

APPENDIX A

PRELIMINARY LIST OF DESIGN SPECIFICATIONS

Appendix A - Preliminary List Of Design Specifications -

Table A-1 Specification List for Force Main

<u>SECTION NO.</u>	<u>SECTION TITLE</u>
DIVISION 0	
	INVITATION TO BID
	INSTRUCTIONS TO BIDDERS
	BIDDER'S CHECKLIST
	BID FORM
	NON-COLLUSION AFFIDAVIT
	BID BOND FORM
	AGREEMENT
	PERFORMANCE AND PAYMENT BOND
	PREVAILING WAGE RATES FOR PUBLIC WORKS CONTRACTS IN OREGON
00700	GENERAL CONDITIONS
SC	SUPPLEMENTARY CONDITIONS
DIVISION 1	GENERAL REQUIREMENTS
01005	ADMINISTRATIVE PROVISIONS
01014	PROTECTION OF THE ENVIRONMENT
01025	MEASUREMENT AND PAYMENT
01050	FIELD ENGINEERING
01300	SUBMITTALS
01410	TESTING LABORATORY SERVICES
01515	TEMPORARY WATER
01545	PROTECTION OF WORK AND PROPERTY
01550	ACCESS AND HAUL ROADS
01560	TEMPORARY CONTROLS
01570	TRAFFIC CONTROL
01590	FIELD OFFICE AND SHEDS
01700	CONTRACT CLOSEOUT
DIVISION 2	SITE WORK
02120	CLEARING AND GRUBBING
02150	TEMPORARY SHORING
02222	EXCAVATING, BACKFILLING, AND COMPACTING FOR UTILITIES
02240	HORIZONTAL BORING (CREEK CROSSINGS)
02275	SEDIMENTATION CONTROL
02530	DEWATERING
02600	PAVING AND SURFACING
02800	LANDSCAPE WORK

Table A-1(cont'd) Specification List for Force Main

<u>SECTION NO.</u>	<u>SECTION TITLE</u>
DIVISION 3	CONCRETE
03252	ANCHORS, INSERTS, AND EMBEDDED PRODUCTS
03300	CAST-IN-PLACE CONCRETE
03485	PRECAST CONCRETE VAULTS
DIVISION 5	METALS
05030	GALVANIZING
05500	METAL FABRICATIONS
DIVISION 9	FINISHES
09900	PAINTING
DIVISION 13	SPECIAL CONSTRUCTION
13120	FIBERGLASS STRUCTURES
DIVISION 15	MECHANICAL
15010	BASIC MECHANICAL REQUIREMENTS
15060	PIPE AND FITTINGS
15100	VALVES
15710	ACTIVATED CARBON ODOR SCRUBBERS

Table A-2 Specification List for Pump Stations

<u>SECTION NO.</u>	<u>SECTION TITLE</u>
DIVISION 0	
	INVITATION TO BID
	INSTRUCTIONS TO BIDDERS
	BIDDER'S CHECKLIST
	BID FORM
	AGREEMENT
	PERFORMANCE AND PAYMENT BOND
	PREVAILING WAGE RATES FOR PUBLIC WORKS CONTRACTS IN OREGON
00700	GENERAL CONDITIONS
SC	SUPPLEMENTARY CONDITIONS
DIVISION 1	GENERAL REQUIREMENTS
01005	ADMINISTRATIVE PROVISIONS
01015	PROTECTION OF THE ENVIRONMENT
01025	MEASUREMENT AND PAYMENT
01050	FIELD ENGINEERING
01340	SUBMITTALS
01410	TESTING LABORATORY SERVICES
01545	PROTECTION OF WORK AND PROPERTY
01560	TEMPORARY CONTROLS
01590	FIELD OFFICE AND SHEDS
01700	CONTRACT CLOSEOUT
DIVISION 2	SITE WORK
02120	CLEARING AND GRUBBING
02150	TEMPORARY SHORING
02222	EXCAVATING, BACKFILLING, AND COMPACTING FOR UTILITIES
02275	SEDIMENTATION CONTROL
02530	DEWATERING
02600	PAVING AND SURFACING
02800	LANDSCAPE WORK
02831	CHAIN LINK FENCES AND GATES
DIVISION 3	CONCRETE
03100	CONCRETE FORMWORK
03200	CONCRETE REINFORCEMENT
03251	EXPANSION, CONTRACTION, AND CONTROL JOINTS
03252	ANCHORS, INSERTS, AND EMBEDDED PRODUCTS
03300	CAST-IN-PLACE CONCRETE

