Show Low Creek Reservoir System Evaluation

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EXECUTIVE SUMMARY

Table 1 below shows a cost summary for Lone Pine Dam remediation alternatives and Schoens reservoir creation. Based on the results shown, we recommend that Alternative 4, Remove Dam and Build Bridge, be implemented because of its high probability of success. Alternative 3, Construct Downstream Slope at Dam and Enlarge Spillway, is the cheapest alternative, but it's probability of success is only moderate because it involves technical, administrative and environmental permitting challenges.

We also recommend that improvements at Schoens reservoir not be pursued because of the high costs involved and the uncertainty of maintaining a permanent pool elevation, especially since data gathered during the 1993 flood has already indicated high rates if seepage.

Table 1 – Cost Summary for Lone Pine Dam Remediation Alternatives and Schoens Reservoir Creation

Item Name	Cost	Opinion of Probability of Success
Lone Pine Dam Remediation Alternatives		
(Costs shown do not include Shoens Dam/Spillway improvements that may be required by ADWR to implement the alternative. See Schoens reservoir improvements below item 5a and report section 9.4)		
1. Reclassify Dam as Roadway Embankment with new 10' CMP's installed.	Not Applicable	Infeasible
2. Construct Cutoff Wall at Dam and Enlarge Spillway	$3,485,000	Moderate
3. Construct Downstream Slope at Dam and Enlarge Spillway	$1,184,000	Moderate
4. Remove Dam and Build Bridge	$2,584,000	High
Schoens Reservoir Improvements		
1. Permitting and Water Rights Administration	Unknown	Moderate
2. Continue Dam Grout Curtain into Abutments	$312,000	Moderate
3. Reservoir Seepage Reduction (estimated costs are for grouting program over projected operating life of reservoir)	$2,600,000	Low
4. Reservoir Slope Stabilization (there is high uncertainty with this item until a detailed geotechnical study is performed to determine stability of landslide deposits)	$2,275,000	Moderate
5. Hydraulic Performance		
a) Raise Dam Crest	$ 351,000	High
b) Raise Pinedale Road	$ 2,215,000	High
Total Schoens Reservoir Improvements=	$ 7,753,000	Low

TABLE OF CONTENTS

v

1.0 INTRODUCTION 1

2.0 .... **PURPOSE AND OBJECTIVES** 3

3.0 OBJECTIVE 1 – REVIEW OF EXISTING STUDIES 4

4.0 OBJECTIVE 2 – DATA COLLECTION 6

5.0 OBJECTIVE 3 – SITE EXAMINATIONS 7

6.0 OBJECTIVE 4 – WATER RIGHTS RESEARCH 8

- **6.1 Lone Pine Dam** 8
- **6.2 Schoens Dam** 8

7.0 OBJECTIVE 5 – EVALUATION OF C-AQUIFER RECHARGE THROUGH LONE PINE RESERVOIR 9

8.0 OBJECTIVE 6 – LONE PINE DAM REMEDIATION ALTERNATIVES 10

- **8.1 Reclassify Dam as Roadway Embankment with Horizontally Jacked Pipe** 10
- **8.2 Construct Cutoff Wall at Dam and Enlarge Spillway** 11
- **8.3 Construct Downstream Slope at Dam and Enlarge Spillway** 14
- **8.4 Remove Dam and Build Bridge** 16

9.0 OBJECTIVE 7 – SCHOENS RESERVOIR EVALUATION 18

- **9.1 Continue Dam Grout Curtain into Abutments** 18
- **9.2 Reservoir Seepage Reduction** 19
- **9.3 Reservoir Slope Stabilization** 20
- **9.4 Hydraulic Performance** 21
- **9.5 Administration** 24

10.0 SUMMARY OF RESULTS AND RECOMMENDATIONS 25

APPENDIX A: REFERENCES 26

APPENDIX B: SCHOENS RESERVOIR GEOLOGY REPORT .. ERROR! BOOKMARK NOT DEFINED.

- **Introduction** .... Error! Bookmark not defined.
- **Purpose** .... Error! Bookmark not defined.
- **Methods** .... Error! Bookmark not defined.
- **Setting** .... Error! Bookmark not defined.
- **Landslide Deposits** .... Error! Bookmark not defined.
- **Permian Sedimentary Rocks** .... Error! Bookmark not defined.
- **References** .... Error! Bookmark not defined.
- **Figure Captions** .... Error! Bookmark not defined.

APPENDIX C: LONE PINE RESERVOIR RECHARGE EVALUATION ERROR! BOOKMARK NOT DEFINED.

APPENDIX D: SUPPORTING DOCUMENTATION AND CALCULATIONS FOR LONE PINE DAM REMEDIATION ALTERNATIVES .... ERROR! BOOKMARK NOT DEFINED.

APPENDIX E: SUPPORTING DOCUMENTATION AND CALCULATIONS FOR SCHOENS RESERVOIR EVALUATION .... ERROR! BOOKMARK NOT DEFINED.

RECREATION OF SHB NETWORK IN PONDPACK FROM THEIR HEC1 FILES PREPARED IN 1984 FOR SCHOENS DAM AND RESERVOIR ANALYSIS .... ERROR! BOOKMARK NOT DEFINED.

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TABLE OF CONTENTS

LIST OF FIGURES

Figure 1.1 Location Map 3
Figure 1.2 Vicinity Map... 3

(more figures will be added)

LIST OF TABLES

Table 1 – Cost Summary for Lone Pine Dam Remediation Alternatives and Schoens Reservoir Creation 21

LIST OF EXHIBITS

Exhibit 1 3.5” Floppy Disk with Topographic Survey of Lone Pine Dam
Exhibit 2 Vendor Information
Exhibit 3 (Selected Reports that Navajo County should have?)

1.0 INTRODUCTION

Lone Pine Dam and Schoens Dam are located on Show Low Creek, approximately 2.5 miles and 9 miles respectively, southwest and upstream from the confluence of Show Low Creek and Silver Creek. Shumway, just two miles above the confluence with Silver Creek, is the nearest community. The Show Low Creek watershed begins at the Mogollon Rim to the south and is highly controlled by several lakes and reservoirs upstream from Lone Pine Dam that serve agricultural, municipal and recreational purposes of the nearby communities of Show Low, Lake of the Woods and Pinetop-Lakeside. Figure 1 and Figure 2 in Appendix C show the location and vicinity of the Show Low Creek reservoir system.

Lone Pine Dam is a 98 foot tall, 450 foot long earthen embankment dam that is classified as an *unsafe, non-emergency, significant hazard* dam by the Arizona Department of Water Resources (ADWR). Lone Pine Dam was intended to store up to 10, 800 acre-feet of water for irrigation. Lone Pine Dam has a clay core with 3:1 slope for the upstream face and a 2:1 slope for the downstream face with a rockfill toe at the downstream end. The primary spillway is a 24" pipe and the emergency spillway is an uncontrolled 400' wide earthen spillway. Lone Pine Dam has had severe leakage and seepage problems ever since it was built in 1936 by the Public Works Administration (PWA) to serve as irrigation storage. ADWR is concerned that piping of the very earthen materials from which Lone Pine Dam is constructed has and continues to occur when the reservoir holds significant quantities of water. This piping can occur, in large part, due to the manner of construction in which the impoundment soils were placed directly against fractured and fissured bedrock. "Seepage and Piping Erosion Control Measures at Tongue River Dam," by Miller et al., presented at the 2001 Annual Conference Association of State Dam Safety Officials, is a graphic illustration of possible consequences of piping. Numerous reports have been prepared to quantify the problems of Lone Pine Dam and all share the same conclusion that the highly permeable Kaibab Limestone is largely responsible for the dam foundation seepage losses and reservoir seepage losses. Diligent efforts early after the dam was built to identify and repair sinkholes as they developed were unsuccessful. After a flood in 1973, the principal spillway, a 36" pipe, was noted as failing and repaired by inserting a 24" pipe and encasing it in concrete. The 1973 flood also required the use of the emergency spillway. A severe flood in 1978 and another flood in 1979 fueled the importance of determining the spillway adequacy. Phase I Investigation and Evaluation of Lone Pine Dam, prepared by Engineers Testing laboratories, Inc., 1979, essentially represents the beginning of extended efforts to bring finality to Lone Pine Dam's remediation.

Schoens Dam is a 140 foot tall, 800 foot long earthen embankment dam that was built by Navajo County in 1985 and serves primarily as a flood control structure to protect the downstream towns of Taylor and Snowflake from property damage and loss of life during infrequent flooding events as well as a failure of Lone Pine Dam. Schoens Dam's effectiveness as a flood control structure is supported by a reservoir capacity that is nearly triple that available at Lone Pine. Schoens Dam has a clay core with a 1.63:1 sloping rockfill shells on the upstream and downstream slopes and can store up to 30,700 acre-feet of water. The primary spillway is a hydraulically controlled and gated 48 inch pipe and the emergency spillway consists of an approximately 110 feet wide grouted rock channel. Currently, Schoens Dam shows no major problems. Schoens Dam does allow for a fraction of its reservoir capacity to store water for irrigation and sedimentation, but its potential as a multi-purpose dam to provide flood control, irrigation storage and recreation currently awaits this feasibility study as well as the conclusion of Lone Pine Dam's remediation.

2.0 PURPOSE AND OBJECTIVES

The purpose of this report is to identify alternatives for the remediation of Lone Pine Dam and to determine the feasibility for a larger pool at Schoens Dam. Specific objectives are the following:

1. Review existing studies.
2. Collect pertinent data.
3. Examine both dams and Schoens reservoir area.
4. Research existing water rights for both dams.
5. Assess recharge to the Coconino Aquifer (C-Aquifer) via Lone Pine reservoir.
6. Identify Lone Pine Dam remediation alternatives; develop alternatives with estimates of preliminary cost and opinions of probability of success.
7. Evaluate the feasibility of a larger pool at Schoens Dam and provide a preliminary cost estimate and opinion of probability of success.

The first four objectives create insightful understanding of the project and serve as necessary and essential background for meeting objectives 5, 6 and 7.

Due to the uncertainty that remains at a conceptual level of planning, new preliminary cost estimates include a 30% contingency to account for additional project costs arising from unforeseen circumstances. (New cost estimates after final design is complete commonly have 10%-15% contingencies.) Where possible the unit costs were taken from actual complete construction projects including administration and design. The preliminary cost estimates are simplistic but appropriate for conceptual level planning purposes. A refined preliminary cost estimate will be provided in a value engineering analysis of the preferred alternative.

3.0 OBJECTIVE 1 – REVIEW OF EXISTING STUDIES

Navajo County has maintained good records of the planning, design, development, construction and repair information for Schoens Dam, much of which was prepared by the geotechnical engineering consulting firm, Sergent, Hauskins and Beckwith (SHB) in the 1980's. Particularly useful is their Grouting Report, 1987, which documents the construction of the grout curtain in Schoens Dam, and other design documents and reports that allowed for the hydraulic and hydrologic modeling of the reservoir and dam. A flood in 1993 provided an opportunity for Navajo County personnel to document the flood and the performance of Lone Pine Dam and its reservoir. This information serves as the best data available for quantifying the recharge to the Coconino aquifer, (C-aquifer) via Lone Pine reservoir.

Most of the relevant data needed for this project's objectives concerning Lone Pine Dam are contained within three previous studies of Lone Pine Dam and one groundwater report:

1. "Geologic Causes for Failure of Lone Pine Reservoir", by George A. Kiersch, 1958, provides a summary of the early history of Lone Pine Dam and description of the geology in the area. It concludes that the inability of Lone Pine Dam and its reservoir to store water stems from the disregard of the enhanced permeability of the Kaibab Limestone which serves as the dam's foundation as well as the reservoir floor.

2. Phase I Investigation and Evaluation of Lone Pine Dam, prepared by Engineers Testing laboratories (ETL), Inc., 1979, hereafter referred to as ETL report, was an effort to closely inspect and assess the problems of Lone Pine Dam to that date, and provide recommended remedies. The report provided details of both the historical and current problems at Lone Pine Dam and recommended both immediate and future actions. The report concluded that the dam is unsafe for any lengthy period(s) of reservoir storage. Immediate actions recommended were: the principal spillway remain open at all times, the emergency spillway be enlarged, and that the dam be restricted for flood control purposes only. Recommended future actions were: fixing observed sinkholes, exploring the subsurface conditions of the dam, examine the feasibility for constructing an impervious liner on the upstream slope, conducting additional hydrologic and hydraulic studies, preparing a periodic maintenance and inspection plan, and preparing an emergency warning plan.

3. Final Report for the Reconnaissance-Level Flood Control Study of Lone Pine Dam, prepared by Dames and Moore, 1981, hereafter referred to as Dames and Moore report, served as a response to the recommendations of ETL report. Dames and Moore conducted exploratory subsurface borings and performed detailed analyses for hydrology, hydraulics, seepage, sediment accumulation, and dam stability. Again, problems with Lone Pine Dam and its reservoir were re-confirmed. The report recommended two possible remedial actions: a) An extensive foundation grouting program, or b) build a new dam downstream to provide a flood control function in the event of Lone Pine Dam's failure.

4. Ground-Water Resources and Water Use in Southern Navajo County, Arizona, Arizona Water Commission Bulletin 10, prepared by Larry J. Mann, 1976, is the most comprehensive groundwater resources report in the Lone Pine Dam and Schoens Dam region. Although Mann's report did not quantify the recharge to the C-aquifer, it did present geology, well locations and the potentiometric surface information that contributed significantly to our estimation of recharge.

4.0 OBJECTIVE 2 – DATA COLLECTION

NAU surveyed the dam and spillway area to get updated topography and design information for the outlet and secondary spillway. A printout of the survey is included in Appendix D and an electronic copy is also attached. An extensive search for data relating to either dam was undertaken early on so that the most relevant data could be used to achieve this project's objectives. Although not all of the data references listed in Appendix A were used for this report, all of the references were reviewed as to their usefulness and listed so that this report can serve as an updated and comprehensive resource to identify data relating to either Schoens or Lone Pine Dam. The listed references resulted from correspondence and/or meetings with the following organizations: Navajo County, Silver Creek Irrigation District, Arizona Department of Water Resources (ADWR), Northern Arizona University (NAU), Jim Swaisgood (Consulting Professional Geologist), U.S. Army Corps of Engineers (USACOE), Natural Resource and Conservation Service (NRCS), Salt River Project (SRP), Arizona Game and Fish Department, Arizona State Parks, United States Geological Survey (USGS), United States Forest Service (USFS), United States Bureau of Land Management (BLM), United States Bureau of Reclamation, Arizona Public Service (APS)-Cholla Power Plant in Holbrook, Colorado Unified Water District, Geo-Con, Inc., and numerous contractors and product vendors. Additionally, files at Navajo County and ADWR containing correspondence and other information on Lone Pine and Schoens Dams were searched for data that might prove useful for this project.

5.0 OBJECTIVE 3 – SITE EXAMINATIONS

Schoens Dam, Lone Pine Dam and their reservoirs and spillways were examined by Dr. Charlie Schlinger, PhD., P.E., P.G., Jim Swaisgood, P.E., C.P.G., and Jim Janecek, P.E. Although sinkholes and minor seeps were noted, these have been previously documented in other reports. During construction, the emergency spillway for Schoens Dam had slope stability problems, related to the Bidahochi Formation, but after completion of extensive slope modifications the dam and spillway have shown no major problems. However, there are two other problems identified that warranted our attention: 1) There is evidence of slope failure in the Schoens reservoir region near the current operational high water mark of 5754. This has been documented as an ongoing issue by Kirk Anderson, PhD., who was hired specifically to examine the Schoens reservoir landslide deposits and the reservoir floor geology. His report is included in this report as Appendix B. 2) On the uncontrolled emergency spillway for Lone Pine Dam, County Road 129 acts as a broad crested weir and is being threatened by erosional headcutting approximately 65 feet away. Historically, the headcutting was very close to the road and already threatened the road but the area has been filled in and reworked to provide some protection for the road. The downcutting is limited vertically to approximately 8 feet to where it reaches the top of an underlying basalt flow.

6.0 OBJECTIVE 4 – WATER RIGHTS RESEARCH

Based on our discussions with Elizabeth Logan at ADWR, the following sections 6.1 and 6.2 summarize our understanding of water right claims at Lone Pine and Schoens. Additional information on filings and decrees can be found in the Hydrographic Survey Report for the Silver Creek Watershed, Volume 4: Watershed File Reports for Region 51, prepared by the Arizona Department of Water Resources, 1990.

6.1 Lone Pine Dam

Lone Pine reservoir has a claim of water right attached to it. This is a Pre-1919 water right claim, though the dam was constructed in the mid-1930's, because water in Show Low Creek had been historically put to beneficial use since 1878. The claim number is 36-81226 and claim allows 13,000 ac-ft/yr to be used for irrigation. We understand that this claim of water right was, in some sense, transferred to Schoens reservoir, based on a statement in a letter from the BLM to ADWR (Bisson to Ramsey, 8/8/1988), in which it is stated that no new waters were being appropriated in Application to Appropriate Public Waters No. 33-90552 (discussed below). A License of Approval to use the Lone Pine dam and reservoir has been issued by the ADWR Dam Safety Section.

6.2 Schoens Dam

Schoens reservoir has two Applications to Appropriate Public Water associated with it. The primary application, from Navajo County Flood Control District, is no. 33-89615. Originally, this was an application for 22,400 ac-ft; once the reservoir level was fixed at 5754 ft with a corresponding capacity of 6000 ac-ft, this application was revised to 6000 ac-ft. The secondary application, from the Silver Creek Irrigation District, is numbered 33-90559. This application is for 13,000 ac-ft/yr, to be applied to 3000 acres. Draft permits were drawn up in response to these applications, but were never issued. An issue may be the priority dates, typically the dates of filing, on the applications. A License of Approval to use the Schoens dam and reservoir has been issued by the ADWR Dam Safety Section (Dam and Reservoir File Number 09.33).

7.0 OBJECTIVE 5 – EVALUATION OF C-AQUIFER RECHARGE THROUGH LONE PINE RESERVOIR

The recharge potential of Lone Pine reservoir has been evaluated by means of a realistic, rather than conservative, study of available information. The recharge report is under a separate cover and is being enclosed with this report. We estimate that approximately 2% of the average annual recharge available to the regional groundwater pumping center, which is defined by groundwater pumping in the communities of Snowflake, Taylor and Shumway, is provided by recharge at the Lone Pine dam site. For the purpose of this project, this amount is not held to be significant

8.0 OBJECTIVE 6 – LONE PINE DAM REMEDIATION ALTERNATIVES

Currently Lone Pine Dam is classified as a "significant hazard" dam. An idea of installing warning beacons and/or remotely controlled traffic stops to warn or prevent drivers from crossing the dam during flood events was presented to ADWR as a means for mitigation for the dam. In any case, however, ADWR emphasizes that Lone Pine Dam would still be considered unsafe, and mitigation still required. These discussions with ADWR are documented in the Summary of Teleconference Meeting on 10/16/01 which is included in Appendix D.

8.1 Reclassify Dam as Roadway Embankment with Horizontally Jacked Pipe

Reclassifying the dam as a roadway embankment would require the following:

1. *Large culverts are installed at the base of the dam*. Construction methods are available by means of which horizontal borings in the fill are excavated, casing is advanced, and pipes subsequently jacked through the casings. The culverts shall be designed to pass the 100-year flood event per County or ADOT design guidelines. The ADOT roadway drainage guidelines recommend that the ratio of headwater to culvert diameter (Hw/D) not exceed 1.5.

2. *The dam no longer satisfies any ADWR dam definition per ADWR criteria*. Since flood water levels during the 100-year flood event are low due to the Hw/D ratio constraints, ADWR's definition of a dam associated with the "very low" hazard classification will be used in determining whether the embankment qualifies as a dam. Per the Arizona Administrative Code Title 12, Chapter 15 (AAC12-15), the "very low" hazard classification requires that the total stored water for the 100-year storm event be less than 50 acre-feet.

3. *The roadway embankment satisfies construction specifications of Navajo County*. Geotechnical testing will be required to verify its conformance. If Navajo County decides to use ADOT fill specifications, the Arizona Department of Transportation Specifications for Road and Bridge Construction indicates three notable embankment requirements; 1) Compaction shall achieve 95% of maximum density, 2) compacted layers shall not exceed 8", 3) Boulders greater than 3 feet are not allowed. One might argue that these construction requirements are moot considering that a road already exists on the embankment.

Conversations with ADWR indicate that reclassification using this process is unprecedented. Specialized Services, a construction company in Phoenix, Arizona, that specializes in horizontal borings, was contacted to obtain a rough estimate of construction costs. Mr. Arvid Veedmark, an estimator with Specialized Services, responded with $750/linear foot (LF) of 72" diameter reinforced concrete pipe (RCP) installed with casing, and $900/LF of 96" diameter RCP installed with casing. Specialized Services provided this estimate strictly for conceptual planning purposes, and it shall not be construed as a bid.

Using the watershed hydrologic data of the watershed from the ETL report, a 24-hour storm hydrograph was reproduced to match the 10,530 cfs 100-year flood calculated in the Dames and Moore report. This hydrograph was then routed through Lone Pine Reservoir and proposed outlets until the stored volume of runoff in the reservoir was below the minimum dam jurisdiction criteria. The reservoir capacity relationship for water levels this low was mostly calculated based on NAU's updated and local topographic survey near the dam. Some of the higher depths were taken from the Dames and Moore report's reservoir capacity curve. To improve results as much as possible, the inlets of the RCP's would need to be 5.5 feet below the bottom of the reservoir in a drop structure. The result was 18 RCP's with 10-foot diameters. This many pipes installed at this location is not feasible. The estimated construction cost of approximately $12 million adds to this alternative's infeasibility. It would be cheaper to remove the dam, install the culverts and replace the dam. The construction cost for this option is approximately $4.5 million. Nevertheless, either option is infeasible due to canyon bottom width constraints. Detailed calculations for this analysis are included in Appendix D.

8.2 Construct Cutoff Wall at Dam and Enlarge Spillway

If the dam is remediated with a cutoff wall and the dam is classified as a significant hazard dam (due to the existence of Schoens Dam downstream) then the spillway must be modified to pass half of the Probable Maximum Flood (PMF) per the Arizona Administrative Code, Title 12, Chapter 15 (AAC12-15).

A cutoff wall is an impermeable wall constructed through the embankment and foundation of the dam and/or at locations at the upstream toe or downstream toe of the dam. Cutoff walls can also be constructed in the abutments of dams. The wall is typically 1 to 4 feet thick and can be hundreds of feet deep. The purpose of the wall would be to reduce seepage through the dam's foundation which lies on the Kaibab Formation, a highly permeable limestone. The final depth and location of the wall will depend on detailed seepage analyses, but the depth at this time is estimated at approximately 100' deep beyond the dam's base. Since the dam is approximately 100 feet tall, constructing the cutoff wall along the crest of the dam would require the wall excavation be 200 feet deep.

Excavation for the cutoff wall would depend on the Contractor's experience and availability of equipment. Essentially, the trench would be dug one section at a time. The walls of the trench would be stabilized using a soil/bentonite slurry. Either the slurry is allowed to harden as the cutoff wall, or more reliable plastic or concrete piles are inserted into the slurry. International Construction Equipment, based in North Carolina, has a Casagrande Hydromill which can excavate a trench 197' deep, 4 feet wide and 10 feet long. Many companies offer slurry cutoff wall construction to depths of up to 80 feet with less sophisticated equipment. These more conventional methods can be used for the cutoff wall construction at the upstream or downstream toes of the dam. A cutoff wall up to 400 foot deep is being proposed for the Horsetooth Reservoir in Ft. Collins Colorado. The Wolf Creek Dam in Kentucky has a cutoff wall 281 feet deep, and the Manicougan Dam in Quebec, Canada, has a cutoff wall 430 feet deep. These last two dams used inserted panels in the slurry to maintain continuity of low permeable material.

A grout curtain for Lone Pine Dam was not explored as a solution to the foundation seepage problems. Numerous examples provide evidence that grout curtains are uncertain remedies. The Bureau of Reclamation in their Environmental Assessment of the Horsetooth Reservoir (near Ft. Collins, Colorado) dated August 4, 2000, argues that grouting will likely not solve the seepage problems in the Forelle Limestone foundation. "Grouting could increase piping concerns within the embankment due to possible hydraulic fracturing of the impermeable core of the dam during drilling and grouting. Also, grout introduced near the foundation contact can cause localized concentration of seepage and increase potential for internal erosion." "Grouting (in solutioned limestone) frequently initially results in a dramatic reduction in seepage. However, the seepage has a tendency to increase with time after grouting is completed."

Another example of grout curtain futility in limestone units is the Quail Creek Dike near St. George, Utah. An extensive foundation grouting program was undertaken to fill the openings and reduce seepage. The grout was blocked by gypsum that filled the fractures. When the reservoir was filled the high hydrostatic pressures quickly washed away the gypsum and springs and seeps were observed at the downstream toe of the dam. Eventually, the dam failed.

According to "New Technologies For Subsurface Barrier Wall Construction," by Mutch et al., 1997, numerous technologies exist for subsurface barrier wall construction:

1. Compacted clay
2. Soil-Bentonite Slurry Trench
3. Self-Hardening Slurries
4. Plastic Concrete Slurry Trench
5. Deep Soil Mixing
6. Jet Grouting
7. Vibrating Beam
8. Ground Freezing
9. Waterloo Barrier Sheet Pilings
10. Permeation Grouting
11. Geomembrane Technologies

Each of these technologies has permutations, but most have problems when cutoff walls exceed 150 feet. Conventional, soil-bentonite slurry trenches generally are not used due to stability considerations. Deep soil mixing, vibrating beam and jet grouting have difficulty assuring gaps will not occur between panels. Plastic concrete walls have become the preferred type of barriers for deep walls.

Mr. Al Kiene at the Bureau of Reclamation offices in Denver, Colorado, has been involved with the Horsetooth Reservoir cutoff wall. Although the wall was never built, costs were estimated as $220/square foot (sf) of cutoff wall installed. It is important to note that costs for cutoff walls that exceed 100 feet in depth require more expensive construction procedures. Geocon, Inc., a construction company in Sacramento, California, has built numerous cutoff walls. Geo-Con's Statement of Qualifications indicate numerous projects costs for walls approximately 80 feet deep at $9/sf. Thomas Gayer of Geo-Con, Inc., provided a rough estimate of $50/sf for a 200 foot deep cutoff wall. This cost seems reasonable since it falls between the $220/sf for a 400 foot deep wall and $9/sf for an 80 foot deep wall.

Assuming that the wall at Lone Pine dam will be installed along the entire length of the crest of the dam and penetrate at least 100 feet into the foundation and abutments, the wall will be 50,000 sf.

According to the AAC12-15, the emergency spillway shall be designed to safely pass the design flood as determined by its hazard classification. Assuming Lone Pine is reclassified to a "significant hazard" dam, its emergency spillway must pass the 0.5 PMF. According to the Dames and Moore report, the 24-hour storm PMF is 80,000 cfs, and therefore one half is 40,000 cfs. This assumption is adequate for conceptual planning purposes, but if this alternative is implemented, a new detailed hydrological analysis should be done to identify the PMF for all of the different storm durations (such as the 72-hour storm) as outlined in the Hydrometeorological Report No. 49 (HMR49). According to the Dames and Moore report, the 100-year storm would be contained in the reservoir if the reservoir were empty upon its arrival. The calculated water surface elevation for the 100-year storm is 30 feet below the existing crest of the spillway. More conservative assumptions with reservoir stage and additional updated analyses for different HMR 49 storm durations may warrant an emergency notification to drivers on County Road 129 when the spillway is flooded. The spillway has been flooded on previous occasions, most notably during the 1993 snowmelt flood. Lengthening the crest of the spillway rather than deepening the spillway is also an option for improving the spillway if the depth of flow in roadway overtopping during the 100-year flood is too deep.

AAC12-15 states that the emergency spillway shall have 3 feet of residual freeboard measured from the maximum pool elevation of the design flood to the crest of the dam. Other criteria include wave run-up and a minimum of 5 feet of freeboard measured from the crest of the spillway to the crest of the dam. No wave run-up was calculated because no upstream dam failure, landslide, or powerful flash flood that would warrant a wave run-up analysis is expected. The existing spillway geometry is already above the 5 foot minimum. NAU has surveyed the dam as part of this project in order to get the most recent crest and spillway elevations. According to this survey, the emergency spillway for Lone Pine Dam is controlled by County Road 129 which acts as a broad crested weir. The lowest elevation of this road at the spillway is 11 feet below the crest of the dam. Given the current geometry of the road, the spillway has a maximum capacity of approximately 18,000 cfs with the required 3 feet of residual freeboard, far short of the 40,000 cfs needed for the 0.5 PMF.

The rating table for the broad crested weir can be calculated using the broad crested weir equation. Selection of the weir coefficient for use in this equation is subjective since research for this coefficient is limited. The uncertainty of this coefficient requires careful consideration for factors of safety. The Handbook of Hydraulics, 7th Ed., by Brater et al., 1996, includes research results where various broad crested weirs were tested and weir coefficients subsequently derived. As head and breadth of crest increases, the broad crested weir coefficient approaches 2.6, a common value used for bridge decks during floods. However, the roadway side slopes increase the capacity of the weir and research indicates that the weir coefficient can actually be greater than 4, but the research did not directly measure roadway embankments and uncertainty remains. Therefore in order to create a conservative capacity for roadway embankments acting as broad crested weirs, a value of 3 is commonly used and recommended by the Federal Highway Administration. The construction plans for Lone Pine Dam call for a 400 foot wide spillway. The NAU survey shows the spillway at 385 feet wide. Using this width, the entire spillway must be lowered to 14 feet below the crest of the dam, or 3' lower than its current low point. In other words, the spillway will be inundated with 11 feet of water. Additional details for this analysis are shown in Appendix D.

The spillway excavation at the road is not expected to reach the basalt rock which is estimated to be 6 to 8 feet below the road based on visual observations lower in the spillway. The spillway improvements would entail removing the road, excavating the spillway to the required elevation and replacing the road with new approaches in accordance with AASHTO design guidelines. These new roadway approaches to the spillway will also require excavation. Excavation for the spillway and road is calculated as 26,500 cubic yards (CY). One thousand feet of 26' wide roadway will need to be removed and replaced. The replacement section of the road is estimated as 3" of asphalt concrete on 5" aggregate base course. Erosional headcutting in the spillway has historically threatened the road, and therefore erosion protection should be provided to stop the headcut from compromising the road. Drop structures can be used to dissipate the energy and rip-rap or gabions are just two examples for slope reinforcement that can be employed here. The uncontrolled erosion in the spillway that does not endanger the road will not affect the performance of Lone Pine Dam and its reservoir during infrequent flooding events, however, ecological damage from excessive sediments and spillway widening should be considered. The costs shown for the spillway excavation and roadway were derived in part using the Construction Cost Index prepared by the Arizona Department of Transportation as a compilation of actual ADOT project costs. These costs are chosen to be conservative enough to cover mobilization, traffic control and erosion control.

The estimated cost for this alternative is the following:

50,000 SF of cutoff wall * $50/SF	=	$2,500,000
Spillway Improvements		
Spillway excavation – 26,500 CY *$5/CY =		$ 133,000
1000 feet of 3" A.C. on 5" A.B.C roadway		
466 tons of A.C * $65/ton =		$ 30,000
400 CY of A.B.C. * $45/CY =		$ 18,000
30% contingency -		$ 804,000
Total -		$3,485,000

8.3 Construct Downstream Slope at Dam and Enlarge Spillway

This option involves flattening the downstream slope of Lone Pine Dam to the extent where the hydraulic gradient and exit velocities of seepage through the foundation of the dam are no longer a threat to the structural integrity of the dam. The slope would start at the crest of the dam and continue at a 3:1 Slope. The existing downstream slope of the dam, now approximately 2:1 with periodic benching, would be protected by a layer filtering strategy where the first layer would be a rock drain. The drain would then be layered with rock up to 6 inches in diameter, and subsequent layers of rock would have larger diameters, perhaps up to 18". The new rock slope would be structurally anchored with an excavated key and berm at the toe of the slope. The primary spillway outlet would need to be extended to the new location further downstream. These changes to the primary spillway are expected to have minimal impact on its performance. However, environmental impacts created by the burial of additional sections of Show Low Creek will need to be mitigated.

This approach was proposed by the US Bureau of Reclamation for the Horsetooth reservoir near Ft. Collins, Colorado, to improve the safety of the dam by updating the dam to current design regulations. This information is available to the public through a website: *www.abouthorsetooth.com*. The concerns at Horsetooth reservoir are different from Lone Pine. The downstream slope improvements are being constructed in conjunction with other improvements since the Bureau of Reclamation and the Northern Colorado Water District are also trying to maintain a reservoir. The concerns at Lone Pine are simpler and singular because maintaining a reservoir is not being pursued.

Two other example projects exist where a downstream slope improvement was designed and constructed successfully. The Sinnard Reservoir Rehabilitation Project in Wyoming involved correcting a foundation seepage problem for the 25-foot high earth embankment dam with a concrete face. Quoting the <u>Sinnard Reservoir Rehabilitation Project Preliminary Report – Level III – Final Design</u>, prepared January, 1994, by ECI in Englewood, CO, "To address the problem of uncontrolled seepage and piping, the proposed rehabilitation includes a drainage blanket downstream of the dam connected with a chimney drain sloping up the downstream face, covered by an earth buttress. The drainage blanket will collect seepage from the slope and toe areas and will be designed appropriately to hold the underlying soil particles in place to prevent piping. This drainage blanket and the buttress of earth on top of it will extend the full length of the embankment and will be extended onto one or both abutments as necessary to intercept seepage that may be making its way around the ends of the dam and causing sloughing of the abutments. The buttress fill will also flatten the downstream slope to about 2.5H:1V, increasing its stability." This approach was also designed and constructed successfully for the 60-foot high earth embankment dam, Washakie Reservoir, located on the Wind River Indian Reservation, Wyoming. This reservoir is similar to Lone Pine in that the dam has a history of seepage problems in the karstic foundation. The design report, Feasibility Design Summary Report for Enlargement of Washakie Reservoir, was prepared by GEI Consultants, Inc., Englewood, CO, 1993. Figure 3 in Appendix C illustrates what this improvement might require.

One of the major considerations for implementing this alternative at Lone Pine is locating a source for rock. The emergency spillway itself does have an approximately 8 to 10 foot thick layer of basalts that would serve as a source while excavating in an area already disturbed by the construction of the spillway. The amount of rock in the emergency spillway is estimated as 35,000 CY. The estimated rockfill required is 42,000 C.Y. The rock quarry used to construct Schoens Dam may also serve as a source of rockfill. According to Schoens Dam construction costs documented by Navajo County in 1985, basalt excavation and placement was $4/CY. This cost inflates to approximately $7/CY using 3.2% average inflation rate since then. Smaller projects have had rock excavation and placement as high as $30 CY. But for the economies of scale for a project this large, $10/CY appears to be more indicative of an anticipated cost. Wade Mcelwain of Eagle Mountain Construction Co. Inc., concurred that $10/CY is reasonable for rock excavation and placement, but that $15/CY would be more appropriate for rock excavation trucked in from up to 10 miles away. Since it is unknown at this time where the rock excavation will come from, $15/CY will be used.

This option will also require spillway improvements. The details for the spillway improvements are identical to that presented in Section 8.2. Another consideration for implementing this alternative is obtaining the necessary environmental permitting (eg. federal 404 permit) for disturbing additional areas of Show Low Creek.

The estimated cost for this alternative is the following:

42,000 CY of Rockfill * $15/CY	=	$ 630,000
Filter Drains	=	$ 100,000
Spillway Improvements		
Spillway excavation – 26,500 CY *$5/CY =		$ 133,000
1000 feet of 3" A.C. on 5" A.B.C roadway		
466 tons of A.C * $65/ton =		$ 30,000
400 CY of A.B.C. * $45/CY =		$ 18,000
30% contingency -		$ 273,000
Total -		$1,184,000

8.4 Remove Dam and Build Bridge

Assuming no roadway re-alignment, the bridge would be constructed where the dam is removed. Slopes that are now devoid of vegetation after the dam has been removed would need to be examined for excessive erosion potential and subsequent erosion mitigation.

Using cross sections cut every 50 feet perpendicular to the axis of the dam, the estimated quantity of fill to be removed is 146,000 CY. The Arizona Department of Transportation publishes contractor bids it receives for its projects, and ranges for unit excavation costs can be obtained for projects with similar quantities as to what would be expected for the Lone Pine Dam removal. Using this resource, unit excavation costs range from $1.00 to $3.00 per cubic yard depending on the difficulty of transporting the excavated material to a suitable location. An estimate of $3.00 was used because of the remote location and to create a conservative estimate.

Since County Road 129 currently crosses the top of the dam and serves as a convenient access between Taylor and Pinedale, a bridge is proposed to maintain access. Vastco, Inc., a construction company in Chino Valley, Arizona, that specializes in pre-stressed concrete-box-type bridges was contacted to obtain a rough estimate of construction costs. Vastco responded with $800,000 for a 311 foot long bridge. Vastco provided this "ballpark" cost estimate strictly for our conceptual cost estimating purposes.

Prefabricated bridges were also investigated through Continental Bridge, Inc., but found to be impractical for 300 to 400 foot spans with heavy vehicle loading. Bridges of this size require large structural members in the truss and therefore making it easier to simply construct the bridge on site one member at a time.

Ted Buell from Canon and Associates, Inc., a structural design consulting firm in Tucson, AZ, and a division of TranSystems Corporation, provided a conceptual level cost estimate of $1.5 million for a 400 foot long single span bridge. The cost estimate includes the costs for the possibility that the abutments for the bridge may need drilled piers. This represents a more conservative approach to building a bridge.

Removing the dam and replacing the access with a bridge also provides a unique opportunity to realign County Road 129 to improve safety. Currently, vehicles must make a sharp turn to cross the dam and make another sharp turn after the dam has been crossed. This report does not make any estimates as to the costs for any roadway realignments.

