NAVAJO GALLUP WATER SUPPLY PROJECT

APPRAISAL LEVEL DESIGNS AND COST ESTIMATES

APPENDIX H

EVALUATION OF EXISTING PNM DIVERSION AND SEDIMENTATION FACILITY

CONCEPT SEDIMENT ANALYSIS REPORT
PUBLIC SERVICE COMPANY OF NEW MEXICO
DIVERSION DAM FISH PASSAGE STRUCTURE
FRUITLAND, NEW MEXICO

Prepared for:
United States Bureau of Reclamation
Grand Junction Area Office
P.O. Box 60340
Grand Junction, Colorado 81506

Contract No. 1425-6-CA-40-1730A
Delivery Order No. 26A

Prepared by:
Tetra-Tech Inc.
P.O. Box 1659
410 South French Street
Breckenridge, CO 80424

March 27, 2001

Revised April 6, 2201

5-11-01

Memorandum

To: Leo Kinney, Chief Designer PMN San Juan Diversion Study

From: Cassie C. Klumpp, Hydraulic Engineer, Sedimentation and River Hydraulics Group

Subject: Settling Basins at PMN San Juan Diversion

A review and analysis was made for the Concept Sediment Analysis Report Public Service Company of New Mexico Diversion Dam, prepared for the United States Bureau of Reclamation, Grand Junction Area Office, by Tetra Tech Inc. of Breckinridge Colorado. Tetra Tech developed a simple HECRAS model of the PNM diversion and the settling channel describing the hydraulics and theoretical settling characteristics of sediment in the intake channel. This report is based only on theoretical conditions for sediment in the channel, not on any measured suspended sediment concentrations and sediment size, which is critical to describing the settling characteristics of the sediment. The HECRAS model describes a range of river discharges (500 cfs through 10,000 cfs) and a constant diversion into the PMN and San Juan Diversion. The major analysis of the structure is concerned with 37 cfs although a range of diversions from 37 up to 106 cfs is analyzed in the report. The critical discharges for the San Juan Diversion are:

1. 74 cfs (37 cfs for Public Service and 37 cfs for San Juan Diversion,
2. 83 cfs (46 cfs for Public Service and 37 cfs the San Juan Diversion),
3. 97 cfs (37 and 60 for Public Service and the San Juan Diversion),
4. 106 cfs (46 and 60 cfs for Public Service and the San Juan Diversion).

Our present design includes the separation of the Public Service and San Juan Diversion flows before the water enters the settling channels. We are constructing a new settling channel that is the mirror image of the existing channel. We then show two different alternatives: a) settling water in separate settling channel then pump water to settling ponds and treatment plant and b) pump sediment laden water to the settling ponds and treatment plant. If we use the first option, the range of material that we can settle out in the settling channel is very fine silt or sand and coarser. If the flow rate is 37 cfs, then we can settle out all sediment that is coarser than 0.055 mm., coarse silt. If our flow rate is 60 cfs then we will be able to settle out particles coarser than very fine sand (0.077 mm) and the theoretical trap efficiency will be approximately 62 percent. This is not a concern because the rest of the material will be settled out in the settling ponds near the treatment plant. If it is feasible, we will sluice material out of the settling channel on a weekly or bi-weekly schedule. If we are prohibited from sluicing sediment from the settling channel, we will shut down periodically and remove the sediment and dispose of it at a proper location. The settling ponds will be operated on a similar basis. When a pond fills with sediment, it will be shut down, sediment will be dried and removed to a proper location.

United States Department of the Interior
BUREAU OF RECLAMATION
Upper Colorado Region
Western Colorado Area Office

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Mr. Matt Lavery
Public Service Company of New Mexico
Alvarado Square
Albuquerque NM 87158 - Mail Stop Z-110

Subject: Transmittal of Revised Concept Sediment Analysis Report - Public Service Company of New Mexico Diversion Dam - Navajo-Gallup Water Supply Project

Dear Mr. Lavery:

Enclosed for your review and information is one copy of the Revised Concept Sediment Analysis Report that was prepared for Reclamation by Tetra-Tech Inc. Revisions to the report primarily include the addition of Section 4.3, Sediment Removal.

If you have questions or comments on the report, please contact me at 970 248-0635.

Sincerely,

Kevin Moran
Civil Engineer

Enclosure

cc: Mr. John Leeper
Navajo Nation
Department of Water Resources
P.O. Drawer 678
Fort Defiance AZ 86504 (w/encl)

bc: Construction Manager - Farmington Construction Office, NM
Attention: FCO- 203 (w/encl, 2 copies)

Rec'd 2 1
Enclosures Retained By:

CONCEPT SEDIMENT ANALYSIS REPORT
PUBLIC SERVICE COMPANY OF NEW MEXICO
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I. INTRODUCTION

This report summarizes the findings of the concept sedimentation analysis for the Public Service Company of New Mexico (PNM) Diversion Dam operations on the San Juan River near Fruitland, New Mexico. Potential changes to the amount of water that is diverted from the San Juan River may affect the rate and volume of sediment that is transported and deposited within the settling channel of the diversion structure. This report analyzes and presents the potential changes in sedimentation due to future water demands through the diversion settling channel. The information presented herein is approximate only, basin on reported performance of the PNM diversion and settling channel and extrapolated for potential future conditions.

II. BACKGROUND

2.1 Current Conditions

The PNM diversion structure is comprised of a dam spanning the entire San Juan River channel, with diversion headworks and structures on the right bank. The intake of the diversion facilities is covered by a log rack, which faces the flow of the San Juan River at a slight angle. Water flows through the log rack and enters a chamber with two outlets; a sluice gate directing water through a tunnel in the dam and back to the river, and a second trash rack (perpendicular to the river) at the inlet to the diversion channel. Water passes the second trash rack and flows in an open channel around a 90° bend into a trapezoidal settling channel. At the downstream end of the settling channel, two outlets exist. The outlet on the left (looking downstream) is used to flush the settling channel and is control by radial gates that open to allow water to flow through a 20' wide concrete channel back to the river, confluencing downstream of the dam. The second outlet is a

concrete wall, 2 feet high, over which the water spills into the pump house. From the pumping station, the diverted water is pumped offsite.

Currently, PNM controls the amount of diverted water with a combination of the elevation of the tunnel sluice gate at the inlet and the pumps and pumping rate at the outlet. Under normal operating conditions, a discharge of 37 cfs (1,000,000 gallons per hour) flows through the diversion structure. In a typical week, an average of 6" of sediment accumulates on the bottom of the settling basin. (Ashman, 2001) In order to remove this sediment, PNM opens the radial gates at the downstream end of the settling basin, allowing the water to flow back to the river, flushing out the accumulated sediment. The flushing process is typically necessary once a week for a full day.

2.2 Future Demands

Future conditions for PNM diversions may include additional water to accommodate an additional generating station (SJ5). (Ashman, 2001) Water rights available for this is approximately 500 acre-feet per month. (Ashman, 2001), increasing the amount of diverted flow from 37 cfs to 46 cfs. In addition to the PNM increase, the Navajo-Gallop Water Supply Project (NGWSP) is investigating possibilities for extracting water from the San Juan River at the PNM diversion dam. The NGWSP may divert between 37 cfs and 60 cfs for water supply purposes. The NGWSP planning is in preliminary stages at this time.

The additional water for NGWSP, if allowed to flow through the PNM structure, will affect the operations of the settling basin and may alter the characteristics of the sediment both at the inlet and outlet of the diversion structure.

2.3 Sediment Information

Detailed information regarding the concentrations and average sizes of the

sediment that is transported by the San Juan River near the inlet of the diversion structure are unknown at this time. Additionally, very little is known about the properties of the sediment that deposits in the settling basin, other than the typical depth of deposited sediment.

An in-depth sediment study is difficult to perform without this information. However, estimates of travel times and trap efficiencies can be made based on the hydraulic properties of the settling basin. The next section describes the process used to evaluate the effects of the additional discharge through the diversion structure.

III. METHOD OF ANALYSIS

3.1 Hydraulic Model

The velocity of the water passing through the settling basin is critical to the ability of the flow to either transport or deposit sediment. In order to estimate the velocity at different levels of flow intake, a hydraulic model was created using HEC-RAS. Eight cross sections are used to model from the inlet at the second trash rack to the outlet at the downstream end of the settling basin. The flow levels for the model vary according to the various combinations of potential water needs as shown in Table 1.

Table 1. Discharge Levels into the Diversion Structure

PNM Diversion (cfs)	NGWSP Diversion (cfs)	Q_T into Diversion Structure (cfs)
37	0	37
46	0	46
37	37	74
46	37	83
37	60	97
46	60	106

The elevation of the water surface as it enters the diversion structure is dependent upon the amount of flow in the San Juan River. A rating curve, developed for the fish passage project, relates the discharge in the river to the water surface elevation just upstream of the diversion structure. (Tetra Tech, Inc. 2000) This rating curve, contained in Appendix B, is used to help establish the water surface elevation at the inlet of the diversion.

Five different river flow levels are modeled in conjunction with the six different intake discharges. The river flow levels incorporated in the model are: 500 cfs (low flow conditions), 950 cfs (average August flow), 4,000 cfs (one month before peak), 7,000 cfs (flow prior to flood losses on south bank) and 10,000 (SJRIP seasonal peak). (Tetra Tech, Inc. 2000)

The most important result from the HEC-RAS model for sedimentation purposes is the value of the velocity at xsec 3 (upstream end of the settling basin) and xsec 2 (downstream end of the settling basin). These values are averaged to approximate the velocity of the flow as it travels through the settling basin.

3.2 Trap Efficiency

With the hydraulic parameters of the settling basin known, the traveling time, surface velocity and the trap efficiency of the basin can be determined. The average velocity, of xsec 2 and 3, divided into the length of the sediment basin yields the travel time as shown.

$$T_T = \frac{L}{V}$$

where T_T = *travel time (seconds)*

L = *length of travel = length of settling basin (ft)*

V = *average velocity of length of travel (ft/s)*

In addition to estimating the travel time, the fall velocity and the surface velocity are also important in evaluating the sediment behavior in the settling basin. The fall velocity, the rate at which a given diameter sized particle of sediment (d) falls, is calculated as:

$$\omega = \frac{gd^2}{18\upsilon}\left(\frac{\gamma_s - \gamma_w}{\gamma_w}\right)$$ *where* ω *= fall velocity (ft/s)*

g = gravity= 32.2 ft/s^2
d = mean diameter of the falling particle (ft)
υ = kinematic viscosity of the water = 1.7x10^{-5} (ft^2/s)
γ_s= specific weight of sediment = 165.4 lb/ft^3
γ_w= specific weight of water = 62.4 lb/ft^3

Substituting the known values into the equation yields:
$\omega = 173{,}695\ d^2$.