Table A-2(cont'd) Specification List for Pump Stations

<u>SECTION NO.</u>	<u>SECTION TITLE</u>
DIVISION 4 04200	MASONRY UNIT MASONRY
DIVISION 5 05500	METALS METAL FABRICATIONS
DIVISION 6 06100 06192	WOOD AND PLASTICS ROUGH CARPENTRY PREFABRICATED METAL-PLATE-CONNECTED WOOD TRUSSES
DIVISION 7 07210 07411 07901	THERMAL AND MOISTURE PROTECTION BUILDING INSULATION MANUFACTURED ROOF PANELS JOINT SEALANTS
DIVISION 8 08110 08300 08710	DOORS, WINDOWS, AND GLAZING STEEL DOORS AND FRAMES FLOOR DOORS DOOR HARDWARE
DIVISION 9 09255 09520 09900	FINISHES GYPSUM BOARD ASSEMBLIES ACOUSTICAL WALL PANELS PAINTING
DIVISION 10 10200 10522	SPECIALTIES LOUVERS FIRE EXTINGUISHERS AND ACCESSORIES
DIVISION 11 11010 11063 11310 11320	EQUIPMENT EQUIPMENT GENERAL PROVISIONS SUBMERSIBLE SUMP PUMP SYSTEM SUBMERSIBLE SEWAGE PUMPS CENTRIFUGAL SEWAGE PUMPS
DIVISION 13 13410	SPECIAL CONSTRUCTION MAGNETIC FLOWMETERS
DIVISION 15 15010 15060 15085 15100 15110	MECHANICAL BASIC MECHANICAL REQUIREMENTS PIPE AND FITTINGS PIPING CONNECTIONS VALVES VALVE OPERATORS

Table A-2(cont'd)

Specification List for Pump Stations

SECTION NO.

SECTION TITLE

15400

PLUMBING

15700

HEATING AND VENTILATION

15815

AIR DISTRIBUTION SYSTEM

DIVISION 16

ELECTRICAL

16010

BASIC ELECTRICAL REQUIREMENTS

16100

BASIC MATERIALS AND METHODS

16200

STANDBY GENERATOR SYSTEM

16400

SERVICE AND DISTRIBUTION

16500

LIGHTING

16620

AUTOMATIC TRANSFER SYSTEM

16900

MOTORS AND CONTROLS

DIVISION 17

ELECTRICAL

17100

INSTRUMENTATION AND CONTROL SYSTEM

APPENDIX B

PRELIMINARY LIST OF ENGINEERING PLAN SHEETS

Anticipated Sheet Count
Redwood Pump Stations and Pipeline

Pipeline

1. Vicinity & Location Maps, Index
2. Legend, Abbreviations
3. Plan & Profile
4. Plan & Profile
5. Plan & Profile
6. Plan & Profile
7. Plan & Profile
8. Plan & Profile
9. Plan & Profile
10. Plan & Profile
11. Plan & Profile
12. Plan & Profile
13. Plan & Profile
14. Plan & Profile
15. Plan & Profile
16. Plan & Profile
17. Plan & Profile
18. Plan & Profile
19. Plan & Profile
20. Plan & Profile
21. Plan & Profile
22. Plan & Profile
23. Pipeline Connection at Bridge Approach
24. Sections & Details
25. Treatment Plant Connection
26. Treatment Plant Connection Details
27. Treatment Plant Connection Details
28. Restoration Details
29. Details
30. Details
31. Details
32. Traffic Control Details and Notes
33. Traffic Control Details and Notes
34. Traffic Control Plan Sta x to Sta y
35. Traffic Control Plan Sta x to Sta y
36. Traffic Control Plan Sta x to Sta y
37. Traffic Control Plan Sta x to Sta y
38. Traffic Control Plan Sta x to Sta y
39. Traffic Control Plan Sta x to Sta y
40. Traffic Control Plan Sta x to Sta y
41. Traffic Control Plan Sta x to Sta y

