Pioneer Water Users Association

Gunn Ditch Improvements Pump Station & Pressure Pipe

- **75% Engineering Report - January 2011**

Prepared for:

Pioneer Water Users Association

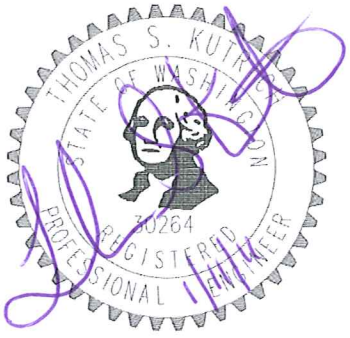

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TABLE OF CONTENTS

1.0 INTRODUCTION 1
2.0 PRESSURIZED PIPELINE WITH COLUMBIA RIVER DIVERSION 2
3.0 PROJECTED POWER REQUIREMENTS 3
4.0 O&M / EQUIPMENT REPLACEMENT COST OPINION 3

TABLES

Table 1 Estimated Flow Requirements
Table 2 Estimated Power Requirements

APPENDICES

Appendix A Calculations
Appendix B Equipment Replacement Cost Opinion

1.0 INTRODUCTION

The Pioneer Water Users Association (PWUA) currently provides irrigation water to 107 users having a total of 527 shares. These users are located on the north and south side of the Wenatchee River. Based on recent survey information, the total estimated acreage served by PWUA north of the Wenatchee River is 385 acres with 81 users. The acreage is defined as the total parcel acreage and is not limited to irrigation acreage. Crop water requirement estimates indicate an average annual flow requirement to serve the northern users of approximately 3.7 cubic feet per second (cfs) or 1,700 gallons per minute (gpm). The peak flow required to serve these users during summer months is estimated at approximately 7.7 cfs or 3,400 gpm. It is estimated that the flow require to serve the southern PWUA users is approximately 2.0 cfs or approximately 900 gpm. Service to the southern users in not addressed in this report.

The existing system primarily consists of the following major elements.

1. Approximately 25,000 feet of unlined open canal
2. Approximately 10,000 feet of piped section
3. Two siphon highway crossings
4. An inverted siphon river crossing
5. A fish screen and diversion structure
6. Flow measurement flume

Historical deliveries have ranged from 11 to 15 cfs. Water is diverted from the Wenatchee River near Highway 2 through a diversion structure and fish screen. The current delivery system suffers from significant conveyance losses through the unlined sections of the canal. Losses are on the order of 40 to 60 percent leaving a flow delivered to the point of use of approximately 4 to 5 cfs.

Trout Unlimited/Washington Water Project in cooperation with Chelan County Natural Resources and PWUA have considered a variety of alternatives for rehabilitation of Gunn Ditch in the past. These alternatives have included various options for conversion of the canal system to pipe, adjustments to the service area, and potential development of a ground water supply source. The primary goals in this effort are to provide PWUA with a long term low cost water supply, reduce delivery losses, and increase in-stream flows in the Wenatchee River.

In July 2010, a 30% plan and engineering report for a pressurized pump and pipeline delivery system replacing the existing canal was prepared by Forsgren Associates. After review of this 30% document, it was determined that two additional alternatives needed to be considered at the 30% level. These options included:

1. Upgrade the existing diversion site to provide adequate fish screening, relocate the diversion point to a stable section of the main river channel, and convert the existing canal to a pipeline maintaining a gravity flow delivery system;
2. Relocate the diversion to just downstream of the Monitor Bridge, provide a pumped diversion with adequate fish screening, and convert the existing canal to a pipeline utilizing partial gravity flow to offset pumping costs.

These two additional alternatives assumed the same flow requirements estimated in the July 2010 30% engineering report. A discussion of these two alternatives was presented in a second report

prepared by Forsgren Associates in December 2010. Following the review of the December 2010 report, the PWUA decided to implement the pressurized pump and pipeline delivery system described in the July 2010 documents.

This third report documents and summarizes efforts on design of the pressurized pump and pipeline delivery system to the 75% level. The 75% level of effort was determined based on available funding. The flow requirements developed in the July 2010 report continued to be the basis for design and are shown in Table 1.

Table 1: Estimated Flow Requirements

	Net Irrigation Requirement (in)	Diversion Flow[1] (gpm)	Diversion Flow (cfs)
Jan	0.00	0	0.00
Feb	0.00	0	0.00
Mar	0.00	0	0.00
Apr	0.24	84	0.19
May	4.14	1,430	3.19
Jun	7.77	2,687	5.99
Jul	10.03	3,469	7.73
Aug	7.14	2,467	5.50
Sep	4.74	1,637	3.65
Oct	0.43	148	0.33
Nov	0.00	0	0.00
Dec	0.00	0	0.00
Totals	34.49		

Notes: [1]Assumes 385 acres with irrigation efficiency of %70.

2.0 PRESSURIZED PIPELINE WITH COLUMBIA RIVER DIVERSION

Under this preferred alternative, the existing gravity diversion dam will be abandoned and the existing canal will be replaced with a pressurized pipeline. A pump station and diversion will be constructed at Confluence State Park along the Columbia River. The major elements of this alternative are summarized below.