The following is a summary of the costs for this alternative:

Removal of Dam – 146,000 CY * $3.00/CY =	$ 438,000
Construct Bridge -	$1,500,000
Erosion Control -	$ 50,000
30% contingency -	$ 596,000
Total -	$2,584,000

9.0 OBJECTIVE 7 – SCHOENS RESERVOIR EVALUATION

Schoens Dam was built primarily as a flood control structure. It does have 6000 ac-feet of permanent pooling allowed, with 3000 ac-feet reserved for 100 years of sediment storage and 3000 acre-feet for irrigation purposes. However, the reservoir has up to 30,700 acre-feet of storage available. Navajo County, Silver Creek Irrigation District and the Schoens Reservoir Recreation Committee seek the feasibility of increasing the permanent pool elevation for additional irrigation storage as well as providing potential for recreation at the reservoir. The following sections address 5 major considerations for implementing a large pool at Schoens reservoir.

9.1 Continue Dam Grout Curtain into Abutments

Schoens Dam has had an extensive grout curtain installed at the time of its construction in 1985. However, at that time, only a shallow reservoir was planned, and the grout curtain was only constructed in the foundation. Schoens Dam can be expected to require a grout curtain continued through the abutments if a permanent deep reservoir is proposed. A grout curtain is a series of successive vertical guide holes drilled close enough so that when a cement based grout is injected into the native rock or soil with high enough pressure that the voids are replaced with the grout to effectively form a continuous underground barrier to reduce seepage. The grout curtain at Schoens Dam has the following details:

Average depth of 40 ft into foundation (30 ft minimum recommended by SHB in 1985)
Assume 5 foot intervals (existing curtain intervals ranged from 2' to 10'),
Length of Curtain 200 ft either side = 400 ft
Number of Holes = 80, Total =3200 LF
(Grout Curtain can also be expressed as 16,000 SF)

Using the above details and construction costs for drilling and grout documented by Navajo County in 1985, the grout curtain costs approximately $5/SF. This cost inflates to approximately $9/SF using 3.2% average inflation rate since then.
$9/SF X 16,000 SF = $144,000

Using similar GeoCon projects, Niagara Falls Grout Curtain $3,000,000 for 2500 ft long curtain (80 ft deep) or $15/SF. Using this unit cost, Schoens abutment grout curtain = 16,000 SF X $15/SF = $240,000

"New Technologies For Subsurface Barrier Wall Construction," by Mutch et al., 1997, estimates pressure grouting as $15/SF to $30/SF. The unit cost per square foot of grout wall increases with depth.

Upon considering all three unit cost estimates, \$15/SF seems to be reasonably conservative.

Abutment Grout Curtain – (\$15/SF X 16,000 SF)	\$ 240,000
30% contingency -	\$ 72,000
Total -	\$ 312,000

9.2 Reservoir Seepage Reduction

Schoens reservoir has extensive Kaibab Formation outcrop which historically has proven to create seepage problems in Lone Pine reservoir and other reservoirs with similar geology. Stopping all leakage will be nearly impossible, but leakage may be reduced to an acceptable level. Installing a low permeable liner over the reservoir has a higher probability of success in reducing seepage than other methods. Liners usually consist of an impervious synthetic layer with a clay blanket carefully constructed on either side of the synthetic layer to prevent its puncture. The probability of puncture will depend on the thickness of the synthetic layer. According to "Loading Point Puncturability Analysis of Geosynthetic Liner Materials", a paper presented at the Geosynthetics conference in San Diego by D.L. Laine, M.P. Miklas and C.H. Parr of the Southwest Research Institute, 100 mil HDPE underlain by 150 mil geotextile failed puncture tests over a 1 inch cone with 20 feet of water pressure, but did not fail with 200 mil of geotextile. Due to the imperfect nature of construction practices, it is highly recommended that reservoir liners use thick synthetic layers with ample geotextile blankets constructed on both sides using strict construction and quality control specifications. The USBR recently employed using a liner for the Horsetooth Reservoir near Ft. Collins CO. The liner includes a 40 mil LLDPE synthetic layer with a 2' clay blanket. Cost estimates from the USBR show \$600,000 to \$800,000 for a 5.5 acre liner, or\$145,000 per installed acre. ADWR provided a copy of the engineer's construction cost estimate for 2 alternatives, fully lined and partially lined, for lining the Golder Dam reservoir. Using the quantity specified as "Furnishing and applying soil sterilant", as an approximate estimate of the acreage of the lined reservoir, total project costs for installing the liner ranged from \$60,000/acre to \$100,000/acre for 85 acres and 173 acres of lining respectively. Using the reservoir surface area to reservoir elevation curve shown in the Schoens Dam construction documents, the reservoir acreage for an assumed permanent pool elevation of 5770 is approximately 500 acres. If all 500 acres were lined using the lowest cost per acre of \$60,000 as stated so far, lining the reservoir would cost 30 million dollars.

Another approach, which may be more cost-effective, is an approach as outlined in Lake Mogollon Project, Report of Final Geotechnical Investigations, prepared in 1994 by ECI of Englewood, CO. This is a reactive approach where sinkholes that develop in the reservoir are identified, excavated to their critical opening and pressure filled with grout. The reservoir would need to be periodically drained to correct the unwanted seepage through sinkholes. This approach was used for nearby Fool's Hollow Lake which also has Kaibab Formation outcrops in the reservoir floor area. According to the ECI report, the proposed Lake Mogollon, at 200 acres, is predicted to have 8 major sinkholes develop during the operating history of the lake, and as much as 8 acre-feet per day of general reservoir seepage not including seepage through sinkholes. If the same estimating procedure is employed for an area of 510 acres at Schoens reservoir with a permanently maintained

pool elevation of 5770, 20 acre-feet per day of general seepage and 20 major sinkholes would be predicted. Using data collected by Navajo County during a 1993 flood, Schoens reservoir dropped from 5773.5 to 5771.5 in four days while the outlet was closed, or 500 acre-feet per day lost to seepage. Lone Pine reservoir was empty during this period as well, therefore, any inflow to Schoens reservoir during this period can only increase the seepage losses. It is unknown and difficult to determine how much of this seepage occurs through sinkholes. The Lake Mogollon report estimates approximately $80,000 for each major sinkhole repair. These estimates were extrapolated from repair costs incurred for sinkholes at Fool's Hollow Lake. Using 3% annual inflation rate, $80,000 becomes approximately $100,000 today.
If reservoir lining is not pursued for Schoens reservoir, the estimated grouting program over the operating history of Schoens reservoir would be the following:

20 major sinkholes X $100,000/sinkhole	=	$2,000,000
30% contingency -		$ 600,000
Total -		$2,600,000

This cost estimate does not include the cost associated with the loss of water every time the reservoir is drained.

9.3 Reservoir Slope Stabilization

Much of the northerly portion of Schoens reservoir is characterized by landslide deposits. According to our geological investigation (included in Appendix B), there is no evidence that these landslides were globally reactivated by the relatively short term water levels from recent flooding events, however the report warns that the potential for landslide reactivation could dramatically increase from sustained high water levels associated with a permanent reservoir pool. These landslides deposits would need to be sampled and carefully examined by a thorough geotechnical investigation for their stability. Schoens Dam Phase II Draft Design Development Report, by SHB in 1993 did show the results of some landslide deposit sampling for their engineering properties, but the sampling was done only near the dam. The toe of the exposed landslide deposits, which are closest to the operational high water level of 5754, have shown some recent instability and erosion. Although the stability conditions of the landslide deposits would not be known until a full geotechnical investigation is completed, the need for stabilization of the landslides for a higher permanent pool elevation in Schoens reservoir is likely. Large slope failures can create a wave that, while unlikely to be large enough to overtop the dam, could endanger the lives of those recreating at the reservoir.

Geologic mapping at the dam shows these landslide deposits as much as 25 feet deep. The bedding planes are highly irregular and discontinuous and show evidence of considerable small scale internal faulting. In fact, these landslide deposits were activated in the spillway area where the slope was steepened due to the excavation. There is also potential that these landslide deposits continue to the reservoir floor as they may be covered by younger colluvium deposits. It is difficult to estimate the anticipated costs for addressing the landslide potential without a geotechnical study. This report will identify some alternatives, and one will be selected for a guess on anticipated costs.

Several technologies exist for mechanically stabilizing slopes. Minimizing slope disturbance by stabilizing the slope in-situ would be desirable. One common method for in-situ slope stabilization is soil nailing. Soil nailing involves drilling a screw through the unstable slope into a stable geologic strata beneath. The head of the screw would hold the soil in place through a concrete, metal or grouted plate. However, soil nailing applications are primarily designed for unsaturated soil conditions. According to the Soil Screw Retention Wall System Design Manual which is based on the Manual for design and Construction Monitoring of Soil Nail Walls, by the FHWA, economical soil nail reinforcement requires soil with good cohesion and shear strength. These engineering properties are in question for the Schoens area landslide deposits, especially given the recently documented history of slope failure both during construction (major slope failure) and since (minor activity).

The FHWA's Mechanically Stabilized Earth Walls and Reinforced Soil Slopes Design and Construction Guidelines indicates potential for reinforced soil slope application in saturated conditions. Reinforced soil is generally applied in locations above the water table, and economical designs depend on soils with good shear strength. Nevertheless, reinforced soil could be applied here. The soil that is to be reinforced would have to be removed and then reconstructed with the reinforcement. Cost will also escalate if temporary retaining is needed to provide safety during construction of the reinforced soil slope section. It might prove to be more economical to remove the landslide deposits in the proposed saturated zone all together. The FHWA manual, prepared in 1997, estimates that reinforced soil slope construction costs for the size of slopes expected to be reinforced in Schoens reservoir could be as high as $260 per square meter.

Placing a thick layer of rockfill against the slope was investigated. Using the infinite-slope stability equations, additional rockfill loading will only aggravate the situation.

The most promising approach to stabilizing the landslide deposits is simply to flatten the slopes. A 4:1 slope is a reasonable estimate of the required slope for stability under saturated conditions. If the landslide deposits lowest elevation is near 5760, starting the slope layback at 5750 until it daylights in areas where the slope is already steeper than 4:1 yields an estimated 350,000 CY of removal.

The estimated costs for this item is the following:

350,000 CY of excavation * $5/CY	=	$ 1,750,000
30% contingency -		$ 525,000
Total -		$ 2,275,000

This report highly recommends a geotechnical engineering evaluation be performed for the landslide deposits and a closer examination of anticipated construction costs based on conceptual designs using the results of the evaluation. It must be emphasized that although it is not probable, it is possible that a geotechnical study would reveal that minimal or no slope stabilization is necessary for the reservoir.

9.4 Hydraulic Performance

There are two main concerns regarding the hydraulic performance of Schoens Dam and reservoir.
1) The Dam should fulfill its flood mitigation responsibilities up to the 100 year storm.
2) The spillway must adequately pass the PMF.

According to the Schoens Dam Phase III Final Design Report, prepared by SHB in 1984, the total volume for the inflow design flood created by the 100 year, 24 hour storm is 16,500 ac-ft. Originally, the report subtracted 4000 ac-ft from the total volume as the amount of the flood that would be captured in an assumed half-full Lone Pine reservoir. The analysis of Schoens reservoir depends on either Lone Pine Dam being repaired or breached. If Lone Pine Dam is removed, its reservoir is assumed to have zero storage capacity and therefore provides no hydrograph attenuation. If Lone Pine Dam is repaired, it will likely be half-full as there will no longer be an incentive to keep the reservoir levels low. Also, routing a Lone Pine Dam break flood through Schoens would no longer be considered. Using the Schoens reservoir capacity curves shown in the SHB construction documents for Schoens Dam, the reservoir will have the required 16,500 ac-ft of storage at a permanent pool elevation of 5777, or 13 feet below the as-built spillway invert elevation, and 48.6 feet below the crest of the dam. If the dam does not utilize the spillway during the 100 year flood event, its flood mitigation goal of outflows not exceeding 500 cfs will be maintained. The primary spillway outlet rating curves shown in the as-built construction documents for Schoens Dam prepared by SHB show a maximum ouflow under 500 cfs even at the highest reservoir levels. The SHB report also indicates a problem with Pinedale road as any elevations above 5770 will overtop the low point in Pinedale road which crosses the northwest corner of the reservoir. Costs will be incurred for raising the road with adequate freeboard. At a minimum, the road will need to be raised to the spillway crest elevation at 5800 feet. This will require 225,000 CY of fill and incidental culvert costs. The fill will be more expensive than excavation because of the probable trucking costs to transport the fill to the site. This will also require 2600 lf of 26 foot wide pavement on Pinedale Road to be replaced.

Pinedale Road Fill – 225,000 CY *$7/CY =	$1,575,000
2600 feet of 3" A.C. on 5" A.B.C roadway	
1268 tons of A.C * $65/ton =	$ 82,000
1043 CY of A.B.C. * $45/CY =	$ 47,000
30% contingency -	$ 511,000
Total -	$2,215,000

Changes to Lone Pine Dam and/or Schoens reservoir permanent pool elevation will change the hydrograph that the Schoens Dam emergency spillway must accommodate. The Schoens Dam Hydrological Analysis HEC-1 model prepared by Sergent, Hauskins and Beckwith in 1984 was used to re-create a PMF hydrologic model for the Schoens reservoir watershed. The model was updated to allow changes to Lone Pine Dam, Schoens Dam and their reservoirs. Schoens emergency spillway was analyzed using hydrographs from four different scenarios, and the results are listed below:

	Routed PMF Max. W.S.E.
Scenario 1 – Schoens permanent pool unchanged, Lone Pine reservoir half full, Lone Pine emergency spillway repaired ………………………..	5823.6
Scenario 2 – Schoens permanent pool unchanged, Lone Pine Dam removed ……………………………………………………………….	5824.5
Scenario 3 – Schoens permanent pool at 5777, Lone Pine Dam removed ……………………………………………………………….	5825.2
Scenario 4 – Schoens permanent pool at 5777, Lone Pine reservoir half full, Lone Pine emergency spillway repaired ………………………..	5824.6

According to AAC12-15, any dam over 100 feet tall must have a minimum crest width of 25 feet and the dam must have a minimum of 3 feet of freeboard above the maximum Water Surface Elevation (W.S.E.) when the PMF is routed through the reservoir and the emergency spillway. Incidentally, the maximum crest width for a dam is also 25 feet per AAC12-15. The existing crest of the dam is approximately 5826. The results above indicate that any scenario will require the dam crest to be raised. However, the results are too close to be certain. Using the worst case scenario from these results the dam crest would need to be raised by 3 feet. Since the dam crest width needs to be maintained at 25 feet, raising the dam will require an additional 3 foot thick rockfill embankment construction on the dam. The upstream face will have fewer construction obstacles as new embankment construction will unlikely affect the operation of the primary spillway. The anticipated costs for this improvement is as follows:

Upstream Rockfill Embankment – 18,000 CY *$15/CY =	$ 270,000
30% contingency -	$ 81,000
Total -	$ 351,000

An Incremental Damage Analysis (IDA) will need to be completed if the peak flows through the spillway increase during the PMF due to Lone Pine Dam remediation. The IDA will determine the incremental increase in damage to downstream communities of Taylor and Snowflake due to the increase in the routed PMF peak flow through the emergency spillway. All of the scenarios show a peak flow lower than the 58,000 cfs shown in the original HEC-1 model output. This implies that a new IDA will likely not be needed.

The benefits of a new detailed hydrologic study of the Show Low Creek watershed and a new detailed hydraulic study of Schoens' emergency spillway is emphasized. The results of these studies may reveal that no improvement to Schoens Dam or its emergency spillway is required. The input parameters for the HEC-1 model seem to be conservative. The "Oak Creek Warning System Hydrology Report", prepared by the Arizona Department of Water Resources in 1990 includes an effort to calibrate input parameters for the hydrologic model, and this report may prove to be a source of more accurate input parameters. Other sources include updated databases for topography, vegetation, soil, and rainfall and stream gaging within the watershed. Improvements have also been made to hydrologic modeling software, including HEC-1, since 1984. The hydraulics of Schoens Dam emergency spillway has also changed. The spillway invert has been raised, the main channel is earthen, the east side of the spillway has dumped rip-rap and a varying width bench, and the west side of the spillway has both grouted rip-rap and shotcrete. The emergency spillway rating table shown in the Schoens Dam as-builts does not appear to have been re-calculated to reflect these changes. Erosion control at the outlet of the emergency spillway should also be considered.

9.5 Administration

Storing additional water at Schoens Dam will require additional water rights if more than 13,000 acre-feet will be stored. US Forest Service and the Federal 404 permits will also likely be involved. These permits center around environmental issues and will also involve the State of Arizona 401 certifications administered by the Arizona Department of Environmental Quality (ADEQ).

10.0 SUMMARY OF RESULTS AND RECOMMENDATIONS

Table 1 below shows a cost summary for Lone Pine Dam remediation alternatives and Schoens reservoir creation. Based on the results shown, we recommend that Alternative 4, Remove Dam and Build Bridge, be implemented because of its high probability of success. Alternative 3, Construct Downstream Slope at Dam and Enlarge Spillway, is the cheapest alternative, but it's probability of success is only moderate because it involves technical, administrative and environmental permitting challenges.

We also recommend that improvements at Schoens reservoir not be pursued because of the high costs involved and the uncertainty of maintaining a permanent pool elevation, especially since data gathered during the 1993 flood has already indicated high rates if seepage.

Table 1 – Cost Summary for Lone Pine Dam Remediation Alternatives and Schoens Reservoir Creation

Item Name	Cost	Opinion of Probability of Success
Lone Pine Dam Remediation Alternatives (Costs shown do not include Shoens Dam/Spillway improvements that may be required by ADWR to implement the alternative. See Schoens reservoir improvements below item 5a and report section 9a)		
1. Reclassify Dam as Roadway Embankment with new 10' CMP's installed.	Not Applicable	Infeasible
5. Construct Cutoff Wall at Dam and Enlarge Spillway	$3,485,000	Moderate
6. Construct Downstream Slope at Dam and Enlarge Spillway	$1,184,000	Moderate
7. Remove Dam and Build Bridge	$2,584,000	High
Schoens Reservoir Improvements		
1. Permitting and Water Rights Administration	Unknown	Moderate
2. Continue Dam Grout Curtain into Abutments	$312,000	Moderate
3. Reservoir Seepage Reduction (estimated costs are for grouting program over projected operating life of reservoir)	$2,600,000	Low
4. Reservoir Slope Stabilization (there is high uncertainty with this item until a detailed geotechnical study is performed to determine stability of landslide deposits)	$2,275,000	Moderate
5. Hydraulic Performance		
c) Raise Dam Crest	$ 351,000	High
d) Raise Pinedale Road	$ 2,215,000	High
Total Schoens Reservoir Improvements=	$ 7,717,000	Low

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APPENDIX B: SCHOENS RESERVOIR GEOLOGY REPORT

Assessment of Quaternary Surficial deposits and Undifferentiated Permian Sedimentary Rocks of Schoens Reservoir, Navajo County, Arizona

Prepared by Kirk Anderson

July 8, 2002

Table of Contents

Introduction B-4
Purpose B-4
Methods B-4
Setting B-5
Landslide Deposits B-6
Permian Sedimentary Rocks B-8
Summary and Implications B-9
References B-11
Figure Captions B-12
Figure 1 .... B-14
Figure 2 .... B-15
Figure 3 .... B-16
Figure 4 .... B-17
Figure 5-6 .... B-18
Figure 7-8 .... B-19
SHB Geologic Map B-20

Assessment of Quaternary Surficial deposits and Undifferentiated Permian Sedimentary Rocks of Schoens Reservoir, Navajo County, AZ

Introduction

Schoens Dam and reservoir, located along Show Low Creek, was initially designed and built for flood control. However, future plans may include expansion to a multi-use reservoir for irrigation and recreation. The goal of this investigation was to obtain a better understanding of the geologic setting of the area and to evaluate the prevailing assumptions associated with existing geologic mapping so that the feasibility and practicality of various alternatives for future use of Schoens Reservoir may be adequately assessed.

Purpose

The purpose of this report is to present the results of geologic field investigations of Schoens Reservoir undertaken in April and May, 2002. The main objective of the investigation was to characterize (1) the Quaternary surficial deposits, specifically landslide units, and (2) the undifferentiated Permian sedimentary sequence. Additionally, the geologic map completed during initial investigations in the early 1980's was evaluated.

Methods

The methods used in the investigations included background research and field reconnaissance. Materials used for the interpretation of the geologic setting included (1) photocopies of color stereo aerial photographs provided by the Sitgreaves National Forest, (2) Taylor, AZ 7.5' USGS topographic quadrangle map, and (3) two geologic maps, one at 1:1000 scale labeled "Generalized Geologic Map in Vicinity of Schoens

Dam and Reservoir" (see Appendix) and another at 1:100 scale labeled "Geologic Map Schoens Dam and Reservoir". Both geologic maps were prepared by Peterson and Hulpke (1982), staff geologists for Sergent, Hauskins, and Beckwith (1982), hereafter referred to as SHB in this report.

Note that figure captions in this report in a section called "Figure Captions". The approximate locations of scenes shown in photographs (Figures 2 through 8) are indicated on Figure 1.

Setting

The project area is located in eastern Arizona, approximately 4 miles south of the town of Taylor, Arizona. The elevation of Show Low Creek at the floor of the reservoir is 5700 feet (1737 m) above sea level. Northward trending Show Low Creek joins Silver Creek approximately 2 miles downstream from the reservoir. Silver Creek is a tributary to the Little Colorado River. Both Show Low Creek and Schoens Reservoir (called Schoens Lake on the Taylor quadrangle map) were dry during the site visits. The project area is located in the extreme northwest edge of the Springerville Volcanic Field (Richard et al., 2000). In general, the geologic sequence includes (1) undifferentiated Permian sedimentary rocks (Pu) characterized by white and light brown limestone, sandstone, limey sandstone, sandy limestone and limey siltstone layers, (2) Triassic Moenkopi Formation (*Trm*), characterized by red and dark brown sandstone and siltstone layers, (3) Tertiary Bidahochi Formation, including light brown sandstone, (4) Neogene alluvial gravels, and (5) Quaternary basalt (Figure 1).

Secondary erosive processes have produced (1) large-scale rotational landslides composed of resistant basalt overlying more easily eroded sedimentary deposits of the Bidahochi and Moenkopi Formations, and (2) colluvium at the toes of the landslide deposits. Also present is Quaternary alluvium associated with Show Low Creek and its tributaries.

Juniper trees dominate vegetation in the reservoir area. A fairly dramatic result of water being held in the reservoir is that all of the juniper trees below the maximum reservoir operating pool elevation of 5754 ft (1754 m) are dead (Figure 2); the distinct line between living and dead trees clearly marks the high water level. As presented below, several small-scale landslides are associated with this line. The following discussion focuses on landslide deposits and Permian sedimentary rocks.

Landslide Deposits

As can be seen in Figure 1, Show Low Creek flows generally northward until it is deflected to the east-northeast by a large basalt-covered mesa. Along the flanks of the basalt-covered mesa (on both river left and river right) are extensive landslide deposits. SHB adequately and accurately map these landslides as Quaternary Landslide deposits, or *Qls*. The association of basalt overlying poorly cemented sedimentary rocks, in this case Triassic Moenkopi and Tertiary Bidahochi, commonly leads to the formation of hummocky landslide terrain. The large-scale landslides in the project area show no evidence of reactivation as a result of the reservoir pool. However, numerous, recent, smaller scale landslides were observed at the toes of the larger landslides within the reservoir area.

Figure 3 illustrates the apparent association of small, recent landslides with the sustained high water level. The landslides in Figure 3 are expressed as red soil exposed as a result of the landslide activity. The association of these small recent landslides with the high water mark is apparent. The high water level was identified by (1) the upper elevation of standing dead trees, notably juniper, that occur at approximately the same elevation (5754 ft, or 1754 m) within the entire reservoir area, and (2) by the location of driftwood, including cottonwood logs, boards, and branches (Figure 4) at this same elevation. Several large (3 feet (1 meter) in diameter) cottonwood logs found at the 5754 ft (1754 m) elevation are particularly important as the only way they could have gotten to their present position is by floating in as driftwood. There are no large, mature cottonwood trees growing on the landslide slopes in this area.

Coincident with the upper elevation limit of the dead trees and the driftwood line is abundant evidence of small-scale earth movement activity that is probably related to a sustained high water level. Although quite variable as to lateral extent and depth, the landslides are on the order of several meters to tens of meters long and wide. The landslide areas are characterized by (1) weak to strongly expressed arcuate headscarpe, (2) hummocky terrain below the headscarp, (3) exposure of underlying red soil and sediments, (4) rotated and rolled basalt boulders, (5) exposed, bare soil, (6) eroded soil line on in place boulders, and (6) located at approximately 5754 ft (1754 m). In some instances there is a trim-line where a thin cover of soil has been eroded by the high water level. These areas are generally located closer to the dam itself, on steep slopes consisting of Moenkopi Formation.

Figures 5 and 6 illustrate a particulary well-formed rotational slump, with a 1.5 meter high headscarp and a deformed, hummocky toe with transverse compression ridges. The toe of this slump is located at an elevation of approx. 5754 ft (1754 m).

Permian Sedimentary Rocks

Permian rocks exposed in the reservoir include limestone, sandy limestone, sandstone, limey siltstone, and limey sandstone beds (Figure 7 and 8). The Permian sedimentary sequence is undifferentiated but probably represents alternating nearshore facies of the Kaibab Formation. No Coconino Formation sandstones were found in the project area. The upper layers of the exposed *Pu* are generally massive limestone beds with fractures, dissolution pitting, and collapse features. Factures and collapse features are on the order of several meters deep. A thicker sequence of limestone occurs upstream near the confluence with Show Low Creek and Bull Hollow, where it reaches a cliff height of about 15 meters (50 feet). Closer to the center of the reservoir, and exposed on the eroded benches, are sandier layers. However, limestone units are still common within the reservoir area. A sinkhole mapped by SHB further indicates large-scale dissolution and possibly collapse features within the reservoir area at an elevation of 5690 feet (1734 m). The elevation of 5690 feet is important because SHB recommend a "permanent, maximum pool at an elevation of 5754 feet (1754 m) be established." However, they add, "Even with this [elevation] limitation, impoundment seepage may occur at a high rate resulting in a very low permanent pool." The easily weathered and fractured *Pu* deposits are the dominant lithologies of the reservoir floor.

In addition to the fractured and weathered nature of the *Pu* deposits, a possible fault offsets the *Trm* from the *Pu* in the vicinity of the main portion of the reservoir (Figure 1). Here, the older *Pu* is at the same or higher elevation as the younger *Trm* deposits.

Numerous faults and folds occur in the project area and surrounding locations and therefore it is not unlikely that unrecorded faults may also occur in the immediate project area, similar to the one mapped by SHB that trends through the Schoens Dam foundation.

Summary and Implications

Surficial deposits in the immediate dam area consist mainly of deposits from large-scale landslides. These deposits are composed of Quaternary basalt overlying unconsolidated or poorly consolidated sedimentary units of the Tertiary Bidahochi and/or Triassic Moenkopi Formations. There is no evidence that the relatively short-term, high water levels associated with reservoir pool fluctuations have reactivated the larger (and older) landslides. However, should there be a sustained reservoir with a water level that saturates these landslides, the potential for landslide reactivation may increase. Although the landslides remain stable, the toes of the landslides have clearly become unstable as a result of the higher water level sustained in the years since Schoens Dam was constructed. Several smaller-scale landslides and surficial erosion can be directly related to this sustained high water level as indicated by their spatial association with the line of dead trees and driftwood.

The bedrock units in the immediate vicinity of the dam are composed of Moenkopi and Bidahochi Formations. Much of the rest of the reservoir is composed of undifferentiated Permian sedimentary rocks with a high content of calcium carbonate (limestone, limey sandstone, etc.), making the rocks susceptible to dissolution weathering. Indeed, a large sinkhole is present in the floor of the reservoir. The rocks are characterized by numerous fractures, dissolution weathering, and some collapse features common in the *Pu* deposits of the region.

The implications of these field investigations are as follows. Regarding the surficial deposits, the sustained high water level (app. 5754 feet; 1754 m) in the reservoir has killed all trees below a certain elevation. This elevation is coincident with the presence of numerous relatively small-scale (meters to 10's meters) landslide and mass wasting features. Hillslope erosion and downslope movement of material as recorded by these mass movement events are due to this sustained high water level. Future high water levels will probably increase the rate of erosion and sedimentation in the reservoir. It is also possible that a sustained high water level might impact the large-scale landslide deposits (*Qls*), decreasing their stability and leading to landslide reactivation. Whether or not such events would lead to a rapid or catastrophic slope failure is unknown.

Undifferentiated Permian rocks underlie most of the reservoir floor, are composed of relatively easily weathered calcium carbonate-rich layers, and are susceptible to dissolution weathering and seepage loss along fractures and sinks.

Based on field investigations and aerial photographic interpretations undertaken by the author, the geologic maps prepared by SHB for the initial investigations of Schoens Dam and Reservoir are adequate and accurate regarding the nature and extent of geologic deposits. The occurrence of unmapped faults within the reservoir area, however, is possible.

In summary, this report presents the results of a geologic assessment of the surficial and bedrock deposits of Schoens Reservoir. Although Schoens Dam may be suitable as a flood control feature (not assessed as part of this report), it appears that the underlying bedrock geology and the surrounding landslides present considerable obstacles to maintaining a sustained reservoir for either recreational or irrigation purposes. Indeed, the potential for seepage loss through the underlying bedrock and for increased rates of reservoir sedimentation, from greater hillslope erosion, are significant.

References

Peterson, D.E., and Hulpke, M.R. (staff geologists), 1982, Generalized Geologic Map in Vicinity of Schoens Dam and Reservoir, in SHB Job # E82-90.

Peterson, D.E., and Hulpke, M.R. (staff geologists), 1982, Geologic Map Schoens Dam and Reservoir, in SHB Job # E82-90.

Sergent, Hauskins, and Beckwith, 1982, Phase II Design Development Report for the Proposed Schoens Dam and Reservoir, SHB Job # E82-90, Show Low Creek, Navajo County, Arizona.

Sergent, Hauskins, and Beckwith 1983. Schoens Dam Phase III, SHB Job # E83-120, Show Low Creek, Navajo County, Arizona.

Richardson, S.M., Reynolds, S.J., Spencer, J.E., and Pearthree, P.A., 2000, Geologic Map of Arizona, Arizona Geological Survey Map 35, Tucson, Arizona.

Figure Captions

Figure 1. This geologic map is reproduced from the original SHB geologic map, with minor additions and comments. A photocopy of the original is included in the Appendix for reference. Numbers are figure numbers, indicating the approximate location of photographs. Map symbols follow those of the original map; there are no changes or additions to the number or types of geologic units. The newly discovered small-scale landslides are too small to map at this scale. A north-south trending normal fault is suspected to offset the Moenkopi layers from the Permian layers but that fault has not been fully documented.

Figure 2. Overview (facing south) of Show Low Creek. Photograph taken from top of landslide deposits (see Figure 1 for photo location). Note the dramatic line of dead trees that represents the elevation of the sustained high water level of the reservoir. Also note the presence of *Pu* flooring the reservoir. The two-track road is for scale.

Figure 3. Overview (facing northeast) of the reservoir area, with axis of Show Low Creek on the right of the photograph. The line of dead juniper trees marks the sustained high water level. At the approximate elevation of this water level are numerous small-scale landslides, which are seen here as exposed red soil. The landslides range in character from the removal of relatively thin (< 4 in [10 cm]) overlying soil and displaced boulders, to the occurrence of a rotational slump with a 5-ft (1.5-m) high scarp (shown in Figures 5 and 6).

Figure 4. Photograph of the sustained high water level indicated by the line of dead juniper trees and large cottonwood driftwood logs. Photograph facing northeast. Person in center of photograph is approximately 5′9″ (1.75 m) tall.

Figure 5. Overview (facing southwest) of rotational slump showing head scarp, transverse compression ridges, and approximate slump boundary. Person in center of photograph (5’9” [1.75 m] tall) is standing at the toe of the slump, which is coincident with the line of dead trees marking the sustained high water level.

Figure 6. Close-up view of head scarp and hummocky surface of transverse ridges associated with the rotational slump shown in Figure 5. Photograph facing northeast. Rotational slump is about 65 ft (20 m) long. Fanny pack in center of photograph is 8 in (20 cm) high.

Figure 7. Photograph showing the occurrence of weathered *Pu* limestone (top of outcrop) and limey sandstone (bottom of outcrop) on the floor of the reservoir. Photograph facing northwest. Line of dead trees is above this outcrop, indicating that much of the fractured bedrock in this area is below water during high reservoir levels.

Figure 8. View of *Pu* showing fractures extending through the upper limestone layers into the lower sandstone layers. Photograph facing east. The high water level occurred approximately half way up this outcrop as indicated by the dead trees in the foreground and the living trees on

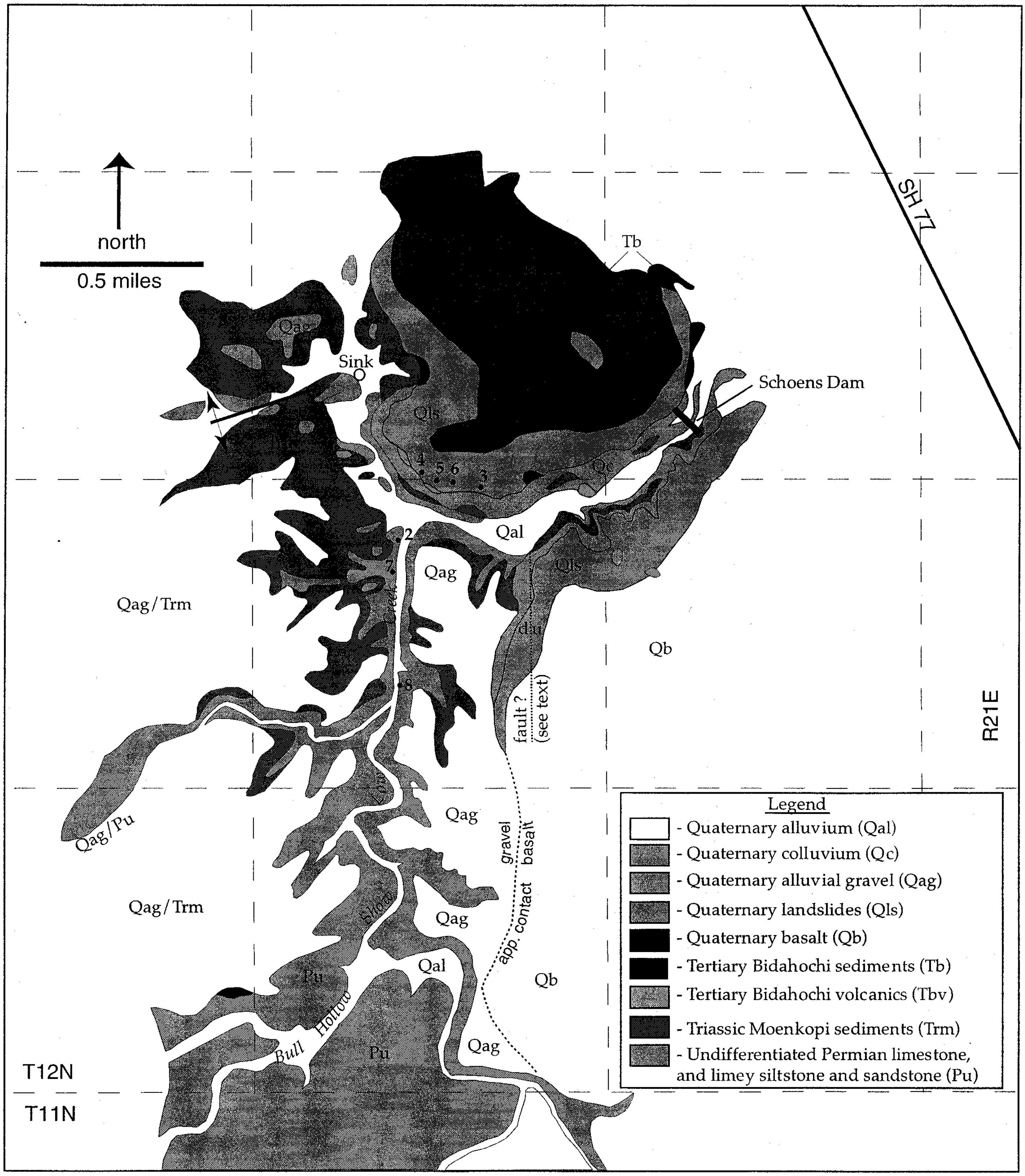


Figure 1. Geologic map modified from Sergent, Hauskins, Beckwith, 1982. (Qag covers much of the project area and its boundaries are not mapped; Qal only in drainages). Numbers indicate Figure numbers and locations discussed in text.

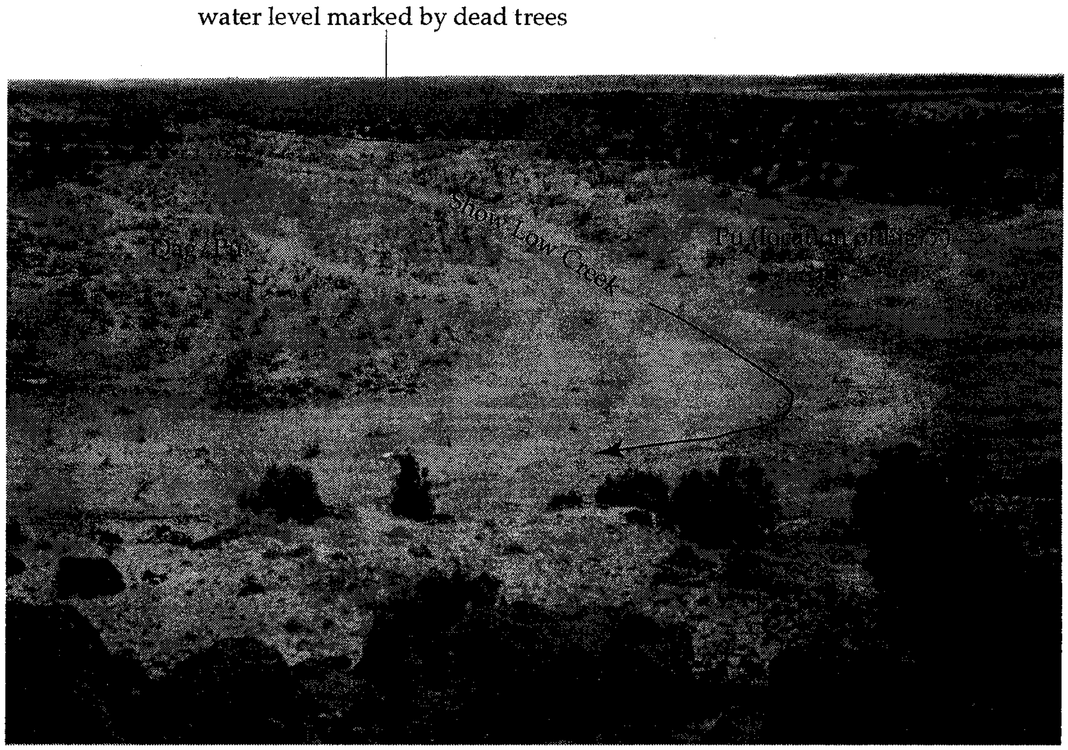


Figure 2.