Pump Stations

1. Vicinity & Location Maps, Index
2. Legend, Abbreviations
- Redwood Pump Station**
3. Civil Site Plan
4. Demolition
5. Architectural
6. Structural
7. Mechanical Plans
8. Mechanical Sections
9. Mechanical Details
10. Electrical One Line
11. Electrical Site Plan
12. Electrical Building Plans
13. MCC Schematics
14. I/C Process/Inst Diagram
15. I/C Block Diagram
16. I/C Panel Layout
17. I/C Panel Schematic
18. I/C Panel Schematic
- New Pump Station**
19. Civil Site Plan
20. Architectural Plan
21. Architectural Plan
22. Architectural Sections
23. Architectural Sections
24. Structural Plans
25. Structural Plans
26. Structural Sections & Details
27. Structural Sections & Details
28. Mechanical Plans
29. Mechanical Plans
30. Mechanical Sections
31. Mechanical Sections
32. Mechanical Details
33. Electrical One Line
34. Electrical Site Plan
35. Electrical Building Plans
36. Electrical Building Plans
37. MCC Schematics
38. I/C Process/Inst Diagram
39. I/C Block Diagram
40. I/C Panel Layout
41. I/C Panel Layout
42. I/C Panel Schematic
43. I/C Panel Schematic
44. I/C Panel Schematic
45. Civil Details
46. Civil Details
47. Structural Details
48. Structural Details
49. Architectural Details
50. Architectural Details
51. Mechanical Details

APPENDIX C

PRELIMINARY HYDRAULIC CALCULATIONS

- **Pipeline Selection**
- **System Curve – Redwood to RI-24**
- **Data Tabulation – Redwood to RI-24**
- **Hydraulic Grade Line – Redwood to RI-24**
- **Data Tabulation – Redwood to RI-24**
- **System Curve – RI-24 to GPWRP**
- **Data Tabulation – RI-24 to GPWRP**
- **Hydraulic Grade Line – RI-24 to GPWRP**
- **Data Tabulation – RI-24 to GPWRP**

REDWOOD FACILITY PLAN UPDATE

PUMP STATION HYDRAULICS

PUMP STATION AT REDWOOD WWTP - TWO FLOW SCENARIOS

Firm Capacity, mgd **0.30**

Diameter inches	Vel, fps	Total gpm	Headloss*	Ea Pump HP **	Ea Pump Flow, gpm
6	2.4	208	65.8	5.8	208
8	1.3	208	31.3	2.7	
10	0.9	208	23.8	2.1	

Firm Capacity, mgd **0.40**

Diameter inches	Vel, fps	Total gpm	Headloss*	Ea Pump HP **	Ea Pump Flow, gpm
6	3.2	278	98.0	11.5	278
8	1.8	278	39.2	4.6	
10	1.1	278	26.5	3.1	

* Length, ft **9,200** C = **120** Static Head = **20** add 5% for fittings

** Assume 60% pump efficiency. At firm capacity, number of pumps in service: **1**

PUMP STATION AT RI-24

Flow, mgd- **4.20**

Diameter inches	Flow Split mgd	gpm	Velocity fps	Headloss*	Ea Pump HP**	Ea Pump Flow, gpm
10	38%	1,108	4.5	216.0	134.6	1,458
12	62%	1,808	5.1	219.3		
12	50%	1,458	4.1	160.4	98.5	
12	50%	1,458	4.1	160.4		
10	29%	846	3.5	146.7	91.3	
14	71%	2,071	4.3	148.8		
12	40%	1,167	3.3	119.7	73.5	
14	60%	1,750	3.6	119.7		