1. Abandonment of the existing diversion dam and fish screen at Monitor,
2. Development a new irrigation water source diversion on the Columbia River,
3. Construction of an irrigation pump station and fish screening structure,
4. Conversion of approximately 21,500 linear feet of unlined and open canal to pressurized pipeline
5. Construction of approximately 4,000 linear feet of transmission pipeline,
6. Connection to or modification of existing highway road crossings and siphons,
7. Installation of service connections at existing irrigation delivery points,
8. Installation of required water control and flow measurement devices.

The pump station layout on the Columbia River is provided in the plans. This location may be adjusted following final permitting.

Fish screening will be provided with a self-cleaning cone type fish screen. This type of screen has been accepted by the Washington Department of Fish and Wildlife and will provide a durable low maintenance screening structure meeting NMFS criteria.

The pump station will consist of two vertical turbine pumps configured in parallel. The pump station will include a variable frequency drive control system to ensure optimum energy efficiency. The pumps and controls will be enclosed in a secure concrete masonry building to control noise and provide weather and vandal protection.

A hydraulic model was prepared as part of the 75% design effort. The model was used to simulate irrigation demands along the length of the pipeline in order to optimize the sizing of the pipe.

3.0 PROJECTED POWER REQUIREMENTS

The power requirements assume a residual pressure will be maintained along the irrigation transmission pipeline. The pump station will lift water from the Columbia River into the new pipeline and provide a residual pressure to a minimum of 40 psi.

The pumping conditions previously described will require approximately 225 horse power. The horse power calculations are provided in the Appendices. Table 4 summarizes the projected power requirements and indicates an annual power cost of approximately $20,690.

Table 2: Estimated Power Requirements

	Net Irrigation Requirement (in)	Diversion Flow[1] (gpm)	Diversion Flow (cfs)	Horsepower Requirement[2]	kw-hr[3]	Pumping Cost
Jan	0.00	0	0.00	0	0	$ -
Feb	0.00	0	0.00	0	0	$ -
Mar	0.00	0	0.00	0	0	$ -
Apr	0.24	84	0.19	7	3,659	$ 146
May	4.14	1,430	3.19	116	62,054	$ 2,482
Jun	7.77	2,687	5.99	217	116,580	$ 4,663
Jul	10.03	3,469	7.73	280	150,472	$ 6,019
Aug	7.14	2,467	5.50	199	107,013	$ 4,281
Sep	4.74	1,637	3.65	132	71,022	$ 2,841
Oct	0.43	148	0.33	12	6,418	$ 257
Nov	0.00	0	0.00	0	0	$ -
Dec	0.00	0	0.00	0	0	$ -
Totals	34.49					$ 20,689

4.0 O&M / EQUIPMENT REPLACEMENT COST OPINION

O&M costs for the pressurized pipeline were evaluated to estimate potential user fees. This effort included estimates of equipment replacement costs over a 40-year life cycle for the project. The life cycle cost analyses are provided in the Appendices. The analyses estimate annual installment requirements for equipment replacement of $32,300 per year. Added to this cost is the estimated

annual power cost of approximately $20,690 per year. The total annual estimated O & M cost is $52,990 per year.

Assuming 385 shares, this translates to an annual user fee of $137.63 per share. This estimated user fee does not consider other administrative and personnel cost associated with operation of the system. These user fees also assume that PWUA will not be responsible for construction of the diversion upgrades and canal to pipeline conversion.

Appendix A

Calculations

Horsepower Estimate for Pioneer Ditch Pipeline

Pipeline Friction Loss Calculations

Pipe Diameter - Inches	21.0	Head Loss - Ft	6.15
Flow - GPM	3400	Head Loss - PSI	2.66
Distance - Ft	4900	Area - Ft^2	2.40
Hazen - Williams "C"	150	Velocity - Ft/S	3.15
Pipe Diameter - Inches	21.0	Head Loss - Ft	2.72
Flow - GPM	2880	Head Loss - PSI	1.18
Distance - Ft	2950	Area - Ft^2	2.40
Hazen - Williams "C"	150	Velocity - Ft/S	2.67
Pipe Diameter - Inches	18.0	Head Loss - Ft	3.57
Flow - GPM	2165	Head Loss - PSI	1.55
Distance - Ft	3100	Area - Ft^2	1.77
Hazen - Williams "C"	150	Velocity - Ft/S	2.73
Pipe Diameter - Inches	15.0	Head Loss - Ft	5.80
Flow - GPM	1460	Head Loss - PSI	2.51
Distance - Ft	4300	Area - Ft^2	1.23
Hazen - Williams "C"	150	Velocity - Ft/S	2.65
Pipe Diameter - Inches	12.0	Head Loss - Ft	11.93
Flow - GPM	925	Head Loss - PSI	5.16
Distance - Ft	6950	Area - Ft^2	0.79
Hazen - Williams "C"	150	Velocity - Ft/S	2.63
Pipe Diameter - Inches	10.0	Head Loss - Ft	5.08
Flow - GPM	540	Head Loss - PSI	2.20
Distance - Ft	3300	Area - Ft^2	0.55
Hazen - Williams "C"	150	Velocity - Ft/S	2.21