The surface velocity is determined by:

$$V_s = \frac{Q}{A_{surface}}$$

where V_s = *surface velocity in ft/s*
Q = *flow traveling through the settling basin, ranging from 37 cfs to 106 cfs (Table 1)*
$A_{surface}$ = *area of the surface of the water in the settling basin = 6634 ft^2*

The trap efficiency of the settling basin is calculated using the following equation:

$$T_E = \frac{\omega}{V_S} x100$$ *where* T_E *= trap efficiency (%)*

ω *=settling velocity(ft/s)*
V_s *= surface velocity(ft/s)*

By setting the value of T_E equal to 100%, the smallest particle size that will always settle can be determined for each value of discharge flowing through the settling basin.

Another way to use the trap efficiency equation for evaluation is to set the particle diameter size at a known value and solve for the surface area that would be required for

100% of particles that size and bigger to deposit in the basin. The equation is then written as:

$$A = \frac{Q}{173{,}695 d^2}$$ *where T_E is set to 100% and d becomes a fixed number.*

The time it will take for a particle to fallout of suspension, T_F, is a factor of the particle fall velocity and the depth through which it needs to fall. In the case of this settling basin, the depth is assumed to be the height of the water above the top of the outlet wall at the pump intake plus an additional depth below the top of the wall to account for any turbulent forces of the moving water. This is assumed to be 0.5 feet. It is also assumed that all particles below this depth will be deposited in basin.

$$T_F = \frac{D}{\omega}$$

where T_F = fall time (sec)
D = distance to fall (ft)
ω = fall velocity (ft/s)

The fall time needs to be less than the travel time through the basin in order for the particle to be deposited. This criterion is also evaluated.

3.3 Velocity at Racks

In addition to sediment evaluations, the velocity at the intake racks needs to be evaluated for consideration of future permitting. First, the amount of discharge that will flow through the sluice gate tunnel is estimated using an orifice equation. Calculations are shown in Appendix B. The amount of diverted discharge (flow through the trash rack) is added to the tunnel discharge to estimate the total discharge that will be flowing through the log rack. The depth of flow at the log rack is determined by using the rating curve to establish the water surface elevation in the San Juan River and subtracting out

the elevation of the bottom of the log rack. The open width at the log rack is determined by subtracting the width of the vertical bars of the rack from the entire width. The open width times the depth is the open area. The velocity through the log rack is determined by dividing the total discharge by the open area in the log rack. The velocities are shown in Table 2 for river flows of 500 cfs (low flow conditions) and 10,000 cfs (seasonal peak). Appendix B contains the velocities for all flow scenarios.

Table 2. Velocity at the Log and Trash Racks

Discharge (cfs)		Velocity (ft/s)	
River	Diverted	Log Rack	Trash Rack
500	37	0.26	0.41
500	46	0.32	0.52
500	74	0.53	0.84
500	83	0.59	0.94
500	97	0.69	1.10
500	106	0.76	1.21
10,000	37	0.14	0.13
10,000	46	0.18	0.17
10,000	74	0.28	0.27
10,000	83	0.32	0.30
10,000	97	0.37	0.35
10,000	106	0.41	0.39

Next, the amount of head lost through the log rack is estimated using Reclamation Design Standard No. 2, Canals and Related Structures head loss equation. This is subtracted from the water surface elevation used to determine the loss through the log rack to yield the water surface elevation at the trash rack. The same calculation process occurs at the trash rack and the velocities are determined. Again, the results of the

calculations are summarized in Appendix B.

V. RESULTS

4.1 Current Conditions

All of equations discussed in Section III have been applied to the different flow scenarios using information from the HEC-RAS model. Table 2 summarized the results of the calculations for the current settling basin configuration.

At the current diversion rate of 37 cfs, the smallest particle size that will fall out of suspension and deposit in the settling basin is 0.055 mm. This size is classified as coarse silt. The fall time for a particle this size in the basin is 174 seconds, which is significantly less than the travel time of 344 seconds. The particle will therefore have sufficient time to fall out of suspension. It is assumed that all sediment larger than 0.055 mm will deposit in the settling basin as well as some of the sediment that is smaller than 0.005mm. However, without knowing any information of the percentages of sediment sizes being transported into the diversion structure, it is impossible to estimate the amount of sediment that will deposit.

If the diversion rate were to increase to 46 cfs, at 100% trap efficiency, the smallest size particle to deposit will be 0.061 mm, also coarse silt. The current size of 0.055 mm would have a trap efficiency of 82%. The required fall time would be 151 seconds, far less than the available travel time of 294 seconds.

At the maximum diversion rate of 106 cfs, the smallest particle size to deposit with 100% trap efficiency would be 0.092 mm, very fine sand. The trap efficiency for 0.055 mm would be 35%. As in all other cases, the fall time, 91 seconds is less than the travel time, 170 seconds. All of the corresponding values for the different diversion rates are shown in Table 2. Summary of Calculations for Current Basin Configuration.

Table 3. Summary of Calculations for Current Basin Configuration

Scenario	Diversion Q (cfs)	Channel Velocity (ft/s) xsec 2	xsec 3	avg	Length L (ft)	Travel Time T_T (sec)	Area $A_{SURFACE}$ (ft^2)	Surface Velocity V_S (ft/s)	Trap Efficiency T_E (%)	Smallest Particle Size (d) for 100% T_E (mm)	Particle Description	T_E for d=0.055 %	Fall Depth D (ft)	Fall Time for d F_T (sec)
1	37	0.66	0.85	0.76	260	344	6,634	0.006	31,143,044 $*d^2$	0.055	Coarse silt	100%	0.97	174
2	46	0.78	0.99	0.89	260	294	6,634	0.007	25,049,840 $*d^2$	0.061	Coarse silt	82%	1.05	151
3	74	1.09	1.35	1.22	260	213	6,634	0.011	15,571,522 $*d^2$	0.077	Very fine sand	51%	1.25	112
4	83	1.18	1.45	1.32	260	198	6,634	0.013	13,883,044 $*d^2$	0.082	Very fine sand	45%	1.31	105
5	97	1.31	1.59	1.45	260	179	6,634	0.015	11,879,305 $*d^2$	0.088	Very fine sand	39%	1.40	96
6	106	1.39	1.67	1.53	260	170	6,634	0.016	10,870,685 $*d^2$	0.092	Very fine sand	35%	1.45	91

Table 4. Summary of Calculations if Second Basin is Constructed

Scenario	Diversion Q (cfs)	Channel Velocity (ft/s) xsec 2	xsec 3	avg	Length (L) (ft)	Travel Time (sec)	Surface Area (ft^2)	Travel Velocity (ft/s)	Trap Efficiency T_E (%)	Smallest Particle Size (D) for 100% T_E (mm)	Particle Description	TE for D=0.055 %	Fall Depth D (ft)	Fall Time for d F_T (sec)
1	37	0.33	0.43	0.38	260	684	13,268	0.003	62,286,088 $*d^2$	0.039	Coarse silt	100%	0.97	348
2	46	0.39	0.50	0.45	260	584	13,268	0.003	50,099,680 $*d^2$	0.043	Coarse silt	163%	1.05	303
3	74	0.54	0.67	0.61	260	430	13,268	0.006	31,143,044 $*d^2$	0.055	Very fine sand	101%	1.25	224
4	83	0.59	0.72	0.66	260	397	13,268	0.006	27,766,087 $*d^2$	0.058	Very fine sand	90%	1.31	209
5	97	0.65	0.79	0.72	260	361	13,268	0.007	23,758,611 $*d^2$	0.063	Very fine sand	77%	1.40	192
6	106	0.69	0.83	0.76	260	342	13,268	0.008	21,741,370 $*d^2$	0.065	Very fine sand	71%	1.45	182

Table 5. Area Needed to Maintain Current Deposition Conditions

Scenario	Diversion Q (cfs)	Surface Area (ft^2)
1	37	6,634
2	46	8,250
3	74	13,270
4	83	14,890
5	97	17,390
6	106	19,000

4.2 Future Conditions

The original construction plans for the PNM settling basin included two identical sections of settling basin to be built side by side. However, only the right side of the basin was constructed. If the second basin were to be constructed now, this would impact the settling capabilities of the basin area. In order to estimate the impact if the second basin is constructed, a second HEC-RAS geometry file was created to estimate the velocities through the basin. Table 3 contains the results of the calculations based on both sides of the settling basin being in operation. The velocities are much slower as expected and the surface area has doubled. This however will only trap the same size sediment as current operating conditions for up to 74 cfs. If any further diversion discharge demands are put on the system, the basins will not have the same trap efficiency as is observed currently.

In order to determine what area would be needed to maintain current conditions, a value of d = 0.055 mm was used in the trap efficiency equation and the area was determined for each value of diversion discharge. The results of this analysis are contained in Table 4. To maintain 100% trap efficiency for particles sized 0.055 mm and bigger at a diversion rate of 106 cfs, a total surface area of 19,000 cfs is required. This is an amount almost 2.9 times the current surface area.

4.3 Sediment Removal

Based on current operations, PNM flushes sediment from the settling channel approximately one time per week with an average sediment depth of 6 inches. Based on the existing dimensions of the settling channel, this translates to approximately 150 cubic yards of sediment per week. Assuming similar concentrations in diversions for the NGWSP would yield an additional 300 cubic yards of sediment. Options for removing

sediment, based on the current settling channel operations, include flushing back to the river and mechanical removal.

4.3.1 Flushing to the San Juan River

Currently there are no TMDL restrictions of this particular reach of the San Juan River. However, it is anticipated that there will be TMDL restrictions for suspended solids by the year 2004 (Ashman, 2001). It is not known at this time if TMDL restrictions will effect current or future flushing procedures. However, it can be anticipated that water quality permitting will be required for flushing sediment from an expanded or new settling channel to serve the NGWSP.

4.3.2 Mechanical Removal

Mechanical removal may be possible, requiring a potential redesign or reconfiguration of the settling channel, as it exists today. One of the challenges of removing the sediment will be locating and accommodating sufficient space for dewatering this large volume of material. Dewatering procedures could vary depending on the requirements for transportation and disposal.

V. CONCLUSIONS

This study is based primarily on the modeled hydraulic conditions of the settling basin. Detailed sediment studies can not be performed at this time due to lack of knowledge of the sediment characteristics in the San Juan River and the settling basin. General conclusions can be made from the trap efficiency and travel time estimates. All other factors remaining the same, the trap efficiency will decrease as the discharge

increases, from 100% for 0.055 mm at 37 cfs to 39% for 0.055mm at 106 cfs. This would indicate that smaller sediment would remain in suspension and be transported through the system. The large sediment will still deposit and the higher discharges will carry more volume of sediment to deposit.

The surface area needed for additional discharge is a direct relationship when applying the trap efficiency equation. For the maximum proposed value of 106 cfs, a surface area of 19,000 ft^2 would be required to maintain the current trap efficiency.