* Length, ft **19,270** C = **120** Static Head = **40** add 5% for fittings

** Assume 60% pump efficiency. At firm capacity, number of pumps in service: **2**

Pipeline Velocity and Head Loss and Corresponding Pump Horsepower

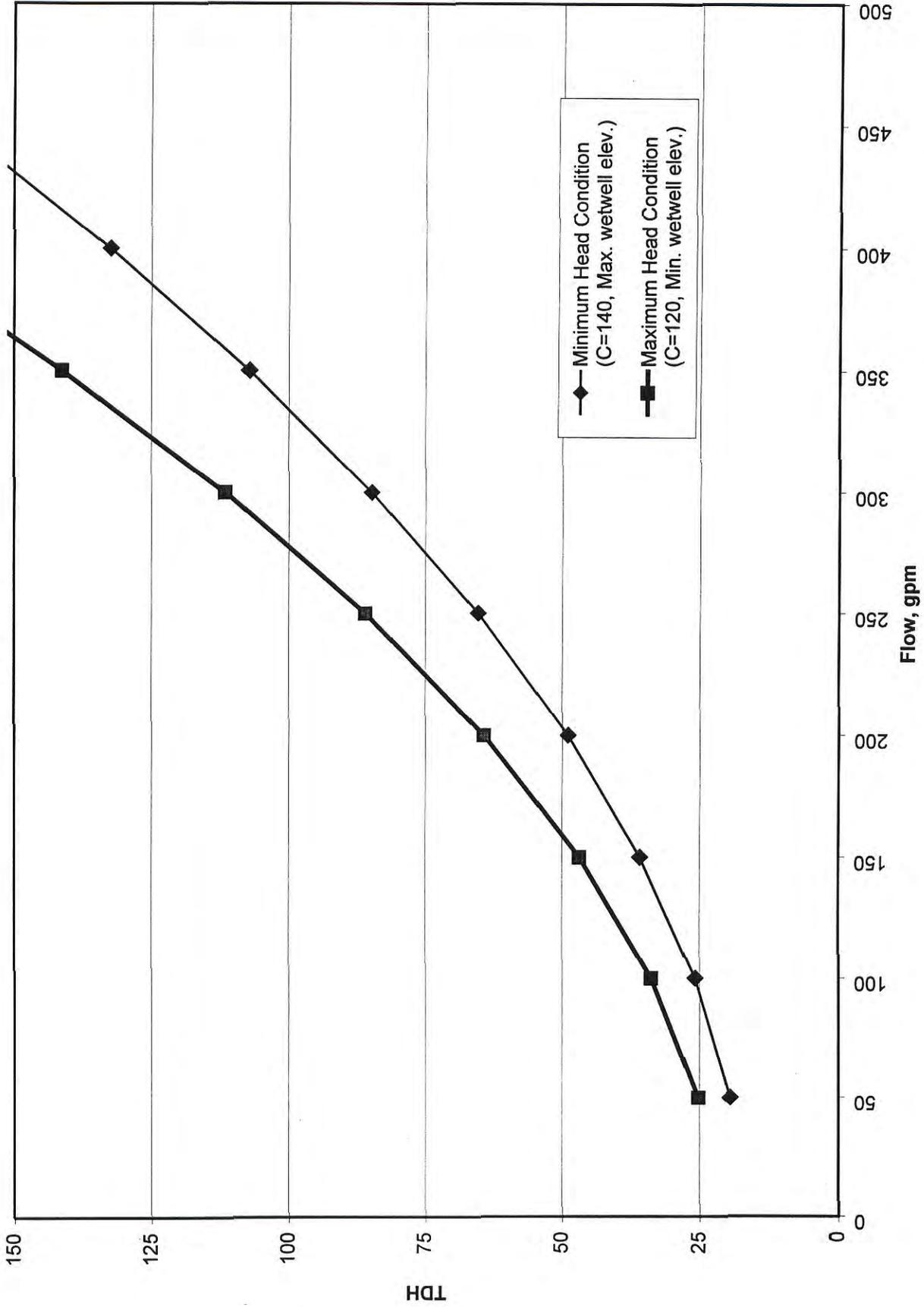
Years when Flowrate Occurs: Peak Winter Average Flowrate	Dia Area, in sq	One 12"		One 14"		One 16"		Dual 12"		Dual -12" & 14"			
		Flow, mgd	Flow, gpm	Vel, fps	head loss	Vel, fps	head loss	Vel, fps	head loss	Vel, fps	head loss	Vel, fps	head loss
1998		0.25	174	0.49	36	0.36	35	0.28	35	0.25	35		
		0.50	347	0.99	41	0.72	37	0.55	36	0.49	36	0.50	36
		0.75	521	1.48	49	1.09	41	0.83	38	0.74	38		
2020		1.00	694	1.97	60	1.45	46	1.11	41	0.99	41		
		1.25	868	2.46	74	1.81	53	1.39	44	1.23	45	1.00	41
		1.50	1,042	2.96	90	2.17	61	1.66	48	1.48	49		
		1.75	1,215	3.45	108	2.53	69	1.94	53	1.72	55		
		2.00	1,389	3.94	129	2.89	79	2.22	58	1.97	60	1.60	50
		2.25	1,563	4.43	153	3.26	90	2.49	64	2.22	67		
1998=2.4		2.50	1,736	4.93	178	3.62	103	2.77	70	2.46	74	2.00	60
		2.75	1,910	5.42	206	3.98	116	3.05	77	2.71	81		
		3.00	2,083	5.91	236	4.34	130	3.32	85	2.96	90		
		3.25	2,257	6.40	269	4.70	146	3.60	93	3.20	99	2.80	80
		3.50	2,431	6.90	303	5.07	162	3.88	101	3.45	108		
		3.75	2,604	7.39	340	5.43	179	4.16	110	3.69	118		
		4.00	2,778	7.88	379	5.79	198	4.43	120	3.94	129		
2020=4.2		4.25	2,951	8.37	420	6.15	218	4.71	131	4.19	141	3.30	100