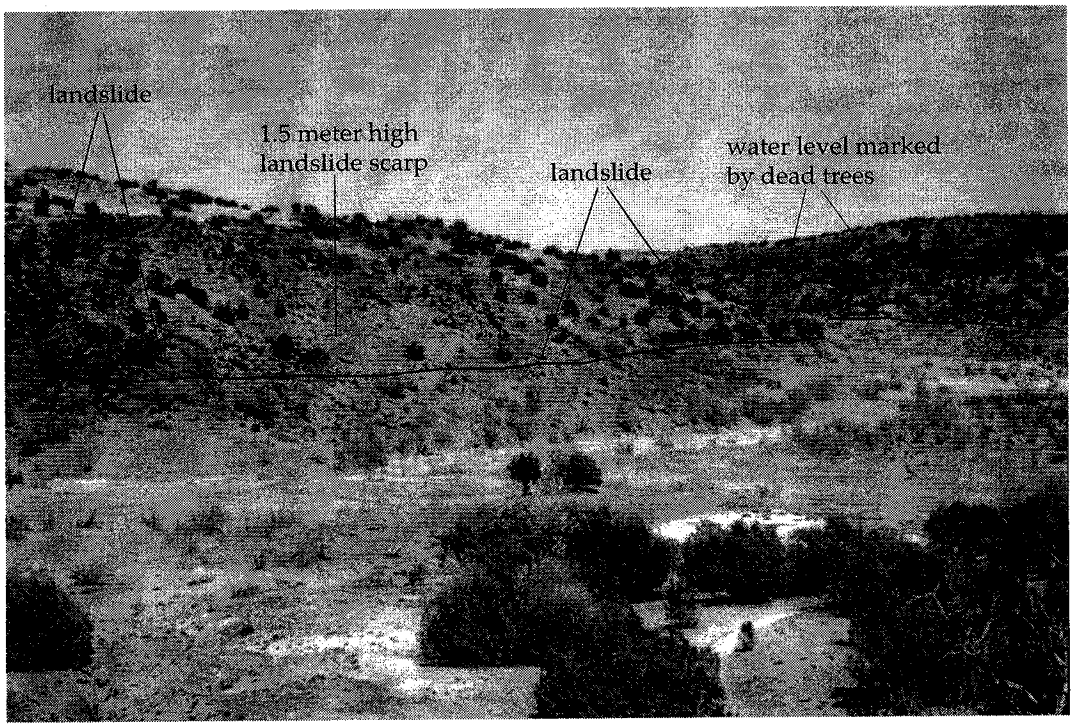

landslide
1.5 meter high
landslide scarp
landslide
water level marked
by dead trees

Figure 3.

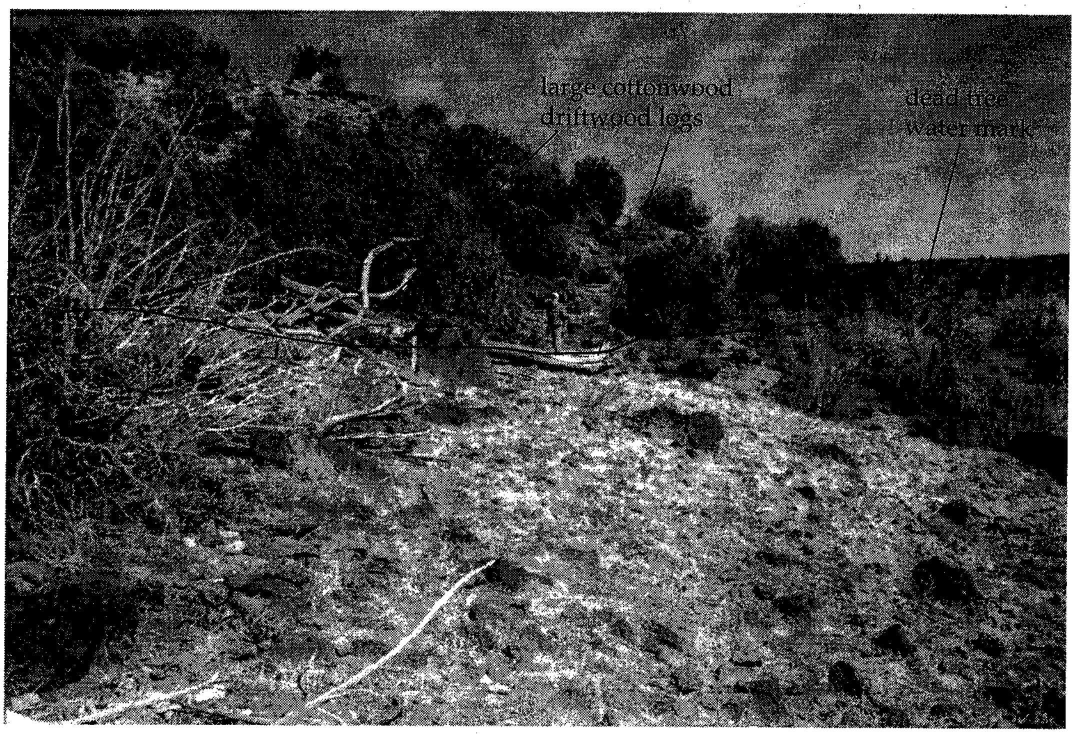


Figure 4.

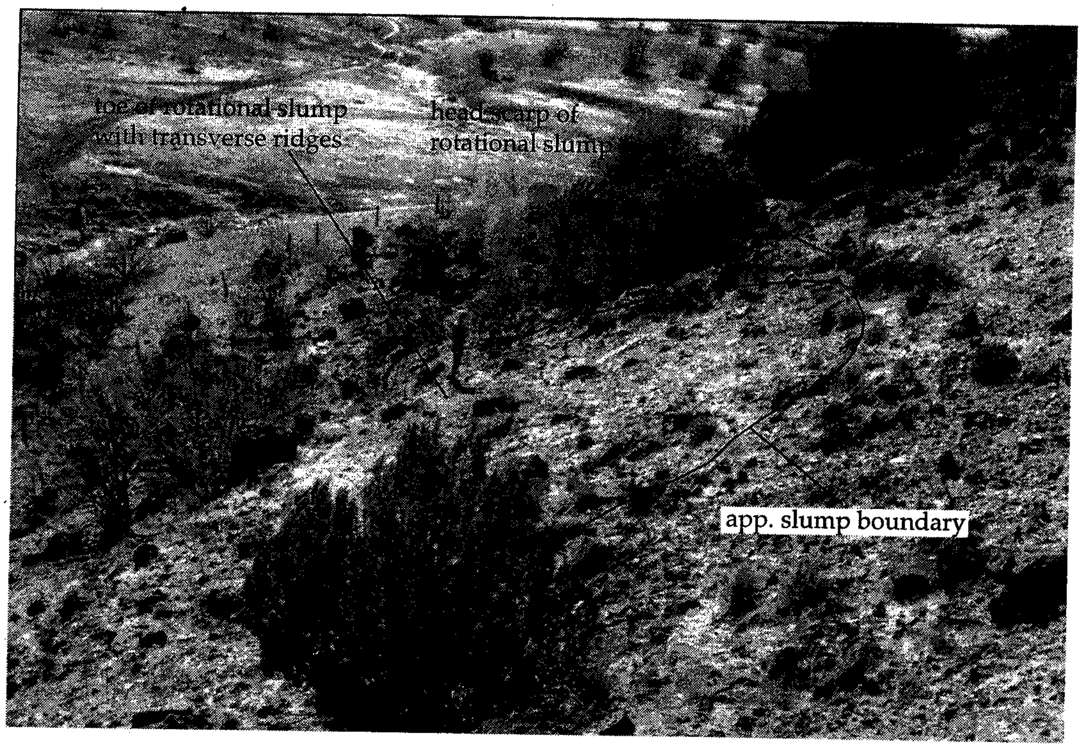


Figure 5.

Figure 6.

Figure 7.

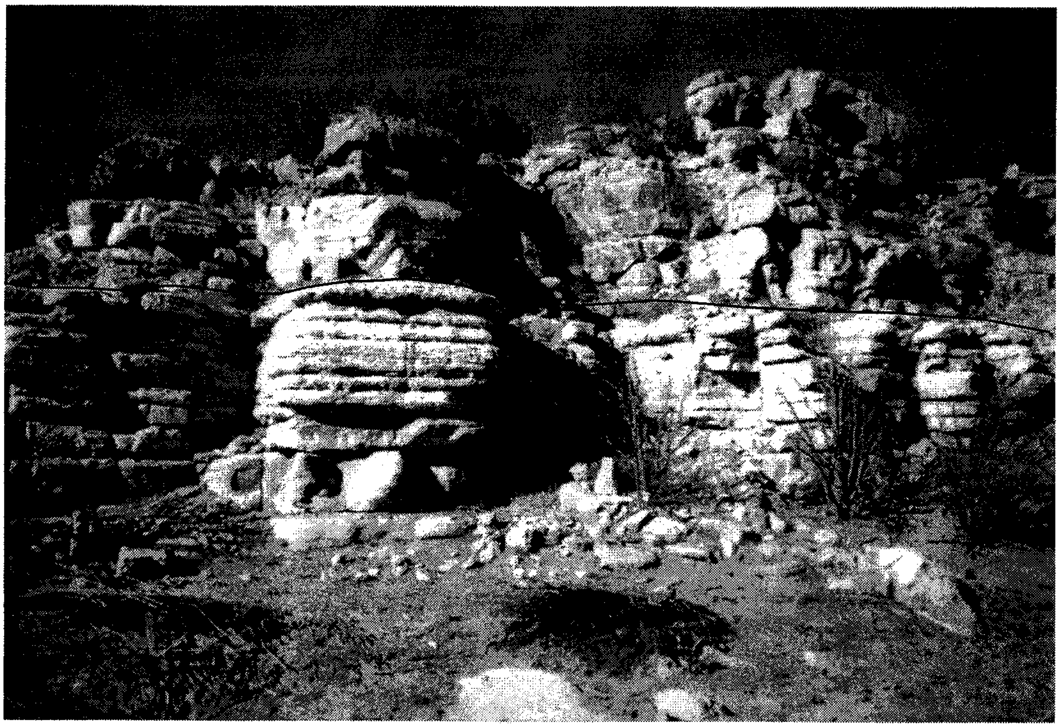
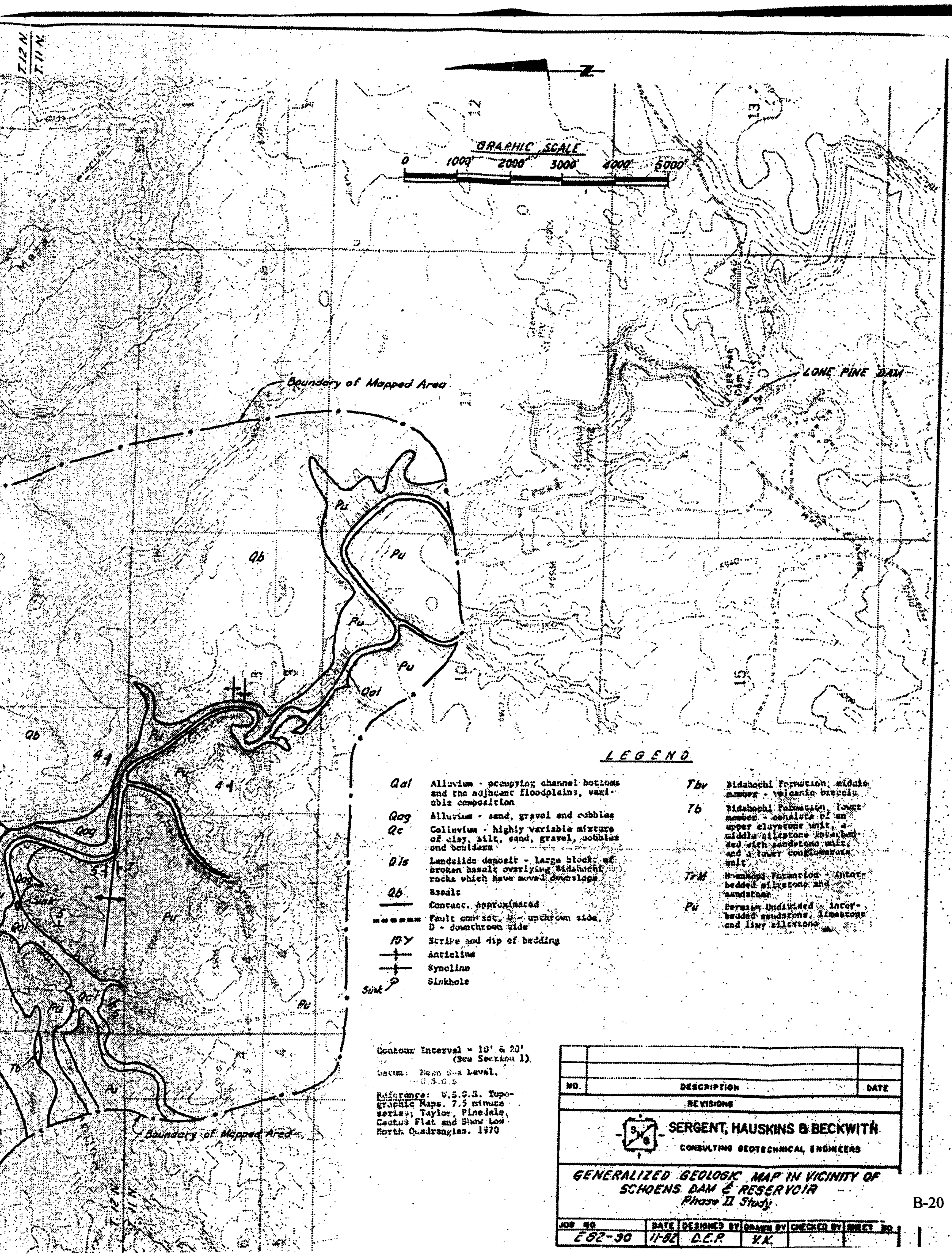


Figure 8.


Shumway
R.22E.
R.21E.
State Highway 77
Proposed Schoens Dam Site
Remote Spillway Site
Pinedale Road
Qag
TrM
Tb
Qal
Qc
Qb
Qls
Tbv
Qag/Tb
Pu
Qag/TrM


N
GRAPHIC SCALE
0 1000' 2000' 3000' 4000' 5000'
T.12 N.
T.11 N.
LONE PINE DAM
Boundary of Mapped Area
Qb
Pu
Qal
Qag
Tb
LEGEND
Qal Alluvium - occupying channel bottoms and the adjacent floodplains, variable composition
Qag Alluvium - sand, gravel and cobbles
Qc Colluvium - highly variable mixture of clay, silt, sand, gravel, cobbles and boulders
Qls Landslide deposit - Large blocks of broken basalt overlying Bidahochi rocks which have moved downslope
Qb Basalt
Contact, approximated
Fault contact, U - upthrown side, D - downthrown side
Strike and dip of bedding
Anticline
Syncline
Sink Sinkhole
Tbv Bidahochi Formation, middle member - volcanic breccia
Tb Bidahochi Formation, lower member - consists of an upper claystone unit, a middle siltstone interbedded with sandstone unit, and a lower conglomerate unit
TRM Moenkopi Formation - interbedded siltstone and sandstone
Pu Permian Undivided - interbedded sandstone, limestone and limy siltstone
Contour Interval = 10' & 20' (See Section 1)
Datum: Mean Sea Level, U.S.G.S.
Reference: U.S.G.S. Topographic Maps, 7.5 minute series; Taylor, Pinedale, Cactus Flat and Show Low North Quadrangles. 1970
NO.
DESCRIPTION
DATE
REVISIONS
SERGENT, HAUSKINS & BECKWITH
CONSULTING GEOTECHNICAL ENGINEERS
GENERALIZED GEOLOGIC MAP IN VICINITY OF SCHOENS DAM & RESERVOIR
Phase II Study
JOB NO. E82-30
DATE 11-82
DESIGNED BY D.C.P.
DRAWN BY V.K.
CHECKED BY
SHEET NO.

APPENDIX C: FIGURES

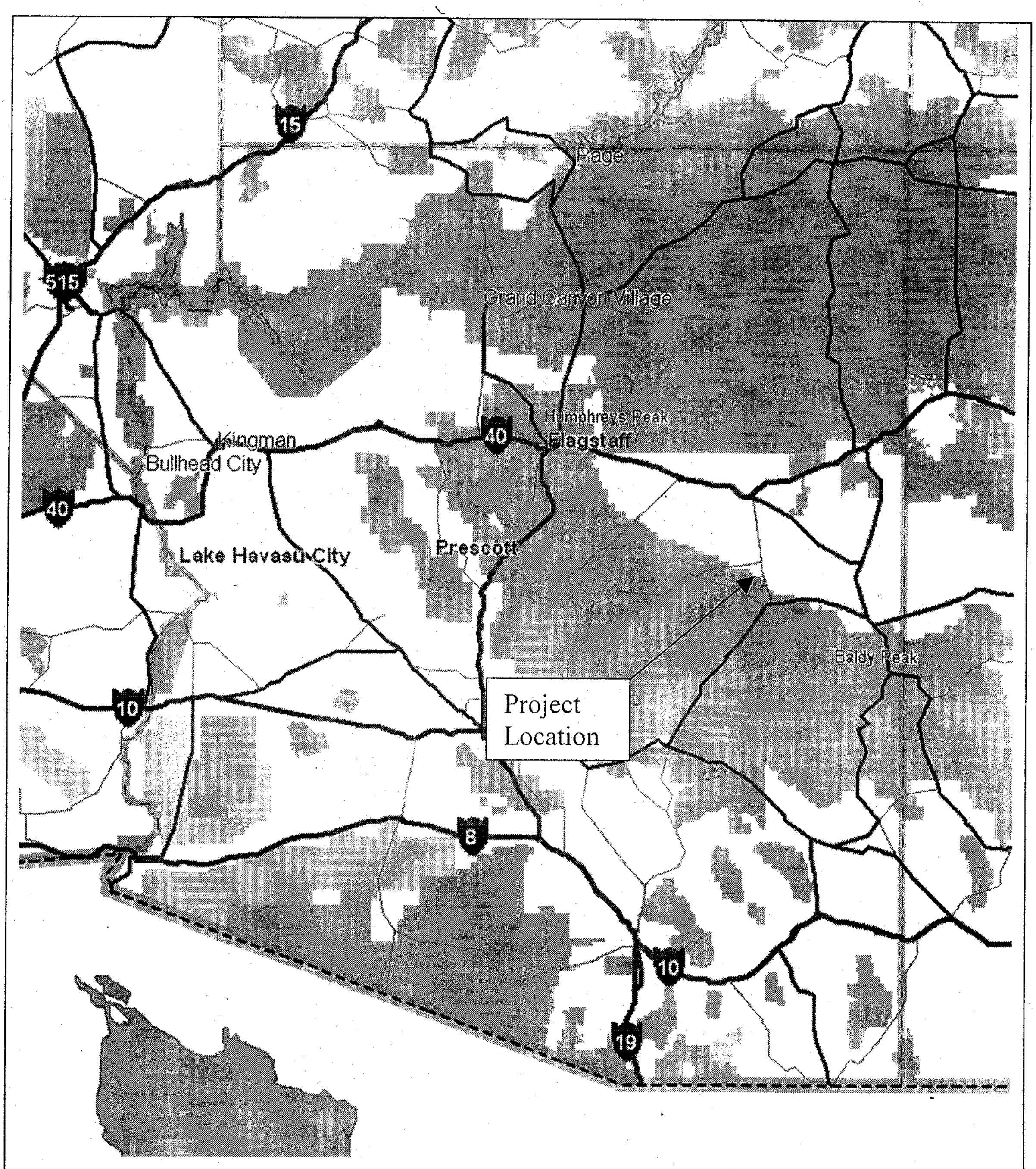


Figure 1 - Location Map

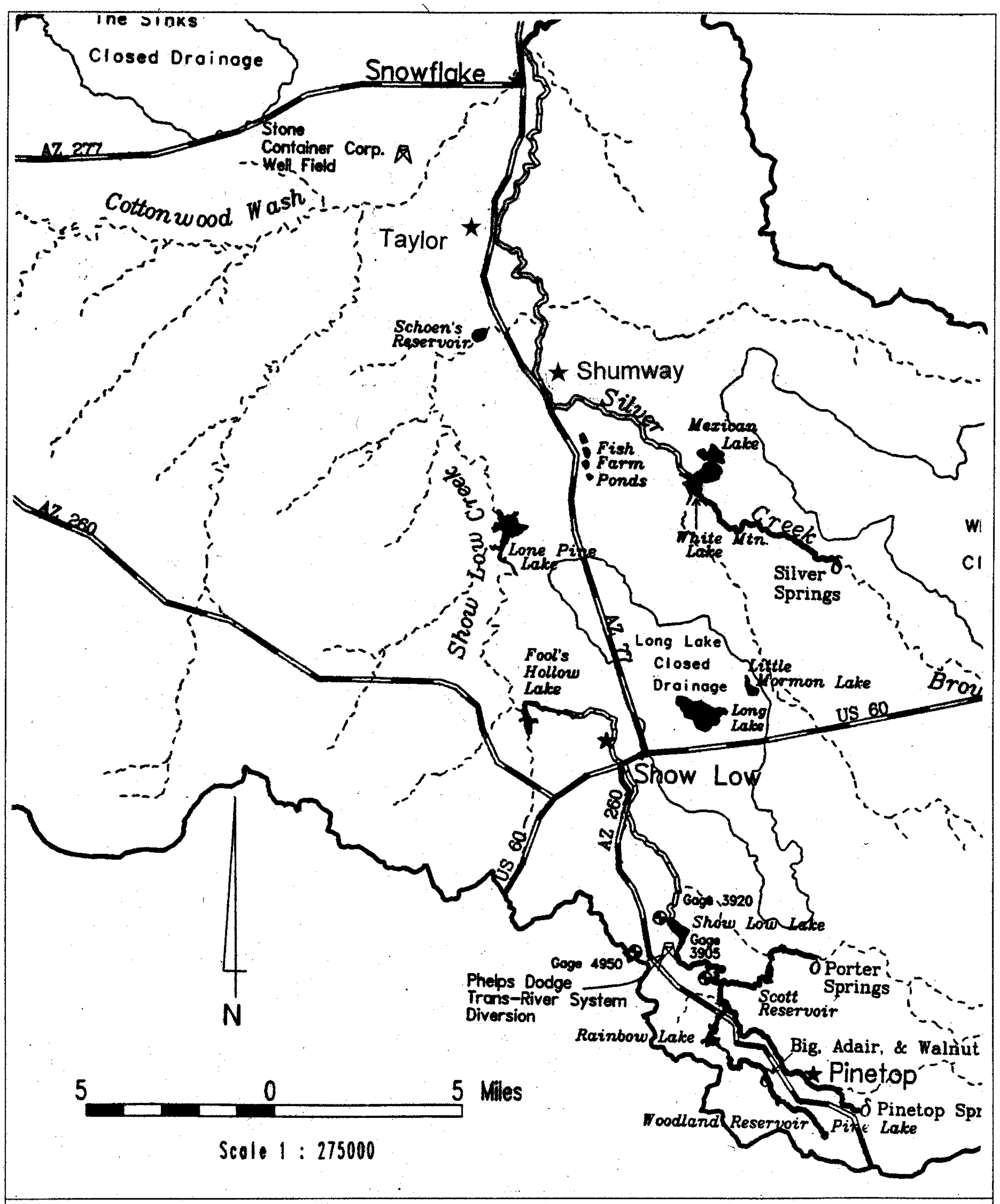


Figure 2 - Vicinity Map

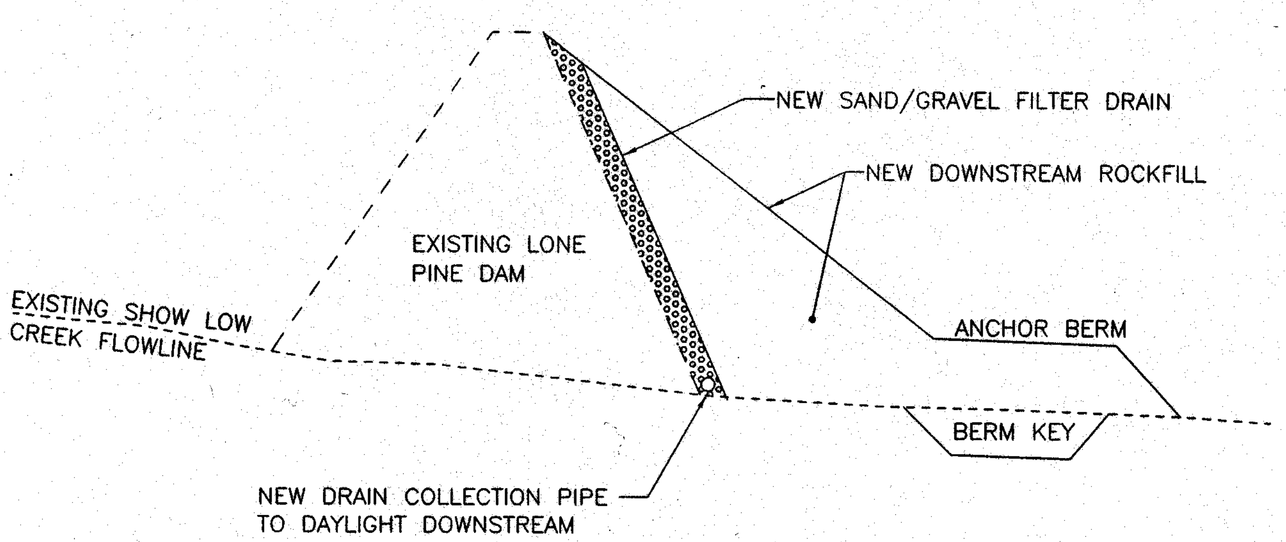


FIGURE 3 – DOWNSTREAM SLOPE IMPROVEMENTS
(NO SCALE)

APPENDIX D: SUPPORTING DOCUMENTATION AND CALCULATIONS FOR LONE PINE DAM REMEDIATION ALTERNATIVES

Summary of Teleconference Meeting on 10/16/01
Subject: Lone Pine Dam and Schoens Dam
Prepared by Jim Janecek and Charlie Schlinger of NAU
NAU Project EGR38BA

Conferees:
Gerry Cox, ADWR
Bill Jenkins, ADWR
Jon Benoist, ADWR
Jim Swaisgood, Swaisgood Consulting
Charlie Schlinger, NAU
Jim Janecek, NAU

- ADWR's concerns for Lone Pine Dam and the agency's *Unsafe, Non-Emergency* classification of the structure reflect the results of past observations and investigations and are the following:

1) The reservoir has repeatedly demonstrated an inability to store water due to seepage through basalts and the underlying cavernous Kaibab limestone. Numerous sinkholes have been documented over the years.
2) The dam foundation has repeatedly shown seepage and potential piping problems when full, due to seepage through basalt and limestone in the foundation. Numerous seeps have been documented, some of which were murky indicating removal of fines.
3) Hydrological studies indicate that the spillway may be inadequate. The reservoir, which is to be maintained in an empty condition due to the dam's unsafe classification, fills very quickly as its 24" outlet pipe, which is maintained open at all times, is undersized.
4) Exploratory drilling of the dam's foundation encountered voids in all of the drill holes.

- Charlie Schlinger inquired whether reclassifying the hazard potential of the dam even in its current condition might yield a lower hazard classification. There is uncertainty as to whether the current *High Hazard* classification is appropriate, given the current use(s) of Schoen's reservoir and the intervening channel area. ADWR staff indicated that as long as the crest of Lone Pine Dam serves as County road, reclassification to a status lower than *Significant* is unlikely. We did not discuss whether any sort of automated crossing gates (similar to those used for railroad tracks) along the county road would permit a classification lower than *Significant*.

- Jim Janecek asked why Lone Pine Dam safety remains an issue after Schoens Dam was built – apparently as a solution offered by Navajo County. ADWR staff indicated that the agency never accepted Schoens Dam as a complete mitigation solution for hazards posed by Lone Pine Dam and the agency remains with concerns about the impact of a failure at Lone Pine Dam on downstream recreational users particularly those who may be in the vicinity of the Schoens reservoir at the time of a failure. To the best of their recollection, Navajo County was aware of this at the time the decision was made to construct Schoens Dam. In any case, Lone Pine Dam is still declared *Unsafe* and ADWR is pursuing resolution.

- Jim Janecek proposed the idea of treating Lone Pine Dam as a roadway earth fill embankment with a large culvert (or series of culverts) that might be jacked horizontally through the fill so that reservoir storage is minimized and the spillway not used. ADWR staff responded that the idea sounded plausible and that such a remedy might be a resolution to the current problem. However, ADWR staff pointed out that for the dam to be treated as a culverted embankment, the headwater during a design flow must not exceed 1.5 times the culvert diameter. ADWR staff indicated that the design flow for such a design would probably be the 100-year event and that this approach would probably require that the County apply to have the dam removed from State jurisdiction; ADWR staff indicated there are no precedents for this sort of an action in ADWR's experience.

- Charlie Schlinger commented that an early pre-design information sheet for Schoens Dam indicated a substantial 30,000+ ac-ft reservoir that included a recreational component, but that the dam ultimately built had as its main purpose flood control, with only 6000 ac-ft for sediment and irrigation water storage. ADWR staff indicated that the County/Irrigation District didn't have 30,000+ ac-ft of water rights and that water rights for Schoens may have been transferred from Lone Pine. ADWR staff encouraged us to resolve the water rights questions (what was there originally at Lone Pine, what was or was not transferred, what is available, etc.). Lisa Logan was mentioned by name as a suggested contact at ADWR for water rights information.

- ADWR was uncertain why, but their staff comments during this part of our discussion revealed that stability analyses were not done for mapped landslide deposits in the Schoens reservoir area since the maximum permanent pool elevation was set somewhat below the toe of mapped landslide deposits. The existing design reports express concern that these landslide deposits may become unstable if saturated from a permanent reservoir pool.

- ADWR staff pointed out that the Schoens Dam foundation had a full grout curtain, but that grouting of the abutments was more limited, since the dam was not designed to hold a full pool for an extended period of time.

- ADWR staff indicated that they believe that their files include reports with stability calculations for the spillway area of Schoens Dam. These stability evaluations were done during initial design and after the landslide occurred in spillway construction. ADWR staff indicated that strength parameters of the

Bidahochi Formation fissured clay, which was key in the spillway slope stability failure, were back calculated by SHB (Sergent Hauskins & Beckwith – the design engineers for Schoens dam).

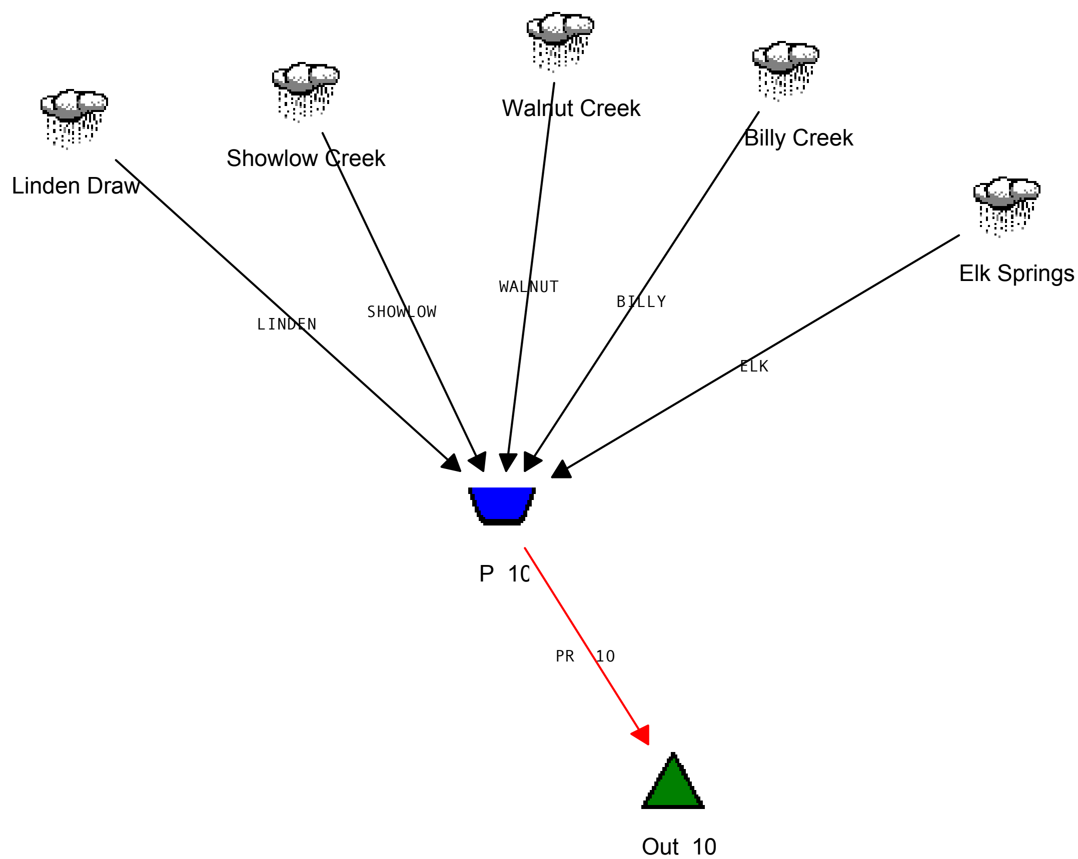
- An issue for both Schoens Dam and Lone Pine Dam is the potential groundwater recharge provided by these structures. Pete Shumway is very interested in this issue as it pertains to Lone Pine Dam. NAU mentioned that they will be examining the recharge potential that Lone Pine may offer and asked whether ADWR was aware of any evaluations in this regard that might have been done in the area. ADWR indicated that they are unaware of any existing studies but pointed out that ADWR does have on its staff individuals who may be able to provide resources in this area.

- ADWR staff pointed out that the Schoens reservoir area has extensive outcroppings of Kaibab Formation limestone above Schoens Crossing and that this may place a limitation on the viability of significant reservoir storage were the necessary permits (U.S. Army Corps of Engineers, U.S. Forest Service) to be obtained to raise the pool and water rights in place, other engineering issues (insufficient abutment grouting; landslide potential) aside.

- ADWR staff pointed out that when the Schoens Reservoir water level has been above its maximum operational level of 5754 ft, the reservoir has exhibited dramatic increases in seepage (no data; visual observations only).

- The Lone Pine reservoir fills up rapidly during significant hydrological events. ADWR indicated that there may be some inadequacy in the spillway. If so, the spillway inadequacy will be considered a safety deficiency by ADWR.

Recreation of Lone Pine Watershed Network in PondPack Using Curve Numbers and Times of Concentration from Engineers Testing Laboratories, Inc. Report, "Phase I – Investigation and Evaluation, Lone Pine Dam, Navajo County, Arizona", dated 12/11/79. SCS Type II 24-Hour Storm Used and Rainfall Adjusted Until 100 Year Peak Storm Runoff Matched the 100 year Peak Runoff Listed in Dames and Moore Report, "Reconnaissance-Level Flood Control Study, Lone Pine Dam," dated 7/20/81.



