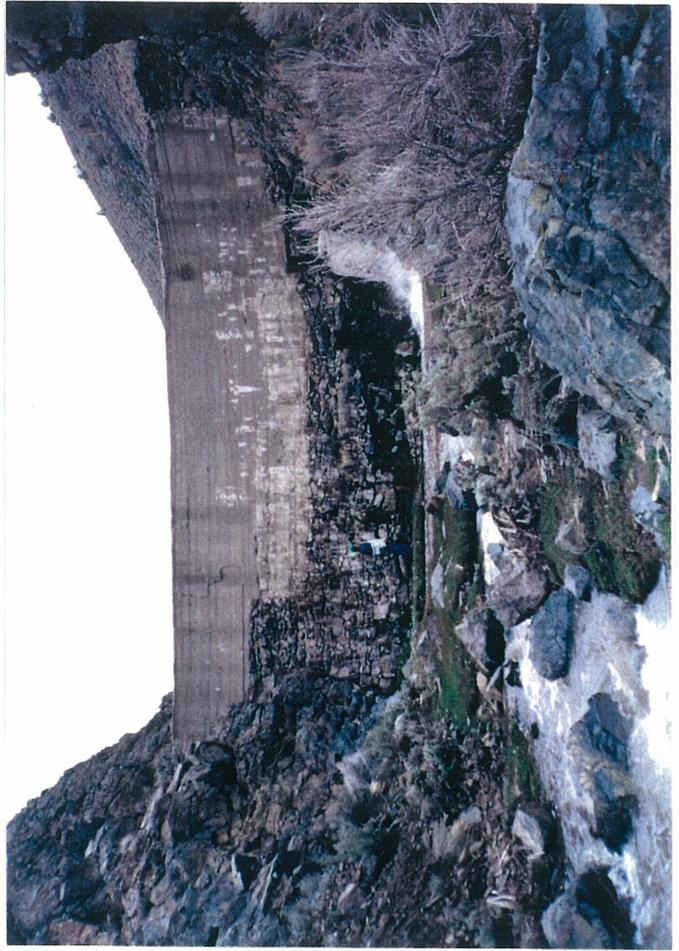
**DRY VALLEY CANYON
WEST OF UPPER DRY VALLEY**



TOP OF DAM IN DRY VALLEY CANYON



**OUTLET IN DAM
IN DRY VALLEY CANYON**



**VIEW LOOKING AT DOWNSTREAM
FACE OF DAM**



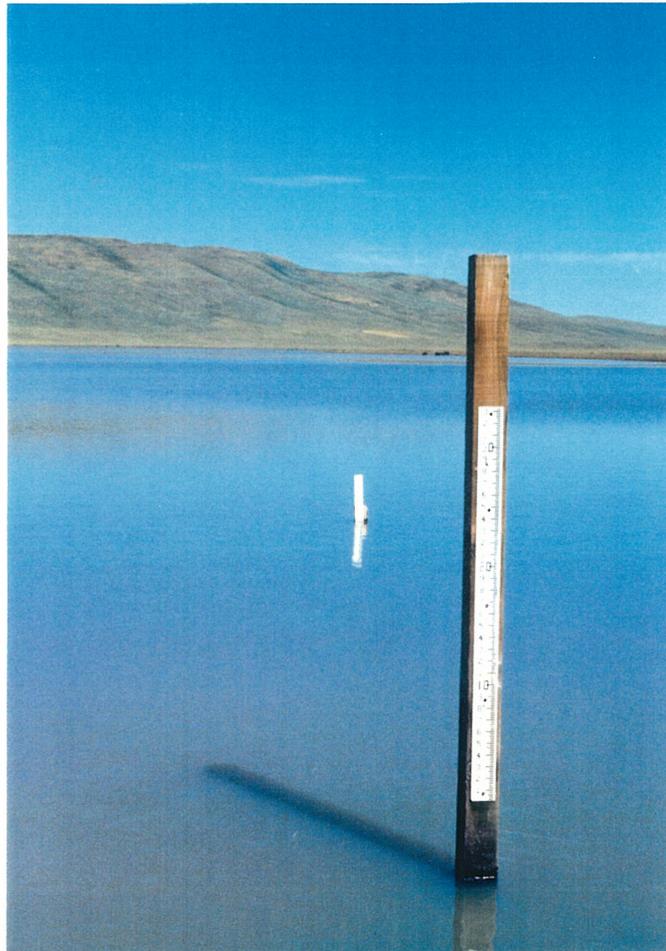
**COTTONWOOD CREEK
ALTERNATIVE DISCHARGE LOCATIONS**



**MEASUREMENT DEVICES
DURING HIGH FLOW**



SPANISH FLAT RESERVOIR OUTLET



SPANISH FLAT RESERVOIR



SPANISH FLAT RESERVOIR OUTLET



SPANISH FLAT RESERVOIR OUTLET



**DIVERSION DITCH FROM SPANISH FLAT
RESERVOIR TO WINNEMUCCA RANCH**



**DIVERSION DITCH FROM SPANISH FLAT
RESERVOIR TO WINNEMUCCA RANCH**

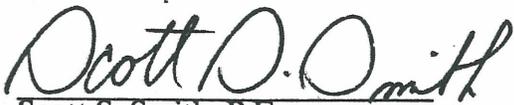
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QUALITY CONTROL REVIEWER



Scott S. Smith, P.E.
Civil Engineer - 6853 (NV)

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