Total Length = 25500 Total Head = 35.26

Horsepower Calculations

Flow	2700 gpm	Assume average flow of 7 gpm per acre
Friction Loss	35.26 ft	
Elevation head	95 ft	elevation difference between fish wheel and minimum water in columbia
Residual Head	92 ft	provide min 40 psi residual
Minor Loss	15 ft	
Well depth	ft	
Total TDH	237.6 ft	
Horsepower	216.0	assume 75% efficiency

Appendix B

Equipment Replacement Cost Opinion

Equipment Replacement
Cost Opinion

P = Present Value
F = Future Value
A = Annualized Value
i = Interest or Inflation rate
n = number of years

Assumed Inflation = 5%
Assume Interest = 6%

1. Replacement costs in Today's Dollars

	Year of Replacement							
	5	10	15	20	25	30	35	40
Item	Year 2016	Year 2021	Year 2026	Year 2031	Year 2036	Year 2041	Year 2046	Year 2051
Pumps (two)			$ 120,000			$ 120,000		
Discharge Piping				$ 15,000				$ 15,000
Pump Station Flow Meter		$ 8,000		$ 8,000		$ 8,000		$ 8,000
Electrical / Pump Controls			$ 60,000			$ 60,000		
Diversion Structure Mechanical			$ 10,000			$ 10,000		
Miscellaneous Equipment	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000
Total (2011 costs)	$ 20,000	$ 28,000	$ 210,000	$ 43,000	$ 20,000	$ 218,000	$ 20,000	$ 43,000

2.Future Replacement Cost
F = P(F/P,i,n)

	Year 2016	Year 2021	Year 2026	Year 2031	Year 2036	Year 2041	Year 2046	Year 2051
Inflated costs	$ 25,526	$ 45,609	$ 436,575	$ 114,092	$ 67,727	$ 942,183	$ 110,320	$ 302,720

3. Annual installment required to finance;
A = F(A/F,i,n)

Year 2016 Equipment Replacement Costs =	$ 4,528
Year 2021 Equipment Replacement Costs =	$ 3,460
Year 2026 Equipment Replacement Costs =	$ 18,756
Year 2031 Equipment Replacement Costs =	$ 3,102
Year 2036 Equipment Replacement Costs =	$ 1,234
Year 2041 Equipment Replacement Costs =	$ 11,918
Year 2046 Equipment Replacement Costs =	$ 990
Year 2051 Equipment Replacement Costs =	$ 1,956

4. Present (2011) value of installments for;
P = A(P/A,i,n)

Year 2016 Equipment Replacement Costs =	$ 19,074
Year 2021 Equipment Replacement Costs =	$ 25,468
Year 2026 Equipment Replacement Costs =	$ 182,167
Year 2031 Equipment Replacement Costs =	$ 35,574
Year 2036 Equipment Replacement Costs =	$ 15,780
Year 2041 Equipment Replacement Costs =	$ 164,044
Year 2046 Equipment Replacement Costs =	$ 14,353
Year 2051 Equipment Replacement Costs =	$ 29,431

5. Total Present (2011) value of annual equipment replacement installments = $ 485,892

6. Annual installment required to finance equipment replacement over the next 40 years = A = P(A/P,i,n) $ 32,293

7. Use **$ 32,300**

Equipment Replacement
Cost Opinion

Equipment Replacement Schedule

Year	Expenditure	Revenue	Balance
2011		$32,300	$32,300
2012		$32,300	$66,538
2013		$32,300	$102,165
2014		$32,300	$139,573
2015		$32,300	$178,852
2016	(25,526)	$32,300	$194,569
2017		$32,300	$236,597
2018		$32,300	$280,727
2019		$32,300	$327,063
2020	(45,609)	$32,300	$330,108
2021		$32,300	$378,913
2022		$32,300	$430,159
2023		$32,300	$483,966
2024		$32,300	$540,465
2025		$32,300	$599,788
2026	(436,575)	$32,300	$225,503
2027		$32,300	$269,078
2028		$32,300	$314,832
2029		$32,300	$362,873
2030		$32,300	$413,317
2031	(114,092)	$32,300	$352,191
2032		$32,300	$402,100
2033		$32,300	$454,505
2034		$32,300	$509,531
2035		$32,300	$567,307
2036	(67,727)	$32,300	$560,245
2037		$32,300	$620,558
2038		$32,300	$683,886
2039		$32,300	$750,380
2040		$32,300	$820,199
2041	(942,183)	$32,300	($48,675)
2042		$32,300	($18,808)
2043		$32,300	$12,551
2044		$32,300	$45,479
2045		$32,300	$80,053
2046	(110,320)	$32,300	$6,035
2047		$32,300	$38,637
2048		$32,300	$72,869
2049		$32,300	$108,812
2050		$32,300	$146,553
2051	(302,720)	$32,300	($116,539)