ANALYSIS OF NEW CULVERTS PROPOSED AT LONE PINE DAM

Type.... Master Summary
Name.... Watershed
File.... C:\JJ\LONE PINE 4.PPW

MASTER DESIGN STORM SUMMARY

Default Network Design Storm File, ID ARIZONA.RNQ   Lone Pine

Return Event	Total Depth in	Rainfall Type	RNF File	RNF ID
100	2.7000	Synthetic Curve	SCSTYPES	TypeII 24hr

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID		Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
BILLY CREEK		AREA	100	545.444		14.0000	1326.09		
ELK SPRINGS		AREA	100	1737.631		14.5000	3351.77		
LINDEN DRAW		AREA	100	594.782		13.5000	1632.97		
*OUT 10		JCT	100	6117.884		15.0000	10446.90		
P 10	IN	POND	100	6117.882		14.5000	10525.13		
P 10	OUT	POND	100	6117.884		15.0000	10446.90	935.49	49.422
SHOWLOW CREEK		AREA	100	2991.652		15.5000	4915.84		
WALNUT CREEK		AREA	100	248.374		13.5000	646.12		

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Type.... Executive Summary (Nodes)
Name.... Watershed                                          Event: 100 yr
File.... C:\JJ\LONE PINE 4.PPW
Storm... TypeII  24hr   Tag: 100

                       NETWORK SUMMARY -- NODES
      (Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

   DEFAULT Design Storm File,ID = ARIZONA.RNQ  Lone Pine


   Storm Tag Name      = 100
   --------------------------------------------------------------------
   Data Type, File, ID = Synthetic Storm  SCSTYPES.RNF  TypeII  24hr
   Storm Frequency     = 100 yr
   Total Rainfall Depth= 2.7000 in
   Duration Multiplier =  1
   Resulting Duration  = 24.0000 hrs
   Resulting Start Time= .0000 hrs  Step= .1000 hrs  End= 24.0000 hrs
```

Node ID		Type	HYG Vol ac-ft	Trun.	Qpeak hrs	Qpeak cfs	Max WSEL ft
	BILLY CREEK	AREA	545.444		14.0000	1326.09	
	ELK SPRINGS	AREA	1737.631		14.5000	3351.77	
	LINDEN DRAW	AREA	594.782		13.5000	1632.97	
Outfall	OUT 10	JCT	6117.884		15.0000	10446.90	
	P 10 IN	POND	6117.882		14.5000	10525.13	
	P 10 OUT	POND	6117.884		15.0000	10446.90	935.49
	SHOWLOW CREEK	AREA	2991.652		15.5000	4915.84	
	WALNUT CREEK	AREA	248.374		13.5000	646.12	

```
Type.... Executive Summary (Links)
Name.... Watershed                                        Event: 100 yr
File.... C:\JJ\LONE PINE 4.PPW
Storm... TypeII  24hr   Tag: 100

                        NETWORK SUMMARY -- LINKS
      (UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
      (Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

   DEFAULT Design Storm File,ID = ARIZONA.RNQ  Lone Pine


   Storm Tag Name      = 100
   --------------------------------------------------------------------
   Data Type, File, ID = Synthetic Storm  SCSTYPES.RNF  TypeII  24hr
   Storm Frequency     = 100 yr
   Total Rainfall Depth= 2.7000 in
   Duration Multiplier =  1
   Resulting Duration  = 24.0000 hrs
   Resulting Start Time= .0000 hrs  Step= .1000 hrs  End= 24.0000 hrs
```

Link ID	Type		HYG Vol ac-ft	Trun.	Peak Time hrs	Peak Q cfs	End Points	
BILLY	ADD	UN	545.444		14.0000	1326.09	BILLY CREEK	
		DL	545.444		14.0000	1326.09		
		DN	6117.882		14.5000	10525.13	P 10	IN
ELK	ADD	UN	1737.631		14.5000	3351.77	ELK SPRINGS	
		DL	1737.631		14.5000	3351.77		
		DN	6117.882		14.5000	10525.13	P 10	IN
LINDEN	ADD	UN	594.782		13.5000	1632.97	LINDEN DRAW	
		DL	594.782		13.5000	1632.97		
		DN	6117.882		14.5000	10525.13	P 10	IN
PR 10	PONDrt	UN	6117.882		14.5000	10525.13	P 10	IN
PR 10			6117.884		15.0000	10446.90	P 10	OUT
		DL	6117.884		15.0000	10446.90		
		DN	6117.884		15.0000	10446.90	OUT 10	
SHOWLOW	ADD	UN	2991.652		15.5000	4915.84	SHOWLOW CREEK	
		DL	2991.652		15.5000	4915.84		
		DN	6117.882		14.5000	10525.13	P 10	IN
WALNUT	ADD	UN	248.374		13.5000	646.12	WALNUT CREEK	
		DL	248.374		13.5000	646.12		
		DN	6117.882		14.5000	10525.13	P 10	IN

```
Type.... Design Storms
Name.... Lone Pine                                          Event: 100 yr
File.... C:\HAESTAD\PPKW\RAINFALL\ARIZONA.RNQ
Storm... TypeII  24hr   Tag: 100

                DESIGN STORMS SUMMARY

 Design Storm File,ID = ARIZONA.RNQ   Lone Pine


 Storm Tag Name      = 100
 ----------------------------------------------------------------------
 Data Type, File, ID = Synthetic Storm  SCSTYPES.RNF  TypeII  24hr
 Storm Frequency     = 100 yr
 Total Rainfall Depth= 2.7000 in
 Duration Multiplier =  1
 Resulting Duration  = 24.0000 hrs
 Resulting Start Time= .0000 hrs  Step= .1000 hrs  End= 24.0000 hrs
```

```
Type.... Synthetic Curve
Name.... TypeII  24hr       Tag: 100
File.... C:\HAESTAD\PPKW\RAINFALL\SCSTYPES.RNF
```

CUMULATIVE RAINFALL FRACTIONS
Output Time increment = .1000 hrs
Time on left represents time for first value in each row.

Time hrs					
.0000	.000	.001	.002	.003	.004
.5000	.005	.006	.007	.008	.009
1.0000	.011	.012	.013	.014	.015
1.5000	.016	.017	.018	.020	.021
2.0000	.022	.023	.024	.026	.027
2.5000	.028	.029	.031	.032	.033
3.0000	.035	.036	.037	.038	.040
3.5000	.041	.042	.044	.045	.047
4.0000	.048	.049	.051	.052	.054
4.5000	.055	.057	.058	.060	.061
5.0000	.063	.065	.066	.068	.070
5.5000	.071	.073	.075	.076	.078
6.0000	.080	.082	.084	.085	.087
6.5000	.089	.091	.093	.095	.097
7.0000	.099	.101	.103	.105	.107
7.5000	.109	.111	.113	.116	.118
8.0000	.120	.122	.125	.127	.130
8.5000	.132	.135	.138	.141	.144
9.0000	.147	.150	.153	.157	.160
9.5000	.163	.166	.170	.173	.177
10.0000	.181	.185	.189	.194	.199
10.5000	.204	.209	.215	.221	.228
11.0000	.235	.243	.251	.261	.271
11.5000	.283	.307	.354	.431	.568
12.0000	.663	.682	.699	.713	.725
12.5000	.735	.743	.751	.759	.766
13.0000	.772	.778	.784	.789	.794
13.5000	.799	.804	.808	.812	.816
14.0000	.820	.824	.827	.831	.834
14.5000	.838	.841	.844	.847	.850
15.0000	.854	.856	.859	.862	.865
15.5000	.868	.870	.873	.875	.878
16.0000	.880	.882	.885	.887	.889
16.5000	.891	.893	.895	.898	.900
17.0000	.902	.904	.906	.908	.910
17.5000	.912	.914	.915	.917	.919
18.0000	.921	.923	.925	.926	.928
18.5000	.930	.931	.933	.935	.936
19.0000	.938	.939	.941	.942	.944
19.5000	.945	.947	.948	.949	.951
20.0000	.952	.953	.955	.956	.957
20.5000	.958	.960	.961	.962	.964
21.0000	.965	.966	.967	.968	.970
21.5000	.971	.972	.973	.975	.976
22.0000	.977	.978	.979	.981	.982
22.5000	.983	.984	.985	.986	.988
23.0000	.989	.990	.991	.992	.993
23.5000	.994	.996	.997	.998	.999
24.0000	1.000				

```
Type.... Synthetic Cumulative Depth
Name.... TypeII  24hr       Tag: 100                      Event: 100 yr
File.... C:\HAESTAD\PPKW\RAINFALL\SCSTYPES.RNF
Storm... TypeII  24hr   Tag: 100
```

CUMULATIVE RAINFALL DEPTHS (in)
Output Time increment = .1000 hrs
Time on left represents time for first value in each row.

Time hrs					
.0000	.0000	.0027	.0055	.0082	.0110
.5000	.0139	.0167	.0196	.0225	.0254
1.0000	.0284	.0313	.0343	.0374	.0404
1.5000	.0436	.0467	.0498	.0530	.0562
2.0000	.0594	.0627	.0659	.0693	.0726
2.5000	.0760	.0793	.0828	.0862	.0897
3.0000	.0932	.0967	.1002	.1038	.1074
3.5000	.1111	.1147	.1184	.1221	.1258
4.0000	.1296	.1334	.1373	.1412	.1452
4.5000	.1492	.1533	.1574	.1616	.1658
5.0000	.1701	.1744	.1788	.1833	.1878
5.5000	.1924	.1970	.2017	.2064	.2112
6.0000	.2160	.2209	.2258	.2308	.2359
6.5000	.2410	.2461	.2513	.2566	.2619
7.0000	.2673	.2727	.2782	.2837	.2893
7.5000	.2950	.3007	.3064	.3122	.3181
8.0000	.3240	.3301	.3364	.3430	.3499
8.5000	.3571	.3645	.3722	.3802	.3884
9.0000	.3969	.4055	.4142	.4228	.4315
9.5000	.4401	.4490	.4582	.4680	.4781
10.0000	.4887	.4998	.5116	.5240	.5371
10.5000	.5508	.5654	.5810	.5978	.6156
11.0000	.6345	.6552	.6786	.7045	.7330
11.5000	.7641	.8285	.9568	1.1631	1.5332
12.0000	1.7901	1.8413	1.8863	1.9252	1.9579
12.5000	1.9845	2.0073	2.0287	2.0487	2.0672
13.0000	2.0844	2.1005	2.1158	2.1304	2.1442
13.5000	2.1573	2.1697	2.1816	2.1929	2.2037
14.0000	2.2140	2.2239	2.2336	2.2431	2.2524
14.5000	2.2616	2.2705	2.2793	2.2879	2.2963
15.0000	2.3045	2.3125	2.3203	2.3279	2.3353
15.5000	2.3426	2.3496	2.3565	2.3632	2.3697
16.0000	2.3760	2.3822	2.3883	2.3943	2.4003
16.5000	2.4062	2.4120	2.4178	2.4235	2.4292
17.0000	2.4347	2.4402	2.4457	2.4510	2.4563
17.5000	2.4616	2.4667	2.4718	2.4768	2.4818
18.0000	2.4867	2.4915	2.4963	2.5010	2.5056
18.5000	2.5102	2.5146	2.5191	2.5234	2.5277
19.0000	2.5319	2.5361	2.5402	2.5442	2.5481
19.5000	2.5520	2.5558	2.5596	2.5632	2.5669
20.0000	2.5704	2.5739	2.5774	2.5809	2.5843
20.5000	2.5878	2.5912	2.5946	2.5980	2.6015
21.0000	2.6048	2.6082	2.6115	2.6149	2.6182
21.5000	2.6215	2.6248	2.6281	2.6314	2.6347
22.0000	2.6379	2.6411	2.6444	2.6476	2.6508
22.5000	2.6539	2.6571	2.6603	2.6634	2.6665
23.0000	2.6696	2.6727	2.6758	2.6789	2.6819
23.5000	2.6850	2.6880	2.6910	2.6940	2.6970
24.0000	2.7000				

```
Type.... SCS Unit Hyd. Equations
File.... C:\JJ\LONE PINE 4.PPW
```

SCS UNIT HYDROGRAPH METHOD
(Computational Notes)

```
 DEFINITION OF TERMS: ------------------------------------------------

 At    = Total area (acres):  At = Ai+Ap
 Ai    = Impervious area (acres)
 Ap    = Pervious area (acres)
 CNi   = Runoff curve number for impervious area
 CNp   = Runoff curve number for pervious area
 fLoss = f loss constant infiltration (depth/time)
 dt    = Computational increment (duration of unit excess rainfall)
         Default dt is smallest value of 0.1333Tc, rtm, and th
         (Smallest dt is then adjusted to match up with Tp)
UDdt   = User specified override computational main time increment
         (only used if UDdt is => .1333Tc)
 D(t)  = Point on distribution curve (fraction of P) for time step t

 K     = 2 / (1 + (Tr/Tp)):  default K = 0.75: (for Tr/Tp = 1.67)
 Ks    = Hydrograph shape factor
       = Unit Conversions * K:
       = ((1hr/3600sec) * (1ft/12in) * ((5280ft)**2/sq.mi)) * K
         Default Ks = 645.333 * 0.75 = 484

 Lag   = Lag time from center of excess runoff (dt) to Tp:  Lag = 0.6Tc
 P     = Total precipitation depth, inches
 Pa(t) = Accumulated rainfall at time step t
 Pi(t) = Incremental rainfall at time step t
 qp    = Peak discharge (cfs) for 1in. runoff, for 1hr, for 1 sq.mi.
       = (Ks * A * Q) / Tp   (where Q = 1in. runoff, A=sq.mi.)
 Qu(t) = Unit hydrograph ordinate (cfs) at time step t
 Q(t)  = Final hydrograph ordinate (cfs) at time step t
 Rai(t)= Accumulated runoff (inches) at time step t for impervious area
 Rap(t)= Accumulated runoff (inches) at time step t for pervious area
 Rii(t)= Incremental runoff (inches) at time step t for impervious area
 Rip(t)= Incremental runoff (inches) at time step t for pervious area
 R(t)  = Incremental weighted total runoff (inches)
 Rtm   = Time increment for rainfall table (.RNF file)
 Si    = S for impervious area:  Si = (1000/CNi) - 10
 Sp    = S for pervious area:    Sp = (1000/CNp) - 10
 t     = Time step (row) number
 Tc    = Time of concentration
 Tb    = Time (hrs) of entire unit hydrograph:  Tb = Tp + Tr
 Tp    = Time (hrs) to peak of a unit hydrograph:  Tp = (dt/2) + Lag
 Tr    = Time (hrs) of receding limb of unit hydrograph:  Tr = ratio of Tp
```

```
Type.... SCS Unit Hyd. Equations
File.... C:\JJ\LONE PINE 4.PPW


                         SCS UNIT HYDROGRAPH METHOD
                           (Computational Notes)

 PRECIPITATION: -----------------------------------------------------------
 Column (1):  Time for time step t
 Column (2):  D(t)  = Point on distribution curve for time step t
 Column (3):  Pi(t) = Pa(t) - Pa(t-1): Col.(4) - Preceding Col.(4)
 Column (4):  Pa(t) = D(t) x P:        Col.(2) x P


 PERVIOUS AREA RUNOFF (using SCS Runoff CN Method) ------------------------
 Column (5):  Rap(t) = Accumulated pervious runoff for time step t
              If (Pa(t) is <= 0.2Sp) then use: Rap(t) = 0.0
              If (Pa(t) is >  0.2Sp) then use:

              Rap(t) = (Col.(4)-0.2Sp)**2 / (Col.(4)+0.8Sp)

 Column (6):  Rip(t) = Incremental pervious runoff for time step t
              Rip(t) =        Rap(t)          -        Rap(t-1)
              Rip(t) = Col.(5) for current row - Col.(5) for preceding row.

 IMPERVIOUS AREA RUNOFF ---------------------------------------------------
 Column (7 & 8)... Did not specify to use impervious areas.


 INCREMENTAL WEIGHTED RUNOFF: ---------------------------------------------
 Column (9):  R(t)  = (Ap/At) x Rip(t)   +  (Ai/At) x Rii(t)
              R(t)  = (Ap/At) x Col.(6)  +  (Ai/At) x Col.(8)


 SCS UNIT HYDROGRAPH METHOD: ----------------------------------------------
 Column (10): Q(t)   is computed with the SCS unit hydrograph method
                     using R() and Qu().
```

```
Type.... SCS Unit Hyd. Summary
Name.... BILLY CREEK       Tag: 100                       Event: 100 yr
File.... C:\JJ\LONE PINE 4.PPW
Storm... TypeII  24hr   Tag: 100

              SCS UNIT HYDROGRAPH METHOD

              STORM EVENT: 100 year storm
              Duration      = 24.0000 hrs     Rain Depth = 2.7000 in
              Rain Dir      = C:\HAESTAD\PPKW\RAINFALL\
              Rain File -ID = SCSTYPES.RNF - TypeII  24hr
              Unit Hyd Type = Default Curvilinear
              HYG Dir       = C:\PROJECTS\CENE690\DATA\
              HYG File - ID =  - BILLY CREEK 100
              Tc            = 2.4800 hrs
              Drainage Area = 12698.000 acres  Runoff CN= 69

              ============================================
              Computational Time Increment   =   .33067 hrs
              Computed Peak Time             =  13.8880 hrs
              Computed Peak Flow             =  1361.08 cfs

              Time Increment for HYG File    =    .5000 hrs
              Peak Time, Interpolated Output =  14.0000 hrs
              Peak Flow, Interpolated Output =  1326.09 cfs
              WARNING: The difference between calculated peak flow
              and interpolated peak flow is greater than 1.50%
              ============================================

                             DRAINAGE AREA
                           -------------------
                           ID:None Selected
                           CN   =   69
                           Area =   12698.000 acres
                           S    =   4.4928 in
                           0.2S =    .8986 in

                            Cumulative Runoff
                           -------------------
                                    .5156 in
                                  545.579 ac-ft

              HYG Volume...        545.444 ac-ft (area under HYG curve)

              ***** UNIT HYDROGRAPH PARAMETERS *****

              Time Concentration, Tc =  2.48000 hrs (ID: None Selected)
              Computational Incr, Tm =   .33067 hrs = 0.20000 Tp

              Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
              K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
              Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

              Unit peak,          qp =  5801.36 cfs
              Unit peak time      Tp =  1.65333 hrs
              Unit receding limb, Tr =  6.61333 hrs
              Total unit time,    Tb =  8.26667 hrs
```

```
Type.... SCS Unit Hyd. (HYG output)
Name.... BILLY CREEK        Tag: 100                      Event: 100 yr
File.... C:\JJ\LONE PINE 4.PPW
Storm... TypeII  24hr   Tag: 100

              SCS UNIT HYDROGRAPH METHOD

              STORM EVENT: 100 year storm
              Duration      = 24.0000 hrs     Rain Depth = 2.7000 in
              Rain Dir      = C:\HAESTAD\PPKW\RAINFALL\
              Rain File -ID = SCSTYPES.RNF - TypeII  24hr
              Unit Hyd Type = Default Curvilinear
              HYG Dir       = C:\PROJECTS\CENE690\DATA\
              HYG File - ID =  - BILLY CREEK 100
              Tc            = 2.4800 hrs
              Drainage Area = 12698.000 acres  Runoff CN= 69
              Calc.Increment= .33067 hrs      Out.Incr.= .5000 hrs
              HYG Volume    = 545.444 ac-ft

                          HYDROGRAPH ORDINATES (cfs)
    Time  |               Output Time increment = .5000 hrs
    hrs   |    Time on left represents time for first value in each row.
 ---------|---------------------------------------------------------------
  11.5000 |        .00       92.78      451.92      997.03     1325.09
  14.0000 |    1326.09     1121.63      910.82      754.34      637.31
  16.5000 |     547.68      479.35      425.83      385.68      354.27
  19.0000 |     329.19      306.35      284.69      265.30      248.25
  21.5000 |     233.83      223.19      215.21      209.37      204.56
  24.0000 |     199.79      189.15      161.27      120.15       79.18
  26.5000 |      47.90       29.23       17.68       10.74        6.42
  29.0000 |       3.85        2.25        1.28         .69         .32
  31.5000 |        .10         .01         .00
```

```
Type.... SCS Unit Hyd. Summary
Name.... ELK SPRINGS        Tag: 100                       Event: 100 yr
File.... C:\JJ\LONE PINE 4.PPW
Storm... TypeII  24hr   Tag: 100

              SCS UNIT HYDROGRAPH METHOD

              STORM EVENT: 100 year storm
              Duration      = 24.0000 hrs     Rain Depth = 2.7000 in
              Rain Dir      = C:\HAESTAD\PPKW\RAINFALL\
              Rain File -ID = SCSTYPES.RNF - TypeII  24hr
              Unit Hyd Type = Default Curvilinear
              HYG Dir       = C:\PROJECTS\CENE690\DATA\
              HYG File - ID =  - ELK SPRINGS 100
              Tc            = 3.6900 hrs
              Drainage Area = 37638.000 acres  Runoff CN= 70

              ============================================
              Computational Time Increment   =   .49200 hrs
              Computed Peak Time             =  14.7600 hrs
              Computed Peak Flow             =  3414.72 cfs

              Time Increment for HYG File    =    .5000 hrs
              Peak Time, Interpolated Output =  14.5000 hrs
              Peak Flow, Interpolated Output =  3351.77 cfs
              WARNING: The difference between calculated peak flow
              and interpolated peak flow is greater than 1.50%
              ============================================

                             DRAINAGE AREA
                            -------------------
                            ID:None Selected
                            CN   =   70
                            Area =   37638.000 acres
                            S    =   4.2857 in
                            0.2S =    .8571 in

                             Cumulative Runoff
                            -------------------
                                     .5541 in
                                  1738.079 ac-ft

              HYG Volume...       1737.631 ac-ft (area under HYG curve)

              ***** UNIT HYDROGRAPH PARAMETERS *****

              Time Concentration, Tc =  3.69000 hrs (ID: None Selected)
              Computational Incr, Tm =   .49200 hrs = 0.20000 Tp

              Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
              K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
              Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

              Unit peak,          qp = 11557.04 cfs
              Unit peak time      Tp =  2.46000 hrs
              Unit receding limb, Tr =  9.84000 hrs
              Total unit time,    Tb = 12.30000 hrs
```

```
Type.... SCS Unit Hyd. (HYG output)
Name.... ELK SPRINGS        Tag: 100                       Event: 100 yr
File.... C:\JJ\LONE PINE 4.PPW
Storm... TypeII  24hr   Tag: 100

              SCS UNIT HYDROGRAPH METHOD

              STORM EVENT: 100 year storm
              Duration      = 24.0000 hrs     Rain Depth = 2.7000 in
              Rain Dir      = C:\HAESTAD\PPKW\RAINFALL\
              Rain File -ID = SCSTYPES.RNF - TypeII  24hr
              Unit Hyd Type = Default Curvilinear
              HYG Dir       = C:\PROJECTS\CENE690\DATA\
              HYG File - ID =  - ELK SPRINGS 100
              Tc            = 3.6900 hrs
              Drainage Area = 37638.000 acres  Runoff CN= 70
              Calc.Increment= .49200 hrs      Out.Incr.= .5000 hrs
              HYG Volume    = 1737.631 ac-ft
```

HYDROGRAPH ORDINATES (cfs)
Output Time increment = .5000 hrs
Time on left represents time for first value in each row.

Time hrs					
11.0000	.00	10.54	136.47	553.48	1332.88
13.5000	2298.52	3027.75	3351.77	3332.79	3041.23
16.0000	2635.30	2281.51	2001.64	1767.47	1572.16
18.5000	1412.84	1280.27	1170.68	1077.69	995.90
21.0000	922.86	858.96	804.54	759.67	722.55
23.5000	691.40	663.55	633.23	587.58	516.62
26.0000	426.33	332.13	246.16	175.74	124.81
28.5000	89.26	63.86	45.38	32.27	22.83
31.0000	16.13	11.38	7.95	5.49	3.72
33.5000	2.46	1.54	.88	.40	.11
36.0000	.00				

```
Type.... SCS Unit Hyd. Summary
Name.... LINDEN DRAW        Tag: 100                       Event: 100 yr
File.... C:\JJ\LONE PINE 4.PPW
Storm... TypeII  24hr   Tag: 100

              SCS UNIT HYDROGRAPH METHOD

              STORM EVENT: 100 year storm
              Duration      = 24.0000 hrs     Rain Depth = 2.7000 in
              Rain Dir      = C:\HAESTAD\PPKW\RAINFALL\
              Rain File -ID = SCSTYPES.RNF - TypeII  24hr
              Unit Hyd Type = Default Curvilinear
              HYG Dir       = C:\PROJECTS\CENE690\DATA\
              HYG File - ID =  - LINDEN DRAW 100
              Tc            = 2.3100 hrs
              Drainage Area = 12013.000 acres  Runoff CN= 71

              ============================================
              Computational Time Increment   =   .30800 hrs
              Computed Peak Time             =  13.5520 hrs
              Computed Peak Flow             =  1646.05 cfs

              Time Increment for HYG File    =    .5000 hrs
              Peak Time, Interpolated Output =  13.5000 hrs
              Peak Flow, Interpolated Output =  1632.97 cfs
              ============================================

                               DRAINAGE AREA
                            -------------------
                            ID:None Selected
                            CN   =   71
                            Area =   12013.000 acres
                            S    =   4.0845 in
                            0.2S =    .8169 in

                             Cumulative Runoff
                            -------------------
                                     .5942 in
                                   594.862 ac-ft

              HYG Volume...        594.782 ac-ft (area under HYG curve)

              ***** UNIT HYDROGRAPH PARAMETERS *****

              Time Concentration, Tc =  2.31000 hrs (ID: None Selected)
              Computational Incr, Tm =   .30800 hrs = 0.20000 Tp

              Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
              K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
              Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

              Unit peak,          qp =  5892.32 cfs
              Unit peak time      Tp =  1.54000 hrs
              Unit receding limb, Tr =  6.16000 hrs
              Total unit time,    Tb =  7.70000 hrs
```

```
Type.... SCS Unit Hyd. (HYG output)
Name.... LINDEN DRAW        Tag: 100                       Event: 100 yr
File.... C:\JJ\LONE PINE 4.PPW
Storm... TypeII  24hr   Tag: 100

              SCS UNIT HYDROGRAPH METHOD

              STORM EVENT: 100 year storm
              Duration      = 24.0000 hrs     Rain Depth = 2.7000 in
              Rain Dir      = C:\HAESTAD\PPKW\RAINFALL\
              Rain File -ID = SCSTYPES.RNF - TypeII  24hr
              Unit Hyd Type = Default Curvilinear
              HYG Dir       = C:\PROJECTS\CENE690\DATA\
              HYG File - ID =  - LINDEN DRAW 100
              Tc            = 2.3100 hrs
              Drainage Area = 12013.000 acres  Runoff CN= 71
              Calc.Increment= .30800 hrs      Out.Incr.= .5000 hrs
              HYG Volume    = 594.782 ac-ft
```

HYDROGRAPH ORDINATES (cfs)
Output Time increment = .5000 hrs
Time on left represents time for first value in each row.

Time hrs					
11.0000	.00	1.03	113.63	660.22	1361.43
13.5000	1632.97	1493.66	1178.47	944.06	769.60
16.0000	643.78	552.08	481.55	428.01	388.44
18.5000	357.90	331.88	307.89	287.61	268.50
21.0000	251.05	236.90	226.53	218.98	213.37
23.5000	208.71	204.40	192.04	160.32	112.95
26.0000	69.98	40.10	23.84	13.88	8.02
28.5000	4.66	2.63	1.45	.75	.33
31.0000	.09	.00			

```
Type.... SCS Unit Hyd. Summary
Name.... SHOWLOW CREEK      Tag: 100                       Event: 100 yr
File.... C:\JJ\LONE PINE 4.PPW
Storm... TypeII  24hr   Tag: 100

              SCS UNIT HYDROGRAPH METHOD

              STORM EVENT: 100 year storm
              Duration      = 24.0000 hrs     Rain Depth = 2.7000 in
              Rain Dir      = C:\HAESTAD\PPKW\RAINFALL\
              Rain File -ID = SCSTYPES.RNF - TypeII  24hr
              Unit Hyd Type = Default Curvilinear
              HYG Dir       = C:\PROJECTS\CENE690\DATA\
              HYG File - ID =  - SHOWLOW CREEK 100
              Tc            = 4.9500 hrs
              Drainage Area = 49581.000 acres  Runoff CN= 74

              ============================================
              Computational Time Increment   =   .66000 hrs
              Computed Peak Time             =  15.8400 hrs
              Computed Peak Flow             =  4918.88 cfs

              Time Increment for HYG File    =    .5000 hrs
              Peak Time, Interpolated Output =  15.5000 hrs
              Peak Flow, Interpolated Output =  4915.84 cfs
              ============================================

                             DRAINAGE AREA
                          -------------------
                          ID:None Selected
                          CN   =   74
                          Area =   49581.000 acres
                          S    =   3.5135 in
                          0.2S =    .7027 in

                           Cumulative Runoff
                          -------------------
                                   .7239 in
                                2990.914 ac-ft

              HYG Volume...       2991.652 ac-ft (area under HYG curve)

              ***** UNIT HYDROGRAPH PARAMETERS *****

              Time Concentration, Tc =  4.95000 hrs (ID: None Selected)
              Computational Incr, Tm =   .66000 hrs = 0.20000 Tp

              Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
              K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
              Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

              Unit peak,          qp = 11348.98 cfs
              Unit peak time      Tp =  3.30000 hrs
              Unit receding limb, Tr = 13.20000 hrs
              Total unit time,    Tb = 16.50000 hrs
```

```
Type.... SCS Unit Hyd. (HYG output)
Name.... SHOWLOW CREEK      Tag: 100                       Event: 100 yr
File.... C:\JJ\LONE PINE 4.PPW
Storm... TypeII  24hr   Tag: 100

              SCS UNIT HYDROGRAPH METHOD

              STORM EVENT: 100 year storm
              Duration      = 24.0000 hrs     Rain Depth = 2.7000 in
              Rain Dir      = C:\HAESTAD\PPKW\RAINFALL\
              Rain File -ID = SCSTYPES.RNF - TypeII  24hr
              Unit Hyd Type = Default Curvilinear
              HYG Dir       = C:\PROJECTS\CENE690\DATA\
              HYG File - ID =  - SHOWLOW CREEK 100
              Tc            = 4.9500 hrs
              Drainage Area = 49581.000 acres  Runoff CN= 74
              Calc.Increment= .66000 hrs      Out.Incr.= .5000 hrs
              HYG Volume    = 2991.652 ac-ft
```

HYDROGRAPH ORDINATES (cfs)

Output Time increment = .5000 hrs

Time on left represents time for first value in each row.

Time hrs					
11.0000	.00	64.58	254.31	679.63	1485.12
13.5000	2476.93	3504.03	4359.16	4771.27	4915.84
16.0000	4819.67	4509.65	4030.61	3586.91	3193.80
18.5000	2863.55	2593.21	2352.06	2139.16	1953.83
21.0000	1794.42	1654.09	1530.02	1421.39	1330.43
23.5000	1253.67	1184.67	1119.53	1050.64	964.45
26.0000	863.15	749.09	627.60	511.40	405.81
28.5000	314.10	241.79	189.20	147.27	114.04
31.0000	87.90	68.78	53.37	41.07	31.33
33.5000	24.38	18.76	14.28	10.74	8.17
36.0000	6.13	4.51	3.22	2.26	1.50
38.5000	.89	.43	.15	.04	.00

```
Type.... SCS Unit Hyd. Summary
Name.... WALNUT CREEK       Tag: 100                       Event: 100 yr
File.... C:\JJ\LONE PINE 4.PPW
Storm... TypeII  24hr   Tag: 100

              SCS UNIT HYDROGRAPH METHOD

              STORM EVENT: 100 year storm
              Duration      = 24.0000 hrs     Rain Depth = 2.7000 in
              Rain Dir      = C:\HAESTAD\PPKW\RAINFALL\
              Rain File -ID = SCSTYPES.RNF - TypeII  24hr
              Unit Hyd Type = Default Curvilinear
              HYG Dir       = C:\PROJECTS\CENE690\DATA\
              HYG File - ID =  - WALNUT CREEK 100
              Tc            = 2.4000 hrs
              Drainage Area = 5382.000 acres  Runoff CN= 70

              ============================================
              Computational Time Increment   =   .32000 hrs
              Computed Peak Time             =  13.7600 hrs
              Computed Peak Flow             =   658.52 cfs

              Time Increment for HYG File    =    .5000 hrs
              Peak Time, Interpolated Output =  13.5000 hrs
              Peak Flow, Interpolated Output =   646.12 cfs
              WARNING: The difference between calculated peak flow
              and interpolated peak flow is greater than 1.50%
              ============================================

                            DRAINAGE AREA
                            -------------------
                            ID:None Selected
                            CN   =   70
                            Area =    5382.000 acres
                            S    =   4.2857 in
                            0.2S =    .8571 in

                             Cumulative Runoff
                            -------------------
                                     .5541 in
                                   248.535 ac-ft

              HYG Volume...        248.374 ac-ft (area under HYG curve)

              ***** UNIT HYDROGRAPH PARAMETERS *****

              Time Concentration, Tc =  2.40000 hrs (ID: None Selected)
              Computational Incr, Tm =   .32000 hrs = 0.20000 Tp

              Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
              K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
              Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

              Unit peak,          qp =  2540.85 cfs
              Unit peak time      Tp =  1.60000 hrs
              Unit receding limb, Tr =  6.40000 hrs
              Total unit time,    Tb =  8.00000 hrs
```

```
Type.... SCS Unit Hyd. (HYG output)
Name.... WALNUT CREEK       Tag: 100                        Event: 100 yr
File.... C:\JJ\LONE PINE 4.PPW
Storm... TypeII  24hr   Tag: 100

              SCS UNIT HYDROGRAPH METHOD

              STORM EVENT: 100 year storm
              Duration      = 24.0000 hrs     Rain Depth = 2.7000 in
              Rain Dir      = C:\HAESTAD\PPKW\RAINFALL\
              Rain File -ID = SCSTYPES.RNF - TypeII  24hr
              Unit Hyd Type = Default Curvilinear
              HYG Dir       = C:\PROJECTS\CENE690\DATA\
              HYG File - ID =  - WALNUT CREEK 100
              Tc            = 2.4000 hrs
              Drainage Area = 5382.000 acres  Runoff CN= 70
              Calc.Increment= .32000 hrs      Out.Incr.= .5000 hrs
              HYG Volume    = 248.374 ac-ft

                          HYDROGRAPH ORDINATES (cfs)
    Time  |               Output Time increment = .5000 hrs
    hrs   |    Time on left represents time for first value in each row.
 ---------|-----------------------------------------------------------------
  11.5000 |         .00       41.69      212.93      495.28      646.12
  14.0000 |      628.39      514.10      409.72      337.03      281.70
  16.5000 |      241.68      210.52      187.08      169.20      155.65
  19.0000 |      144.52      134.19      124.78      116.46      108.95
  21.5000 |      102.72       98.08       94.73       92.18       90.13
  24.0000 |       88.33       83.33       70.64       51.01       32.51
  26.5000 |       19.21       11.54        6.82        4.09        2.39
  29.0000 |        1.41         .80         .44         .22         .08
  31.5000 |         .01         .00
```

```
Type.... Time-Elev
Name.... P  10        OUT   Tag: 100                       Event: 100 yr
File.... C:\JJ\LONE PINE 4.PPW
Storm... TypeII  24hr   Tag: 100
```

TIME vs. ELEVATION (ft)

Output Time increment = .5000 hrs
Time on left represents time for first value in each row.

Time hrs					
11.0000	922.00	922.58	923.92	926.26	929.41
13.5000	932.66	934.66	935.37	935.49	935.27
16.0000	934.82	934.19	933.34	932.41	931.58
18.5000	930.88	930.31	929.82	929.39	929.00
21.0000	928.66	928.36	928.09	927.86	927.66
23.5000	927.50	927.35	927.20	927.00	926.69
26.0000	926.29	925.85	925.42	925.00	924.60
28.5000	924.25	923.94	923.67	923.46	923.25
31.0000	923.09	922.94	922.80	922.68	922.59
33.5000	922.53	922.44	922.33	922.25	922.18
36.0000	922.13	922.10	922.07	922.05	922.04
38.5000	922.02	922.01	922.01	922.00	922.00
41.0000	922.00				

```
Type.... Time vs. Volume
Name.... P  10        OUT   Tag: 100                       Event: 100 yr
File.... C:\JJ\LONE PINE 4.PPW
Storm... TypeII  24hr   Tag: 100
```

TIME vs. VOLUME (ac-ft)

Output Time increment = .5000 hrs
Time on left represents time for first value in each row.

Time hrs					
11.0000	.000	.000	.000	.002	.007
13.5000	.295	21.397	44.942	49.422	41.297
16.0000	26.056	11.208	2.063	.207	.079
18.5000	.029	.012	.009	.007	.005
21.0000	.005	.004	.003	.003	.003
23.5000	.003	.002	.002	.002	.002
26.0000	.002	.001	.001	.001	.001
28.5000	.000	.000	.000	.000	.000
31.0000	.000	.000	.000	.000	.000
33.5000	.000	.000	.000	.000	.000
36.0000	.000	.000	.000	.000	.000
38.5000	.000	.000	.000	.000	.000
41.0000	.000				

Type.... Vol: Elev-Area
Name.... P 10
File.... C:\JJ\LONE PINE 4.PPW

Elevation (ft)	Planimeter (sq.in)	Area (acres)	A1+A2+sqr(A1*A2) (acres)	Volume (ac-ft)	Volume Sum (ac-ft)
922.00**	-----	.0001	.0000	.000	.000
927.50***	-----	.0010	.0014	.003	.003
930.00***	-----	.0050	.0082	.007	.009
932.50***	-----	.2220	.2603	.217	.226
935.00****	-----	35.0000	38.0095	31.675	31.901
937.50****	-----	40.0000	112.4166	93.680	125.581

POND VOLUME EQUATIONS

* Incremental volume computed by the Conic Method for Reservoir Volumes.

Volume = (1/3) * (EL2-EL1) * (Area1 + Area2 + sq.rt.(Area1*Area2))

where: EL1, EL2 = Lower and upper elevations of the increment
Area1,Area2 = Areas computed for EL1, EL2, respectively
Volume = Incremental volume between EL1 and EL2

** Invert of proposed culverts lower than existing primary spillway invert through over-excavation or drop structure.

*** Areas derived from NAU Survey

**** Areas estimated

```
Type.... Outlet Input Data
Name.... 10 FOOT RCP'S
File.... C:\JJ\LONE PINE 4.PPW


                    REQUESTED POND WS ELEVATIONS:

                      Min. Elev.=    922.00 ft
                      Increment =       .50 ft
                      Max. Elev.=    937.50 ft


          ********************************************
                         OUTLET CONNECTIVITY
          ********************************************

           ---> Forward Flow Only (UpStream to DnStream)
          <---  Reverse Flow Only (DnStream to UpStream)
          <---> Forward and Reverse Both Allowed

       Structure         No.        Outfall    E1, ft     E2, ft
   -----------------    ----        -------  ---------  ---------
   Culvert-Circular          --->    TW     922.000    937.500
   TW SETUP, DS Channel
```

```
Type.... Outlet Input Data
Name.... 10 FOOT RCP'S
File.... C:\JJ\LONE PINE 4.PPW


              OUTLET STRUCTURE INPUT DATA



              Structure ID      =
              Structure Type    = Culvert-Circular
              ------------------------------------
              No. Barrels       =        18
              Barrel Diameter   =   10.0000 ft
              Upstream Invert   =    922.00 ft
              Dnstream Invert   =    920.00 ft
              Horiz. Length     =    430.00 ft
              Barrel Length     =    430.00 ft
              Barrel Slope      =    .00465 ft/ft

              OUTLET CONTROL DATA...
              Mannings n        =     .0130
              Ke                =     .5000  (forward entrance loss)
              Kb                =   .001452  (per ft of full flow)
              Kr                =     .5000  (reverse entrance loss)
              HW Convergence    =      .001  +/- ft

              INLET CONTROL DATA...
              Equation form     =         1
              Inlet Control K   =     .0098
              Inlet Control M   =    2.0000
              Inlet Control c   =    .03980
              Inlet Control Y   =     .6700
              T1 ratio (HW/D)   =     1.158
              T2 ratio (HW/D)   =     1.304
              Slope Factor      =     -.500
              Calc inlet only   = Yes

 Use unsubmerged inlet control Form 1 equ. below T1 elev.
 Use   submerged inlet control Form 1 equ. above T2 elev.