A very important factor to consider in evaluating this report is that all calculations have been performed with the assumption that the sediment characteristics of the water coming into the diversion structure do not change as the amount of diverted water increases. This however may not be the case. Without performing a detailed sedimentation study, which would include sediment sampling during a variety of discharge values, the exact changes to be expected can not be determined. The higher discharges may be able to transport a larger sediment load through the intake and therefore deposit a larger volume of sediment. This is an important factor to consider when contemplating future uses. Additionally, if the settling basin surface area is not increased and the diverted discharge does increase, less sediment of the smaller sizes may fall out of suspension. This would result in higher sediment load in the outflow of the settling basin. This may affect any treatments needed of the water after leaving the diversion structure.

VI. REFERENCES

1. Ashman, Rob. Public Service Company of New Mexico. Personal Communication, March 2001.

2. Tetra Tech, Inc. "Concept Development Report, Public Service Company of New Mexico Diversion Dam Fish Passageway Structure, Fruitland, New Mexico." Sept 20, 2000.

APPENDIX A

HEC-RAS MODEL OUTPUT

HEC-RAS Plan: Scenario 1 River: intake Reach: 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	8	500 cfs	37.00	5084.50	5087.70		5087.70	0.000003	0.34	108.81	34.00	0.03
1	8	950 cfs	37.00	5084.50	5088.00		5088.00	0.000002	0.31	119.00	34.00	0.03
1	8	4000 cfs	37.00	5084.50	5090.10		5090.10	0.000001	0.19	190.40	34.00	0.01
1	8	7000 cfs	37.00	5084.50	5092.20		5092.20	0.000000	0.14	261.81	34.00	0.01
1	8	10000 cfs	37.00	5084.50	5094.30		5094.30	0.000000	0.11	333.19	34.00	0.01
1	6.0	500 cfs	37.00	5083.50	5084.78		5084.82	0.000218	1.58	23.42	18.30	0.25
1	6.0	950 cfs	37.00	5083.50	5084.78		5084.82	0.000218	1.58	23.42	18.30	0.25
1	6.0	4000 cfs	37.00	5083.50	5084.78		5084.82	0.000218	1.58	23.42	18.30	0.25
1	6.0	7000 cfs	37.00	5083.50	5084.78		5084.82	0.000218	1.58	23.42	18.30	0.25
1	6.0	10000 cfs	37.00	5083.50	5084.78		5084.82	0.000218	1.58	23.42	18.30	0.25
1	5.0	500 cfs	37.00	5082.90	5084.78		5084.80	0.000065	1.07	34.48	18.30	0.14
1	5.0	950 cfs	37.00	5082.90	5084.78		5084.80	0.000065	1.07	34.48	18.30	0.14
1	5.0	4000 cfs	37.00	5082.90	5084.78		5084.80	0.000065	1.07	34.48	18.30	0.14
1	5.0	7000 cfs	37.00	5082.90	5084.78		5084.80	0.000065	1.07	34.48	18.30	0.14
1	5.0	10000 cfs	37.00	5082.90	5084.78		5084.80	0.000065	1.07	34.48	18.30	0.14
1	4.0	500 cfs	37.00	5082.70	5084.78		5084.80	0.000047	0.97	38.15	18.30	0.12
1	4.0	950 cfs	37.00	5082.70	5084.78		5084.80	0.000047	0.97	38.15	18.30	0.12
1	4.0	4000 cfs	37.00	5082.70	5084.78		5084.80	0.000047	0.97	38.15	18.30	0.12
1	4.0	7000 cfs	37.00	5082.70	5084.78		5084.80	0.000047	0.97	38.15	18.30	0.12
1	4.0	10000 cfs	37.00	5082.70	5084.78		5084.80	0.000047	0.97	38.15	18.30	0.12
1	3.5	500 cfs	37.00	5082.50	5084.79		5084.79	0.000022	0.72	51.40	24.95	0.09
1	3.5	950 cfs	37.00	5082.50	5084.79		5084.79	0.000022	0.72	51.40	24.95	0.09
1	3.5	4000 cfs	37.00	5082.50	5084.79		5084.79	0.000022	0.72	51.40	24.95	0.09
1	3.5	7000 cfs	37.00	5082.50	5084.79		5084.79	0.000022	0.72	51.40	24.95	0.09
1	3.5	10000 cfs	37.00	5082.50	5084.79		5084.79	0.000022	0.72	51.40	24.95	0.09
1	3.0	500 cfs	37.00	5082.50	5084.78		5084.79	0.000049	0.85	43.29	24.94	0.11
1	3.0	950 cfs	37.00	5082.50	5084.78		5084.79	0.000049	0.85	43.29	24.94	0.11
1	3.0	4000 cfs	37.00	5082.50	5084.78		5084.79	0.000049	0.85	43.29	24.94	0.11
1	3.0	7000 cfs	37.00	5082.50	5084.78		5084.79	0.000049	0.85	43.29	24.94	0.11
1	3.0	10000 cfs	37.00	5082.50	5084.78		5084.79	0.000049	0.85	43.29	24.94	0.11
1	2.0	500 cfs	37.00	5082.00	5084.78		5084.78	0.000022	0.66	55.88	26.02	0.08
1	2.0	950 cfs	37.00	5082.00	5084.78		5084.78	0.000022	0.66	55.88	26.02	0.08
1	2.0	4000 cfs	37.00	5082.00	5084.78		5084.78	0.000022	0.66	55.88	26.02	0.08

HEC-RAS Plan: Scenario 1 River: intake Reach: 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	2.0	7000 cfs	37.00	5082.00	5084.78		5084.78	0.000022	0.66	55.88	26.02	0.08
1	2.0	10000 cfs	37.00	5082.00	5084.78		5084.78	0.000022	0.66	55.88	26.02	0.08
1	1.5	500 cfs	37.00	5081.95	5084.78		5084.78	0.000015	0.65	56.50	20.00	0.07
1	1.5	950 cfs	37.00	5081.95	5084.78		5084.78	0.000015	0.65	56.50	20.00	0.07
1	1.5	4000 cfs	37.00	5081.95	5084.78		5084.78	0.000015	0.65	56.50	20.00	0.07
1	1.5	7000 cfs	37.00	5081.95	5084.78		5084.78	0.000015	0.65	56.50	20.00	0.07
1	1.5	10000 cfs	37.00	5081.95	5084.78		5084.78	0.000015	0.65	56.50	20.00	0.07
1	1.0	500 cfs	37.00	5084.00	5084.47	5084.47	5084.71	0.004681	3.96	9.35	20.00	1.02
1	1.0	950 cfs	37.00	5084.00	5084.47	5084.47	5084.71	0.004681	3.96	9.35	20.00	1.02
1	1.0	4000 cfs	37.00	5084.00	5084.47	5084.47	5084.71	0.004681	3.96	9.35	20.00	1.02
1	1.0	7000 cfs	37.00	5084.00	5084.47	5084.47	5084.71	0.004681	3.96	9.35	20.00	1.02
1	1.0	10000 cfs	37.00	5084.00	5084.47	5084.47	5084.71	0.004681	3.96	9.35	20.00	1.02

HEC-RAS Plan: Scenario 2 River: intake Reach: 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	8	500 cfs	46.00	5084.50	5087.70		5087.70	0.000005	0.42	108.81	34.00	0.04
1	8	950 cfs	46.00	5084.50	5088.00		5088.00	0.000004	0.39	119.00	34.00	0.04
1	8	4000 cfs	46.00	5084.50	5090.10		5090.10	0.000001	0.24	190.40	34.00	0.02
1	8	7000 cfs	46.00	5084.50	5092.20		5092.20	0.000000	0.18	261.81	34.00	0.01
1	8	10000 cfs	46.00	5084.50	5094.30		5094.30	0.000000	0.14	333.19	34.00	0.01
1	6.0	500 cfs	46.00	5083.50	5084.90		5084.95	0.000255	1.80	25.57	18.30	0.27
1	6.0	950 cfs	46.00	5083.50	5084.90		5084.95	0.000255	1.80	25.57	18.30	0.27
1	6.0	4000 cfs	46.00	5083.50	5084.90		5084.95	0.000255	1.80	25.57	18.30	0.27
1	6.0	7000 cfs	46.00	5083.50	5084.90		5084.95	0.000255	1.80	25.57	18.30	0.27
1	6.0	10000 cfs	46.00	5083.50	5084.90		5084.95	0.000255	1.80	25.57	18.30	0.27
1	5.0	500 cfs	46.00	5082.90	5084.90		5084.93	0.000083	1.25	36.65	18.30	0.16
1	5.0	950 cfs	46.00	5082.90	5084.90		5084.93	0.000083	1.25	36.65	18.30	0.16
1	5.0	4000 cfs	46.00	5082.90	5084.90		5084.93	0.000083	1.25	36.65	18.30	0.16
1	5.0	7000 cfs	46.00	5082.90	5084.90		5084.93	0.000083	1.25	36.65	18.30	0.16
1	5.0	10000 cfs	46.00	5082.90	5084.90		5084.93	0.000083	1.25	36.65	18.30	0.16
1	4.0	500 cfs	46.00	5082.70	5084.90		5084.92	0.000062	1.14	40.33	18.30	0.14
1	4.0	950 cfs	46.00	5082.70	5084.90		5084.92	0.000062	1.14	40.33	18.30	0.14
1	4.0	4000 cfs	46.00	5082.70	5084.90		5084.92	0.000062	1.14	40.33	18.30	0.14
1	4.0	7000 cfs	46.00	5082.70	5084.90		5084.92	0.000062	1.14	40.33	18.30	0.14
1	4.0	10000 cfs	46.00	5082.70	5084.90		5084.92	0.000062	1.14	40.33	18.30	0.14
1	3.5	500 cfs	46.00	5082.50	5084.91		5084.92	0.000029	0.85	54.41	25.21	0.10
1	3.5	950 cfs	46.00	5082.50	5084.91		5084.92	0.000029	0.85	54.41	25.21	0.10
1	3.5	4000 cfs	46.00	5082.50	5084.91		5084.92	0.000029	0.85	54.41	25.21	0.10
1	3.5	7000 cfs	46.00	5082.50	5084.91		5084.92	0.000029	0.85	54.41	25.21	0.10
1	3.5	10000 cfs	46.00	5082.50	5084.91		5084.92	0.000029	0.85	54.41	25.21	0.10
1	3.0	500 cfs	46.00	5082.50	5084.90		5084.92	0.000062	0.99	46.27	25.20	0.13
1	3.0	950 cfs	46.00	5082.50	5084.90		5084.92	0.000062	0.99	46.27	25.20	0.13
1	3.0	4000 cfs	46.00	5082.50	5084.90		5084.92	0.000062	0.99	46.27	25.20	0.13
1	3.0	7000 cfs	46.00	5082.50	5084.90		5084.92	0.000062	0.99	46.27	25.20	0.13
1	3.0	10000 cfs	46.00	5082.50	5084.90		5084.92	0.000062	0.99	46.27	25.20	0.13
1	2.0	500 cfs	46.00	5082.00	5084.89		5084.90	0.000029	0.78	58.94	26.27	0.09
1	2.0	950 cfs	46.00	5082.00	5084.89		5084.90	0.000029	0.78	58.94	26.27	0.09
1	2.0	4000 cfs	46.00	5082.00	5084.89		5084.90	0.000029	0.78	58.94	26.27	0.09