Assumptions

- 1 Assumes a tri-plex pump station - two pumps handle entire flow, one standby.
- 2 Assume 3@90 elbow, 4@45 elbow, 1@tee thru, 1@tee branch, 1 exit, 1 entrance, 5 gate valves, 1 plug valve, 1 check valve, 1 increaser for total K=16.96
- 3 Assume 10 @ 45 elbow, 2@ thru tees, 2@ gate valve total K= 4.4
- 4 Physical Features

Pipeline length, ft = 16,760 Static Head, ft = 34
 Pipeline friction factor, C = 120 Fittings, K= 17 Note 2

System Head Curve (Redwood to RI-24)



Use Darcy for Fittings, entrance

$$h_l = K (V^2/2g)$$

Use Hazen Williams for pipe losses

Hazen-Williams Formula

$$h_l = 0.002083 L (100)^{-1.85} (Q)^{1.85} / C^{1.85} d^{-4.8655}$$

h_l = head loss, ft
 L = pipe length, ft
 Q = flow, gpm
 d = pipe dia, inches
 C = roughness coefficient

Q, gpd	Increment	Diam, inches		Pipe Line Redwood to RI-25		Vel, fps	Pipe h _l	Pipe h _l	K	h _l	Fitting	Dynamic Headloss	Dynamic Headloss	Discharge Elevation		TDH Low Level	TDH High Level	Flow per Pump # pumps	BHP Effic = 0.6
		6	120	140	Number of Pipes = 1									High Level	Low Level				
72,000	50	9.450	3.196	2.403	0.567	0.0050	9.06	0.045	0.045	0.045	0.045	2.448	3.241	860	25.24	19.45	50	1	
144,000	100	9.450	11.522	8.663	1.135	0.0200	9.06	0.181	0.181	0.181	0.181	8.845	11.703	17.0	33.70	25.84	100	1	
216,000	150	9.450	24.395	18.342	1.702	0.0450	9.06	0.408	0.408	0.408	0.408	18.750	24.803	17.0	46.80	35.75	150	3	
288,000	200	9.450	41.538	31.232	2.269	0.0800	9.06	0.725	0.725	0.725	0.725	31.956	42.263	17.0	64.26	48.96	200	5	
360,000	250	9.450	62.767	47.193	2.837	0.1250	9.06	1.132	1.132	1.132	1.132	48.325	63.899	17.0	85.90	65.33	250	9	
432,000	300	9.450	87.946	66.125	3.404	0.1799	9.06	1.630	1.630	1.630	1.630	67.755	89.576	17.0	111.58	84.75	300	14	
504,000	350	9.450	116.968	87.946	3.972	0.2449	9.06	2.219	2.219	2.219	2.219	90.165	119.187	17.0	141.19	107.16	350	21	
576,000	400	9.450	149.745	112.590	4.539	0.3199	9.06	2.898	2.898	2.898	2.898	115.488	152.643	17.0	174.64	132.49	400	29	
648,000	450	9.450	186.202	140.001	5.106	0.4049	9.06	3.668	3.668	3.668	3.668	143.670	189.870	17.0	211.87	160.67	450	40	
720,000	500	9.450	226.274	170.131	5.674	0.4998	9.06	4.529	4.529	4.529	4.529	174.660	230.803	17.0	252.80	191.66	500	53	
792,000	550	9.450	269.906	202.937	6.241	0.6048	9.06	5.480	5.480	5.480	5.480	208.416	275.385	17.0	297.39	225.42	550	69	
864,000	600	9.450	317.045	238.380	6.808	0.7198	9.06	6.521	6.521	6.521	6.521	244.901	323.566	17.0	345.57	261.90	600	87	
936,000	650	9.450	367.647	276.426	7.376	0.8447	9.06	7.653	7.653	7.653	7.653	284.079	375.300	17.0	397.30	301.08	650	109	
1,008,000	700	9.450	421.670	317.045	7.943	0.9797	9.06	8.876	8.876	8.876	8.876	325.921	430.546	17.0	452.55	342.92	700	133	
1,080,000	750	9.450	479.076	360.207	8.510	1.1246	9.06	10.189	10.189	10.189	10.189	370.397	489.265	17.0	511.27	387.40	750	161	
1,152,000	800	9.450	539.830	405.888	9.078	1.2796	9.06	11.593	11.593	11.593	11.593	417.481	551.424	17.0	573.42	434.48	800	193	
1,224,000	850	9.450	603.901	454.061	9.645	1.4445	9.06	13.088	13.088	13.088	13.088	467.149	616.989	17.0	638.99	484.15	850	229	
1,296,000	900	9.450	671.258	504.705	10.213	1.6195	9.06	14.673	14.673	14.673	14.673	519.378	685.931	17.0	707.93	536.38	900	268	