 In transition zone between unsubmerged and submerged inlet control,
 interpolate between flows at T1 & T2...
 At T1 Elev =    933.58 ft  --->  Flow =    869.28 cfs
 At T2 Elev =    935.04 ft  --->  Flow =    993.46 cfs


              Structure ID      = TW
              Structure Type    = TW SETUP, DS Channel
              ------------------------------------
              FREE OUTFALL CONDITIONS SPECIFIED

              CONVERGENCE TOLERANCES...
              Maximum Iterations=    30
              Min. TW tolerance =    .01 ft
              Max. TW tolerance =    .01 ft
              Min. HW tolerance =    .01 ft
              Max. HW tolerance =    .01 ft
              Min.  Q tolerance =    .10 cfs
              Max.  Q tolerance =    .10 cfs
```

Type.... Individual Outlet Curves
Name.... 10 FOOT RCP'S
File.... C:\JJ\LONE PINE 4.PPW

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = (Culvert-Circular)

Mannings open channel maximum capacity: 1213.14 cfs
Upstream ID = (Pond Water Surface)
DNstream ID = TW (Pond Outfall)

NUMBER OF BARRELS = 18
EACH FLOW = SUM OF BARRELS x FLOW FOR ONE BARREL

WS Elev,Device Q		Tail Water		Notes
WS Elev. ft	Q cfs	TW Elev ft	Converge +/-ft	Computation Messages
922.00	.00	Free Outfall		Upstream HW & DNstream TW < Inv.El
922.50	53.64	Free Outfall		INLET CONTROL... Equ.1: HW =.50 dc=.392 Ac=1.0236
923.00	201.70	Free Outfall		INLET CONTROL... Equ.1: HW =1.00 dc=.763 Ac=2.7474
923.50	442.03	Free Outfall		INLET CONTROL... Equ.1: HW =1.50 dc=1.134 Ac=4.9172
924.00	769.04	Free Outfall		INLET CONTROL... Equ.1: HW =2.00 dc=1.502 Ac=7.4013
924.50	1179.31	Free Outfall		INLET CONTROL... Equ.1: HW =2.50 dc=1.867 Ac=10.1305
925.00	1665.12	Free Outfall		INLET CONTROL... Equ.1: HW =3.00 dc=2.227 Ac=13.0315
925.50	2221.30	Free Outfall		INLET CONTROL... Equ.1: HW =3.50 dc=2.581 Ac=16.0601
926.00	2842.71	Free Outfall		INLET CONTROL... Equ.1: HW =4.00 dc=2.930 Ac=19.1807
926.50	3519.06	Free Outfall		INLET CONTROL... Equ.1: HW =4.50 dc=3.272 Ac=22.3388
927.00	4246.90	Free Outfall		INLET CONTROL... Equ.1: HW =5.00 dc=3.607 Ac=25.5180
927.50	5015.95	Free Outfall		INLET CONTROL... Equ.1: HW =5.50 dc=3.932 Ac=28.6752
928.00	5819.32	Free Outfall		INLET CONTROL... Equ.1: HW =6.00 dc=4.249 Ac=31.7868
928.50	6653.60	Free Outfall		INLET CONTROL... Equ.1: HW =6.50 dc=4.557 Ac=34.8431
929.00	7511.90	Free Outfall		INLET CONTROL...Equ.1: HW =7.00 dc=4.855 Ac=37.8229
929.50	8383.94	Free Outfall		INLET CONTROL...Equ.1: HW =7.50 dc=5.143 Ac=40.6964
930.00	9269.72	Free Outfall		INLET CONTROL...Equ.1: HW =8.00 dc=5.420 Ac=43.4691
930.50	10162.35	Free Outfall		INLET CONTROL...Equ.1: HW =8.50 dc=5.688 Ac=46.1243
931.00	11061.86	Free Outfall		INLET CONTROL...Equ.1: HW =9.00 dc=5.945 Ac=48.6669
931.50	11961.37	Free Outfall		INLET CONTROL...Equ.1: HW =9.50 dc=6.193 Ac=51.0817
932.00	12857.44	Free Outfall		INLET CONTROL...Equ.1: HW =10.00 dc=6.429 Ac=53.3643
932.50	13746.64	Free Outfall		INLET CONTROL...Equ.1: HW =10.50 dc=6.655 Ac=55.5114
933.00	14632.42	Free Outfall		INLET CONTROL...Equ.1: HW =11.00 dc=6.871 Ac=57.5358
933.50	15507.89	Free Outfall		INLET CONTROL...Equ.1: HW =11.50 dc=7.077 Ac=59.4259
934.00	16287.23	Free Outfall		INLET CONTROL... Transition: HW =12.00
934.50	17051.38	Free Outfall		INLET CONTROL... Transition: HW =12.50
935.00	17814.01	Free Outfall		INLET CONTROL... Transition: HW =13.00
935.50	18510.25	Free Outfall		INLET CONTROL... Submerged: HW =13.50
936.00	19176.29	Free Outfall		INLET CONTROL... Submerged: HW =14.00
936.50	19820.02	Free Outfall		INLET CONTROL... Submerged: HW =14.50
937.00	20444.87	Free Outfall		INLET CONTROL... Submerged: HW =15.00
937.50	21049.12	Free Outfall		INLET CONTROL... Submerged: HW =15.50

Type.... Composite Rating Curve
Name.... 10 FOOT RCP'S
File.... C:\JJ\LONE PINE 4.PPW

***** COMPOSITE OUTFLOW SUMMARY ****

WS Elev, Total Q		Converge		Notes
Elev. ft	Q cfs	TW Elev ft	Error +/-ft	Contributing Structures
922.00	.00	Free Outfall		None contributing
922.50	53.64	Free Outfall		
923.00	201.70	Free Outfall		
923.50	442.03	Free Outfall		
924.00	769.04	Free Outfall		
924.50	1179.31	Free Outfall		
925.00	1665.12	Free Outfall		
925.50	2221.30	Free Outfall		
926.00	2842.71	Free Outfall		
926.50	3519.06	Free Outfall		
927.00	4246.90	Free Outfall		
927.50	5015.95	Free Outfall		
928.00	5819.32	Free Outfall		
928.50	6653.60	Free Outfall		
929.00	7511.90	Free Outfall		
929.50	8383.94	Free Outfall		
930.00	9269.72	Free Outfall		
930.50	10162.35	Free Outfall		
931.00	11061.86	Free Outfall		
931.50	11961.37	Free Outfall		
932.00	12857.44	Free Outfall		
932.50	13746.64	Free Outfall		
933.00	14632.42	Free Outfall		
933.50	15507.89	Free Outfall		
934.00	16287.23	Free Outfall		
934.50	17051.38	Free Outfall		
935.00	17814.01	Free Outfall		
935.50	18510.25	Free Outfall		
936.00	19176.29	Free Outfall		
936.50	19820.02	Free Outfall		
937.00	20444.87	Free Outfall		
937.50	21049.12	Free Outfall		

```
Type.... Pond E-V-Q Table
Name.... P  10
File.... C:\JJ\LONE PINE 4.PPW

                    LEVEL POOL ROUTING DATA

 HYG Dir           = C:\PROJECTS\CENE690\DATA\
 Inflow  HYG file = NONE STORED - P  10        IN  100
 Outflow HYG file = NONE STORED - P  10        OUT 100

 Pond Node   Data = P  10
 Pond Volume Data = P  10
 Pond Outlet Data = 10 FOOT RCP'S

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev   =   922.00 ft
 Starting Volume    =     .000 ac-ft
 Starting Outflow   =      .00 cfs
 Starting Infiltr.  =      .00 cfs
 Starting Total Qout=      .00 cfs
 Time Increment     =    .5000 hrs
```

Elevation ft	Outflow cfs	Storage ac-ft	Area acres	Infilt. cfs	Q Total cfs	2S/t + O cfs
922.00	.00	.000	.0001	.00	.00	.00
922.50	53.64	.000	.0001	.00	53.64	53.65
923.00	201.70	.000	.0002	.00	201.70	201.71
923.50	442.03	.000	.0003	.00	442.03	442.04
924.00	769.04	.000	.0003	.00	769.04	769.06
924.50	1179.31	.001	.0004	.00	1179.31	1179.34
925.00	1665.12	.001	.0005	.00	1665.12	1665.15
925.50	2221.30	.001	.0006	.00	2221.30	2221.35
926.00	2842.71	.001	.0007	.00	2842.71	2842.78
926.50	3519.06	.002	.0008	.00	3519.06	3519.14
927.00	4246.90	.002	.0009	.00	4246.90	4247.01
927.50	5015.95	.003	.0010	.00	5015.95	5016.07
928.00	5819.32	.003	.0016	.00	5819.32	5819.48
928.50	6653.60	.004	.0022	.00	6653.60	6653.80
929.00	7511.90	.005	.0030	.00	7511.90	7512.17
929.50	8383.94	.007	.0040	.00	8383.94	8384.29
930.00	9269.72	.009	.0050	.00	9269.72	9270.17
930.50	10162.35	.016	.0227	.00	10162.35	10163.12
931.00	11061.86	.034	.0533	.00	11061.86	11063.52
931.50	11961.37	.071	.0967	.00	11961.37	11964.82
932.00	12857.44	.133	.1529	.00	12857.44	12863.88
932.50	13746.64	.226	.2220	.00	13746.64	13757.60
933.00	14632.42	.792	2.4341	.00	14632.42	14670.73
933.50	15507.89	3.056	7.0179	.00	15507.89	15655.79
934.00	16287.23	8.205	13.9735	.00	16287.23	16684.34
934.50	17051.38	17.425	23.3009	.00	17051.38	17894.73
935.00	17814.01	31.901	35.0000	.00	17814.01	19358.02
935.50	18510.25	49.644	35.9733	.00	18510.25	20913.00
936.00	19176.29	67.876	36.9600	.00	19176.29	22461.52
936.50	19820.02	86.606	37.9600	.00	19820.02	24011.75
937.00	20444.87	105.839	38.9733	.00	20444.87	25567.46
937.50	21049.12	125.581	40.0000	.00	21049.12	27127.26

```
Type.... Node: Pond Inflow Summary
Name.... P  10        IN                             Event: 100 yr
File.... C:\JJ\LONE PINE 4.PPW
Storm... TypeII  24hr   Tag: 100

                    SUMMARY FOR HYDROGRAPH ADDITION
                    at Node: P  10        IN

 HYG Directory: C:\PROJECTS\CENE690\DATA\
```

Upstream Link ID	Upstream Node ID	HYG file	HYG ID	HYG tag
ELK	ELK SPRINGS		ELK SPRINGS	100
LINDEN	LINDEN DRAW		LINDEN DRAW	100
BILLY	BILLY CREEK		BILLY CREEK	100
SHOWLOW	SHOWLOW CREEK		SHOWLOW CREEK	100
WALNUT	WALNUT CREEK		WALNUT CREEK	100

INFLOWS TO: P 10 IN

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
	ELK SPRINGS	100	1737.631	14.5000	3351.77
	LINDEN DRAW	100	594.782	13.5000	1632.97
	BILLY CREEK	100	545.444	14.0000	1326.09
	SHOWLOW CREEK	100	2991.652	15.5000	4915.84
	WALNUT CREEK	100	248.374	13.5000	646.12

TOTAL FLOW INTO: P 10 IN

HYG file	HYG ID	HYG tag	Volume ac-ft	Peak Time hrs	Peak Flow cfs
	P 10 IN	100	6117.882	14.5000	10525.13

```
Type.... Node: Pond Inflow Summary
Name.... P  10        IN                                Event: 100 yr
File.... C:\JJ\LONE PINE 4.PPW
Storm... TypeII  24hr   Tag: 100

            TOTAL NODE INFLOW...
            HYG file =
            HYG ID   = P  10        IN
            HYG Tag  = 100
            -----------------------------------
            Peak Discharge =     10525.13 cfs
            Time to Peak   =      14.5000 hrs
            HYG Volume     =     6117.882 ac-ft
            -----------------------------------
```

HYDROGRAPH ORDINATES (cfs)
Output Time increment = .5000 hrs
Time on left represents time for first value in each row.

Time hrs					
11.0000	.00	76.16	638.87	2558.18	5671.74
13.5000	8379.63	9979.92	10525.13	10368.67	9818.05
16.0000	9017.75	8132.60	7203.66	6395.30	5709.27
18.5000	5144.20	4679.06	4271.18	3913.93	3599.99
21.0000	3325.52	3086.51	2882.36	2709.97	2567.91
23.5000	2448.47	2340.74	2217.28	2030.45	1765.19
26.0000	1471.15	1188.44	938.36	725.52	553.47
28.5000	416.82	313.53	239.08	182.01	138.11
31.0000	104.52	80.27	61.33	46.56	35.05
33.5000	26.84	20.31	15.16	11.14	8.28
36.0000	6.13	4.51	3.22	2.26	1.50
38.5000	.89	.43	.15	.04	.00

```
Type.... Pond Routed HYG (total out)
Name.... P  10        OUT   Tag: 100                       Event: 100 yr
File.... C:\JJ\LONE PINE 4.PPW
Storm... TypeII  24hr   Tag: 100


            POND ROUTED TOTAL OUTFLOW HYG...
            HYG file =
            HYG ID   = P  10        OUT
            HYG Tag  = 100
            -----------------------------------
            Peak Discharge =     10446.90 cfs
            Time to Peak   =      15.0000 hrs
            HYG Volume     =     6117.884 ac-ft
            -----------------------------------

                          HYDROGRAPH ORDINATES (cfs)
    Time  |               Output Time increment = .5000 hrs
    hrs   |    Time on left represents time for first value in each row.
 ---------|---------------------------------------------------------------
  11.0000 |        .00       38.08      357.51     1598.52     4114.96
  13.5000 |    7025.68     9179.78    10252.53    10446.90    10093.36
  16.0000 |    9417.90     8575.18     7668.13     6799.48     6052.29
  18.5000 |    5426.74     4911.63     4475.12     4092.55     3756.96
  21.0000 |    3462.75     3206.02     2984.44     2796.17     2638.94
  23.5000 |    2508.19     2394.60     2279.01     2123.86     1897.82
  26.0000 |    1618.17     1329.80     1063.40      831.94      639.50
  28.5000 |     485.15      365.18      276.30      210.54      160.06
  31.0000 |     121.32       92.40       70.80       53.94       40.80
  33.5000 |      30.94       23.57       17.73       13.15        9.71
  36.0000 |       7.21        5.32        3.86        2.74        1.88
  38.5000 |       1.20         .66         .29         .10         .02
  41.0000 |        .00
```

ANALYSIS OF EXISTING LONE PINE EMERGENCY SPILLWAY

```
Type.... Outlet Input Data
Name.... SPILLWAY (Analysis of Existing Lone Pine Emergency Spillway)
File.... C:\JJ\WEIR.PPW

                      REQUESTED POND WS ELEVATIONS:

                        Min. Elev.=    998.13 ft
                        Increment =       .50 ft
                        Max. Elev.=   1007.13 ft

                        Spot Elevations, ft
                          1005.50

              ***********************************************
                             OUTLET CONNECTIVITY
              ***********************************************

               ---> Forward Flow Only (UpStream to DnStream)
              <---  Reverse Flow Only (DnStream to UpStream)
              <---> Forward and Reverse Both Allowed

          Structure         No.        Outfall    E1, ft     E2, ft
      -----------------    ----        -------  ---------  ---------
      Weir-XY Points             --->    TW     997.630   1007.130
      TW SETUP, DS Channel
```

```
Type.... Outlet Input Data
Name.... SPILLWAY (Analysis of Existing Lone Pine Emergency Spillway)
File.... C:\JJ\WEIR.PPW


                 OUTLET STRUCTURE INPUT DATA



                 Structure ID      =
                 Structure Type    = Weir-XY Points
                 ------------------------------------
                 # of Openings     =         1
                 WEIR X-Y GROUND POINTS

                     X, ft     Elev, ft
                  ---------   ---------
                       .00     1007.50
                     51.00      998.80
                    106.00      998.32
                    140.00      997.65
                    170.00      997.92
                    203.00      997.63
                    266.00      998.25
                    281.00      998.13
                    325.00     1000.00
                    367.00     1002.50
                    399.00     1005.00
                    420.00     1007.50

                 Lowest Elev.      =    997.63 ft

                 Weir Coeff.       =  3.000000

                 Weir TW effects     (Use adjustment equation)



                 Structure ID      = TW
                 Structure Type    = TW SETUP, DS Channel
                 ------------------------------------
                 FREE OUTFALL CONDITIONS SPECIFIED

                 CONVERGENCE TOLERANCES...
                 Maximum Iterations=    30
                 Min. TW tolerance =    .01 ft
                 Max. TW tolerance =    .01 ft
                 Min. HW tolerance =    .01 ft
                 Max. HW tolerance =    .01 ft
                 Min.  Q tolerance =    .10 cfs
                 Max.  Q tolerance =    .10 cfs
```

```
Type.... Individual Outlet Curves
Name.... SPILLWAY (Analysis of Existing Lone Pine Emergency Spillway)
File.... C:\JJ\WEIR.PPW

                  RATING TABLE FOR ONE OUTLET TYPE

                  Structure ID  =   (Weir-XY Points)
                  --------------------------------------
                  Upstream  ID  =    (Pond Water Surface)
                  DNstream  ID  = TW (Pond Outfall)

   WS Elev,Device Q    Tail Water              Notes
   ----------------  ---------------  --------------------------
   WS Elev.    Q      TW Elev Converge
     ft       cfs       ft    +/-ft   Computation Messages
  --------  -------  --------  -----  --------------------------
   997.63       .00   Free Outfall  E = Y min=997.63
   998.13     66.82   Free Outfall  Max.H=.50; Max.Htw=free out;; W(ft)=138.16
   998.63    333.39   Free Outfall  Max.H=1.00; Max.Htw=free out;; W(ft)=222.29
   999.13    804.22   Free Outfall  Max.H=1.50; Max.Htw=free out;; W(ft)=255.46
   999.63   1439.16   Free Outfall  Max.H=2.00; Max.Htw=free out;; W(ft)=270.16
  1000.13   2217.99   Free Outfall  Max.H=2.50; Max.Htw=free out;; W(ft)=283.98
  1000.63   3137.22   Free Outfall  Max.H=3.00; Max.Htw=free out;; W(ft)=295.31
  1001.13   4178.77   Free Outfall  Max.H=3.50; Max.Htw=free out;; W(ft)=306.64
  1001.63   5338.52   Free Outfall  Max.H=4.00; Max.Htw=free out;; W(ft)=317.97
  1002.13   6613.66   Free Outfall  Max.H=4.50; Max.Htw=free out;; W(ft)=329.30
  1002.63   8006.79   Free Outfall  Max.H=5.00; Max.Htw=free out;; W(ft)=340.12
  1003.13   9523.54   Free Outfall  Max.H=5.50; Max.Htw=free out;; W(ft)=349.45
  1003.63  11149.57   Free Outfall  Max.H=6.00; Max.Htw=free out;; W(ft)=358.78
  1004.13  12883.78   Free Outfall  Max.H=6.50; Max.Htw=free out;; W(ft)=368.11
  1004.63  14725.22   Free Outfall  Max.H=7.00; Max.Htw=free out;; W(ft)=377.44
  1005.13  16676.61   Free Outfall  Max.H=7.50; Max.Htw=free out;; W(ft)=386.20
  1005.50  18195.20   Free Outfall  Max.H=7.87; Max.Htw=free out;; W(ft)=391.48
  1005.63  18742.26   Free Outfall  Max.H=8.00; Max.Htw=free out;; W(ft)=393.33
  1006.13  20910.89   Free Outfall  Max.H=8.50; Max.Htw=free out;; W(ft)=400.46
  1006.63  23181.47   Free Outfall  Max.H=9.00; Max.Htw=free out;; W(ft)=407.59
  1007.13  25553.06   Free Outfall  Max.H=9.50; Max.Htw=free out;; W(ft)=414.72
```

```
Type.... Composite Rating Curve
Name.... SPILLWAY (Analysis of Existing Lone Pine Emergency Spillway)
File.... C:\JJ\WEIR.PPW
```

***** COMPOSITE OUTFLOW SUMMARY ****

WS Elev, Total Q		Converge		Notes
Elev. ft	Q cfs	TW Elev ft	Error +/-ft	Contributing Structures
997.63	.00	Free Outfall		
998.13	66.82	Free Outfall		
998.63	333.39	Free Outfall		
999.13	804.22	Free Outfall		
999.63	1439.16	Free Outfall		
1000.13	2217.99	Free Outfall		
1000.63	3137.22	Free Outfall		
1001.13	4178.77	Free Outfall		
1001.63	5338.52	Free Outfall		
1002.13	6613.66	Free Outfall		
1002.63	8006.79	Free Outfall		
1003.13	9523.54	Free Outfall		
1003.63	11149.57	Free Outfall		
1004.13	12883.78	Free Outfall		
1004.63	14725.22	Free Outfall		
1005.13	16676.61	Free Outfall		
1005.50	18195.20	Free Outfall		
1005.63	18742.26	Free Outfall		
1006.13	20910.89	Free Outfall		
1006.63	23181.47	Free Outfall		
1007.13	25553.06	Free Outfall		

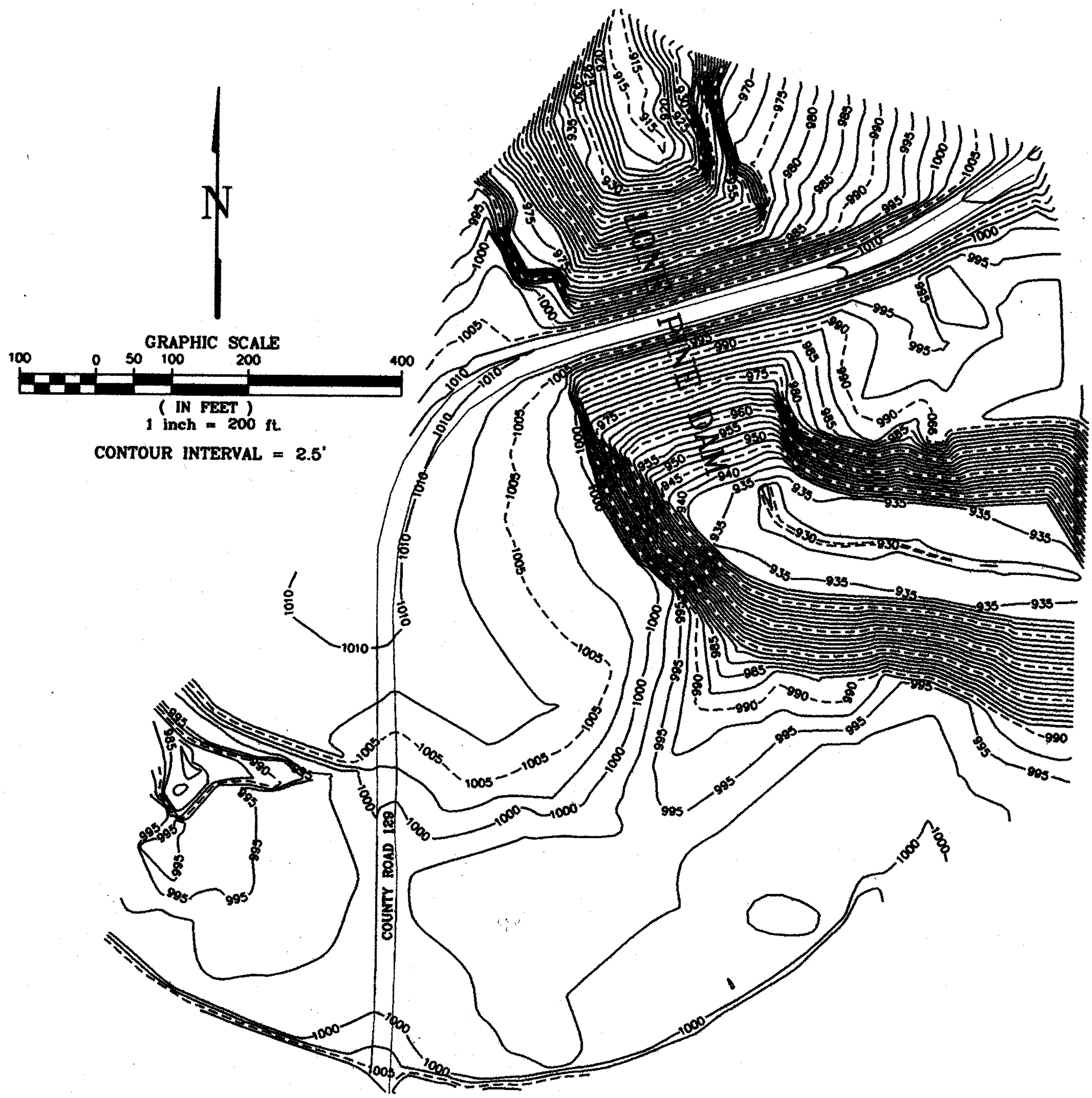
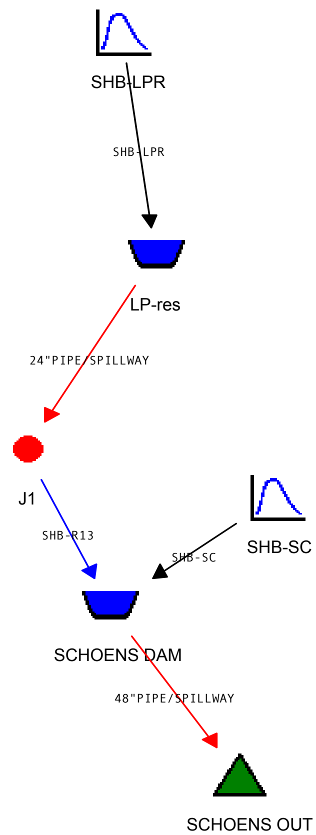


Figure 4 – NAU Survey at Lone Pine Dam

APPENDIX E: SUPPORTING DOCUMENTATION AND CALCULATIONS FOR SCHOENS RESERVOIR EVALUATION

Recreation of SHB Network in PondPack from their HEC1 files prepared in 1984 for Schoens Dam and Reservoir Analysis



Scenario 1 of 4 (Results page 1 of 2)

Schoens Dam and Spillway analysis, SHB network, 72 hour winter storm, Lone Pine half full, No LPR Seepage, New LPR Spillway, Lone Pine Reservoir-Capacity Curve from SHB, Schoens Spillway rating curve from SHB plans, Schoens 48" pipe outlet rating table calculated, Schoens Reservoir-Capacity Curve from SHB, SHB reach routing physical data modeled with Modified Puls, Schoens permanent pool at 5754, 72 hr winter cyclonic storm hydrographs input for Lone Pine and Schoens Reservoirs taken from SHB.

Type.... Master Network Summary
Name.... Watershed
File.... C:\JJ\SCHOENS2.PPW

NETWORK SUMMARY -- NODES
(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID		Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
J1		JCT	72	17162.910		63.5000	30584.07		
LP-RES	IN	POND	72	23074.940		63.0000	47935.00		
LP-RES	OUT	POND	72	17162.910		63.5000	30584.07	1006.86	12242.250
SCHOENS DAM	IN	POND	72	88864.730		63.5000	86182.15		
SCHOENS DAM	OUT	POND	72	75683.440		72.5000	37230.61	5823.59	54946.690
*SCHOENS OUT		JCT	72	75683.440		72.5000	37230.61		
SHB-LPR		HYG	72	23074.940		63.0000	47935.00		
SHB-SC		HYG	72	71503.550		63.2500	57666.00		

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

Link ID	Type		HYG Vol ac-ft	Trun.	Peak Time hrs	Peak Q cfs	End Points	
24"PIPE/SPILLWAY	PONDrt	UN	23074.940		63.0000	47935.00	LP-RES	IN
24"PIPE/SPILLWAY			17162.910		63.5000	30584.07	LP-RES	OUT
		DL	17162.910		63.5000	30584.07		
		DN	17162.910		63.5000	30584.07	J1	
48"PIPE/SPILLWAY	PONDrt	UN	88864.730		63.5000	86182.15	SCHOENS DAM	IN
48"PIPE/SPILLWAY			75683.440		72.5000	37230.61	SCHOENS DAM	OUT
		DL	75683.440		72.5000	37230.61		
		DN	75683.440		72.5000	37230.61	SCHOENS OUT	
SHB-LPR	ADD	UN	23074.940		63.0000	47935.00	SHB-LPR	
		DL	23074.940		63.0000	47935.00		
		DN	23074.940		63.0000	47935.00	LP-RES	IN
SHB-R13	REACH	UN	17162.910		63.5000	30584.07	J1	
		DL	17155.700		63.7500	30128.71		
		DN	88864.730		63.5000	86182.15	SCHOENS DAM	IN
SHB-SC	ADD	UN	71503.550		63.2500	57666.00	SHB-SC	
		DL	71503.550		63.2500	57666.00		
		DN	88864.730		63.5000	86182.15	SCHOENS DAM	IN

Scenario 1 of 4 (Results page 2 of 2)

Schoens Dam and Spillway analysis, SHB network, 72 hour winter storm, Lone Pine half full, No LPR Seepage, New LPR Spillway, Lone Pine Reservoir-Capacity Curve from SHB, Schoens Spillway rating curve from SHB plans, Schoens 48" pipe outlet rating table calculated, Schoens Reservoir-Capacity Curve from SHB, SHB reach routing physical data modeled with Modified Puls, Schoens permanent pool at 5754, 72 hr winter cyclonic storm hydrographs input for Lone Pine and Schoens Reservoirs taken from SHB.

```
   Type.... Pond Routing Summary
   Name.... SCHOENS DAM
   File.... C:\JJ\SCHOENS2.PPW
   Storm... 72   Tag: 72

                     LEVEL POOL ROUTING SUMMARY

    HYG Dir          = C:\JJ\
    Inflow  HYG file = NONE STORED - SCHOENS DAM  IN  72
    Outflow HYG file = NONE STORED - SCHOENS DAM  OUT 72

    Pond Node   Data = SCHOENS DAM
    Pond Volume Data = SCHOENS DAM 5754
    Pond Outlet Data = 48"PIPE/SPILLWAY

    No Infiltration

    INITIAL CONDITIONS
    ----------------------------------
    Starting WS Elev   =  5700.00 ft
    Starting Volume    =    1.000 ac-ft
    Starting Outflow   =      .00 cfs
    Starting Infiltr.  =      .00 cfs
    Starting Total Qout=      .00 cfs
    Time Increment     =    .2500 hrs


    INFLOW/OUTFLOW HYDROGRAPH SUMMARY
    ====================================================
    Peak Inflow       =  86182.15 cfs    at   63.5000 hrs
    Peak Outflow      =  37230.61 cfs    at   72.5000 hrs
    ----------------------------------------------------
    Peak Elevation    =   5823.59 ft
    Peak Storage =      54946.690 ac-ft
    ====================================================


    MASS BALANCE (ac-ft)
    --------------------------
  + Initial Vol  =       1.000
  + HYG Vol IN   =   88864.730
  - Infiltration =        .000
  - HYG Vol OUT  =   75683.440
  - Retained Vol =   13181.830
                  ----------
    Unrouted Vol =       -.470 ac-ft  (.001% of Inflow Volume)
```

Scenario 2 of 4 (Results page 1 of 2)

Schoens Dam and Spillway analysis, SHB network, 72 hour winter storm, Lone Pine Dam removed, No LPR Seepage, Schoens Spillway rating curve from SHB plans, Schoens 48" pipe outlet rating table calculated, Schoens Reservoir-Capacity Curve from SHB, SHB reach routing physical data modeled with Modified Puls, Schoens permanent pool at 5754, 72 hr winter cyclonic storm hydrographs input for Lone Pine and Schoens Reservoirs taken from SHB.

```
Type.... Master Network Summary
Name.... Watershed
File.... C:\JJ\SCHOENS2.PPW
```

NETWORK SUMMARY -- NODES
(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID		Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
J1		JCT	72	23074.940		63.0000	47935.00		
LP-RES	IN	POND	72	23074.940		63.0000	47935.00		
LP-RES	OUT	POND	72	23074.940		63.0000	47935.00		
SCHOENS DAM	IN	POND	72	94783.550		63.2500	103275.10		
SCHOENS DAM	OUT	POND	72	83960.540		72.0000	40050.79	5824.53	56558.820
*SCHOENS OUT		JCT	72	83960.540		72.0000	40050.79		
SHB-LPR		HYG	72	23074.940		63.0000	47935.00		
SHB-SC		HYG	72	71503.550		63.2500	57666.00		

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

Link ID	Type		HYG Vol ac-ft	Trun.	Peak Time hrs	Peak Q cfs	End Points	
24"PIPE/SPILLWAY	PONDrt	UN	23074.940		63.0000	47935.00	LP-RES	IN
24"PIPE/SPILLWAY			23074.940		63.0000	47935.00	LP-RES	OUT
		DL	23074.940		63.0000	47935.00		
		DN	23074.940		63.0000	47935.00	J1	
48"PIPE/SPILLWAY	PONDrt	UN	94783.550		63.2500	103275.10	SCHOENS DAM	IN
48"PIPE/SPILLWAY			83960.540		72.0000	40050.79	SCHOENS DAM	OUT
		DL	83960.540		72.0000	40050.79		
		DN	83960.540		72.0000	40050.79	SCHOENS OUT	
SHB-LPR	ADD	UN	23074.940		63.0000	47935.00	SHB-LPR	
		DL	23074.940		63.0000	47935.00		
		DN	23074.940		63.0000	47935.00	LP-RES	IN
SHB-R13	REACH	UN	23074.940		63.0000	47935.00	J1	
		DL	23074.880		63.2500	45609.07		
		DN	94783.550		63.2500	103275.10	SCHOENS DAM	IN
SHB-SC	ADD	UN	71503.550		63.2500	57666.00	SHB-SC	
		DL	71503.550		63.2500	57666.00		
		DN	94783.550		63.2500	103275.10	SCHOENS DAM	IN

Scenario 2 of 4 (Results page 2 of 2)

Schoens Dam and Spillway analysis, SHB network, 72 hour winter storm, Lone Pine Dam removed, No LPR Seepage, Schoens Spillway rating curve from SHB plans, Schoens 48" pipe outlet rating table calculated, Schoens Reservoir-Capacity Curve from SHB, SHB reach routing physical data modeled with Modified Puls, Schoens permanent pool at 5754, 72 hr winter cyclonic storm hydrographs input for Lone Pine and Schoens Reservoirs taken from SHB.

```
Type.... Pond Routing Summary
Name.... SCHOENS DAM
File.... C:\JJ\SCHOENS2.PPW
Storm... 72   Tag: 72

                    LEVEL POOL ROUTING SUMMARY

 HYG Dir          = C:\JJ\
 Inflow  HYG file = NONE STORED - SCHOENS DAM  IN  72
 Outflow HYG file = NONE STORED - SCHOENS DAM  OUT 72

 Pond Node   Data = SCHOENS DAM
 Pond Volume Data = SCHOENS DAM 5754
 Pond Outlet Data = 48"PIPE/SPILLWAY

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev   =  5700.00 ft
 Starting Volume    =    1.000 ac-ft
 Starting Outflow   =      .00 cfs
 Starting Infiltr.  =      .00 cfs
 Starting Total Qout=      .00 cfs
 Time Increment     =    .2500 hrs


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 =====================================================
 Peak Inflow       = 103275.10 cfs    at   63.2500 hrs
 Peak Outflow      =  40050.79 cfs    at   72.0000 hrs
 -----------------------------------------------------
 Peak Elevation    =   5824.53 ft
 Peak Storage =      56558.820 ac-ft
 =====================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol  =       1.000
+ HYG Vol IN   =   94783.550
- Infiltration =        .000
- HYG Vol OUT  =   83960.540
- Retained Vol =   10824.300
                 ----------
 Unrouted Vol =        .286 ac-ft  (.000% of Inflow Volume)
```

Scenario 3 of 4 (Results page 1 of 2)

Schoens Dam and Spillway analysis, SHB network, 72 hour winter storm, Lone Pine Dam removed, No LPR Seepage, Schoens Spillway rating curve from SHB plans, Schoens 48" pipe outlet rating table calculated, Schoens Reservoir-Capacity Curve from SHB, SHB reach routing physical data modeled with Modified Puls, Schoens permanent pool at 5777, 72 hr winter cyclonic storm hydrographs input for Lone Pine and Schoens Reservoirs taken from SHB.