HEC-RAS Plan: Scenario 2 River: intake Reach: 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	2.0	7000 cfs	46.00	5082.00	5084.89		5084.90	0.000029	0.78	58.94	26.27	0.09
1	2.0	10000 cfs	46.00	5082.00	5084.89		5084.90	0.000029	0.78	58.94	26.27	0.09
1	1.5	500 cfs	46.00	5081.95	5084.89		5084.90	0.000021	0.78	58.84	20.00	0.08
1	1.5	950 cfs	46.00	5081.95	5084.89		5084.90	0.000021	0.78	58.84	20.00	0.08
1	1.5	4000 cfs	46.00	5081.95	5084.89		5084.90	0.000021	0.78	58.84	20.00	0.08
1	1.5	7000 cfs	46.00	5081.95	5084.89		5084.90	0.000021	0.78	58.84	20.00	0.08
1	1.5	10000 cfs	46.00	5081.95	5084.89		5084.90	0.000021	0.78	58.84	20.00	0.08
1	1.0	500 cfs	46.00	5084.00	5084.55	5084.55	5084.82	0.004352	4.21	10.92	20.00	1.00
1	1.0	950 cfs	46.00	5084.00	5084.55	5084.55	5084.82	0.004352	4.21	10.92	20.00	1.00
1	1.0	4000 cfs	46.00	5084.00	5084.55	5084.55	5084.82	0.004352	4.21	10.92	20.00	1.00
1	1.0	7000 cfs	46.00	5084.00	5084.55	5084.55	5084.82	0.004352	4.21	10.92	20.00	1.00
1	1.0	10000 cfs	46.00	5084.00	5084.55	5084.55	5084.82	0.004352	4.21	10.92	20.00	1.00

HEC-RAS Plan: Scenario 3 River: intake Reach: 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	8	500 cfs	74.00	5084.50	5087.60		5087.61	0.000014	0.70	105.40	34.00	0.07
1	8	950 cfs	74.00	5084.50	5087.90		5087.91	0.000010	0.64	115.60	34.00	0.06
1	8	4000 cfs	74.00	5084.50	5090.00		5090.00	0.000002	0.40	187.00	34.00	0.03
1	8	7000 cfs	74.00	5084.50	5092.10		5092.10	0.000001	0.29	258.40	34.00	0.02
1	8	10000 cfs	74.00	5084.50	5094.20		5094.20	0.000000	0.22	329.81	34.00	0.01
1	6.0	500 cfs	74.00	5083.50	5085.22		5085.31	0.000341	2.34	31.56	18.30	0.31
1	6.0	950 cfs	74.00	5083.50	5085.22		5085.31	0.000341	2.34	31.56	18.30	0.31
1	6.0	4000 cfs	74.00	5083.50	5085.22		5085.31	0.000341	2.34	31.56	18.30	0.31
1	6.0	7000 cfs	74.00	5083.50	5085.22		5085.31	0.000341	2.34	31.56	18.30	0.31
1	6.0	10000 cfs	74.00	5083.50	5085.22		5085.31	0.000341	2.34	31.56	18.30	0.31
1	5.0	500 cfs	74.00	5082.90	5085.23		5085.28	0.000134	1.73	42.69	18.30	0.20
1	5.0	950 cfs	74.00	5082.90	5085.23		5085.28	0.000134	1.73	42.69	18.30	0.20
1	5.0	4000 cfs	74.00	5082.90	5085.23		5085.28	0.000134	1.73	42.69	18.30	0.20
1	5.0	7000 cfs	74.00	5082.90	5085.23		5085.28	0.000134	1.73	42.69	18.30	0.20
1	5.0	10000 cfs	74.00	5082.90	5085.23		5085.28	0.000134	1.73	42.69	18.30	0.20
1	4.0	500 cfs	74.00	5082.70	5085.23		5085.27	0.000104	1.60	46.38	18.30	0.18
1	4.0	950 cfs	74.00	5082.70	5085.23		5085.27	0.000104	1.60	46.38	18.30	0.18
1	4.0	4000 cfs	74.00	5082.70	5085.23		5085.27	0.000104	1.60	46.38	18.30	0.18
1	4.0	7000 cfs	74.00	5082.70	5085.23		5085.27	0.000104	1.60	46.38	18.30	0.18
1	4.0	10000 cfs	74.00	5082.70	5085.23		5085.27	0.000104	1.60	46.38	18.30	0.18
1	3.5	500 cfs	74.00	5082.50	5085.24		5085.26	0.000048	1.18	62.95	25.94	0.13
1	3.5	950 cfs	74.00	5082.50	5085.24		5085.26	0.000048	1.18	62.95	25.94	0.13
1	3.5	4000 cfs	74.00	5082.50	5085.24		5085.26	0.000048	1.18	62.95	25.94	0.13
1	3.5	7000 cfs	74.00	5082.50	5085.24		5085.26	0.000048	1.18	62.95	25.94	0.13
1	3.5	10000 cfs	74.00	5082.50	5085.24		5085.26	0.000048	1.18	62.95	25.94	0.13
1	3.0	500 cfs	74.00	5082.50	5085.23		5085.26	0.000096	1.35	54.72	25.92	0.16
1	3.0	950 cfs	74.00	5082.50	5085.23		5085.26	0.000096	1.35	54.72	25.92	0.16
1	3.0	4000 cfs	74.00	5082.50	5085.23		5085.26	0.000096	1.35	54.72	25.92	0.16
1	3.0	7000 cfs	74.00	5082.50	5085.23		5085.26	0.000096	1.35	54.72	25.92	0.16
1	3.0	10000 cfs	74.00	5082.50	5085.23		5085.26	0.000096	1.35	54.72	25.92	0.16
1	2.0	500 cfs	74.00	5082.00	5085.22		5085.24	0.000050	1.09	67.61	26.98	0.12
1	2.0	950 cfs	74.00	5082.00	5085.22		5085.24	0.000050	1.09	67.61	26.98	0.12
1	2.0	4000 cfs	74.00	5082.00	5085.22		5085.24	0.000050	1.09	67.61	26.98	0.12

HEC-RAS Plan: Scenario 3 River: intake Reach: 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	2.0	7000 cfs	74.00	5082.00	5085.22		5085.24	0.000050	1.09	67.61	26.98	0.12
1	2.0	10000 cfs	74.00	5082.00	5085.22		5085.24	0.000050	1.09	67.61	26.98	0.12
1	1.5	500 cfs	74.00	5081.95	5085.22		5085.24	0.000039	1.13	65.30	20.00	0.11
1	1.5	950 cfs	74.00	5081.95	5085.22		5085.24	0.000039	1.13	65.30	20.00	0.11
1	1.5	4000 cfs	74.00	5081.95	5085.22		5085.24	0.000039	1.13	65.30	20.00	0.11
1	1.5	7000 cfs	74.00	5081.95	5085.22		5085.24	0.000039	1.13	65.30	20.00	0.11
1	1.5	10000 cfs	74.00	5081.95	5085.22		5085.24	0.000039	1.13	65.30	20.00	0.11
1	1.0	500 cfs	74.00	5084.00	5084.75	5084.75	5085.13	0.003974	4.92	15.04	20.00	1.00
1	1.0	950 cfs	74.00	5084.00	5084.75	5084.75	5085.13	0.003974	4.92	15.04	20.00	1.00
1	1.0	4000 cfs	74.00	5084.00	5084.75	5084.75	5085.13	0.003974	4.92	15.04	20.00	1.00
1	1.0	7000 cfs	74.00	5084.00	5084.75	5084.75	5085.13	0.003974	4.92	15.04	20.00	1.00
1	1.0	10000 cfs	74.00	5084.00	5084.75	5084.75	5085.13	0.003974	4.92	15.04	20.00	1.00

HEC-RAS Plan: Scenario 4 River: intake Reach: 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	8	500 cfs	83.00	5084.50	5087.60		5087.61	0.000017	0.79	105.40	34.00	0.08
1	8	950 cfs	83.00	5084.50	5087.90		5087.91	0.000013	0.72	115.60	34.00	0.07
1	8	4000 cfs	83.00	5084.50	5090.00		5090.00	0.000003	0.44	187.00	34.00	0.03
1	8	7000 cfs	83.00	5084.50	5092.10		5092.10	0.000001	0.32	258.40	34.00	0.02
1	8	10000 cfs	83.00	5084.50	5094.20		5094.20	0.000001	0.25	329.81	34.00	0.01
	6											
1	6.0	500 cfs	83.00	5083.50	5085.32		5085.42	0.000362	2.49	33.33	18.30	0.33
1	6.0	950 cfs	83.00	5083.50	5085.32		5085.42	0.000362	2.49	33.33	18.30	0.33
1	6.0	4000 cfs	83.00	5083.50	5085.32		5085.42	0.000362	2.49	33.33	18.30	0.33
1	6.0	7000 cfs	83.00	5083.50	5085.32		5085.42	0.000362	2.49	33.33	18.30	0.33
1	6.0	10000 cfs	83.00	5083.50	5085.32		5085.42	0.000362	2.49	33.33	18.30	0.33
1	5.0	500 cfs	83.00	5082.90	5085.33		5085.38	0.000149	1.87	44.47	18.30	0.21
1	5.0	950 cfs	83.00	5082.90	5085.33		5085.38	0.000149	1.87	44.47	18.30	0.21
1	5.0	4000 cfs	83.00	5082.90	5085.33		5085.38	0.000149	1.87	44.47	18.30	0.21
1	5.0	7000 cfs	83.00	5082.90	5085.33		5085.38	0.000149	1.87	44.47	18.30	0.21
1	5.0	10000 cfs	83.00	5082.90	5085.33		5085.38	0.000149	1.87	44.47	18.30	0.21
1	4.0	500 cfs	83.00	5082.70	5085.33		5085.38	0.000117	1.72	48.15	18.30	0.19
1	4.0	950 cfs	83.00	5082.70	5085.33		5085.38	0.000117	1.72	48.15	18.30	0.19
1	4.0	4000 cfs	83.00	5082.70	5085.33		5085.38	0.000117	1.72	48.15	18.30	0.19
1	4.0	7000 cfs	83.00	5082.70	5085.33		5085.38	0.000117	1.72	48.15	18.30	0.19
1	4.0	10000 cfs	83.00	5082.70	5085.33		5085.38	0.000117	1.72	48.15	18.30	0.19
1	3.5	500 cfs	83.00	5082.50	5085.34		5085.36	0.000054	1.27	65.51	26.15	0.14
1	3.5	950 cfs	83.00	5082.50	5085.34		5085.36	0.000054	1.27	65.51	26.15	0.14
1	3.5	4000 cfs	83.00	5082.50	5085.34		5085.36	0.000054	1.27	65.51	26.15	0.14
1	3.5	7000 cfs	83.00	5082.50	5085.34		5085.36	0.000054	1.27	65.51	26.15	0.14
1	3.5	10000 cfs	83.00	5082.50	5085.34		5085.36	0.000054	1.27	65.51	26.15	0.14
1	3.0	500 cfs	83.00	5082.50	5085.33		5085.36	0.000105	1.45	57.25	26.13	0.17
1	3.0	950 cfs	83.00	5082.50	5085.33		5085.36	0.000105	1.45	57.25	26.13	0.17
1	3.0	4000 cfs	83.00	5082.50	5085.33		5085.36	0.000105	1.45	57.25	26.13	0.17
1	3.0	7000 cfs	83.00	5082.50	5085.33		5085.36	0.000105	1.45	57.25	26.13	0.17
1	3.0	10000 cfs	83.00	5082.50	5085.33		5085.36	0.000105	1.45	57.25	26.13	0.17
1	2.0	500 cfs	83.00	5082.00	5085.31		5085.34	0.000056	1.18	70.20	27.18	0.13
1	2.0	950 cfs	83.00	5082.00	5085.31		5085.34	0.000056	1.18	70.20	27.18	0.13
1	2.0	4000 cfs	83.00	5082.00	5085.31		5085.34	0.000056	1.18	70.20	27.18	0.13

HEC-RAS Plan: Scenario 4 River: intake Reach: 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	2.0	7000 cfs	83.00	5082.00	5085.31		5085.34	0.000056	1.18	70.20	27.18	0.13
1	2.0	10000 cfs	83.00	5082.00	5085.31		5085.34	0.000056	1.18	70.20	27.18	0.13
1	1.5	500 cfs	83.00	5081.95	5085.31		5085.33	0.000045	1.24	67.20	20.00	0.12
1	1.5	950 cfs	83.00	5081.95	5085.31		5085.33	0.000045	1.24	67.20	20.00	0.12
1	1.5	4000 cfs	83.00	5081.95	5085.31		5085.33	0.000045	1.24	67.20	20.00	0.12
1	1.5	7000 cfs	83.00	5081.95	5085.31		5085.33	0.000045	1.24	67.20	20.00	0.12
1	1.5	10000 cfs	83.00	5081.95	5085.31		5085.33	0.000045	1.24	67.20	20.00	0.12
1	1.0	500 cfs	83.00	5084.00	5084.81	5084.81	5085.22	0.003960	5.14	16.16	20.00	1.01
1	1.0	950 cfs	83.00	5084.00	5084.81	5084.81	5085.22	0.003960	5.14	16.16	20.00	1.01
1	1.0	4000 cfs	83.00	5084.00	5084.81	5084.81	5085.22	0.003960	5.14	16.16	20.00	1.01
1	1.0	7000 cfs	83.00	5084.00	5084.81	5084.81	5085.22	0.003960	5.14	16.16	20.00	1.01
1	1.0	10000 cfs	83.00	5084.00	5084.81	5084.81	5085.22	0.003960	5.14	16.16	20.00	1.01

HEC-RAS Plan: Scenario 5 River: intake Reach: 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	8	500 cfs	97.00	5084.50	5087.60		5087.61	0.000024	0.92	105.40	34.00	0.09
1	8	950 cfs	97.00	5084.50	5087.90		5087.91	0.000018	0.84	115.60	34.00	0.08
1	8	4000 cfs	97.00	5084.50	5090.00		5090.00	0.000004	0.52	187.00	34.00	0.04
1	8	7000 cfs	97.00	5084.50	5092.10		5092.10	0.000002	0.38	258.40	34.00	0.02
1	8	10000 cfs	97.00	5084.50	5094.20		5094.20	0.000001	0.29	329.81	34.00	0.02
1	6.0	500 cfs	97.00	5083.50	5085.46		5085.57	0.000393	2.70	35.89	18.30	0.34
1	6.0	950 cfs	97.00	5083.50	5085.46		5085.57	0.000393	2.70	35.89	18.30	0.34
1	6.0	4000 cfs	97.00	5083.50	5085.46		5085.57	0.000393	2.70	35.89	18.30	0.34
1	6.0	7000 cfs	97.00	5083.50	5085.46		5085.57	0.000393	2.70	35.89	18.30	0.34
1	6.0	10000 cfs	97.00	5083.50	5085.46		5085.57	0.000393	2.70	35.89	18.30	0.34
1	5.0	500 cfs	97.00	5082.90	5085.47		5085.54	0.000171	2.06	47.05	18.30	0.23
1	5.0	950 cfs	97.00	5082.90	5085.47		5085.54	0.000171	2.06	47.05	18.30	0.23
1	5.0	4000 cfs	97.00	5082.90	5085.47		5085.54	0.000171	2.06	47.05	18.30	0.23
1	5.0	7000 cfs	97.00	5082.90	5085.47		5085.54	0.000171	2.06	47.05	18.30	0.23
1	5.0	10000 cfs	97.00	5082.90	5085.47		5085.54	0.000171	2.06	47.05	18.30	0.23
1	4.0	500 cfs	97.00	5082.70	5085.47		5085.53	0.000136	1.91	50.74	18.30	0.20
1	4.0	950 cfs	97.00	5082.70	5085.47		5085.53	0.000136	1.91	50.74	18.30	0.20
1	4.0	4000 cfs	97.00	5082.70	5085.47		5085.53	0.000136	1.91	50.74	18.30	0.20
1	4.0	7000 cfs	97.00	5082.70	5085.47		5085.53	0.000136	1.91	50.74	18.30	0.20
1	4.0	10000 cfs	97.00	5082.70	5085.47		5085.53	0.000136	1.91	50.74	18.30	0.20
1	3.5	500 cfs	97.00	5082.50	5085.48		5085.51	0.000062	1.40	69.30	26.46	0.15
1	3.5	950 cfs	97.00	5082.50	5085.48		5085.51	0.000062	1.40	69.30	26.46	0.15
1	3.5	4000 cfs	97.00	5082.50	5085.48		5085.51	0.000062	1.40	69.30	26.46	0.15
1	3.5	7000 cfs	97.00	5082.50	5085.48		5085.51	0.000062	1.40	69.30	26.46	0.15
1	3.5	10000 cfs	97.00	5082.50	5085.48		5085.51	0.000062	1.40	69.30	26.46	0.15
1	3.0	500 cfs	97.00	5082.50	5085.47		5085.51	0.000118	1.59	60.99	26.44	0.18
1	3.0	950 cfs	97.00	5082.50	5085.47		5085.51	0.000118	1.59	60.99	26.44	0.18
1	3.0	4000 cfs	97.00	5082.50	5085.47		5085.51	0.000118	1.59	60.99	26.44	0.18
1	3.0	7000 cfs	97.00	5082.50	5085.47		5085.51	0.000118	1.59	60.99	26.44	0.18
1	3.0	10000 cfs	97.00	5082.50	5085.47		5085.51	0.000118	1.59	60.99	26.44	0.18
1	2.0	500 cfs	97.00	5082.00	5085.46		5085.48	0.000065	1.31	74.03	27.49	0.14
1	2.0	950 cfs	97.00	5082.00	5085.46		5085.48	0.000065	1.31	74.03	27.49	0.14
1	2.0	4000 cfs	97.00	5082.00	5085.46		5085.48	0.000065	1.31	74.03	27.49	0.14

HEC-RAS Plan: Scenario 5 River: intake Reach: 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	2.0	7000 cfs	97.00	5082.00	5085.46		5085.48	0.000065	1.31	74.03	27.49	0.14
1	2.0	10000 cfs	97.00	5082.00	5085.46		5085.48	0.000065	1.31	74.03	27.49	0.14
1	1.5	500 cfs	97.00	5081.95	5085.45		5085.48	0.000055	1.39	69.95	20.00	0.13
1	1.5	950 cfs	97.00	5081.95	5085.45		5085.48	0.000055	1.39	69.95	20.00	0.13
1	1.5	4000 cfs	97.00	5081.95	5085.45		5085.48	0.000055	1.39	69.95	20.00	0.13
1	1.5	7000 cfs	97.00	5081.95	5085.45		5085.48	0.000055	1.39	69.95	20.00	0.13
1	1.5	10000 cfs	97.00	5081.95	5085.45		5085.48	0.000055	1.39	69.95	20.00	0.13
1	1.0	500 cfs	97.00	5084.00	5084.90	5084.90	5085.35	0.003808	5.38	18.02	20.00	1.00
1	1.0	950 cfs	97.00	5084.00	5084.90	5084.90	5085.35	0.003808	5.38	18.02	20.00	1.00
1	1.0	4000 cfs	97.00	5084.00	5084.90	5084.90	5085.35	0.003808	5.38	18.02	20.00	1.00
1	1.0	7000 cfs	97.00	5084.00	5084.90	5084.90	5085.35	0.003808	5.38	18.02	20.00	1.00
1	1.0	10000 cfs	97.00	5084.00	5084.90	5084.90	5085.35	0.003808	5.38	18.02	20.00	1.00