```
   Type.... Master Network Summary
   Name.... Watershed
   File.... C:\JJ\SCHOENS2.PPW
```

NETWORK SUMMARY -- NODES
(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID		Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
J1		JCT	72	23074.940		63.0000	47935.00		
LP-RES	IN	POND	72	23074.940		63.0000	47935.00		
LP-RES	OUT	POND	72	23074.940		63.0000	47935.00		
SCHOENS DAM	IN	POND	72	94783.550		63.2500	103275.10		
SCHOENS DAM	OUT	POND	72	92779.180		71.0000	42028.36	5825.19	48872.960
*SCHOENS OUT		JCT	72	92779.180		71.0000	42028.36		
SHB-LPR		HYG	72	23074.940		63.0000	47935.00		
SHB-SC		HYG	72	71503.550		63.2500	57666.00		

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

Link ID	Type		HYG Vol ac-ft	Trun.	Peak Time hrs	Peak Q cfs	End Points	
24"PIPE/SPILLWAY	PONDrt	UN	23074.940		63.0000	47935.00	LP-RES	IN
24"PIPE/SPILLWAY			23074.940		63.0000	47935.00	LP-RES	OUT
		DL	23074.940		63.0000	47935.00		
		DN	23074.940		63.0000	47935.00	J1	
48"PIPE/SPILLWAY	PONDrt	UN	94783.550		63.2500	103275.10	SCHOENS DAM	IN
48"PIPE/SPILLWAY			92779.180		71.0000	42028.36	SCHOENS DAM	OUT
		DL	92779.180		71.0000	42028.36		
		DN	92779.180		71.0000	42028.36	SCHOENS OUT	
SHB-LPR	ADD	UN	23074.940		63.0000	47935.00	SHB-LPR	
		DL	23074.940		63.0000	47935.00		
		DN	23074.940		63.0000	47935.00	LP-RES	IN
SHB-R13	REACH	UN	23074.940		63.0000	47935.00	J1	
		DL	23074.880		63.2500	45609.07		
		DN	94783.550		63.2500	103275.10	SCHOENS DAM	IN
SHB-SC	ADD	UN	71503.550		63.2500	57666.00	SHB-SC	
		DL	71503.550		63.2500	57666.00		
		DN	94783.550		63.2500	103275.10	SCHOENS DAM	IN

Scenario 3 of 4 (Results page 2 of 2)

Schoens Dam and Spillway analysis, SHB network, 72 hour winter storm, Lone Pine Dam removed, No LPR Seepage, Schoens Spillway rating curve from SHB plans, Schoens 48" pipe outlet rating table calculated, Schoens Reservoir-Capacity Curve from SHB, SHB reach routing physical data modeled with Modified Puls, Schoens permanent pool at 5777, 72 hr winter cyclonic storm hydrographs input for Lone Pine and Schoens Reservoirs taken from SHB.

```
Type.... Pond Routing Summary
Name.... SCHOENS DAM
File.... C:\JJ\SCHOENS2.PPW
Storm... 72   Tag: 72

                    LEVEL POOL ROUTING SUMMARY

 HYG Dir          = C:\JJ\
 Inflow  HYG file = NONE STORED - SCHOENS DAM  IN  72
 Outflow HYG file = NONE STORED - SCHOENS DAM  OUT 72

 Pond Node   Data = SCHOENS DAM
 Pond Volume Data = SCHOENS DAM 5777
 Pond Outlet Data = 48"PIPE/SPILLWAY

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev   =  5700.00 ft
 Starting Volume    =    1.000 ac-ft
 Starting Outflow   =      .00 cfs
 Starting Infiltr.  =      .00 cfs
 Starting Total Qout=      .00 cfs
 Time Increment     =    .2500 hrs


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 =====================================================
 Peak Inflow       = 103275.10 cfs    at   63.2500 hrs
 Peak Outflow      =  42028.36 cfs    at   71.0000 hrs
 -----------------------------------------------------
 Peak Elevation    =   5825.19 ft
 Peak Storage =      48872.960 ac-ft
 =====================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol  =       1.000
+ HYG Vol IN   =   94783.550
- Infiltration =        .000
- HYG Vol OUT  =   92779.180
- Retained Vol =    2005.564
                  ----------
 Unrouted Vol =        .195 ac-ft  (.000% of Inflow Volume)
```

Scenario 4 of 4 (Results page 1 of 2)

Schoens Dam and Spillway analysis, SHB network, 72 hour winter storm, Lone Pine half full, No LPR Seepage, New LPR Spillway, Lone Pine Reservoir-Capacity Curve from SHB, Schoens Spillway rating curve from SHB plans, Schoens 48" pipe outlet rating table calculated, Schoens Reservoir-Capacity Curve from SHB, SHB reach routing physical data modeled with Modified Puls, Schoens permanent pool at 5777, 72 hr winter cyclonic storm hydrographs input for Lone Pine and Schoens Reservoirs taken from SHB.

```
   Type.... Master Network Summary
   Name.... Watershed
   File.... C:\JJ\SCHOENS2.PPW
```

NETWORK SUMMARY -- NODES
(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID		Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
J1		JCT	72	17162.910		63.5000	30584.07		
LP-RES	IN	POND	72	23074.940		63.0000	47935.00		
LP-RES	OUT	POND	72	17162.910		63.5000	30584.07	1006.86	12242.250
SCHOENS DAM	IN	POND	72	88864.730		63.5000	86182.15		
SCHOENS DAM	OUT	POND	72	84498.580		72.0000	40180.19	5824.57	47804.940
*SCHOENS OUT		JCT	72	84498.580		72.0000	40180.19		
SHB-LPR		HYG	72	23074.940		63.0000	47935.00		
SHB-SC		HYG	72	71503.550		63.2500	57666.00		

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

Link ID	Type		HYG Vol ac-ft	Trun.	Peak Time hrs	Peak Q cfs	End Points	
24"PIPE/SPILLWAY	PONDrt	UN	23074.940		63.0000	47935.00	LP-RES	IN
24"PIPE/SPILLWAY			17162.910		63.5000	30584.07	LP-RES	OUT
		DL	17162.910		63.5000	30584.07		
		DN	17162.910		63.5000	30584.07	J1	
48"PIPE/SPILLWAY	PONDrt	UN	88864.730		63.5000	86182.15	SCHOENS DAM	IN
48"PIPE/SPILLWAY			84498.580		72.0000	40180.19	SCHOENS DAM	OUT
		DL	84498.580		72.0000	40180.19		
		DN	84498.580		72.0000	40180.19	SCHOENS OUT	
SHB-LPR	ADD	UN	23074.940		63.0000	47935.00	SHB-LPR	
		DL	23074.940		63.0000	47935.00		
		DN	23074.940		63.0000	47935.00	LP-RES	IN
SHB-R13	REACH	UN	17162.910		63.5000	30584.07	J1	
		DL	17155.700		63.7500	30128.71		
		DN	88864.730		63.5000	86182.15	SCHOENS DAM	IN
SHB-SC	ADD	UN	71503.550		63.2500	57666.00	SHB-SC	
		DL	71503.550		63.2500	57666.00		
		DN	88864.730		63.5000	86182.15	SCHOENS DAM	IN

Scenario 4 of 4 (Results page 2 of 2)

Schoens Dam and Spillway analysis, SHB network, 72 hour winter storm, Lone Pine half full, No LPR Seepage, New LPR Spillway, Lone Pine Reservoir-Capacity Curve from SHB, Schoens Spillway rating curve from SHB plans, Schoens 48" pipe outlet rating table calculated, Schoens Reservoir-Capacity Curve from SHB, SHB reach routing physical data modeled with Modified Puls, Schoens permanent pool at 5777, 72 hr winter cyclonic storm hydrographs input for Lone Pine and Schoens Reservoirs taken from SHB.

```
   Type.... Pond Routing Summary
   Name.... SCHOENS DAM
   File.... C:\JJ\SCHOENS2.PPW
   Storm... 72   Tag: 72

                     LEVEL POOL ROUTING SUMMARY

    HYG Dir          = C:\JJ\
    Inflow  HYG file = NONE STORED - SCHOENS DAM  IN  72
    Outflow HYG file = NONE STORED - SCHOENS DAM  OUT 72

    Pond Node   Data = SCHOENS DAM
    Pond Volume Data = SCHOENS DAM 5777
    Pond Outlet Data = 48"PIPE/SPILLWAY

    No Infiltration

    INITIAL CONDITIONS
    ---------------------------------
    Starting WS Elev   =  5700.00 ft
    Starting Volume    =    1.000 ac-ft
    Starting Outflow   =      .00 cfs
    Starting Infiltr.  =      .00 cfs
    Starting Total Qout=      .00 cfs
    Time Increment     =    .2500 hrs


    INFLOW/OUTFLOW HYDROGRAPH SUMMARY
    =====================================================
    Peak Inflow       =  86182.15 cfs    at   63.5000 hrs
    Peak Outflow      =  40180.19 cfs    at   72.0000 hrs
    -----------------------------------------------------
    Peak Elevation    =   5824.57 ft
    Peak Storage =      47804.940 ac-ft
    =====================================================


    MASS BALANCE (ac-ft)
    --------------------------
  + Initial Vol  =       1.000
  + HYG Vol IN   =   88864.730
  - Infiltration =        .000
  - HYG Vol OUT  =   84498.580
  - Retained Vol =    4367.015
                    ----------
    Unrouted Vol =       -.143 ac-ft  (.000% of Inflow Volume)
```

```
Type.... Read HYG
Name.... SHB-LPR
File.... C:\JJ\SCHOENS2.PPW
Storm... Tag: 72

            HYG file = C:\JJ\SCHOENS.HYG
            HYG ID   = SC-72 HR
            HYG Tag  = 72
            -----------------------------------
            Peak Discharge =     47935.00 cfs
            Time to Peak   =      63.0000 hrs
            HYG Volume     =    23074.940 ac-ft
            -----------------------------------
```

HYDROGRAPH ORDINATES (cfs)
Output Time increment = .2500 hrs
Time on left represents time for first value in each row.

Time hrs					
.0000	.00	.00	.00	.00	.00
1.2500	.00	.00	.00	.00	.00
2.5000	.00	.00	.00	.00	.00
3.7500	.00	.00	.00	.00	.00
5.0000	.00	.00	.00	.00	.00
6.2500	.00	.00	.00	.00	.00
7.5000	.00	.00	.00	.00	.00
8.7500	.00	1.00	7.00	18.00	32.00
10.0000	47.00	62.00	77.00	92.00	107.00
11.2500	122.00	136.00	150.00	164.00	178.00
12.5000	191.00	204.00	217.00	230.00	243.00
13.7500	255.00	267.00	279.00	291.00	303.00
15.0000	314.00	326.00	337.00	348.00	358.00
16.2500	369.00	380.00	390.00	400.00	410.00
17.5000	420.00	430.00	440.00	449.00	458.00
18.7500	468.00	477.00	486.00	495.00	503.00
20.0000	512.00	520.00	529.00	537.00	545.00
21.2500	553.00	561.00	569.00	577.00	584.00
22.5000	592.00	599.00	607.00	614.00	621.00
23.7500	628.00	635.00	805.00	1130.00	1335.00
25.0000	1438.00	1499.00	1541.00	1576.00	1606.00
26.2500	1635.00	1661.00	1687.00	1713.00	1737.00
27.5000	1761.00	1785.00	1808.00	1830.00	1852.00
28.7500	1873.00	1894.00	1914.00	1934.00	1953.00
30.0000	1972.00	1990.00	2008.00	2026.00	2043.00
31.2500	2060.00	2077.00	2093.00	2108.00	2124.00
32.5000	2139.00	2154.00	2168.00	2182.00	2196.00
33.7500	2210.00	2223.00	2236.00	2249.00	2261.00
35.0000	2274.00	2286.00	2297.00	2309.00	2320.00
36.2500	2331.00	2342.00	2353.00	2363.00	2374.00
37.5000	2384.00	2394.00	2403.00	2413.00	2422.00
38.7500	2431.00	2440.00	2449.00	2458.00	2467.00
40.0000	2475.00	2483.00	2491.00	2499.00	2507.00

```
Type.... Read HYG
Name.... SHB-LPR
File.... C:\JJ\SCHOENS2.PPW
Storm... Tag: 72

                         HYDROGRAPH ORDINATES (cfs)
   Time  |               Output Time increment = .2500 hrs
   hrs   |    Time on left represents time for first value in each row.
---------|--------------------------------------------------------------
 41.2500 |     2515.00     2522.00     2530.00     2537.00     2544.00
 42.5000 |     2551.00     2558.00     2565.00     2572.00     2578.00
 43.7500 |     2585.00     2591.00     2598.00     2604.00     2610.00
 45.0000 |     2616.00     2622.00     2628.00     2633.00     2639.00
 46.2500 |     2645.00     2650.00     2655.00     2661.00     2666.00
 47.5000 |     2671.00     2676.00     2681.00     2990.00     3578.00
 48.7500 |     3928.00     4080.00     4150.00     4185.00     4207.00
 50.0000 |     4222.00     4233.00     4243.00     4252.00     4262.00
 51.2500 |     4271.00     4280.00     4289.00     4297.00     4305.00
 52.5000 |     4314.00     4322.00     4330.00     4337.00     4345.00
 53.7500 |     4352.00     4360.00     5219.00     6851.00     7839.00
 55.0000 |     8256.00     8446.00     8540.00     8592.00     8627.00
 56.2500 |     8652.00     8672.00     8692.00     8710.00     8728.00
 57.5000 |     8746.00     8763.00     8779.00     8795.00     8811.00
 58.7500 |     8826.00     8840.00     8854.00     8868.00     8881.00
 60.0000 |     8894.00     8952.00     9082.00     9157.00     9195.00
 61.2500 |     9330.00     9561.00     9702.00     9767.00    18177.00
 62.5000 |    34271.00    43853.00    47935.00    43327.00    31843.00
 63.7500 |    24973.00    22165.00    18145.00    12222.00     8821.00
 65.0000 |     7408.00     6823.00     6591.00     6493.00     6449.00
 66.2500 |     6436.00     6438.00     6440.00     6442.00     6444.00
 67.5000 |     6446.00     6448.00     6450.00     6451.00     6453.00
 68.7500 |     6455.00     6457.00     6458.00     6460.00     6462.00
 70.0000 |     6463.00     6465.00     6467.00     6468.00     6470.00
 71.2500 |     6471.00     6473.00     6474.00     6476.00     5138.00
 72.5000 |     2578.00     1072.00      450.00      187.00       76.00
 73.7500 |       29.00        7.00         .00         .00         .00
 75.0000 |         .00         .00         .00         .00
```

```
Type.... Read HYG
Name.... SHB-SC
File.... C:\JJ\SCHOENS2.PPW
Storm... Tag: 72


            HYG file = C:\JJ\SCHOENS.HYG
            HYG ID   = LPR-72 HR
            HYG Tag  = 72
            -----------------------------------
            Peak Discharge =     57666.00 cfs
            Time to Peak   =      63.2500 hrs
            HYG Volume     =    71503.550 ac-ft
            -----------------------------------
```

HYDROGRAPH ORDINATES (cfs)
Output Time increment = .2500 hrs
Time on left represents time for first value in each row.

Time hrs					
.0000	.00	.00	.00	.00	.00
1.2500	.00	.00	.00	.00	.00
2.5000	.00	.00	.00	.00	.00
3.7500	.00	.00	.00	.00	.00
5.0000	.00	.00	.00	.00	.00
6.2500	.00	.00	.00	.00	.00
7.5000	.00	1.00	1.00	1.00	2.00
8.7500	3.00	4.00	5.00	7.00	10.00
10.0000	15.00	23.00	33.00	45.00	57.00
11.2500	69.00	82.00	95.00	109.00	124.00
12.5000	138.00	154.00	169.00	185.00	202.00
13.7500	220.00	239.00	259.00	279.00	300.00
15.0000	321.00	343.00	364.00	386.00	408.00
16.2500	430.00	453.00	475.00	498.00	522.00
17.5000	545.00	568.00	592.00	618.00	644.00
18.7500	683.00	718.00	752.00	783.00	812.00
20.0000	840.00	867.00	894.00	920.00	947.00
21.2500	973.00	999.00	1025.00	1050.00	1075.00
22.5000	1100.00	1124.00	1148.00	1173.00	1198.00
23.7500	1222.00	1246.00	1311.00	1464.00	1641.00
25.0000	1789.00	1898.00	1991.00	2078.00	2164.00
26.2500	2254.00	2343.00	2434.00	2540.00	2645.00
27.5000	2749.00	2852.00	2953.00	3052.00	3149.00
28.7500	3245.00	3341.00	3435.00	3529.00	3622.00
30.0000	3717.00	3815.00	3924.00	4028.00	4129.00
31.2500	4227.00	4323.00	4419.00	4517.00	4617.00
32.5000	4721.00	4827.00	4934.00	5044.00	5154.00
33.7500	5263.00	5381.00	5494.00	5601.00	5704.00
35.0000	5805.00	5903.00	5998.00	6092.00	6183.00
36.2500	6273.00	6361.00	6448.00	6535.00	6619.00
37.5000	6702.00	6783.00	6861.00	6938.00	7019.00
38.7500	7099.00	7175.00	7250.00	7321.00	7390.00
40.0000	7457.00	7522.00	7585.00	7646.00	7705.00

```
Type.... Read HYG
Name.... SHB-SC
File.... C:\JJ\SCHOENS2.PPW
Storm... Tag: 72
```

HYDROGRAPH ORDINATES (cfs)
Output Time increment = .2500 hrs
Time on left represents time for first value in each row.

Time hrs					
41.2500	7763.00	7819.00	7874.00	7928.00	7980.00
42.5000	8031.00	8081.00	8131.00	8179.00	8226.00
43.7500	8271.00	8314.00	8357.00	8397.00	8437.00
45.0000	8475.00	8512.00	8548.00	8584.00	8618.00
46.2500	8650.00	8683.00	8714.00	8744.00	8773.00
47.5000	8802.00	8830.00	8858.00	8964.00	9244.00
48.7500	9571.00	9839.00	10035.00	10203.00	10359.00
50.0000	10510.00	10658.00	10802.00	10940.00	11073.00
51.2500	11203.00	11330.00	11454.00	11574.00	11691.00
52.5000	11805.00	11916.00	12025.00	12133.00	12240.00
53.7500	12345.00	12451.00	12783.00	13611.00	14576.00
55.0000	15380.00	15991.00	16531.00	17047.00	17560.00
56.2500	18068.00	18567.00	19064.00	19542.00	19990.00
57.5000	20412.00	20816.00	21203.00	21568.00	21907.00
58.7500	22215.00	22509.00	22797.00	23084.00	23380.00
60.0000	23697.00	24045.00	24437.00	24830.00	25199.00
61.2500	25578.00	26014.00	26462.00	26880.00	29509.00
62.5000	37024.00	46028.00	53589.00	57666.00	57354.00
63.7500	55518.00	54311.00	53238.00	50675.00	47737.00
65.0000	45405.00	43865.00	42768.00	41978.00	41411.00
66.2500	41007.00	40716.00	40493.00	40310.00	40151.00
67.5000	39991.00	39817.00	39624.00	39409.00	39169.00
68.7500	38903.00	38611.00	38296.00	37965.00	37609.00
70.0000	37232.00	36836.00	36424.00	35999.00	35565.00
71.2500	35120.00	34667.00	34214.00	33761.00	32925.00
72.5000	31256.00	29316.00	27615.00	26237.00	25029.00
73.7500	23894.00	22812.00	21771.00	20796.00	19869.00

```
Type.... Chn-Irreg.
Name.... SHB-R13

File.... C:\JJ\SCHOENS2.PPW

                      COMPOSITE CHANNEL SECTION

                      Slope        = .014000 ft/ft
                      Elev.Constant=     .00 ft

                      GROUND ELEVATION POINTS
                      Cross Section ID: SHB-R13
                      Lowest Elev. =     .00 ft

                  X Distance     Y Elev     Y+Constant
                     (ft)         (ft)         (ft)
                  ----------  ----------  ----------
                        .00       60.00       60.00
                      60.00       40.00       40.00
                     120.00       20.00       20.00
                     180.00         .00         .00
                     260.00         .00         .00
                     300.00       20.00       20.00
                     340.00       40.00       40.00
                     380.00       60.00       60.00


                THE INFORMATION BELOW WAS USED TO COMPUTE
                  FLOW RATE SEPARATELY FOR EACH SEGMENT.

                       Cross Section ID: SHB-R13

            CROSS SECTION SUBDIVIDED INTO DIFFERENT SEGMENTS
                  X Left   X Right
        Segment    (ft)      (ft)    Ground n   Descr.
        -------  --------  --------  --------   -----------------
           1         .00    120.00    0.08000   Left Overbank
           2      120.00    300.00    0.06000   Main Channel
           3      300.00    380.00    0.08000   Right Overbank
```

Type.... Chn-Irreg.
Name.... SHB-R13

File.... C:\JJ\SCHOENS2.PPW

Solution to Mannings Open Channel Flow Equation
(Computed values are based on normal depth.)

IRREGULAR CROSS SECTION
Cross Section ID: SHB-R13

Slope = .014000 ft/ft

FLOW RATE COMPUTED SEPARATELY FOR EACH SEGMENT.

COMPOSITE CROSS SECTION

Seg. No.	Elev. (ft)	Max. Depth (ft)	Seg. n	Flow (cfs)	Avg.Vel (ft/sec)	Area (sq.ft)	Top W (ft)	Wet.P (ft)	Hd (ft)	Froude No.
	.00	Q=0.0; Water surface at or below lowest cross section point.								
	.00	Q=0.0; Water surface at or below lowest cross section point.								
2	.01	.01	.0600	.11	.14	.8002	80.05	80.05	.01	.24
	TOTAL FLOW			.11		.8002	80.05	80.05		
2	1.20	1.20	.0600	320.68	3.22	99.6000	86.00	86.48	1.16	.53
	TOTAL FLOW			320.68		99.6000	86.00	86.48		
2	2.40	2.40	.0600	1029.37	4.99	206.4000	92.00	92.96	2.24	.59
	TOTAL FLOW			1029.37		206.4000	92.00	92.96		
2	3.60	3.60	.0600	2048.20	6.39	320.4000	98.00	99.43	3.27	.62
	TOTAL FLOW			2048.20		320.4000	98.00	99.43		
2	4.80	4.80	.0600	3352.17	7.59	441.6000	104.00	105.91	4.25	.65
	TOTAL FLOW			3352.17		441.6000	104.00	105.91		
2	6.00	6.00	.0600	4930.38	8.65	570.0000	110.00	112.39	5.18	.67
	TOTAL FLOW			4930.38		570.0000	110.00	112.39		
2	7.20	7.20	.0600	6778.42	9.61	705.6000	116.00	118.87	6.08	.69
	TOTAL FLOW			6778.42		705.6000	116.00	118.87		
2	8.40	8.40	.0600	8895.46	10.48	848.4000	122.00	125.35	6.95	.70
	TOTAL FLOW			8895.46		848.4000	122.00	125.35		
2	9.60	9.60	.0600	11282.85	11.30	998.4000	128.00	131.82	7.80	.71
	TOTAL FLOW			11282.85		998.4000	128.00	131.82		
2	10.80	10.80	.0600	13943.37	12.07	1155.6000	134.00	138.30	8.62	.72
	TOTAL FLOW			13943.37		1155.6000	134.00	138.30		
2	12.00	12.00	.0600	16880.75	12.79	1320.0000	140.00	144.78	9.43	.73
	TOTAL FLOW			16880.75		1320.0000	140.00	144.78		
2	13.20	13.20	.0600	20099.38	13.48	1491.6000	146.00	151.26	10.22	.74
	TOTAL FLOW			20099.38		1491.6000	146.00	151.26		
2	14.40	14.40	.0600	23604.12	14.13	1670.4000	152.00	157.74	10.99	.75
	TOTAL FLOW			23604.12		1670.4000	152.00	157.74		

Type.... Chn-Irreg.
Name.... SHB-R13
File.... C:\JJ\SCHOENS2.PPW

Solution to Mannings Open Channel Flow Equation
(Computed values are based on normal depth.)

IRREGULAR CROSS SECTION
Cross Section ID: SHB-R13

Slope = .014000 ft/ft

FLOW RATE COMPUTED SEPARATELY FOR EACH SEGMENT.

COMPOSITE CROSS SECTION

Seg. No.	Elev. (ft)	Max. Depth (ft)	Seg. n	Flow (cfs)	Avg.Vel (ft/sec)	Area (sq.ft)	Top W (ft)	Wet.P (ft)	Hd (ft)	Froude No.
2	15.60	15.60	.0600	27400.18	14.76	1856.4000	158.00	164.21	11.75	.76
	TOTAL FLOW			27400.18		1856.4000	158.00	164.21		
2	16.80	16.80	.0600	31493.00	15.37	2049.6000	164.00	170.69	12.50	.77
	TOTAL FLOW			31493.00		2049.6000	164.00	170.69		
2	18.00	18.00	.0600	35888.20	15.95	2250.0000	170.00	177.17	13.24	.77
	TOTAL FLOW			35888.20		2250.0000	170.00	177.17		
2	19.20	19.20	.0600	40591.53	16.52	2457.6000	176.00	183.65	13.96	.78
	TOTAL FLOW			40591.53		2457.6000	176.00	183.65		
1	20.40	.40	.0800	.17	.73	.2400	1.20	1.26	.20	.29
2	20.40	20.40	.0600	45945.97	17.20	2672.0000	180.00	187.97	14.84	.79
3	20.40	.40	.0800	.11	.70	.1600	.80	.89	.20	.28
	TOTAL FLOW			45946.26		2672.4000	182.00	190.13		
1	21.60	1.60	.0800	7.02	1.83	3.8398	4.80	5.06	.80	.36
2	21.60	21.60	.0600	52301.65	18.11	2888.0000	180.00	187.97	16.04	.80
3	21.60	1.60	.0800	4.50	1.76	2.5599	3.20	3.58	.80	.35
	TOTAL FLOW			52313.17		2894.4000	188.00	196.60		
1	22.80	2.80	.0800	31.23	2.66	11.7597	8.40	8.85	1.40	.40
2	22.80	22.80	.0600	58982.48	19.00	3104.0010	180.00	187.97	17.24	.81
3	22.80	2.80	.0800	20.02	2.55	7.8398	5.60	6.26	1.40	.38
	TOTAL FLOW			59033.72		3123.6000	194.00	203.08		
1	24.00	4.00	.0800	80.84	3.37	23.9996	12.00	12.65	2.00	.42
2	24.00	24.00	.0600	65980.72	19.87	3320.0010	180.00	187.97	18.44	.82
3	24.00	4.00	.0800	51.82	3.24	15.9996	8.00	8.94	2.00	.40
	TOTAL FLOW			66113.37		3360.0000	200.00	209.56		
1	25.20	5.20	.0800	162.73	4.01	40.5595	15.60	16.44	2.60	.44
2	25.20	25.20	.0600	73289.30	20.73	3536.0010	180.00	187.97	19.64	.82
3	25.20	5.20	.0800	104.31	3.86	27.0395	10.40	11.63	2.60	.42
	TOTAL FLOW			73556.33		3603.6000	206.00	216.04		
1	26.40	6.40	.0800	283.09	4.61	61.4394	19.20	20.24	3.20	.45
2	26.40	26.40	.0600	80901.82	21.56	3752.0010	180.00	187.97	20.84	.83
3	26.40	6.40	.0800	181.46	4.43	40.9594	12.80	14.31	3.20	.44
	TOTAL FLOW			81366.38		3854.4000	212.00	222.52		
1	27.60	7.60	.0800	447.66	5.17	86.6393	22.80	24.03	3.80	.47
2	27.60	27.60	.0600	88812.29	22.38	3968.0020	180.00	187.97	22.04	.84
3	27.60	7.60	.0800	286.95	4.97	57.7594	15.20	16.99	3.80	.45
	TOTAL FLOW			89546.91		4112.4000	218.00	228.99		

Type.... Chn-Irreg.
Name.... SHB-R13

File.... C:\JJ\SCHOENS2.PPW

Solution to Mannings Open Channel Flow Equation
(Computed values are based on normal depth.)

IRREGULAR CROSS SECTION
Cross Section ID: SHB-R13

Slope = .014000 ft/ft

FLOW RATE COMPUTED SEPARATELY FOR EACH SEGMENT.

COMPOSITE CROSS SECTION

Seg. No.	Elev. (ft)	Max. Depth (ft)	Seg. n	Flow (cfs)	Avg.Vel (ft/sec)	Area (sq.ft)	Top W (ft)	Wet.P (ft)	Hd (ft)	Froude No.
1	28.80	8.80	.0800	661.82	5.70	116.1591	26.40	27.83	4.40	.48
2	28.80	28.80	.0600	97015.20	23.19	4184.0020	180.00	187.97	23.24	.85
3	28.80	8.80	.0800	424.22	5.48	77.4392	17.60	19.68	4.40	.46
	TOTAL FLOW			98101.23		4377.6010	224.00	235.47		
1	30.00	10.00	.0800	930.65	6.20	149.9991	30.00	31.62	5.00	.49
2	30.00	30.00	.0600	105505.40	23.98	4400.0020	180.00	187.97	24.44	.86
3	30.00	10.00	.0800	596.54	5.97	99.9991	20.00	22.36	5.00	.47
	TOTAL FLOW			107032.60		4650.0000	230.00	241.95		
1	31.20	11.20	.0800	1259.02	6.69	188.1589	33.60	35.42	5.60	.50
2	31.20	31.20	.0600	114278.20	24.76	4616.0020	180.00	187.97	25.64	.86
3	31.20	11.20	.0800	807.03	6.43	125.4389	22.40	25.04	5.60	.48
	TOTAL FLOW			116344.20		4929.6000	236.00	248.43		
1	32.40	12.40	.0800	1651.62	7.16	230.6388	37.20	39.21	6.20	.51
2	32.40	32.40	.0600	123329.00	25.52	4832.0020	180.00	187.97	26.84	.87
3	32.40	12.40	.0800	1058.68	6.89	153.7588	24.80	27.73	6.20	.49
	TOTAL FLOW			126039.30		5216.4000	242.00	254.91		
1	33.60	13.60	.0800	2112.95	7.62	277.4387	40.80	43.01	6.80	.51
2	33.60	33.60	.0600	132653.70	26.28	5048.0030	180.00	187.97	28.04	.87
3	33.60	13.60	.0800	1354.40	7.32	184.9589	27.20	30.41	6.80	.50
	TOTAL FLOW			136121.00		5510.4010	248.00	261.38		
1	34.80	14.80	.0800	2647.38	8.06	328.5587	44.40	46.80	7.40	.52
2	34.80	34.80	.0600	142248.20	27.02	5264.0030	180.00	187.97	29.24	.88
3	34.80	14.80	.0800	1696.97	7.75	219.0387	29.60	33.09	7.40	.50
	TOTAL FLOW			146592.60		5811.6010	254.00	267.86		
1	36.00	16.00	.0800	3259.16	8.49	383.9984	48.00	50.60	8.00	.53
2	36.00	36.00	.0600	152108.90	27.76	5480.0030	180.00	187.97	30.44	.89
3	36.00	16.00	.0800	2089.12	8.16	255.9985	32.00	35.78	8.00	.51
	TOTAL FLOW			157457.20		6120.0000	260.00	274.34		
1	37.20	17.20	.0800	3952.41	8.91	443.7584	51.60	54.39	8.60	.54
2	37.20	37.20	.0600	162232.20	28.48	5696.0030	180.00	187.97	31.64	.89
3	37.20	17.20	.0800	2533.49	8.56	295.8384	34.40	38.46	8.60	.51
	TOTAL FLOW			168718.10		6435.6000	266.00	280.82		
1	38.40	18.40	.0800	4731.15	9.32	507.8383	55.20	58.19	9.20	.54
2	38.40	38.40	.0600	172614.70	29.20	5912.0030	180.00	187.97	32.84	.90
3	38.40	18.40	.0800	3032.66	8.96	338.5582	36.80	41.14	9.20	.52
	TOTAL FLOW			180378.50		6758.4000	272.00	287.30		

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   Type.... Chn-Irreg.
   Name.... SHB-R13

   File.... C:\JJ\SCHOENS2.PPW

                 Solution to Mannings Open Channel Flow Equation
                   (Computed values are based on normal depth.)

                            IRREGULAR CROSS SECTION
                            Cross Section ID: SHB-R13

                            Slope = .014000 ft/ft

                 FLOW RATE COMPUTED SEPARATELY FOR EACH SEGMENT.

                              COMPOSITE CROSS SECTION
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Seg. No.	Elev. (ft)	Max. Depth (ft)	Seg. n	Flow (cfs)	Avg.Vel (ft/sec)	Area (sq.ft)	Top W (ft)	Wet.P (ft)	Hd (ft)	Froude No.
1	39.60	19.60	.0800	5599.33	9.72	576.2382	58.80	61.98	9.80	.55
2	39.60	39.60	.0600	183253.30	29.90	6128.0040	180.00	187.97	34.04	.90
3	39.60	19.60	.0800	3589.16	9.34	384.1584	39.20	43.83	9.80	.53
	TOTAL FLOW			192441.80		7088.4010	278.00	293.77		
1	40.80	20.80	.0800	6560.77	10.11	648.9581	62.40	65.78	10.40	.55
2	40.80	40.80	.0600	194144.80	30.60	6344.0040	180.00	187.97	35.24	.91
3	40.80	20.80	.0800	4205.45	9.72	432.6382	41.60	46.51	10.40	.53
	TOTAL FLOW			204911.00		7425.6010	284.00	300.25		
1	42.00	22.00	.0800	7619.27	10.49	725.9978	66.00	69.57	11.00	.56
2	42.00	42.00	.0600	205286.40	31.29	6560.0040	180.00	187.97	36.44	.91
3	42.00	22.00	.0800	4883.94	10.09	483.9980	44.00	49.19	11.00	.54
	TOTAL FLOW			217789.60		7770.0000	290.00	306.73		
1	43.20	23.20	.0800	8778.51	10.87	807.3577	69.60	73.36	11.60	.56
2	43.20	43.20	.0600	216675.30	31.98	6776.0040	180.00	187.97	37.64	.92
3	43.20	23.20	.0800	5627.02	10.45	538.2379	46.40	51.88	11.60	.54
	TOTAL FLOW			231080.80		8121.6000	296.00	313.21		
1	44.40	24.40	.0800	10042.13	11.24	893.0377	73.20	77.16	12.20	.57
2	44.40	44.40	.0600	228308.90	32.65	6992.0050	180.00	187.97	38.84	.92
3	44.40	24.40	.0800	6437.00	10.81	595.3578	48.80	54.56	12.20	.55
	TOTAL FLOW			244788.00		8480.4000	302.00	319.69		
1	45.60	25.60	.0800	11413.70	11.61	983.0376	76.80	80.95	12.80	.57
2	45.60	45.60	.0600	240184.60	33.32	7208.0050	180.00	187.97	40.04	.93
3	45.60	25.60	.0800	7316.17	11.16	655.3578	51.20	57.24	12.80	.55
	TOTAL FLOW			258914.50		8846.4000	308.00	326.16		
1	46.80	26.80	.0800	12896.72	11.97	1077.3580	80.40	84.75	13.40	.58
2	46.80	46.80	.0600	252299.90	33.98	7424.0050	180.00	187.97	41.24	.93
3	46.80	26.80	.0800	8266.79	11.51	718.2377	53.60	59.93	13.40	.55
	TOTAL FLOW			273463.40		9219.6010	314.00	332.64		
1	48.00	28.00	.0800	14494.66	12.33	1175.9970	84.00	88.54	14.00	.58
2	48.00	48.00	.0600	264652.60	34.64	7640.0050	180.00	187.97	42.44	.94
3	48.00	28.00	.0800	9291.06	11.85	783.9974	56.00	62.61	14.00	.56
	TOTAL FLOW			288438.30		9600.0000	320.00	339.12		
1	49.20	29.20	.0800	16210.92	12.68	1278.9570	87.60	92.34	14.60	.58
2	49.20	49.20	.0600	277240.30	35.29	7856.0050	180.00	187.97	43.64	.94
3	49.20	29.20	.0800	10391.18	12.19	852.6373	58.40	65.29	14.60	.56
	TOTAL FLOW			303842.30		9987.6010	326.00	345.60		

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Type.... Chn-Irreg.
Name.... SHB-R13

File.... C:\JJ\SCHOENS2.PPW
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Solution to Mannings Open Channel Flow Equation
(Computed values are based on normal depth.)

IRREGULAR CROSS SECTION
Cross Section ID: SHB-R13

Slope = .014000 ft/ft

FLOW RATE COMPUTED SEPARATELY FOR EACH SEGMENT.

COMPOSITE CROSS SECTION

Seg. No.	Elev. (ft)	Max. Depth (ft)	Seg. n	Flow (cfs)	Avg.Vel (ft/sec)	Area (sq.ft)	Top W (ft)	Wet.P (ft)	Hd (ft)	Froude No.
1	50.40	30.40	.0800	18048.85	13.02	1386.2370	91.20	96.13	15.20	.59
2	50.40	50.40	.0600	290060.80	35.93	8072.0060	180.00	187.97	44.84	.95
3	50.40	30.40	.0800	11569.30	12.52	924.1573	60.80	67.98	15.20	.57
	TOTAL FLOW			319679.00		10382.4000	332.00	352.08		
1	51.60	31.60	.0800	20011.78	13.36	1497.8370	94.80	99.93	15.80	.59
2	51.60	51.60	.0600	303112.30	36.57	8288.0070	180.00	187.97	46.04	.95
3	51.60	31.60	.0800	12827.53	12.85	998.5573	63.20	70.66	15.80	.57
	TOTAL FLOW			335951.60		10784.4000	338.00	358.55		
1	52.80	32.80	.0800	22102.96	13.70	1613.7570	98.40	103.72	16.40	.60
2	52.80	52.80	.0600	316392.40	37.21	8504.0070	180.00	187.97	47.24	.95
3	52.80	32.80	.0800	14167.98	13.17	1075.8370	65.60	73.34	16.40	.57
	TOTAL FLOW			352663.30		11193.6000	344.00	365.03		
1	54.00	34.00	.0800	24325.63	14.03	1733.9970	102.00	107.52	17.00	.60
2	54.00	54.00	.0600	329899.30	37.83	8720.0070	180.00	187.97	48.44	.96
3	54.00	34.00	.0800	15592.71	13.49	1155.9970	68.00	76.03	17.00	.58
	TOTAL FLOW			369817.60		11610.0000	350.00	371.51		
1	55.20	35.20	.0800	26682.96	14.36	1858.5570	105.60	111.31	17.60	.60
2	55.20	55.20	.0600	343631.10	38.45	8936.0070	180.00	187.97	49.64	.96
3	55.20	35.20	.0800	17103.76	13.80	1239.0370	70.40	78.71	17.60	.58
	TOTAL FLOW			387417.80		12033.6000	356.00	377.99		
1	56.40	36.40	.0800	29178.12	14.68	1987.4370	109.20	115.11	18.20	.61
2	56.40	56.40	.0600	357586.00	39.07	9152.0070	180.00	187.97	50.84	.97
3	56.40	36.40	.0800	18703.15	14.12	1324.9570	72.80	81.39	18.20	.58
	TOTAL FLOW			405467.30		12464.4000	362.00	384.47		
1	57.60	37.60	.0800	31814.22	15.00	2120.6360	112.80	118.90	18.80	.61
2	57.60	57.60	.0600	371762.30	39.68	9368.0080	180.00	187.97	52.04	.97
3	57.60	37.60	.0800	20392.89	14.42	1413.7570	75.20	84.08	18.80	.59
	TOTAL FLOW			423969.50		12902.4000	368.00	390.94		
1	58.80	38.80	.0800	34594.34	15.32	2258.1560	116.40	122.70	19.40	.61
2	58.80	58.80	.0600	386158.20	40.29	9584.0080	180.00	187.97	53.24	.97
3	58.80	38.80	.0800	22174.95	14.73	1505.4370	77.60	86.76	19.40	.59
	TOTAL FLOW			442927.50		13347.6000	374.00	397.42		
1	60.00	40.00	.0800	37521.51	15.63	2399.9960	120.00	126.49	20.00	.62
2	60.00	60.00	.0600	400772.00	40.90	9800.0080	180.00	187.97	54.44	.98
3	60.00	40.00	.0800	24051.26	15.03	1599.9960	80.00	89.44	20.00	.59
	TOTAL FLOW			462344.80		13800.0000	380.00	403.90		

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Type.... Channel Equations
Name.... SHB-R13

File.... C:\JJ\SCHOENS2.PPW

              SOLUTION TO MANNINGS OPEN CHANNEL FLOW EQUATION
                (Computed values are based on normal depth.)


        Q  = (k/n) * A * (R**2/3) * (S**1/2)

        where:                       English Units     SI units
                                     -------------    ---------
        Q  = Channel flow                 cfs            cms
        k  = Mannings constant          1.485919           1.0
        n  = Mannings n                 no units       no units
        R  = Hydraulic radius, A/WP       ft             m
        A  = X-section flow area          sq.ft.         sq.m.
        WP = Wetted perimeter             ft             m
        S  = Slope                        ft/ft          m/m


        ADDITIONAL OUTPUT VARIABLES:
        Vel= Q/A
        Hd = A/TpW
        F  = Vel / (g * Hd)**1/2

        where:                       English Units     SI units
                                     -------------    ---------
        Vel= Velocity                     ft/sec         m/sec
        Q  = Channel flow                 cfs            cms
        A  = X-section flow area          sq.ft.         sq.m.
        Hd = Hydraulic depth              ft             m
        TpW= Top width for flow area      ft             m
        g  = Acceleration of gravity      ft/sec**2      m/sec**2
        F  = Froude No.                 no units       no units
        (Subcritical: F < 1;  Critical: F = 1;  Supercritical: F > 1)
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Type.... Reach E-V-Q Table
Name.... SHB-R13
File.... C:\JJ\SCHOENS2.PPW

                    MODIFIED PULS REACH DATA

 HYG Dir           = C:\JJ\
 Inflow  HYG file = NONE STORED - J1                72
 Outflow HYG file = NONE STORED - SHB-R13           72

 Reach Link Data  = SHB-R13
 Reach Length     = 12500.00 ft
 Approx. Total Tt = .3038 hrs  (based on Wtd.Q = 11675.54 cfs)
 Reach Channel    = SHB-R13  (Chn-Irreg.)
 Overflow Elev.   = 60.00 ft
 Overflow Channel = NONE

 No Infiltration

 INITIAL CONDITIONS
 --------------------------------
 Starting WS Elev   =      .00 ft
 Starting Volume    =     .000 ac-ft
 Starting Outflow   =      .00 cfs
 Starting Infiltr.  =      .00 cfs
 Starting Total Qout=      .00 cfs
 Time Increment     =    .2500 hrs
```