HEC-RAS Plan: Scenario 6 River: intake Reach: 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	8	500 cfs	106.00	5084.50	5087.50		5087.52	0.000032	1.04	102.00	34.00	0.11
1	8	950 cfs	106.00	5084.50	5087.90		5087.91	0.000021	0.92	115.60	34.00	0.09
1	8	4000 cfs	106.00	5084.50	5090.00		5090.00	0.000005	0.57	187.00	34.00	0.04
1	8	7000 cfs	106.00	5084.50	5092.10		5092.10	0.000002	0.41	258.40	34.00	0.03
1	8	10000 cfs	106.00	5084.50	5094.20		5094.20	0.000001	0.32	329.81	34.00	0.02
1	6.0	500 cfs	106.00	5083.50	5085.55		5085.67	0.000410	2.83	37.48	18.30	0.35
1	6.0	950 cfs	106.00	5083.50	5085.55		5085.67	0.000410	2.83	37.48	18.30	0.35
1	6.0	4000 cfs	106.00	5083.50	5085.55		5085.67	0.000410	2.83	37.48	18.30	0.35
1	6.0	7000 cfs	106.00	5083.50	5085.55		5085.67	0.000410	2.83	37.48	18.30	0.35
1	6.0	10000 cfs	106.00	5083.50	5085.55		5085.67	0.000410	2.83	37.48	18.30	0.35
1	5.0	500 cfs	106.00	5082.90	5085.56		5085.63	0.000184	2.18	48.66	18.30	0.24
1	5.0	950 cfs	106.00	5082.90	5085.56		5085.63	0.000184	2.18	48.66	18.30	0.24
1	5.0	4000 cfs	106.00	5082.90	5085.56		5085.63	0.000184	2.18	48.66	18.30	0.24
1	5.0	7000 cfs	106.00	5082.90	5085.56		5085.63	0.000184	2.18	48.66	18.30	0.24
1	5.0	10000 cfs	106.00	5082.90	5085.56		5085.63	0.000184	2.18	48.66	18.30	0.24
1	4.0	500 cfs	106.00	5082.70	5085.56		5085.62	0.000148	2.02	52.35	18.30	0.21
1	4.0	950 cfs	106.00	5082.70	5085.56		5085.62	0.000148	2.02	52.35	18.30	0.21
1	4.0	4000 cfs	106.00	5082.70	5085.56		5085.62	0.000148	2.02	52.35	18.30	0.21
1	4.0	7000 cfs	106.00	5082.70	5085.56		5085.62	0.000148	2.02	52.35	18.30	0.21
1	4.0	10000 cfs	106.00	5082.70	5085.56		5085.62	0.000148	2.02	52.35	18.30	0.21
1	3.5	500 cfs	106.00	5082.50	5085.57		5085.61	0.000067	1.48	71.67	26.66	0.16
1	3.5	950 cfs	106.00	5082.50	5085.57		5085.61	0.000067	1.48	71.67	26.66	0.16
1	3.5	4000 cfs	106.00	5082.50	5085.57		5085.61	0.000067	1.48	71.67	26.66	0.16
1	3.5	7000 cfs	106.00	5082.50	5085.57		5085.61	0.000067	1.48	71.67	26.66	0.16
1	3.5	10000 cfs	106.00	5082.50	5085.57		5085.61	0.000067	1.48	71.67	26.66	0.16
1	3.0	500 cfs	106.00	5082.50	5085.56		5085.60	0.000125	1.67	63.35	26.63	0.19
1	3.0	950 cfs	106.00	5082.50	5085.56		5085.60	0.000125	1.67	63.35	26.63	0.19
1	3.0	4000 cfs	106.00	5082.50	5085.56		5085.60	0.000125	1.67	63.35	26.63	0.19
1	3.0	7000 cfs	106.00	5082.50	5085.56		5085.60	0.000125	1.67	63.35	26.63	0.19
1	3.0	10000 cfs	106.00	5082.50	5085.56		5085.60	0.000125	1.67	63.35	26.63	0.19
1	2.0	500 cfs	106.00	5082.00	5085.54		5085.57	0.000071	1.39	76.46	27.68	0.15
1	2.0	950 cfs	106.00	5082.00	5085.54		5085.57	0.000071	1.39	76.46	27.68	0.15
1	2.0	4000 cfs	106.00	5082.00	5085.54		5085.57	0.000071	1.39	76.46	27.68	0.15

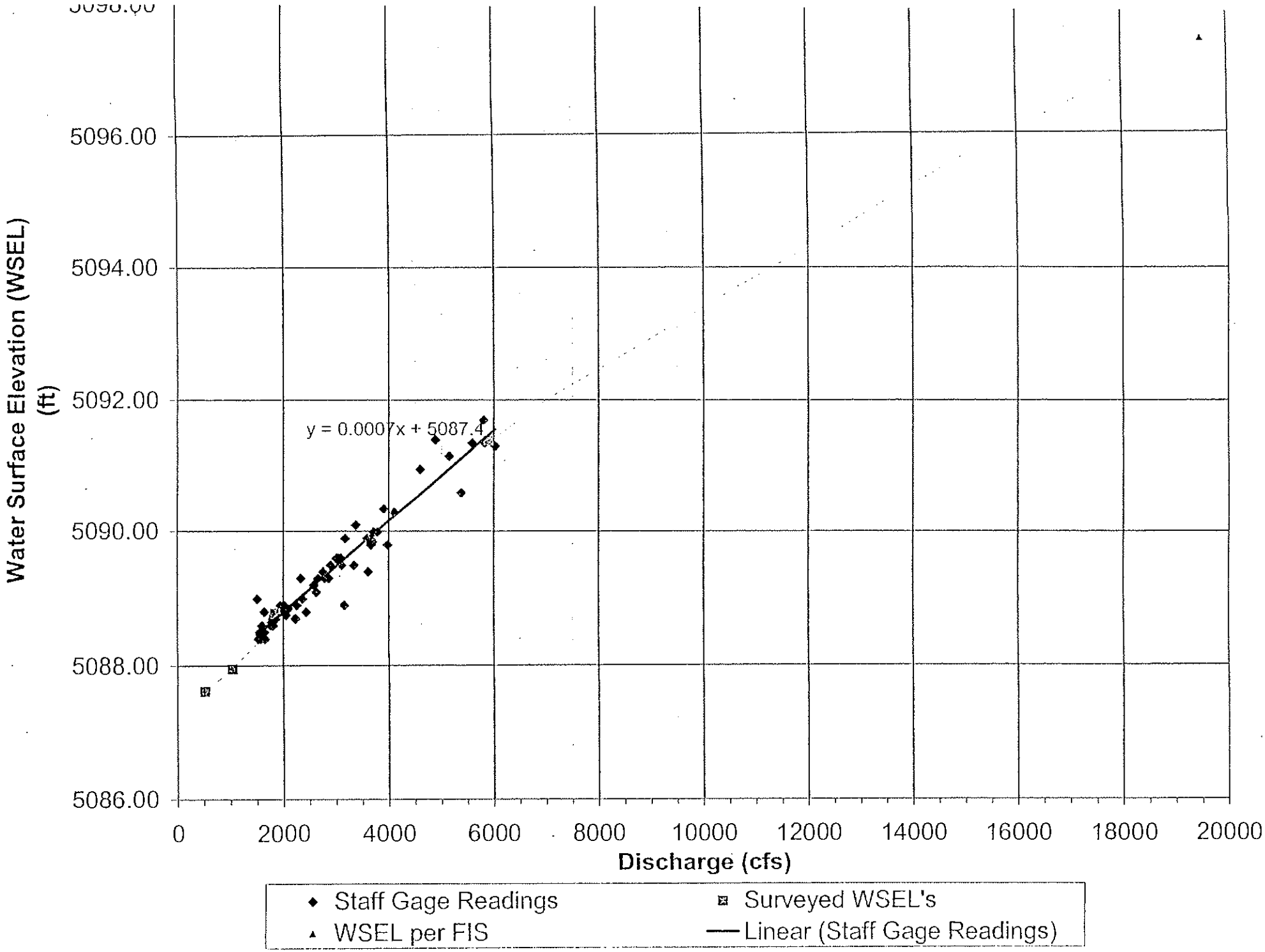
HEC-RAS Plan: Scenario 6 River: intake Reach: 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	2.0	7000 cfs	106.00	5082.00	5085.54		5085.57	0.000071	1.39	76.46	27.68	0.15
1	2.0	10000 cfs	106.00	5082.00	5085.54		5085.57	0.000071	1.39	76.46	27.68	0.15
1	1.5	500 cfs	106.00	5081.95	5085.53		5085.57	0.000061	1.48	71.68	20.00	0.14
1	1.5	950 cfs	106.00	5081.95	5085.53		5085.57	0.000061	1.48	71.68	20.00	0.14
1	1.5	4000 cfs	106.00	5081.95	5085.53		5085.57	0.000061	1.48	71.68	20.00	0.14
1	1.5	7000 cfs	106.00	5081.95	5085.53		5085.57	0.000061	1.48	71.68	20.00	0.14
1	1.5	10000 cfs	106.00	5081.95	5085.53		5085.57	0.000061	1.48	71.68	20.00	0.14
1	1.0	500 cfs	106.00	5084.00	5084.95	5084.95	5085.43	0.003812	5.57	19.03	20.00	1.01
1	1.0	950 cfs	106.00	5084.00	5084.95	5084.95	5085.43	0.003812	5.57	19.03	20.00	1.01
1	1.0	4000 cfs	106.00	5084.00	5084.95	5084.95	5085.43	0.003812	5.57	19.03	20.00	1.01
1	1.0	7000 cfs	106.00	5084.00	5084.95	5084.95	5085.43	0.003812	5.57	19.03	20.00	1.01
1	1.0	10000 cfs	106.00	5084.00	5084.95	5084.95	5085.43	0.003812	5.57	19.03	20.00	1.01

APPENDIX B

CALCULATIONS

River flow cfs	Ladder flow cfs	Sluiceway thru dam cfs	PNM diversion cfs	NGWSP cfs	Sum cfs	Q xs 1400 cfs	Q xs 1300 cfs	Q xs 1000 cfs	Q xs 900 cfs	WSEL xs 1300	Log screen				Trash Rack				WSEL inlet
											depth ft	area sq ft	velocity fps	headloss ft	depth ft	area sq ft	velocity fps	headloss ft	
500	0	23	37		60	500	440	440	463	5087.71	7.71	141.8	0.26	0.001	3.21	90.7	0.41	0.007	5087.70
	0	23	46		69	500	431	431	454	5087.70	7.70	141.7	0.32	0.002	3.20	90.5	0.51	0.012	5087.69
	72	23	37		132	500	368	368	463	5087.66	7.66	140.9	0.26	0.001	3.16	89.3	0.41	0.008	5087.65
	72	23	46		141	500	359	359	454	5087.65	7.65	140.8	0.33	0.002	3.15	89.1	0.52	0.012	5087.64
	72	23	37	37	169	500	331	331	426	5087.63	7.63	140.4	0.53	0.005	3.13	88.5	0.84	0.031	5087.59
	72	23	46	37	178	500	322	322	417	5087.63	7.63	140.3	0.59	0.007	3.12	88.3	0.94	0.040	5087.58
	72	23	37	60	192	500	308	308	403	5087.62	7.62	140.1	0.69	0.009	3.11	87.9	1.10	0.055	5087.55
	72	23	46	60	201	500	299	299	394	5087.61	7.61	140.0	0.76	0.011	3.10	87.7	1.21	0.066	5087.53
950	0	24	37		61	950	889	889	913	5088.02	8.02	147.6	0.25	0.001	3.52	99.6	0.37	0.006	5088.01
	0	24	46		70	950	880	880	904	5088.02	8.02	147.5	0.31	0.002	3.51	99.4	0.46	0.010	5088.00
	84	24	37		145	950	805	805	913	5087.96	7.96	146.5	0.25	0.001	3.46	98.0	0.38	0.006	5087.96
	84	24	46		154	950	796	796	904	5087.96	7.96	146.4	0.31	0.002	3.46	97.8	0.47	0.010	5087.95
	84	24	37	37	182	950	768	768	876	5087.94	7.94	146.0	0.51	0.005	3.43	97.1	0.76	0.026	5087.91
	84	24	46	37	191	950	759	759	867	5087.93	7.93	145.9	0.57	0.006	3.43	96.9	0.86	0.033	5087.89
	84	24	37	60	205	950	745	745	853	5087.92	7.92	145.8	0.67	0.008	3.41	96.6	1.00	0.045	5087.87
	84	24	46	60	214	950	736	736	844	5087.92	7.92	145.6	0.73	0.010	3.40	96.4	1.10	0.054	5087.85
4000	0	27	37		64	4000	3936	3936	3963	5090.15	10.15	186.9	0.20	0.001	5.65	160.0	0.23	0.002	5090.15
	0	27	46		73	4000	3927	3927	3954	5090.15	10.15	186.7	0.25	0.001	5.65	159.8	0.29	0.004	5090.14
	132	27	37		196	4000	3804	3804	3963	5090.06	10.06	185.2	0.20	0.001	5.56	157.4	0.24	0.002	5090.06
	132	27	46		205	4000	3795	3795	3954	5090.06	10.06	185.0	0.25	0.001	5.56	157.2	0.29	0.004	5090.05
	132	27	37	37	233	4000	3767	3767	3926	5090.04	10.04	184.7	0.40	0.003	5.53	156.6	0.47	0.010	5090.02
	132	27	46	37	242	4000	3758	3758	3917	5090.03	10.03	184.6	0.45	0.004	5.53	156.4	0.53	0.013	5090.01
	132	27	37	60	256	4000	3744	3744	3903	5090.02	10.02	184.4	0.53	0.005	5.52	156.1	0.62	0.017	5090.00
	132	27	46	60	265	4000	3735	3735	3894	5090.01	10.01	184.3	0.58	0.006	5.51	155.9	0.68	0.021	5089.99
7000	0	28	37		65	7000	6935	6935	6963	5092.25	12.25	225.5	0.16	0.001	7.75	219.4	0.17	0.001	5092.25
	0	28	46		74	7000	6926	6926	6954	5092.25	12.25	225.4	0.20	0.001	7.75	219.2	0.21	0.002	5092.25
	136	28	37		201	7000	6799	6799	6963	5092.16	12.16	223.7	0.17	0.001	7.66	216.7	0.17	0.001	5092.16
	136	28	46		210	7000	6790	6790	6954	5092.15	12.15	223.6	0.21	0.001	7.65	216.6	0.21	0.002	5092.15
	136	28	37	37	238	7000	6762	6762	6926	5092.13	12.13	223.3	0.33	0.002	7.63	216.0	0.34	0.005	5092.13
	136	28	46	37	247	7000	6753	6753	6917	5092.13	12.13	223.1	0.37	0.003	7.62	215.8	0.38	0.007	5092.12
	136	28	37	60	261	7000	6739	6739	6903	5092.12	12.12	223.0	0.44	0.004	7.61	215.5	0.45	0.009	5092.10
	136	28	46	60	270	7000	6730	6730	6894	5092.11	12.11	222.8	0.48	0.004	7.61	215.3	0.49	0.011	5092.10
10000	0	29	37		66	10000	9935	9935	9963	5094.35	14.35	264.1	0.14	0.000	9.85	278.9	0.13	0.001	5094.35
	0	29	46		75	10000	9926	9926	9954	5094.35	14.35	264.0	0.17	0.001	9.85	278.7	0.17	0.001	5094.35
	138	29	37		204	10000	9797	9797	9963	5094.26	14.26	262.3	0.14	0.000	9.76	276.1	0.13	0.001	5094.26
	138	29	46		213	10000	9788	9788	9954	5094.25	14.25	262.2	0.18	0.001	9.75	275.9	0.17	0.001	5094.25
	138	29	37	37	241	10000	9760	9760	9926	5094.23	14.23	261.9	0.28	0.002	9.73	275.4	0.27	0.003	5094.23
	138	29	46	37	250	10000	9751	9751	9917	5094.23	14.23	261.7	0.32	0.002	9.72	275.2	0.30	0.004	5094.22
	138	29	37	60	264	10000	9737	9737	9903	5094.22	14.22	261.6	0.37	0.003	9.71	274.9	0.35	0.006	5094.21
	138	29	46	60	273	10000	9728	9728	9894	5094.21	14.21	261.5	0.41	0.003	9.71	274.7	0.39	0.007	5094.20


5098.00
5096.00
5094.00
5092.00
5090.00
5088.00
5086.00
Water Surface Elevation (WSEL) (ft)
y = 0.0007x + 5087.4
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
Discharge (cfs)
Staff Gage Readings
Surveyed WSEL's
WSEL per FIS
Linear (Staff Gage Readings)

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PROJECT NO. 600.26 SHEET 1 OF 1

PROJECT PNM

CALC. PMB DATE 3/19/01

SUBJECT NGWSP

CHKD. DATE

The purpose of this analysis is to estimate velocities & sedimentation capabilities at the PNM diversion on the San Juan River. This analysis considers existing conditions compared to several different future conditions scenarios:

Scenario	PNM diversion	Fish Passage	NGWSP
1	37 cfs	yes, varies w/ river flow	no
2	46 cfs		no
3	37 cfs + 9 cfs	yes, varies w/ river flow	37 cfs
4	46 cfs		37 cfs
5	37 cfs	"	60 cfs
6	46 cfs	"	60 cfs

Velocities will be estimated at the river intake log screen, the river intake trash rack, and traveling screens at PNM's pump intake.

These velocities will be estimated for river flows between 500 cfs and 10,000 cfs.

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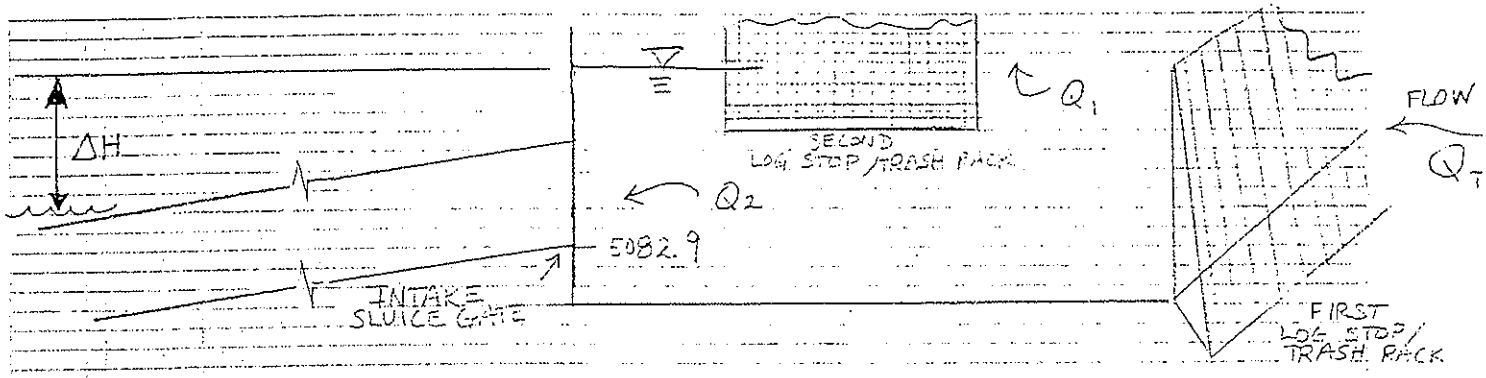
PROJECT NO. 10600.26 SHEET 1 OF 1

PROJECT PNM SAN JUAN DIVERSION CALC. ALS DATE 3/22/01

SUBJECT ADDITIONAL DISCHARGE DETERMINATION CHKD. _____ DATE _____



IN ORDER TO EVALUATE THE VELOCITIES IN THE AREA OF THE FIRST LOG STOP/TRASH RACK, THE ENTIRE DISCHARGE FLOWING THROUGH THE AREA BETWEEN THE FIRST AND SECOND TRASH RACKS MUST BE DETERMINED.

$Q_T = Q_1 + Q_2$ where Q_T = TOTAL DISCHARGE

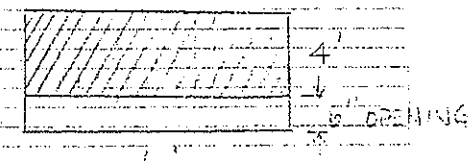
Q_1 = DISCHARGE FLOWING INTO THE SETTLING BASIN

Q_2 = DISCHARGE FLOWING THROUGH THE INTAKE SLUICE GATE

Q_1 IS DETERMINED BY THE PNM PUMPING RATE. CURRENTLY Q_1 = 37 CFS

Q_2 IS CONTROLLED BY THE HYDRAULIC HEAD FORCING WATER THROUGH THE INTAKE SLUICE GATE WHICH ACTS AS A SUBMERGED ORIFICE. THE ORIFICE EQUATION IS:

$$Q_2 = CA\sqrt{2g\,\Delta h}$$



$C = 0.6$

$A = 4' \times 6' = 24\ ft^2$

$g = 32.2\ \frac{ft}{s^2}$

Δh = varies depending upon the flow level in the river

$Q_2 = 144\sqrt{\Delta h}$

River flow (cfs)	Δh (ft)	Q_2 (cfs)
500	2.6	23.3
950	2.8	24.2
4000	3.6	27.4
7000	3.6	28.2
10,000	3.9	28.5

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PROJECT NO. 1060026 SHEET 1 OF 3

PROJECT PNM CALC. PMR DATE 7/15/00

SUBJECT Screen Analysis (NGUSP) CHKD. DATE Rev 3/19/01

PNM has 3 sets of screens

1 @ river intake 36" x 8" vertical bars (log screen 1-)

1 @ channel 6" x 3" vertical bars (trash rack)

1 @ pump intake 1/4" x 1/4" traveling screens

Typical head loss calculations are based on Reclamation Design Standard No. 2, Canals and Related Structures.

$$H = 1.32 \left(\frac{TV}{D}\right)^2 \sin A$$

H = head loss through trash rack

T = bar thickness

V = Water velocity

D = spacing

A = angle of inclination

Screen loss can be estimated by

$$H = K \frac{V^2}{2g}$$

V = approach velocity

K ∝ f(angle to flow)

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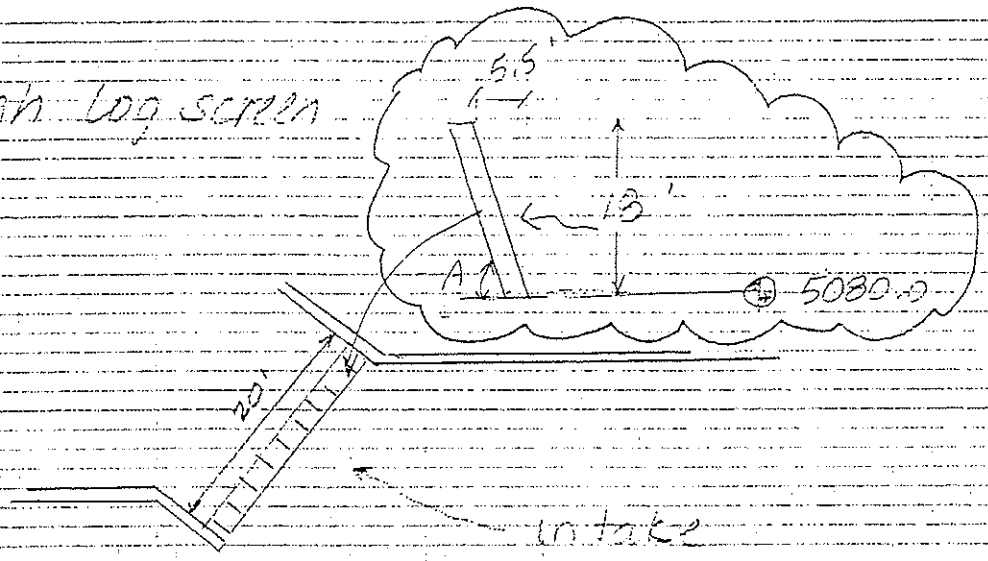
PROJECT NO. 10600.26 SHEET 2 OF 3