Elevation ft	Outflow cfs	Storage ac-ft	Area acres	Infilt. cfs	Q Total cfs	2S/t + O cfs
.00	.00	.000	.0000	.00	.00	.00
.01	.11	.230	22.9712	.00	.11	22.34
1.20	320.68	28.581	24.6786	.00	320.68	3087.35
2.40	1029.37	59.229	26.4004	.00	1029.37	6762.71
3.60	2048.20	91.942	28.1221	.00	2048.20	10948.20
4.80	3352.17	126.722	29.8439	.00	3352.17	15618.84
6.00	4930.38	163.568	31.5657	.00	4930.38	20763.72
7.20	6778.42	202.479	33.2874	.00	6778.42	26378.42
8.40	8895.46	243.457	35.0092	.00	8895.46	32462.13
9.60	11282.85	286.501	36.7310	.00	11282.85	39016.19
10.80	13943.37	331.612	38.4527	.00	13943.37	46043.38
12.00	16880.75	378.788	40.1745	.00	16880.75	53547.42
13.20	20099.38	428.030	41.8962	.00	20099.38	61532.72
14.40	23604.12	479.339	43.6180	.00	23604.12	70004.12
15.60	27400.18	532.714	45.3398	.00	27400.18	78966.85
16.80	31493.00	588.154	47.0615	.00	31493.00	88426.34
18.00	35888.20	645.661	48.7833	.00	35888.20	98388.20
19.20	40591.53	705.234	50.5051	.00	40591.53	108858.20
20.40	45946.26	766.873	52.2268	.00	45946.26	120179.60
21.60	52313.17	830.579	53.9486	.00	52313.17	132713.20
22.80	59033.72	896.350	55.6703	.00	59033.72	145800.40
24.00	66113.37	964.187	57.3921	.00	66113.37	159446.70
25.20	73556.33	1034.091	59.1139	.00	73556.33	173656.30

Type.... Reach E-V-Q Table
Name.... SHB-R13
File.... C:\JJ\SCHOENS2.PPW

MODIFIED PULS REACH DATA

Elevation ft	Outflow cfs	Storage ac-ft	Area acres	Infilt. cfs	Q Total cfs	2S/t + O cfs
26.40	81366.38	1106.061	60.8356	.00	81366.38	188433.00
27.60	89546.91	1180.097	62.5574	.00	89546.91	203780.30
28.80	98101.23	1256.198	64.2792	.00	98101.23	219701.30
30.00	107032.60	1334.367	66.0009	.00	107032.60	236199.30
31.20	116344.20	1414.600	67.7227	.00	116344.20	253277.60
32.40	126039.30	1496.901	69.4444	.00	126039.30	270939.30
33.60	136121.00	1581.267	71.1662	.00	136121.00	289187.80
34.80	146592.60	1667.700	72.8880	.00	146592.60	308025.90
36.00	157457.20	1756.198	74.6097	.00	157457.20	327457.20
37.20	168718.10	1846.763	76.3315	.00	168718.10	347484.80
38.40	180378.50	1939.394	78.0533	.00	180378.50	368111.80
39.60	192441.80	2034.091	79.7750	.00	192441.80	389341.80
40.80	204911.00	2130.854	81.4968	.00	204911.00	411177.80
42.00	217789.60	2229.683	83.2186	.00	217789.60	433622.90
43.20	231080.80	2330.579	84.9403	.00	231080.80	456680.80
44.40	244788.00	2433.540	86.6621	.00	244788.00	480354.70
45.60	258914.50	2538.568	88.3839	.00	258914.50	504647.80
46.80	273463.40	2645.661	90.1056	.00	273463.40	529563.40
48.00	288438.30	2754.821	91.8274	.00	288438.30	555104.90
49.20	303842.30	2866.047	93.5491	.00	303842.30	581275.70
50.40	319679.00	2979.339	95.2709	.00	319679.00	608079.00
51.60	335951.60	3094.698	96.9927	.00	335951.60	635518.30
52.80	352663.30	3212.121	98.7144	.00	352663.30	663596.60
54.00	369817.60	3331.612	100.4362	.00	369817.60	692317.60
55.20	387417.80	3453.168	102.1579	.00	387417.80	721684.50
56.40	405467.30	3576.791	103.8797	.00	405467.30	751700.60
57.60	423969.50	3702.480	105.6015	.00	423969.50	782369.50
58.80	442927.50	3830.234	107.3232	.00	442927.50	813694.10
60.00	462344.80	3960.055	109.0450	.00	462344.80	845678.10

```
Type.... Reach Routing Summary
Name.... SHB-R13
File.... C:\JJ\SCHOENS2.PPW
Storm... 72   Tag: 72

                    MODIFIED PULS REACH ROUTING SUMMARY

 HYG Dir          = C:\JJ\
 Inflow  HYG file = NONE STORED - J1               72
 Outflow HYG file = NONE STORED - SHB-R13          72

 Reach Link Data  = SHB-R13
 Reach Length     = 12500.00 ft
 Approx. Total Tt = .3038 hrs  (based on Wtd.Q = 11675.54 cfs)
 Reach Channel    = SHB-R13  (Chn-Irreg.)
 Overflow Elev.   = 60.00 ft
 Overflow Channel = NONE

 No Infiltration

 INITIAL CONDITIONS
 --------------------------------
 Starting WS Elev   =      .00 ft
 Starting Volume    =     .000 ac-ft
 Starting Outflow   =      .00 cfs
 Starting Infiltr.  =      .00 cfs
 Starting Total Qout=      .00 cfs
 Time Increment     =    .2500 hrs


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 =====================================================
 Peak Inflow       =  30584.07 cfs    at   63.5000 hrs
 Peak Outflow      =  30128.71 cfs    at   63.7500 hrs
 =====================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =   17162.910
- Infiltration =        .000
- HYG Vol OUT  =   17155.700
- Retained Vol =       7.224
                  ----------
 Unrouted Vol =        .016 ac-ft  (.000% of Inflow Volume)
```

```
   Type.... Vol: Elev-Volume
   Name.... LP-RES HALF FULL
   File.... C:\JJ\SCHOENS2.PPW

                       USER DEFINED VOLUME RATING TABLE
These numbers were taken from the SHB HEC1 input file for Schoens Dam Analysis, 1984.
All Volume numbers for stages above 965 (approximately half full) had the volume at
stage 965 subtracted. Elevation 925 is relative primary spillway invert as surveyed
by NAU.
                            Elevation    Volume
                               (ft)      (ac-ft)
                            ---------------------
                              925.00       .000
                              965.00      1.000
                              990.00   1783.000
                              992.00   6343.000
                              999.00   9123.000
                             1002.00  10313.000
                             1008.00  12693.000


   Type.... Vol: Elev-Volume
   Name.... SCHOENS DAM PERMANENT POOL AT 5754
   File.... C:\JJ\SCHOENS2.PPW

                       USER DEFINED VOLUME RATING TABLE
These numbers were taken from the SHB HEC1 input file for Schoens Dam Analysis, 1984.
All Volume numbers for stages above 5754 (approximately half full) had the volume at
stage 5754 subtracted.
                            Elevation    Volume
                               (ft)      (ac-ft)
                            ---------------------
                             5700.00      1.000
                             5754.00      2.000
                             5760.00   1620.000
                             5780.00  10100.000
                             5800.00  24700.000
                             5810.00  35000.000
                             5820.00  48750.000
                             5826.00  59100.000


   Type.... Vol: Elev-Volume
   Name.... SCHOENS DAM PERMANENT POOL AT 5777
   File.... C:\JJ\SCHOENS2.PPW

                       USER DEFINED VOLUME RATING TABLE
These numbers were taken from the SHB HEC1 input file for Schoens Dam Analysis, 1984.
All Volume numbers for stages above 5777 (approximately half full) had the volume at
stage 5777 subtracted.
                            Elevation    Volume
                               (ft)      (ac-ft)
                            ---------------------
                             5700.00      1.000
                             5777.00      2.000
                             5780.00   1272.000
                             5800.00  15872.000
                             5810.00  26171.990
                             5820.00  39921.990
                             5826.00  50272.000
```

```
Type.... Outlet Input Data
Name.... 24" PIPE

File.... C:\JJ\SCHOENS2.PPW


                   REQUESTED POND WS ELEVATIONS:

                     Min. Elev.=    925.00 ft
                     Increment =      1.00 ft
                     Max. Elev.=   1008.00 ft


           ********************************************
                          OUTLET CONNECTIVITY
           ********************************************

            ---> Forward Flow Only (UpStream to DnStream)
           <---  Reverse Flow Only (DnStream to UpStream)
           <---> Forward and Reverse Both Allowed

       Structure         No.        Outfall    E1, ft     E2, ft
   -----------------    ----        -------  ---------  ---------
   Weir-Rectangular           --->    TW      998.000   1008.000
   Culvert-Circular           --->    TW      925.000   1008.000
   TW SETUP, DS Channel
```

```
Type.... Outlet Input Data
Name.... 24" PIPE
File.... C:\JJ\SCHOENS2.PPW

              OUTLET STRUCTURE INPUT DATA

              Structure ID      =
              Structure Type    = Weir-Rectangular
              ------------------------------------
              # of Openings     =         1
              Crest Elev.       =    998.00 ft
              Weir Length       =    385.00 ft
              Weir Coeff.       =  3.000000

              Weir TW effects     (Use adjustment equation)


              Structure ID      =
              Structure Type    = Culvert-Circular
              ------------------------------------
              No. Barrels       =         1
              Barrel Diameter   =    2.0000 ft
              Upstream Invert   =    925.00 ft
              Dnstream Invert   =    923.17 ft
              Horiz. Length     =    423.00 ft
              Barrel Length     =    423.00 ft
              Barrel Slope      =    .00433 ft/ft

              OUTLET CONTROL DATA...
              Mannings n        =     .0130
              Ke                =     .5000  (forward entrance loss)
              Kb                =   .012411  (per ft of full flow)
              Kr                =     .5000  (reverse entrance loss)
              HW Convergence    =      .001  +/- ft

              INLET CONTROL DATA...
              Equation form     =         1
              Inlet Control K   =     .0098
              Inlet Control M   =    2.0000
              Inlet Control c   =    .03980
              Inlet Control Y   =     .6700
              T1 ratio (HW/D)   =     1.158
              T2 ratio (HW/D)   =     1.305
              Slope Factor      =     -.500

 Use unsubmerged inlet control Form 1 equ. below T1 elev.
 Use   submerged inlet control Form 1 equ. above T2 elev.

 In transition zone between unsubmerged and submerged inlet control,
 interpolate between flows at T1 & T2...
 At T1 Elev =    927.32 ft  --->  Flow =     15.55 cfs
 At T2 Elev =    927.61 ft  --->  Flow =     17.77 cfs


              Structure ID      = TW
              Structure Type    = TW SETUP, DS Channel
              ------------------------------------
              FREE OUTFALL CONDITIONS SPECIFIED

              CONVERGENCE TOLERANCES...
              Maximum Iterations=    30
              Min. TW tolerance =    .01 ft
              Max. TW tolerance =    .01 ft
              Min. HW tolerance =    .01 ft
              Max. HW tolerance =    .01 ft
              Min.  Q tolerance =    .10 cfs
              Max.  Q tolerance =    .10 cfs
```

```
Type.... Individual Outlet Curves
Name.... 24" PIPE
File.... C:\JJ\SCHOENS2.PPW

               RATING TABLE FOR ONE OUTLET TYPE

               Structure ID  =   (Weir-Rectangular)
               --------------------------------------
               Upstream  ID  =    (Pond Water Surface)
               DNstream  ID  = TW (Pond Outfall)
```

WS Elev. ft	Q cfs	TW Elev ft	Converge +/-ft	Computation Messages
925.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
926.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
927.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
928.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
929.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
930.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
931.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
932.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
933.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
934.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
935.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
936.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
937.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
938.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
939.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
940.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
941.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
942.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
943.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
944.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
945.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
946.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
947.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
948.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
949.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
950.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
951.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
952.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
953.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
954.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
955.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
956.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
957.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
958.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
959.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
960.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
961.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
962.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
963.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
964.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
965.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
966.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
967.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
968.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
969.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
970.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
971.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
972.00	.00	Free Outfall		HW & TW below Inv.El.=998.000
973.00	.00	Free Outfall		HW & TW below Inv.El.=998.000

```
Type.... Individual Outlet Curves
Name.... 24" PIPE
File.... C:\JJ\SCHOENS2.PPW


               RATING TABLE FOR ONE OUTLET TYPE

               Structure ID  =   (Weir-Rectangular)
               --------------------------------------
               Upstream  ID  =    (Pond Water Surface)
               DNstream  ID  = TW (Pond Outfall)


WS Elev,Device Q    Tail Water            Notes
----------------  ---------------  --------------------------
WS Elev.    Q      TW Elev Converge
  ft       cfs        ft    +/-ft   Computation Messages
--------  -------  --------  -----  --------------------------
 974.00       .00   Free Outfall    HW & TW below Inv.El.=998.000
 975.00       .00   Free Outfall    HW & TW below Inv.El.=998.000
 976.00       .00   Free Outfall    HW & TW below Inv.El.=998.000
 977.00       .00   Free Outfall    HW & TW below Inv.El.=998.000
 978.00       .00   Free Outfall    HW & TW below Inv.El.=998.000
 979.00       .00   Free Outfall    HW & TW below Inv.El.=998.000
 980.00       .00   Free Outfall    HW & TW below Inv.El.=998.000
 981.00       .00   Free Outfall    HW & TW below Inv.El.=998.000
 982.00       .00   Free Outfall    HW & TW below Inv.El.=998.000
 983.00       .00   Free Outfall    HW & TW below Inv.El.=998.000
 984.00       .00   Free Outfall    HW & TW below Inv.El.=998.000
 985.00       .00   Free Outfall    HW & TW below Inv.El.=998.000
 986.00       .00   Free Outfall    HW & TW below Inv.El.=998.000
 987.00       .00   Free Outfall    HW & TW below Inv.El.=998.000
 988.00       .00   Free Outfall    HW & TW below Inv.El.=998.000
 989.00       .00   Free Outfall    HW & TW below Inv.El.=998.000
 990.00       .00   Free Outfall    HW & TW below Inv.El.=998.000
 991.00       .00   Free Outfall    HW & TW below Inv.El.=998.000
 992.00       .00   Free Outfall    HW & TW below Inv.El.=998.000
 993.00       .00   Free Outfall    HW & TW below Inv.El.=998.000
 994.00       .00   Free Outfall    HW & TW below Inv.El.=998.000
 995.00       .00   Free Outfall    HW & TW below Inv.El.=998.000
 996.00       .00   Free Outfall    HW & TW below Inv.El.=998.000
 997.00       .00   Free Outfall    HW & TW below Inv.El.=998.000
 998.00       .00   Free Outfall    H=.00; Htw=.00; Qfree=.00;
 999.00   1155.00   Free Outfall    H=1.00; Htw=.00; Qfree=1155.00;
1000.00   3266.83   Free Outfall    H=2.00; Htw=.00; Qfree=3266.83;
1001.00   6001.56   Free Outfall    H=3.00; Htw=.00; Qfree=6001.56;
1002.00   9240.00   Free Outfall    H=4.00; Htw=.00; Qfree=9240.00;
1003.00  12913.29   Free Outfall    H=5.00; Htw=.00; Qfree=12913.29;
1004.00  16974.96   Free Outfall    H=6.00; Htw=.00; Qfree=16974.96;
1005.00  21390.90   Free Outfall    H=7.00; Htw=.00; Qfree=21390.90;
1006.00  26134.67   Free Outfall    H=8.00; Htw=.00; Qfree=26134.67;
1007.00  31185.00   Free Outfall    H=9.00; Htw=.00; Qfree=31185.00;
1008.00  36524.31   Free Outfall    H=10.00; Htw=.00; Qfree=36524.31;
```

Type.... Individual Outlet Curves
Name.... 24" PIPE
File.... C:\JJ\SCHOENS2.PPW

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = (Culvert-Circular)

Mannings open channel maximum capacity: 16.01 cfs
Upstream ID = (Pond Water Surface)
DNstream ID = TW (Pond Outfall)

WS Elev, Device Q		Tail Water		Notes
WS Elev. ft	Q cfs	TW Elev ft	Converge +/-ft	Computation Messages
925.00	.00	Free Outfall		Upstream HW & DNstream TW < Inv.El
926.00	3.43	Free Outfall		CRIT.DEPTH CONTROL Vh=.235ft Dcr=.648ft H.JUMP IN PIPE
927.00	11.91	Free Outfall		BACKWATER CONTROL. Vh=.430ft hwDi=1.354ft Lbw= 423.0ft
928.00	17.38	Free Outfall		FULL FLOW...Lfull=181.20ft Vh=.476ft HL=1.784ft
929.00	19.57	Free Outfall		FULL FLOW...Lfull=346.53ft Vh=.603ft HL=3.498ft
930.00	21.69	Free Outfall		FULL FLOW...Lfull=387.53ft Vh=.741ft HL=4.676ft
931.00	23.68	Free Outfall		FULL FLOW...Lfull=403.54ft Vh=.883ft HL=5.745ft
932.00	25.53	Free Outfall		FULL FLOW...Lfull=411.47ft Vh=1.026ft HL=6.780ft
933.00	27.28	Free Outfall		FULL FLOW...Lfull=415.28ft Vh=1.172ft HL=7.797ft
934.00	28.93	Free Outfall		FULL FLOW...Lfull=417.74ft Vh=1.318ft HL=8.808ft
935.00	30.49	Free Outfall		FULL FLOW...Lfull=419.44ft Vh=1.464ft HL=9.814ft
936.00	31.98	Free Outfall		FULL FLOW...Lfull=420.48ft Vh=1.610ft HL=10.819ft
937.00	33.41	Free Outfall		FULL FLOW...Lfull=420.95ft Vh=1.758ft HL=11.821ft
938.00	34.78	Free Outfall		FULL FLOW...Lfull=421.78ft Vh=1.904ft HL=12.824ft
939.00	36.10	Free Outfall		FULL FLOW...Lfull=421.90ft Vh=2.052ft HL=13.825ft
940.00	37.39	Free Outfall		FULL FLOW...Lfull=421.92ft Vh=2.201ft HL=14.828ft
941.00	38.62	Free Outfall		FULL FLOW...Lfull=422.19ft Vh=2.348ft HL=15.827ft
942.00	39.81	Free Outfall		FULL FLOW...Lfull=422.34ft Vh=2.496ft HL=16.826ft
943.00	40.98	Free Outfall		FULL FLOW...Lfull=422.50ft Vh=2.644ft HL=17.828ft
944.00	42.11	Free Outfall		FULL FLOW...Lfull=422.56ft Vh=2.792ft HL=18.828ft
945.00	43.20	Free Outfall		FULL FLOW...Lfull=422.74ft Vh=2.939ft HL=19.828ft
946.00	44.28	Free Outfall		FULL FLOW...Lfull=422.75ft Vh=3.087ft HL=20.830ft
947.00	45.33	Free Outfall		FULL FLOW...Lfull=422.77ft Vh=3.235ft HL=21.828ft
948.00	46.36	Free Outfall		FULL FLOW...Lfull=422.78ft Vh=3.384ft HL=22.829ft
949.00	47.36	Free Outfall		FULL FLOW...Lfull=422.79ft Vh=3.532ft HL=23.830ft
950.00	48.34	Free Outfall		FULL FLOW...Lfull=422.83ft Vh=3.680ft HL=24.830ft
951.00	49.31	Free Outfall		FULL FLOW...Lfull=422.83ft Vh=3.828ft HL=25.829ft
952.00	50.25	Free Outfall		FULL FLOW...Lfull=422.92ft Vh=3.975ft HL=26.829ft
953.00	51.17	Free Outfall		FULL FLOW...Lfull=422.92ft Vh=4.124ft HL=27.829ft
954.00	52.09	Free Outfall		FULL FLOW...Lfull=422.92ft Vh=4.272ft HL=28.830ft
955.00	52.98	Free Outfall		FULL FLOW...Lfull=422.92ft Vh=4.420ft HL=29.830ft
956.00	53.86	Free Outfall		FULL FLOW...Lfull=422.92ft Vh=4.568ft HL=30.830ft
957.00	54.73	Free Outfall		FULL FLOW...Lfull=422.92ft Vh=4.716ft HL=31.830ft
958.00	55.58	Free Outfall		FULL FLOW...Lfull=422.92ft Vh=4.864ft HL=32.829ft
959.00	56.42	Free Outfall		FULL FLOW...Lfull=422.92ft Vh=5.013ft HL=33.830ft
960.00	57.25	Free Outfall		FULL FLOW...Lfull=422.92ft Vh=5.161ft HL=34.829ft
961.00	58.07	Free Outfall		FULL FLOW...Lfull=422.92ft Vh=5.309ft HL=35.829ft
962.00	58.87	Free Outfall		FULL FLOW...Lfull=422.92ft Vh=5.457ft HL=36.830ft
963.00	59.67	Free Outfall		FULL FLOW...Lfull=422.92ft Vh=5.605ft HL=37.830ft
964.00	60.45	Free Outfall		FULL FLOW...Lfull=422.92ft Vh=5.754ft HL=38.830ft
965.00	61.22	Free Outfall		FULL FLOW...Lfull=422.92ft Vh=5.902ft HL=39.829ft
966.00	61.99	Free Outfall		FULL FLOW...Lfull=422.92ft Vh=6.050ft HL=40.829ft
967.00	62.74	Free Outfall		FULL FLOW...Lfull=422.92ft Vh=6.198ft HL=41.830ft
968.00	63.49	Free Outfall		FULL FLOW...Lfull=422.92ft Vh=6.346ft HL=42.830ft
969.00	64.22	Free Outfall		FULL FLOW...Lfull=422.92ft Vh=6.495ft HL=43.830ft
970.00	64.95	Free Outfall		FULL FLOW...Lfull=422.92ft Vh=6.642ft HL=44.829ft
971.00	65.67	Free Outfall		FULL FLOW...Lfull=422.92ft Vh=6.791ft HL=45.829ft
972.00	66.38	Free Outfall		FULL FLOW...Lfull=422.92ft Vh=6.939ft HL=46.829ft
973.00	67.09	Free Outfall		FULL FLOW...Lfull=422.92ft Vh=7.087ft HL=47.830ft

```
Type.... Individual Outlet Curves
Name.... 24" PIPE
File.... C:\JJ\SCHOENS2.PPW


               RATING TABLE FOR ONE OUTLET TYPE

               Structure ID  =   (Culvert-Circular)
               ------------------------------------
               Mannings open channel maximum capacity: 16.01 cfs
               Upstream  ID  =    (Pond Water Surface)
               DNstream  ID  = TW (Pond Outfall)


WS Elev,Device Q    Tail Water             Notes
----------------  ---------------  --------------------------
WS Elev.    Q      TW Elev Converge
  ft       cfs        ft    +/-ft   Computation Messages
--------  -------  --------  -----  --------------------------

 974.00     67.79   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=7.235ft  HL=48.830ft
 975.00     68.48   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=7.384ft  HL=49.830ft
 976.00     69.16   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=7.531ft  HL=50.829ft
 977.00     69.84   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=7.680ft  HL=51.829ft
 978.00     70.51   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=7.828ft  HL=52.829ft
 979.00     71.17   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=7.976ft  HL=53.829ft
 980.00     71.83   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=8.124ft  HL=54.830ft
 981.00     72.48   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=8.272ft  HL=55.830ft
 982.00     73.13   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=8.421ft  HL=56.829ft
 983.00     73.77   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=8.569ft  HL=57.830ft
 984.00     74.40   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=8.717ft  HL=58.829ft
 985.00     75.03   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=8.865ft  HL=59.829ft
 986.00     75.66   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=9.013ft  HL=60.830ft
 987.00     76.28   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=9.161ft  HL=61.829ft
 988.00     76.89   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=9.310ft  HL=62.829ft
 989.00     77.50   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=9.458ft  HL=63.829ft
 990.00     78.11   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=9.606ft  HL=64.830ft
 991.00     78.71   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=9.754ft  HL=65.830ft
 992.00     79.30   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=9.902ft  HL=66.829ft
 993.00     79.89   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=10.051ft  HL=67.830ft
 994.00     80.48   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=10.199ft  HL=68.830ft
 995.00     81.06   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=10.347ft  HL=69.830ft
 996.00     81.64   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=10.495ft  HL=70.830ft
 997.00     82.22   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=10.643ft  HL=71.830ft
 998.00     82.79   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=10.791ft  HL=72.830ft
 999.00     83.35   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=10.940ft  HL=73.830ft
1000.00     83.91   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=11.088ft  HL=74.829ft
1001.00     84.47   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=11.236ft  HL=75.829ft
1002.00     85.03   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=11.384ft  HL=76.829ft
1003.00     85.58   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=11.532ft  HL=77.830ft
1004.00     86.13   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=11.680ft  HL=78.829ft
1005.00     86.67   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=11.829ft  HL=79.830ft
1006.00     87.21   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=11.977ft  HL=80.830ft
1007.00     87.75   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=12.125ft  HL=81.830ft
1008.00     88.29   Free Outfall  FULL FLOW...Lfull=422.92ft  Vh=12.273ft  HL=82.829ft
```

```
Type.... Composite Rating Curve
Name.... 24" PIPE

File.... C:\JJ\SCHOENS2.PPW


                ***** COMPOSITE OUTFLOW SUMMARY ****

WS Elev, Total Q                                    Notes
----------------  -------- Converge -------------------------
 Elev.      Q       TW Elev  Error
  ft       cfs        ft     +/-ft   Contributing Structures
--------  -------  --------  -----  --------------------------
925.00       .00    Free Outfall
926.00      3.43    Free Outfall
927.00     11.91    Free Outfall
928.00     17.38    Free Outfall
929.00     19.57    Free Outfall
930.00     21.69    Free Outfall
931.00     23.68    Free Outfall
932.00     25.53    Free Outfall
933.00     27.28    Free Outfall
934.00     28.93    Free Outfall
935.00     30.49    Free Outfall
936.00     31.98    Free Outfall
937.00     33.41    Free Outfall
938.00     34.78    Free Outfall
939.00     36.10    Free Outfall
940.00     37.39    Free Outfall
941.00     38.62    Free Outfall
942.00     39.81    Free Outfall
943.00     40.98    Free Outfall
944.00     42.11    Free Outfall
945.00     43.20    Free Outfall
946.00     44.28    Free Outfall
947.00     45.33    Free Outfall
948.00     46.36    Free Outfall
949.00     47.36    Free Outfall
950.00     48.34    Free Outfall
951.00     49.31    Free Outfall
952.00     50.25    Free Outfall
953.00     51.17    Free Outfall
954.00     52.09    Free Outfall
955.00     52.98    Free Outfall
956.00     53.86    Free Outfall
957.00     54.73    Free Outfall
958.00     55.58    Free Outfall
959.00     56.42    Free Outfall
960.00     57.25    Free Outfall
961.00     58.07    Free Outfall
962.00     58.87    Free Outfall
```

Type.... Composite Rating Curve
Name.... 24" PIPE

File.... C:\JJ\SCHOENS2.PPW

***** COMPOSITE OUTFLOW SUMMARY ****

WS Elev, Total Q		Notes		
		Converge		
Elev. ft	Q cfs	TW Elev ft	Error +/-ft	Contributing Structures
963.00	59.67	Free Outfall		
964.00	60.45	Free Outfall		
965.00	61.22	Free Outfall		
966.00	61.99	Free Outfall		
967.00	62.74	Free Outfall		
968.00	63.49	Free Outfall		
969.00	64.22	Free Outfall		
970.00	64.95	Free Outfall		
971.00	65.67	Free Outfall		
972.00	66.38	Free Outfall		
973.00	67.09	Free Outfall		
974.00	67.79	Free Outfall		
975.00	68.48	Free Outfall		
976.00	69.16	Free Outfall		
977.00	69.84	Free Outfall		
978.00	70.51	Free Outfall		
979.00	71.17	Free Outfall		
980.00	71.83	Free Outfall		
981.00	72.48	Free Outfall		
982.00	73.13	Free Outfall		
983.00	73.77	Free Outfall		
984.00	74.40	Free Outfall		
985.00	75.03	Free Outfall		
986.00	75.66	Free Outfall		
987.00	76.28	Free Outfall		
988.00	76.89	Free Outfall		
989.00	77.50	Free Outfall		
990.00	78.11	Free Outfall		
991.00	78.71	Free Outfall		
992.00	79.30	Free Outfall		
993.00	79.89	Free Outfall		
994.00	80.48	Free Outfall		
995.00	81.06	Free Outfall		
996.00	81.64	Free Outfall		
997.00	82.22	Free Outfall		
998.00	82.79	Free Outfall		
999.00	1238.35	Free Outfall		
1000.00	3350.75	Free Outfall		
1001.00	6086.03	Free Outfall		
1002.00	9325.03	Free Outfall		
1003.00	12998.87	Free Outfall		
1004.00	17061.09	Free Outfall		
1005.00	21477.57	Free Outfall		
1006.00	26221.88	Free Outfall		
1007.00	31272.75	Free Outfall		
1008.00	36612.59	Free Outfall		

```
Type.... Outlet Input Data
Name.... 48"PIPE/SPILLWAY

File.... C:\JJ\SCHOENS2.PPW


                    REQUESTED POND WS ELEVATIONS:

                      Min. Elev.=   5700.00 ft
                      Increment =      1.00 ft
                      Max. Elev.=   5826.00 ft


            **********************************************
                           OUTLET CONNECTIVITY
            **********************************************

             ---> Forward Flow Only (UpStream to DnStream)
            <---  Reverse Flow Only (DnStream to UpStream)
            <---> Forward and Reverse Both Allowed

       Structure         No.        Outfall    E1, ft     E2, ft
   -----------------    ----        -------  ---------  ---------
   User Defined Table        --->    TW        .000   5826.000
   TW SETUP, DS Channel
```

```
Type.... Outlet Input Data
Name.... 48"PIPE/SPILLWAY

File.... C:\JJ\SCHOENS2.PPW


              OUTLET STRUCTURE INPUT DATA

              Structure ID      =
              Structure Type    = User Defined Table
              ------------------------------------
                              ELEV-FLOW RATING TABLE

                Elev, ft   Flow, cfs
               ---------   ---------
                5700.00         .00
                5710.00      171.00
                5720.00      263.00
                5730.00      310.00
                5740.00      350.00
                5750.00      386.00
                5760.00      411.00
                5770.00      450.00
                5780.00      479.00
                5790.00      506.00
                5800.00      531.00
                5803.80     1041.00
                5804.40     1542.00
                5806.20     3046.00
                5808.50     5552.00
                5812.00    10561.00
                5817.30    20573.00
                5821.40    30583.00
                5824.70    40590.00
                5826.00    44417.00


              Structure ID      = TW
              Structure Type    = TW SETUP, DS Channel
              ------------------------------------
              FREE OUTFALL CONDITIONS SPECIFIED

              CONVERGENCE TOLERANCES...
              Maximum Iterations=    30
              Min. TW tolerance =    .01 ft
              Max. TW tolerance =    .01 ft
              Min. HW tolerance =    .01 ft
              Max. HW tolerance =    .01 ft
              Min.  Q tolerance =    .10 cfs
              Max.  Q tolerance =    .10 cfs
```

```
Type.... Individual Outlet Curves
Name.... 48"PIPE/SPILLWAY
File.... C:\JJ\SCHOENS2.PPW

               RATING TABLE FOR ONE OUTLET TYPE

               Structure ID  =   (User Defined Table)
               -------------------------------------
               Upstream  ID  =    (Pond Water Surface)
               DNstream  ID  = TW (Pond Outfall)

WS Elev,Device Q    Tail Water            Notes
----------------  ---------------  --------------------------
WS Elev.    Q     TW Elev Converge
  ft       cfs       ft    +/-ft   Computation Messages
--------  -------  --------  -----  --------------------------
5700.00       .00   Free Outfall
5701.00     17.10   Free Outfall    Interpolated from input table
5702.00     34.20   Free Outfall    Interpolated from input table
5703.00     51.30   Free Outfall    Interpolated from input table
5704.00     68.40   Free Outfall    Interpolated from input table
5705.00     85.50   Free Outfall    Interpolated from input table
5706.00    102.60   Free Outfall    Interpolated from input table
5707.00    119.70   Free Outfall    Interpolated from input table
5708.00    136.80   Free Outfall    Interpolated from input table
5709.00    153.90   Free Outfall    Interpolated from input table
5710.00    171.00   Free Outfall
5711.00    180.20   Free Outfall    Interpolated from input table
5712.00    189.40   Free Outfall    Interpolated from input table
5713.00    198.60   Free Outfall    Interpolated from input table
5714.00    207.80   Free Outfall    Interpolated from input table
5715.00    217.00   Free Outfall    Interpolated from input table
5716.00    226.20   Free Outfall    Interpolated from input table
5717.00    235.40   Free Outfall    Interpolated from input table
5718.00    244.60   Free Outfall    Interpolated from input table
5719.00    253.80   Free Outfall    Interpolated from input table
5720.00    263.00   Free Outfall
5721.00    267.70   Free Outfall    Interpolated from input table
5722.00    272.40   Free Outfall    Interpolated from input table
5723.00    277.10   Free Outfall    Interpolated from input table
5724.00    281.80   Free Outfall    Interpolated from input table
5725.00    286.50   Free Outfall    Interpolated from input table
5726.00    291.20   Free Outfall    Interpolated from input table
5727.00    295.90   Free Outfall    Interpolated from input table
5728.00    300.60   Free Outfall    Interpolated from input table
5729.00    305.30   Free Outfall    Interpolated from input table
5730.00    310.00   Free Outfall
5731.00    314.00   Free Outfall    Interpolated from input table
5732.00    318.00   Free Outfall    Interpolated from input table
5733.00    322.00   Free Outfall    Interpolated from input table
5734.00    326.00   Free Outfall    Interpolated from input table
5735.00    330.00   Free Outfall    Interpolated from input table
5736.00    334.00   Free Outfall    Interpolated from input table
5737.00    338.00   Free Outfall    Interpolated from input table
5738.00    342.00   Free Outfall    Interpolated from input table
5739.00    346.00   Free Outfall    Interpolated from input table
5740.00    350.00   Free Outfall
5741.00    353.60   Free Outfall    Interpolated from input table
5742.00    357.20   Free Outfall    Interpolated from input table
5743.00    360.80   Free Outfall    Interpolated from input table
5744.00    364.40   Free Outfall    Interpolated from input table
5745.00    368.00   Free Outfall    Interpolated from input table
5746.00    371.60   Free Outfall    Interpolated from input table
5747.00    375.20   Free Outfall    Interpolated from input table
5748.00    378.80   Free Outfall    Interpolated from input table
5749.00    382.40   Free Outfall    Interpolated from input table
5750.00    386.00   Free Outfall
5751.00    388.50   Free Outfall    Interpolated from input table
5752.00    391.00   Free Outfall    Interpolated from input table
```

```
Type.... Individual Outlet Curves
Name.... 48"PIPE/SPILLWAY
File.... C:\JJ\SCHOENS2.PPW

               RATING TABLE FOR ONE OUTLET TYPE

               Structure ID  =   (User Defined Table)
               -------------------------------------
               Upstream  ID  =    (Pond Water Surface)
               DNstream  ID  = TW (Pond Outfall)
```