PROJECT PNM CALC. PMB DATE 7/15/00

SUBJECT Screen Analysis CHKD. DATE REV 3/19/01

• Through log screen



intake

8" spacing

27 slots

San Juan

$$H = 1.32\left(\frac{TV}{D}\right)^2 \sin A$$

$A \cong 73°$ (scaled from plans)

$D = 8\frac{1}{4}''/12 = 0.69$ ft

$V = Q/A_o$ A_o = open area

$A_o = 27 \times (.68 d_1) = 18.56 d_1$

d_1 = depth of water in slots = (WSEL − 5080)

$T = 1'' = .083$ ft

$V = Q/18.56 d_1$

$H = 1.32\left(\frac{.083}{.68}\right)^2 V^2 \sin 73°$

$H = .019 V^2$

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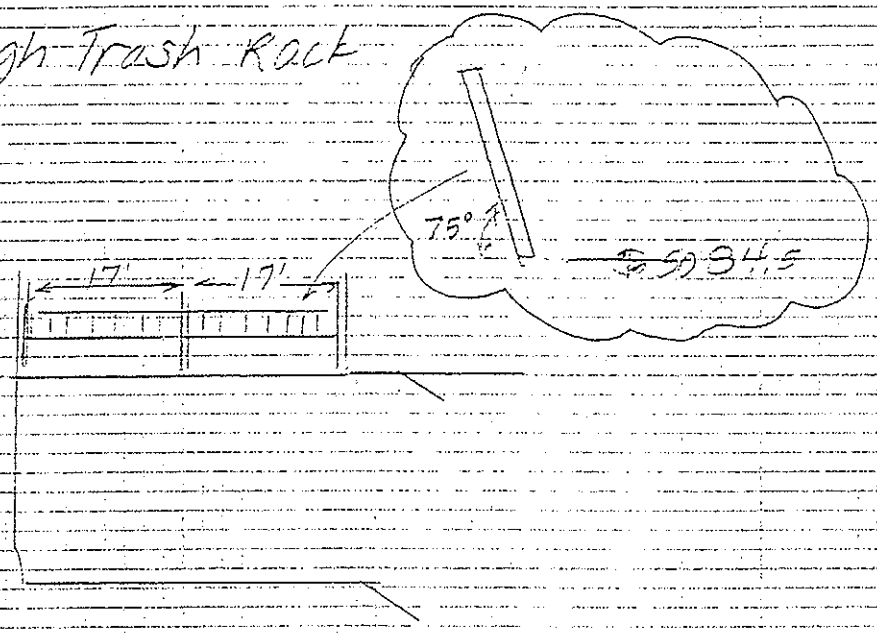
PROJECT NO 10100.26 SHEET 3 OF 3

PROJECT PMM CALC. AMB DATE July 19, 2000

SUBJECT Trash Analysis CHKD. _____ DATE _____

- Through Trash Rack



$H = 1.32 \left(\frac{TV}{D}\right)^2 \sin A$

A = 75° (from plans by Sterns-Roser)

D = 2" spacing (approximate)

T = 3/8" (approximated in ft) = .375

Number of slots per side: $(17(12) - .375") / 2.375 = 85$

Area = $2/12 \times (85 \times 2) d = 28.3 d_2$ $d_2 = WSEL - 5034.5$

$V = Q / 28.3 d_2$

$H = 1.32 \left(\frac{.375}{2}\right)^2 V^2 \sin 75° = .045 V^2$

TETRA TECH, INC.

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PROJECT NO. 10400.26 SHEET 1 OF 1

PROJECT PNM CALC. PMB DATE 3/19/01

SUBJECT TRAP EFFICIENCY CALCS CHKD. DATE

Summary for 37 cfs between 2 & 3

$V_{ave} = (.66 + .85)/2 = .76$ fps $Q_A = 37$ cfs

$A_{S_{ave}} = 260 \times (26.05 + 24.93)/2 = 6634$ ft² (surface area)

$V_T = Q_A / A_{S_{ave}} = 37/6634 = .005$ fps

W = fall velocity $= \frac{g d^2}{18 \nu} \left(\frac{\gamma_s - \gamma_w}{\gamma_w} \right)$

d = diameter of particle in feet

ν = kinematic viscosity $= 1.7 \times 10^{-5}$ ft²/s

$\gamma_s = 165.4$ lb/ft³ $\gamma_w = 62.4$ lb/ft³

$W = \frac{g (d^2)}{18 (1.7 \times 10^{-5})} \left(\frac{165.4 - 62.4}{62.4} \right) = 173{,}695\ d^2$

$TE = W / \underbrace{(Q_A / A_{S_{ave}})}_{V_T} = \frac{173{,}695\ d^2}{.005} = 34{,}739{,}000\ d^2$

sediment sizes

for 100% TE particle size = .052 mm = 0.000171 ft

$V_T = .005$ ft/sec

travel time 260 ft/.76 = 342 sec.

to drop at least .62 ft (5084.62 − 5084.00 = .62')

need a minimum of .62'/.005 ft/sec = 124 sec. ok

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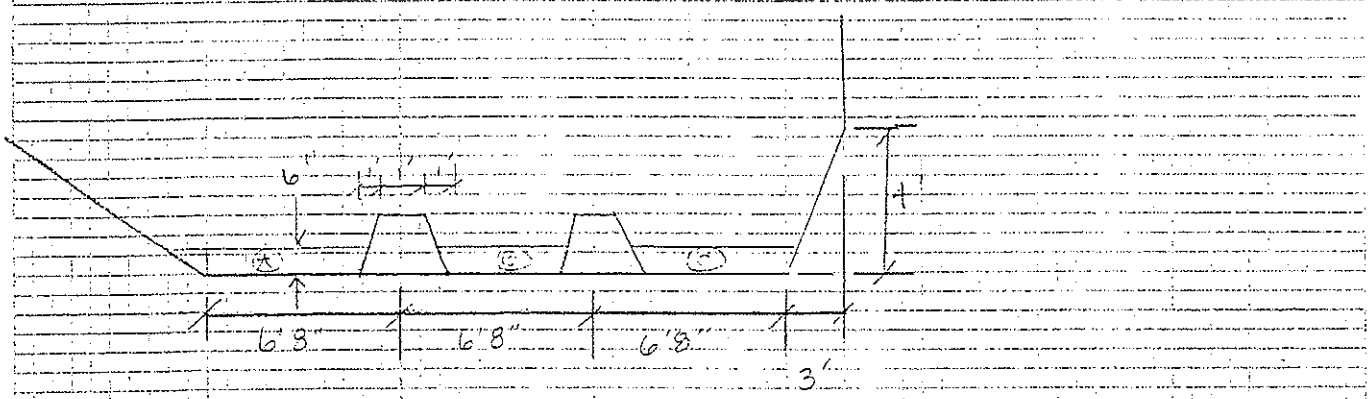
PROJECT NO. 10600.26 SHEET 1 OF 2

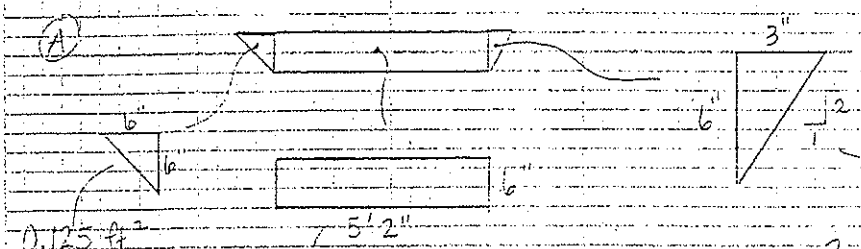
PROJECT PNM SAN JUAN DIVERSION CALC. ALS DATE 3/22/01

SUBJECT VOLUME OF SEDIMENT (TYPICAL) CHKD. _____ DATE _____

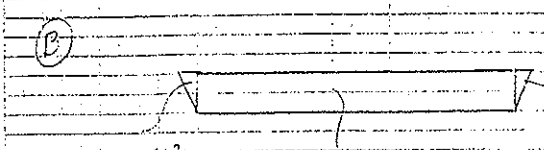
IN ORDER TO EVELUATE CHANGES TO THE SETTLING BASIN, THE VOLUME OF SEDIMENT THAT SETTLES UNDER CURRENT CONDITIONS NEEDS TO BE EVALUATED.

IF A 6" DEPTH DEPOSITS OVER ONE WEEKS TIME, THIS RESULTS IN A TOTAL VOLUME OF:

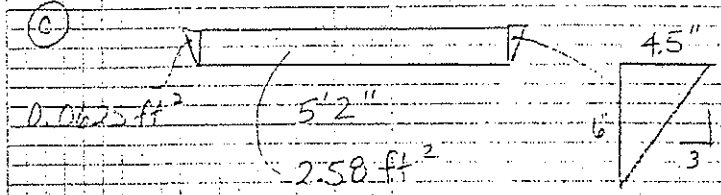




2.77 ft²



1.96 ft²



2.74 ft²

TOTAL X-SEC AREA = 7.47 ft²

LENGTH OF STILLING BASIN = 260'

VOLUME = 1942 ft³ ≈ 72 yd³ at 6" depth

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PROJECT NO. 1060.26 SHEET 2 OF 2

PROJECT PNM SAN JUAN DIVERSION CALC. ALS DATE 3/22/01

SUBJECT SEDIMENT ANALYSIS: VOLUME CHKD. _____ DATE _____

IF THE DISCHARGE THROUGH THE DIVERSION WERE TO INCREASE, THE SURFACE AREA OF THE SETTLING BASIN NEEDS TO BE INCREASED AS WELL IN ORDER TO MAINTAIN THE SAME TRAP EFFICIENCY FOR A PARTICLE DIAMETER SIZE 0.052 mm.

$$T_E = w \Big/ \left(Q_L / A_{SURFACE}\right) = 1$$

WHERE w = fall velocity, is constant for diameter size 0.052 mm

FOR Q = 46 cfs:

$$\frac{w}{\left(37/6634\right)} = 1 = \frac{w}{\left(46/X\right)}$$

$$\frac{37\ ft^3/s}{6634\ ft^2} = \frac{46\ ft^3/s}{X}$$

$X = 8{,}250\ ft^2$ = required area

FOR Q = 74 cfs: $X = 13{,}270\ ft^2$ = required area

FOR Q = 83 cfs: $X = 14{,}890\ ft^2$ = required area

FOR Q = 97 cfs: $X = 17{,}390\ ft^2$ = required area

FOR Q = 106 cfs: $X = 19{,}000\ ft^2$ = required area