WS Elev. ft	Q cfs	TW Elev ft	Converge +/-ft	Computation Messages
5753.00	393.50	Free Outfall		Interpolated from input table
5754.00	396.00	Free Outfall		Interpolated from input table
5755.00	398.50	Free Outfall		Interpolated from input table
5756.00	401.00	Free Outfall		Interpolated from input table
5757.00	403.50	Free Outfall		Interpolated from input table
5758.00	406.00	Free Outfall		Interpolated from input table
5759.00	408.50	Free Outfall		Interpolated from input table
5760.00	411.00	Free Outfall		
5761.00	414.90	Free Outfall		Interpolated from input table
5762.00	418.80	Free Outfall		Interpolated from input table
5763.00	422.70	Free Outfall		Interpolated from input table
5764.00	426.60	Free Outfall		Interpolated from input table
5765.00	430.50	Free Outfall		Interpolated from input table
5766.00	434.40	Free Outfall		Interpolated from input table
5767.00	438.30	Free Outfall		Interpolated from input table
5768.00	442.20	Free Outfall		Interpolated from input table
5769.00	446.10	Free Outfall		Interpolated from input table
5770.00	450.00	Free Outfall		
5771.00	452.90	Free Outfall		Interpolated from input table
5772.00	455.80	Free Outfall		Interpolated from input table
5773.00	458.70	Free Outfall		Interpolated from input table
5774.00	461.60	Free Outfall		Interpolated from input table
5775.00	464.50	Free Outfall		Interpolated from input table
5776.00	467.40	Free Outfall		Interpolated from input table
5777.00	470.30	Free Outfall		Interpolated from input table
5778.00	473.20	Free Outfall		Interpolated from input table
5779.00	476.10	Free Outfall		Interpolated from input table
5780.00	479.00	Free Outfall		
5781.00	481.70	Free Outfall		Interpolated from input table
5782.00	484.40	Free Outfall		Interpolated from input table
5783.00	487.10	Free Outfall		Interpolated from input table
5784.00	489.80	Free Outfall		Interpolated from input table
5785.00	492.50	Free Outfall		Interpolated from input table
5786.00	495.20	Free Outfall		Interpolated from input table
5787.00	497.90	Free Outfall		Interpolated from input table
5788.00	500.60	Free Outfall		Interpolated from input table
5789.00	503.30	Free Outfall		Interpolated from input table
5790.00	506.00	Free Outfall		
5791.00	508.50	Free Outfall		Interpolated from input table
5792.00	511.00	Free Outfall		Interpolated from input table
5793.00	513.50	Free Outfall		Interpolated from input table
5794.00	516.00	Free Outfall		Interpolated from input table
5795.00	518.50	Free Outfall		Interpolated from input table
5796.00	521.00	Free Outfall		Interpolated from input table
5797.00	523.50	Free Outfall		Interpolated from input table
5798.00	526.00	Free Outfall		Interpolated from input table
5799.00	528.50	Free Outfall		Interpolated from input table
5800.00	531.00	Free Outfall		
5801.00	665.22	Free Outfall		Interpolated from input table
5802.00	799.43	Free Outfall		Interpolated from input table
5803.00	933.65	Free Outfall		Interpolated from input table
5804.00	1208.14	Free Outfall		Interpolated from input table
5805.00	2043.33	Free Outfall		Interpolated from input table

```
Type.... Individual Outlet Curves
Name.... 48"PIPE/SPILLWAY
File.... C:\JJ\SCHOENS2.PPW

               RATING TABLE FOR ONE OUTLET TYPE

               Structure ID  =   (User Defined Table)
               --------------------------------------
               Upstream  ID  =    (Pond Water Surface)
               DNstream  ID  = TW (Pond Outfall)
```

WS Elev. ft	Q cfs	TW Elev ft	Converge +/-ft	Computation Messages
5806.00	2878.75	Free Outfall		Interpolated from input table
5807.00	3917.51	Free Outfall		Interpolated from input table
5808.00	5007.17	Free Outfall		Interpolated from input table
5809.00	6267.57	Free Outfall		Interpolated from input table
5810.00	7698.71	Free Outfall		Interpolated from input table
5811.00	9129.86	Free Outfall		Interpolated from input table
5812.00	10561.00	Free Outfall		
5813.00	12450.13	Free Outfall		Interpolated from input table
5814.00	14339.25	Free Outfall		Interpolated from input table
5815.00	16228.38	Free Outfall		Interpolated from input table
5816.00	18117.50	Free Outfall		Interpolated from input table
5817.00	20006.63	Free Outfall		Interpolated from input table
5818.00	22282.46	Free Outfall		Interpolated from input table
5819.00	24723.87	Free Outfall		Interpolated from input table
5820.00	27165.27	Free Outfall		Interpolated from input table
5821.00	29606.68	Free Outfall		Interpolated from input table
5822.00	32402.59	Free Outfall		Interpolated from input table
5823.00	35434.74	Free Outfall		Interpolated from input table
5824.00	38466.90	Free Outfall		Interpolated from input table
5825.00	41472.71	Free Outfall		Interpolated from input table
5826.00	44417.00	Free Outfall		

Type.... Composite Rating Curve
Name.... 48"PIPE/SPILLWAY

File.... C:\JJ\SCHOENS2.PPW

***** COMPOSITE OUTFLOW SUMMARY ****

WS Elev, Total Q		Notes		
		Converge		
Elev. ft	Q cfs	TW Elev ft	Error +/-ft	Contributing Structures
5700.00	.00	Free Outfall		
5701.00	17.10	Free Outfall		
5702.00	34.20	Free Outfall		
5703.00	51.30	Free Outfall		
5704.00	68.40	Free Outfall		
5705.00	85.50	Free Outfall		
5706.00	102.60	Free Outfall		
5707.00	119.70	Free Outfall		
5708.00	136.80	Free Outfall		
5709.00	153.90	Free Outfall		
5710.00	171.00	Free Outfall		
5711.00	180.20	Free Outfall		
5712.00	189.40	Free Outfall		
5713.00	198.60	Free Outfall		
5714.00	207.80	Free Outfall		
5715.00	217.00	Free Outfall		
5716.00	226.20	Free Outfall		
5717.00	235.40	Free Outfall		
5718.00	244.60	Free Outfall		
5719.00	253.80	Free Outfall		
5720.00	263.00	Free Outfall		
5721.00	267.70	Free Outfall		
5722.00	272.40	Free Outfall		
5723.00	277.10	Free Outfall		
5724.00	281.80	Free Outfall		
5725.00	286.50	Free Outfall		
5726.00	291.20	Free Outfall		
5727.00	295.90	Free Outfall		
5728.00	300.60	Free Outfall		
5729.00	305.30	Free Outfall		
5730.00	310.00	Free Outfall		
5731.00	314.00	Free Outfall		
5732.00	318.00	Free Outfall		
5733.00	322.00	Free Outfall		
5734.00	326.00	Free Outfall		
5735.00	330.00	Free Outfall		
5736.00	334.00	Free Outfall		
5737.00	338.00	Free Outfall		
5738.00	342.00	Free Outfall		
5739.00	346.00	Free Outfall		
5740.00	350.00	Free Outfall		
5741.00	353.60	Free Outfall		
5742.00	357.20	Free Outfall		
5743.00	360.80	Free Outfall		
5744.00	364.40	Free Outfall		
5745.00	368.00	Free Outfall		
5746.00	371.60	Free Outfall		
5747.00	375.20	Free Outfall		
5748.00	378.80	Free Outfall		
5749.00	382.40	Free Outfall		
5750.00	386.00	Free Outfall		
5751.00	388.50	Free Outfall		
5752.00	391.00	Free Outfall		
5753.00	393.50	Free Outfall		
5754.00	396.00	Free Outfall		

Type.... Composite Rating Curve
Name.... 48"PIPE/SPILLWAY

File.... C:\JJ\SCHOENS2.PPW

***** COMPOSITE OUTFLOW SUMMARY ****

WS Elev, Total Q		Notes		
		Converge		
Elev. ft	Q cfs	TW Elev ft	Error +/-ft	Contributing Structures
5755.00	398.50	Free Outfall		
5756.00	401.00	Free Outfall		
5757.00	403.50	Free Outfall		
5758.00	406.00	Free Outfall		
5759.00	408.50	Free Outfall		
5760.00	411.00	Free Outfall		
5761.00	414.90	Free Outfall		
5762.00	418.80	Free Outfall		
5763.00	422.70	Free Outfall		
5764.00	426.60	Free Outfall		
5765.00	430.50	Free Outfall		
5766.00	434.40	Free Outfall		
5767.00	438.30	Free Outfall		
5768.00	442.20	Free Outfall		
5769.00	446.10	Free Outfall		
5770.00	450.00	Free Outfall		
5771.00	452.90	Free Outfall		
5772.00	455.80	Free Outfall		
5773.00	458.70	Free Outfall		
5774.00	461.60	Free Outfall		
5775.00	464.50	Free Outfall		
5776.00	467.40	Free Outfall		
5777.00	470.30	Free Outfall		
5778.00	473.20	Free Outfall		
5779.00	476.10	Free Outfall		
5780.00	479.00	Free Outfall		
5781.00	481.70	Free Outfall		
5782.00	484.40	Free Outfall		
5783.00	487.10	Free Outfall		
5784.00	489.80	Free Outfall		
5785.00	492.50	Free Outfall		
5786.00	495.20	Free Outfall		
5787.00	497.90	Free Outfall		
5788.00	500.60	Free Outfall		
5789.00	503.30	Free Outfall		
5790.00	506.00	Free Outfall		
5791.00	508.50	Free Outfall		
5792.00	511.00	Free Outfall		
5793.00	513.50	Free Outfall		
5794.00	516.00	Free Outfall		
5795.00	518.50	Free Outfall		
5796.00	521.00	Free Outfall		
5797.00	523.50	Free Outfall		
5798.00	526.00	Free Outfall		
5799.00	528.50	Free Outfall		
5800.00	531.00	Free Outfall		
5801.00	665.22	Free Outfall		
5802.00	799.43	Free Outfall		
5803.00	933.65	Free Outfall		
5804.00	1208.14	Free Outfall		
5805.00	2043.33	Free Outfall		
5806.00	2878.75	Free Outfall		
5807.00	3917.51	Free Outfall		
5808.00	5007.17	Free Outfall		
5809.00	6267.57	Free Outfall		

Type.... Composite Rating Curve
Name.... 48"PIPE/SPILLWAY

File.... C:\JJ\SCHOENS2.PPW

***** COMPOSITE OUTFLOW SUMMARY ****

WS Elev, Total Q		Converge		Notes
Elev. ft	Q cfs	TW Elev ft	Error +/-ft	Contributing Structures
5810.00	7698.71	Free Outfall		
5811.00	9129.86	Free Outfall		
5812.00	10561.00	Free Outfall		
5813.00	12450.13	Free Outfall		
5814.00	14339.25	Free Outfall		
5815.00	16228.38	Free Outfall		
5816.00	18117.50	Free Outfall		
5817.00	20006.63	Free Outfall		
5818.00	22282.46	Free Outfall		
5819.00	24723.87	Free Outfall		
5820.00	27165.27	Free Outfall		
5821.00	29606.68	Free Outfall		
5822.00	32402.59	Free Outfall		
5823.00	35434.74	Free Outfall		
5824.00	38466.90	Free Outfall		
5825.00	41472.71	Free Outfall		
5826.00	44417.00	Free Outfall		

```
Type.... Pond E-V-Q Table
Name.... LP-RES
File.... C:\JJ\SCHOENS2.PPW

                    LEVEL POOL ROUTING DATA

 HYG Dir          = C:\JJ\
 Inflow  HYG file = NONE STORED - LP-RES       IN  72
 Outflow HYG file = NONE STORED - LP-RES       OUT 72

 Pond Node   Data = LP-RES
 Pond Volume Data = LP-RES half full
 Pond Outlet Data = 24" PIPE

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev   =   925.00 ft
 Starting Volume    =     .000 ac-ft
 Starting Outflow   =      .00 cfs
 Starting Infiltr.  =      .00 cfs
 Starting Total Qout=      .00 cfs
 Time Increment     =    .2500 hrs
```

Elevation ft	Outflow cfs	Storage ac-ft	Infilt. cfs	Q Total cfs	2S/t + O cfs
925.00	.00	.000	.00	.00	.00
926.00	3.43	.025	.00	3.43	5.85
927.00	11.91	.050	.00	11.91	16.75
928.00	17.38	.075	.00	17.38	24.64
929.00	19.57	.100	.00	19.57	29.25
930.00	21.69	.125	.00	21.69	33.79
931.00	23.68	.150	.00	23.68	38.20
932.00	25.53	.175	.00	25.53	42.47
933.00	27.28	.200	.00	27.28	46.64
934.00	28.93	.225	.00	28.93	50.71
935.00	30.49	.250	.00	30.49	54.69
936.00	31.98	.275	.00	31.98	58.60
937.00	33.41	.300	.00	33.41	62.45
938.00	34.78	.325	.00	34.78	66.24
939.00	36.10	.350	.00	36.10	69.98
940.00	37.39	.375	.00	37.39	73.69
941.00	38.62	.400	.00	38.62	77.34
942.00	39.81	.425	.00	39.81	80.95
943.00	40.98	.450	.00	40.98	84.54
944.00	42.11	.475	.00	42.11	88.09
945.00	43.20	.500	.00	43.20	91.60
946.00	44.28	.525	.00	44.28	95.10
947.00	45.33	.550	.00	45.33	98.57
948.00	46.36	.575	.00	46.36	102.02
949.00	47.36	.600	.00	47.36	105.44
950.00	48.34	.625	.00	48.34	108.84
951.00	49.31	.650	.00	49.31	112.23
952.00	50.25	.675	.00	50.25	115.59
953.00	51.17	.700	.00	51.17	118.93
954.00	52.09	.725	.00	52.09	122.27
955.00	52.98	.750	.00	52.98	125.58
956.00	53.86	.775	.00	53.86	128.88
957.00	54.73	.800	.00	54.73	132.17
958.00	55.58	.825	.00	55.58	135.44
959.00	56.42	.850	.00	56.42	138.70
960.00	57.25	.875	.00	57.25	141.95
961.00	58.07	.900	.00	58.07	145.19
962.00	58.87	.925	.00	58.87	148.41
963.00	59.67	.950	.00	59.67	151.63

Type.... Pond E-V-Q Table
Name.... LP-RES
File.... C:\JJ\SCHOENS2.PPW

LEVEL POOL ROUTING DATA

Elevation ft	Outflow cfs	Storage ac-ft	Infilt. cfs	Q Total cfs	2S/t + O cfs
964.00	60.45	.975	.00	60.45	154.83
965.00	61.22	1.000	.00	61.22	158.02
966.00	61.99	72.280	.00	61.99	7058.69
967.00	62.74	143.560	.00	62.74	13959.35
968.00	63.49	214.840	.00	63.49	20860.00
969.00	64.22	286.120	.00	64.22	27760.64
970.00	64.95	357.400	.00	64.95	34661.27
971.00	65.67	428.680	.00	65.67	41561.89
972.00	66.38	499.960	.00	66.38	48462.51
973.00	67.09	571.240	.00	67.09	55363.12
974.00	67.79	642.520	.00	67.79	62263.72
975.00	68.48	713.800	.00	68.48	69164.32
976.00	69.16	785.080	.00	69.16	76064.91
977.00	69.84	856.360	.00	69.84	82965.48
978.00	70.51	927.640	.00	70.51	89866.06
979.00	71.17	998.920	.00	71.17	96766.63
980.00	71.83	1070.200	.00	71.83	103667.20
981.00	72.48	1141.480	.00	72.48	110567.80
982.00	73.13	1212.760	.00	73.13	117468.30
983.00	73.77	1284.040	.00	73.77	124368.90
984.00	74.40	1355.320	.00	74.40	131269.40
985.00	75.03	1426.600	.00	75.03	138169.90
986.00	75.66	1497.880	.00	75.66	145070.40
987.00	76.28	1569.160	.00	76.28	151971.00
988.00	76.89	1640.440	.00	76.89	158871.50
989.00	77.50	1711.720	.00	77.50	165772.00
990.00	78.11	1783.000	.00	78.11	172672.50
991.00	78.71	4063.000	.00	78.71	393377.10
992.00	79.30	6343.000	.00	79.30	614081.80
993.00	79.89	6740.144	.00	79.89	652525.80
994.00	80.48	7137.286	.00	80.48	690969.80
995.00	81.06	7534.429	.00	81.06	729413.80
996.00	81.64	7931.572	.00	81.64	767857.80
997.00	82.22	8328.715	.00	82.22	806301.80
998.00	82.79	8725.857	.00	82.79	844745.80
999.00	1238.35	9123.000	.00	1238.35	884344.80
1000.00	3350.75	9519.667	.00	3350.75	924854.60
1001.00	6086.03	9916.334	.00	6086.03	965987.10
1002.00	9325.03	10313.000	.00	9325.03	1007623.00
1003.00	12998.87	10709.670	.00	12998.87	1049695.00
1004.00	17061.09	11106.330	.00	17061.09	1092154.00
1005.00	21477.57	11503.000	.00	21477.57	1134968.00
1006.00	26221.88	11899.670	.00	26221.88	1178110.00
1007.00	31272.75	12296.330	.00	31272.75	1221558.00
1008.00	36612.59	12693.000	.00	36612.59	1265295.00

```
Type.... Pond Routing Summary
Name.... LP-RES
File.... C:\JJ\SCHOENS2.PPW
Storm... 72   Tag: 72

                    LEVEL POOL ROUTING SUMMARY

 HYG Dir          = C:\JJ\
 Inflow  HYG file = NONE STORED - LP-RES       IN  72
 Outflow HYG file = NONE STORED - LP-RES       OUT 72

 Pond Node   Data = LP-RES
 Pond Volume Data = LP-RES half full
 Pond Outlet Data = 24" PIPE

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev   =   925.00 ft
 Starting Volume    =     .000 ac-ft
 Starting Outflow   =      .00 cfs
 Starting Infiltr.  =      .00 cfs
 Starting Total Qout=      .00 cfs
 Time Increment     =    .2500 hrs


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 =====================================================
 Peak Inflow       =  47935.00 cfs    at   63.0000 hrs
 Peak Outflow      =  30584.07 cfs    at   63.5000 hrs
 -----------------------------------------------------
 Peak Elevation    =   1006.86 ft
 Peak Storage =      12242.250 ac-ft
 =====================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =   23074.940
- Infiltration =        .000
- HYG Vol OUT  =   17162.910
- Retained Vol =    5912.021
                  ----------
 Unrouted Vol =       -.008 ac-ft  (.000% of Inflow Volume)
```

```
Type.... Pond E-V-Q Table
Name.... SCHOENS DAM
File.... C:\JJ\SCHOENS2.PPW

                    LEVEL POOL ROUTING DATA

 HYG Dir          = C:\JJ\
 Inflow  HYG file = NONE STORED - SCHOENS DAM  IN  72
 Outflow HYG file = NONE STORED - SCHOENS DAM  OUT 72

 Pond Node   Data = SCHOENS DAM
 Pond Volume Data = SCHOENS DAM PERMANENT POOL AT 5754
 Pond Outlet Data = 48"PIPE/SPILLWAY

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev   =  5700.00 ft
 Starting Volume    =    1.000 ac-ft
 Starting Outflow   =      .00 cfs
 Starting Infiltr.  =      .00 cfs
 Starting Total Qout=      .00 cfs
 Time Increment     =    .2500 hrs
```

Elevation ft	Outflow cfs	Storage ac-ft	Infilt. cfs	Q Total cfs	2S/t + O cfs
5700.00	.00	1.000	.00	.00	96.80
5701.00	17.10	1.019	.00	17.10	115.69
5702.00	34.20	1.037	.00	34.20	134.59
5703.00	51.30	1.056	.00	51.30	153.48
5704.00	68.40	1.074	.00	68.40	172.37
5705.00	85.50	1.093	.00	85.50	191.26
5706.00	102.60	1.111	.00	102.60	210.16
5707.00	119.70	1.130	.00	119.70	229.05
5708.00	136.80	1.148	.00	136.80	247.94
5709.00	153.90	1.167	.00	153.90	266.83
5710.00	171.00	1.185	.00	171.00	285.73
5711.00	180.20	1.204	.00	180.20	296.72
5712.00	189.40	1.222	.00	189.40	307.71
5713.00	198.60	1.241	.00	198.60	318.70
5714.00	207.80	1.259	.00	207.80	329.70
5715.00	217.00	1.278	.00	217.00	340.69
5716.00	226.20	1.296	.00	226.20	351.68
5717.00	235.40	1.315	.00	235.40	362.67
5718.00	244.60	1.333	.00	244.60	373.67
5719.00	253.80	1.352	.00	253.80	384.66
5720.00	263.00	1.370	.00	263.00	395.65
5721.00	267.70	1.389	.00	267.70	402.14
5722.00	272.40	1.407	.00	272.40	408.64
5723.00	277.10	1.426	.00	277.10	415.13
5724.00	281.80	1.444	.00	281.80	421.62
5725.00	286.50	1.463	.00	286.50	428.11
5726.00	291.20	1.481	.00	291.20	434.61
5727.00	295.90	1.500	.00	295.90	441.10
5728.00	300.60	1.519	.00	300.60	447.59
5729.00	305.30	1.537	.00	305.30	454.09
5730.00	310.00	1.556	.00	310.00	460.58
5731.00	314.00	1.574	.00	314.00	466.37
5732.00	318.00	1.593	.00	318.00	472.16
5733.00	322.00	1.611	.00	322.00	477.96
5734.00	326.00	1.630	.00	326.00	483.75
5735.00	330.00	1.648	.00	330.00	489.54
5736.00	334.00	1.667	.00	334.00	495.33
5737.00	338.00	1.685	.00	338.00	501.13
5738.00	342.00	1.704	.00	342.00	506.92
5739.00	346.00	1.722	.00	346.00	512.71

Type.... Pond E-V-Q Table
Name.... SCHOENS DAM
File.... C:\JJ\SCHOENS2.PPW

LEVEL POOL ROUTING DATA

Elevation ft	Outflow cfs	Storage ac-ft	Infilt. cfs	Q Total cfs	2S/t + O cfs
5740.00	350.00	1.741	.00	350.00	518.50
5741.00	353.60	1.759	.00	353.60	523.90
5742.00	357.20	1.778	.00	357.20	529.29
5743.00	360.80	1.796	.00	360.80	534.68
5744.00	364.40	1.815	.00	364.40	540.07
5745.00	368.00	1.833	.00	368.00	545.47
5746.00	371.60	1.852	.00	371.60	550.86
5747.00	375.20	1.870	.00	375.20	556.25
5748.00	378.80	1.889	.00	378.80	561.64
5749.00	382.40	1.907	.00	382.40	567.04
5750.00	386.00	1.926	.00	386.00	572.43
5751.00	388.50	1.944	.00	388.50	576.72
5752.00	391.00	1.963	.00	391.00	581.01
5753.00	393.50	1.981	.00	393.50	585.31
5754.00	396.00	2.000	.00	396.00	589.60
5755.00	398.50	271.667	.00	398.50	26695.83
5756.00	401.00	541.333	.00	401.00	52802.07
5757.00	403.50	811.000	.00	403.50	78908.30
5758.00	406.00	1080.667	.00	406.00	105014.50
5759.00	408.50	1350.333	.00	408.50	131120.80
5760.00	411.00	1620.000	.00	411.00	157227.00
5761.00	414.90	2044.000	.00	414.90	198274.10
5762.00	418.80	2468.000	.00	418.80	239321.20
5763.00	422.70	2892.000	.00	422.70	280368.30
5764.00	426.60	3316.000	.00	426.60	321415.40
5765.00	430.50	3740.000	.00	430.50	362462.50
5766.00	434.40	4164.000	.00	434.40	403509.60
5767.00	438.30	4588.000	.00	438.30	444556.70
5768.00	442.20	5012.000	.00	442.20	485603.80
5769.00	446.10	5436.000	.00	446.10	526650.90
5770.00	450.00	5860.000	.00	450.00	567698.00
5771.00	452.90	6284.000	.00	452.90	608744.10
5772.00	455.80	6708.000	.00	455.80	649790.20
5773.00	458.70	7132.000	.00	458.70	690836.30
5774.00	461.60	7556.000	.00	461.60	731882.40
5775.00	464.50	7980.000	.00	464.50	772928.50
5776.00	467.40	8404.000	.00	467.40	813974.60
5777.00	470.30	8828.000	.00	470.30	855020.70
5778.00	473.20	9252.000	.00	473.20	896066.80
5779.00	476.10	9676.000	.00	476.10	937112.90
5780.00	479.00	10100.000	.00	479.00	978159.00
5781.00	481.70	10830.000	.00	481.70	1048826.00
5782.00	484.40	11560.000	.00	484.40	1119492.00
5783.00	487.10	12290.000	.00	487.10	1190159.00
5784.00	489.80	13020.000	.00	489.80	1260826.00
5785.00	492.50	13750.000	.00	492.50	1331493.00
5786.00	495.20	14480.000	.00	495.20	1402159.00
5787.00	497.90	15210.000	.00	497.90	1472826.00
5788.00	500.60	15940.000	.00	500.60	1543493.00
5789.00	503.30	16670.000	.00	503.30	1614159.00
5790.00	506.00	17400.000	.00	506.00	1684826.00
5791.00	508.50	18130.000	.00	508.50	1755493.00

Type.... Pond E-V-Q Table
Name.... SCHOENS DAM
File.... C:\JJ\SCHOENS2.PPW

LEVEL POOL ROUTING DATA

Elevation ft	Outflow cfs	Storage ac-ft	Infilt. cfs	Q Total cfs	2S/t + O cfs
5792.00	511.00	18860.000	.00	511.00	1826159.00
5793.00	513.50	19590.000	.00	513.50	1896826.00
5794.00	516.00	20320.000	.00	516.00	1967492.00
5795.00	518.50	21050.000	.00	518.50	2038159.00
5796.00	521.00	21780.000	.00	521.00	2108825.00
5797.00	523.50	22510.000	.00	523.50	2179492.00
5798.00	526.00	23240.000	.00	526.00	2250158.00
5799.00	528.50	23970.000	.00	528.50	2320825.00
5800.00	531.00	24700.000	.00	531.00	2391491.00
5801.00	665.22	25730.000	.00	665.22	2491329.00
5802.00	799.43	26760.000	.00	799.43	2591168.00
5803.00	933.65	27790.000	.00	933.65	2691006.00
5804.00	1208.14	28820.000	.00	1208.14	2790985.00
5805.00	2043.33	29850.000	.00	2043.33	2891523.00
5806.00	2878.75	30880.000	.00	2878.75	2992063.00
5807.00	3917.51	31910.000	.00	3917.51	3092806.00
5808.00	5007.17	32940.000	.00	5007.17	3193599.00
5809.00	6267.57	33970.000	.00	6267.57	3294564.00
5810.00	7698.71	35000.000	.00	7698.71	3395699.00
5811.00	9129.86	36375.000	.00	9129.86	3530230.00
5812.00	10561.00	37750.000	.00	10561.00	3664761.00
5813.00	12450.13	39125.000	.00	12450.13	3799750.00
5814.00	14339.25	40500.000	.00	14339.25	3934739.00
5815.00	16228.38	41875.000	.00	16228.38	4069729.00
5816.00	18117.50	43250.000	.00	18117.50	4204718.00
5817.00	20006.63	44625.000	.00	20006.63	4339707.00
5818.00	22282.46	46000.000	.00	22282.46	4475083.00
5819.00	24723.87	47375.000	.00	24723.87	4610624.00
5820.00	27165.27	48750.000	.00	27165.27	4746166.00
5821.00	29606.68	50475.000	.00	29606.68	4915586.00
5822.00	32402.59	52200.000	.00	32402.59	5085363.00
5823.00	35434.74	53925.000	.00	35434.74	5255375.00
5824.00	38466.90	55650.000	.00	38466.90	5425387.00
5825.00	41472.71	57375.000	.00	41472.71	5595372.00
5826.00	44417.00	59100.000	.00	44417.00	5765297.00

```
Type.... Pond E-V-Q Table
Name.... SCHOENS DAM
File.... C:\JJ\SCHOENS2.PPW

                     LEVEL POOL ROUTING DATA

 HYG Dir           = C:\JJ\
 Inflow  HYG file = NONE STORED - SCHOENS DAM  IN  72
 Outflow HYG file = NONE STORED - SCHOENS DAM  OUT 72

 Pond Node   Data = SCHOENS DAM
 Pond Volume Data = SCHOENS DAM PERMANENT POOL AT 5777
 Pond Outlet Data = 48"PIPE/SPILLWAY

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev   =  5700.00 ft
 Starting Volume    =    1.000 ac-ft
 Starting Outflow   =      .00 cfs
 Starting Infiltr.  =      .00 cfs
 Starting Total Qout=      .00 cfs
 Time Increment     =    .2500 hrs
```

Elevation ft	Outflow cfs	Storage ac-ft	Infilt. cfs	Q Total cfs	2S/t + O cfs
5700.00	.00	1.000	.00	.00	96.80
5701.00	17.10	1.013	.00	17.10	115.16
5702.00	34.20	1.026	.00	34.20	133.51
5703.00	51.30	1.039	.00	51.30	151.87
5704.00	68.40	1.052	.00	68.40	170.23
5705.00	85.50	1.065	.00	85.50	188.59
5706.00	102.60	1.078	.00	102.60	206.94
5707.00	119.70	1.091	.00	119.70	225.30
5708.00	136.80	1.104	.00	136.80	243.66
5709.00	153.90	1.117	.00	153.90	262.01
5710.00	171.00	1.130	.00	171.00	280.37
5711.00	180.20	1.143	.00	180.20	290.83
5712.00	189.40	1.156	.00	189.40	301.29
5713.00	198.60	1.169	.00	198.60	311.74
5714.00	207.80	1.182	.00	207.80	322.20
5715.00	217.00	1.195	.00	217.00	332.66
5716.00	226.20	1.208	.00	226.20	343.11
5717.00	235.40	1.221	.00	235.40	353.57
5718.00	244.60	1.234	.00	244.60	364.03
5719.00	253.80	1.247	.00	253.80	374.49
5720.00	263.00	1.260	.00	263.00	384.94
5721.00	267.70	1.273	.00	267.70	390.90
5722.00	272.40	1.286	.00	272.40	396.86
5723.00	277.10	1.299	.00	277.10	402.81
5724.00	281.80	1.312	.00	281.80	408.77
5725.00	286.50	1.325	.00	286.50	414.73
5726.00	291.20	1.338	.00	291.20	420.69
5727.00	295.90	1.351	.00	295.90	426.64
5728.00	300.60	1.364	.00	300.60	432.60
5729.00	305.30	1.377	.00	305.30	438.56
5730.00	310.00	1.390	.00	310.00	444.51
5731.00	314.00	1.403	.00	314.00	449.77
5732.00	318.00	1.416	.00	318.00	455.03
5733.00	322.00	1.429	.00	322.00	460.29
5734.00	326.00	1.442	.00	326.00	465.54
5735.00	330.00	1.455	.00	330.00	470.80
5736.00	334.00	1.468	.00	334.00	476.06
5737.00	338.00	1.481	.00	338.00	481.31
5738.00	342.00	1.494	.00	342.00	486.57
5739.00	346.00	1.506	.00	346.00	491.83
5740.00	350.00	1.519	.00	350.00	497.09

Type.... Pond E-V-Q Table
Name.... SCHOENS DAM
File.... C:\JJ\SCHOENS2.PPW

LEVEL POOL ROUTING DATA

Elevation ft	Outflow cfs	Storage ac-ft	Infilt. cfs	Q Total cfs	2S/t + O cfs
5741.00	353.60	1.532	.00	353.60	501.94
5742.00	357.20	1.545	.00	357.20	506.80
5743.00	360.80	1.558	.00	360.80	511.66
5744.00	364.40	1.571	.00	364.40	516.51
5745.00	368.00	1.584	.00	368.00	521.37
5746.00	371.60	1.597	.00	371.60	526.23
5747.00	375.20	1.610	.00	375.20	531.09
5748.00	378.80	1.623	.00	378.80	535.94
5749.00	382.40	1.636	.00	382.40	540.80
5750.00	386.00	1.649	.00	386.00	545.66
5751.00	388.50	1.662	.00	388.50	549.41
5752.00	391.00	1.675	.00	391.00	553.17
5753.00	393.50	1.688	.00	393.50	556.93
5754.00	396.00	1.701	.00	396.00	560.69
5755.00	398.50	1.714	.00	398.50	564.44
5756.00	401.00	1.727	.00	401.00	568.20
5757.00	403.50	1.740	.00	403.50	571.96
5758.00	406.00	1.753	.00	406.00	575.71
5759.00	408.50	1.766	.00	408.50	579.47
5760.00	411.00	1.779	.00	411.00	583.23
5761.00	414.90	1.792	.00	414.90	588.39
5762.00	418.80	1.805	.00	418.80	593.54
5763.00	422.70	1.818	.00	422.70	598.70
5764.00	426.60	1.831	.00	426.60	603.86
5765.00	430.50	1.844	.00	430.50	609.01
5766.00	434.40	1.857	.00	434.40	614.17
5767.00	438.30	1.870	.00	438.30	619.33
5768.00	442.20	1.883	.00	442.20	624.49
5769.00	446.10	1.896	.00	446.10	629.64
5770.00	450.00	1.909	.00	450.00	634.80
5771.00	452.90	1.922	.00	452.90	638.96
5772.00	455.80	1.935	.00	455.80	643.11
5773.00	458.70	1.948	.00	458.70	647.27
5774.00	461.60	1.961	.00	461.60	651.43
5775.00	464.50	1.974	.00	464.50	655.59
5776.00	467.40	1.987	.00	467.40	659.74
5777.00	470.30	2.000	.00	470.30	663.90
5778.00	473.20	425.333	.00	473.20	41645.46
5779.00	476.10	848.667	.00	476.10	82627.03
5780.00	479.00	1272.000	.00	479.00	123608.60
5781.00	481.70	2002.000	.00	481.70	194275.30
5782.00	484.40	2732.000	.00	484.40	264942.00
5783.00	487.10	3462.000	.00	487.10	335608.70
5784.00	489.80	4192.000	.00	489.80	406275.40
5785.00	492.50	4922.000	.00	492.50	476942.10
5786.00	495.20	5652.000	.00	495.20	547608.80
5787.00	497.90	6382.000	.00	497.90	618275.50
5788.00	500.60	7112.000	.00	500.60	688942.30
5789.00	503.30	7842.000	.00	503.30	759608.90
5790.00	506.00	8572.000	.00	506.00	830275.60
5791.00	508.50	9302.000	.00	508.50	900942.10

Type.... Pond E-V-Q Table
Name.... SCHOENS DAM
File.... C:\JJ\SCHOENS2.PPW

LEVEL POOL ROUTING DATA

Elevation ft	Outflow cfs	Storage ac-ft	Infilt. cfs	Q Total cfs	2S/t + O cfs
5792.00	511.00	10032.000	.00	511.00	971608.60
5793.00	513.50	10762.000	.00	513.50	1042275.00
5794.00	516.00	11492.000	.00	516.00	1112942.00
5795.00	518.50	12222.000	.00	518.50	1183608.00
5796.00	521.00	12952.000	.00	521.00	1254275.00
5797.00	523.50	13682.000	.00	523.50	1324941.00
5798.00	526.00	14412.000	.00	526.00	1395608.00
5799.00	528.50	15142.000	.00	528.50	1466274.00
5800.00	531.00	15872.000	.00	531.00	1536941.00
5801.00	665.22	16902.000	.00	665.22	1636779.00
5802.00	799.43	17932.000	.00	799.43	1736617.00
5803.00	933.65	18962.000	.00	933.65	1836455.00
5804.00	1208.14	19992.000	.00	1208.14	1936434.00
5805.00	2043.33	21022.000	.00	2043.33	2036973.00
5806.00	2878.75	22051.990	.00	2878.75	2137512.00
5807.00	3917.51	23081.990	.00	3917.51	2238255.00
5808.00	5007.17	24111.990	.00	5007.17	2339048.00
5809.00	6267.57	25141.990	.00	6267.57	2440012.00
5810.00	7698.71	26171.990	.00	7698.71	2541148.00
5811.00	9129.86	27546.990	.00	9129.86	2675679.00
5812.00	10561.00	28921.990	.00	10561.00	2810210.00
5813.00	12450.13	30296.990	.00	12450.13	2945199.00
5814.00	14339.25	31671.990	.00	14339.25	3080188.00
5815.00	16228.38	33046.990	.00	16228.38	3215177.00
5816.00	18117.50	34421.990	.00	18117.50	3350166.00
5817.00	20006.63	35796.990	.00	20006.63	3485156.00
5818.00	22282.46	37171.990	.00	22282.46	3620532.00
5819.00	24723.87	38546.990	.00	24723.87	3756073.00
5820.00	27165.27	39921.990	.00	27165.27	3891614.00
5821.00	29606.68	41646.990	.00	29606.68	4061036.00
5822.00	32402.59	43371.990	.00	32402.59	4230812.00
5823.00	35434.74	45096.990	.00	35434.74	4400824.00
5824.00	38466.90	46822.000	.00	38466.90	4570836.00
5825.00	41472.71	48547.000	.00	41472.71	4740822.00
5826.00	44417.00	50272.000	.00	44417.00	4910746.00