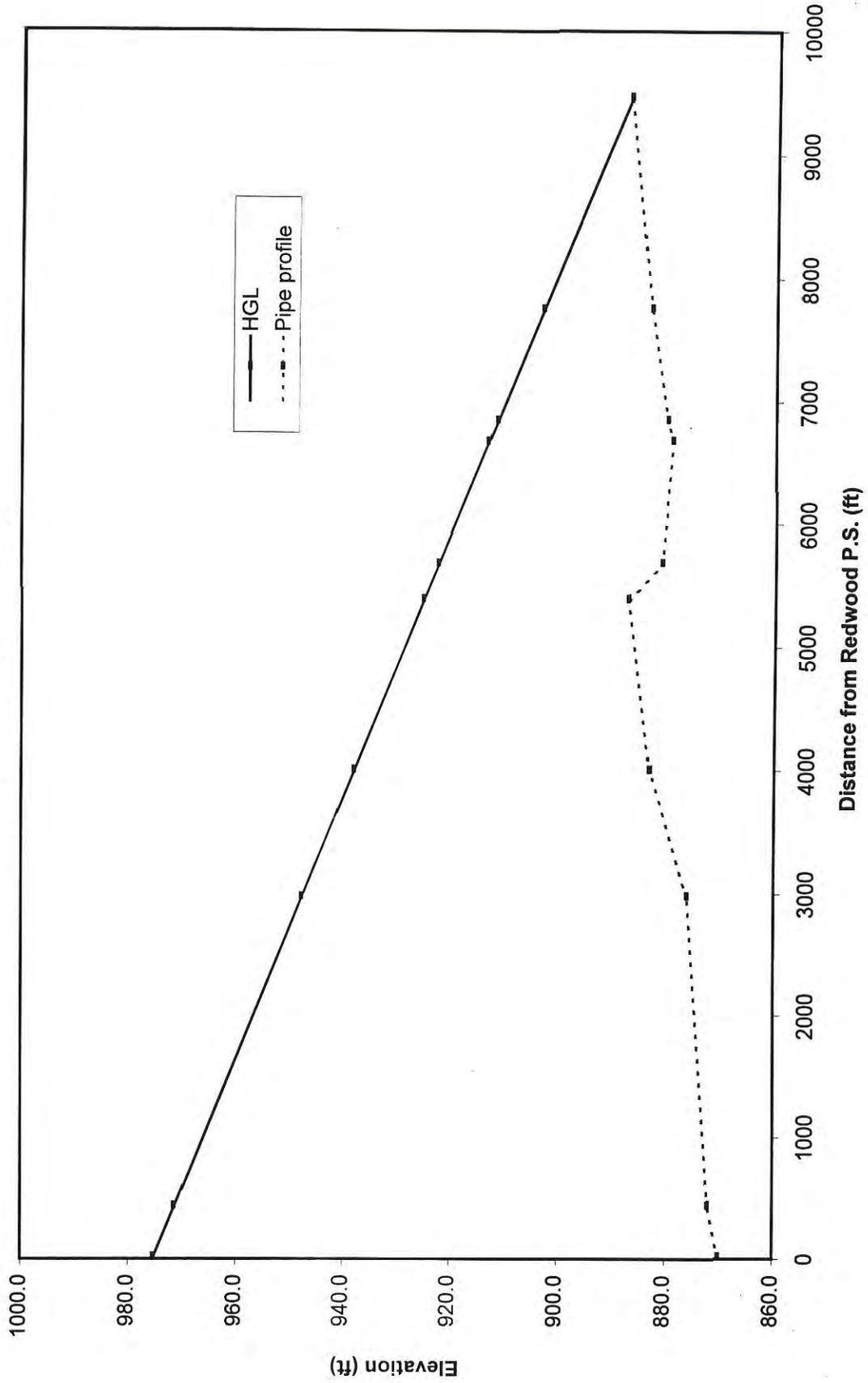
Type	K	#	Total
Elbow, 90	0.25	3	0.75
Elbow, 45	0.18	4	0.72
Elbow, 22.5	0.08	3	0.24
Elbow, 11.25	0.05	3	0.15
Tee, thru	0.3	1	0.3
Tee, branch		1	0
Entrance	0.5		0
Exit	1	1	1
Plug Valve	1	1	1
Gate Valve	0.3	3	0.9
Check Valve	4	1	4
Increaser		0	0
Reducer		0	0
TOTAL			9.06

Formulas from Cameron Hydraulics Handbook, 16 ed, pages 3-7, 3-110; K values from 3-111 to 3-116.

$$K = (894 \times d^4) / (C^2)$$

Parametrix

Hydraulic Grade Line (from Redwood PS to RI-24)



Hydraulic Grade Line Calculations for 6" Forcemain from Redwood Pump Station to RI-24

Use Darcy for Fittings, entrance
 $h_l = K (v^2/2g)$

	K		K
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FITTINGS:		VALVES:	
90 Deg Elbow	0.25	Plug Valve	1.00
45 Deg Elbow	0.18	Gate Valve	0.30
22.5 Deg Elbow	0.08	Swing Check Va. w/ Sprin	4.00
11 Deg Elbow	0.05	Air Vac. Assembly	0.15
Tee, straight thru	0.30		
Wye, straight through	0.25	VELOCITY HEAD	1.00
		ENTRANCE LOSS	0.50
		ENTRANCE LOSS (flared)	0.04
		EXIT LOSS	1.00

Use Hazen Williams for pipe losses
Hazen-Williams Formula
 $h_l = \frac{0.002083 L (100)^{1.85} (Q)^{1.85}}{C^{1.85} d^{4.8655}}$

h_l = head loss, ft
 L = pipe length, ft
 Q = flow, gpm
 d = pipe dia, inches
 C = roughness coefficient

BHP
 $BHP = (Flow) \cdot (TDH) / (3960 \cdot 0.6) = 14.1766$

Generator Size
 1 pump @ 14.2 = 14.2 hp
 Convert hp to kw = 12.4 KW

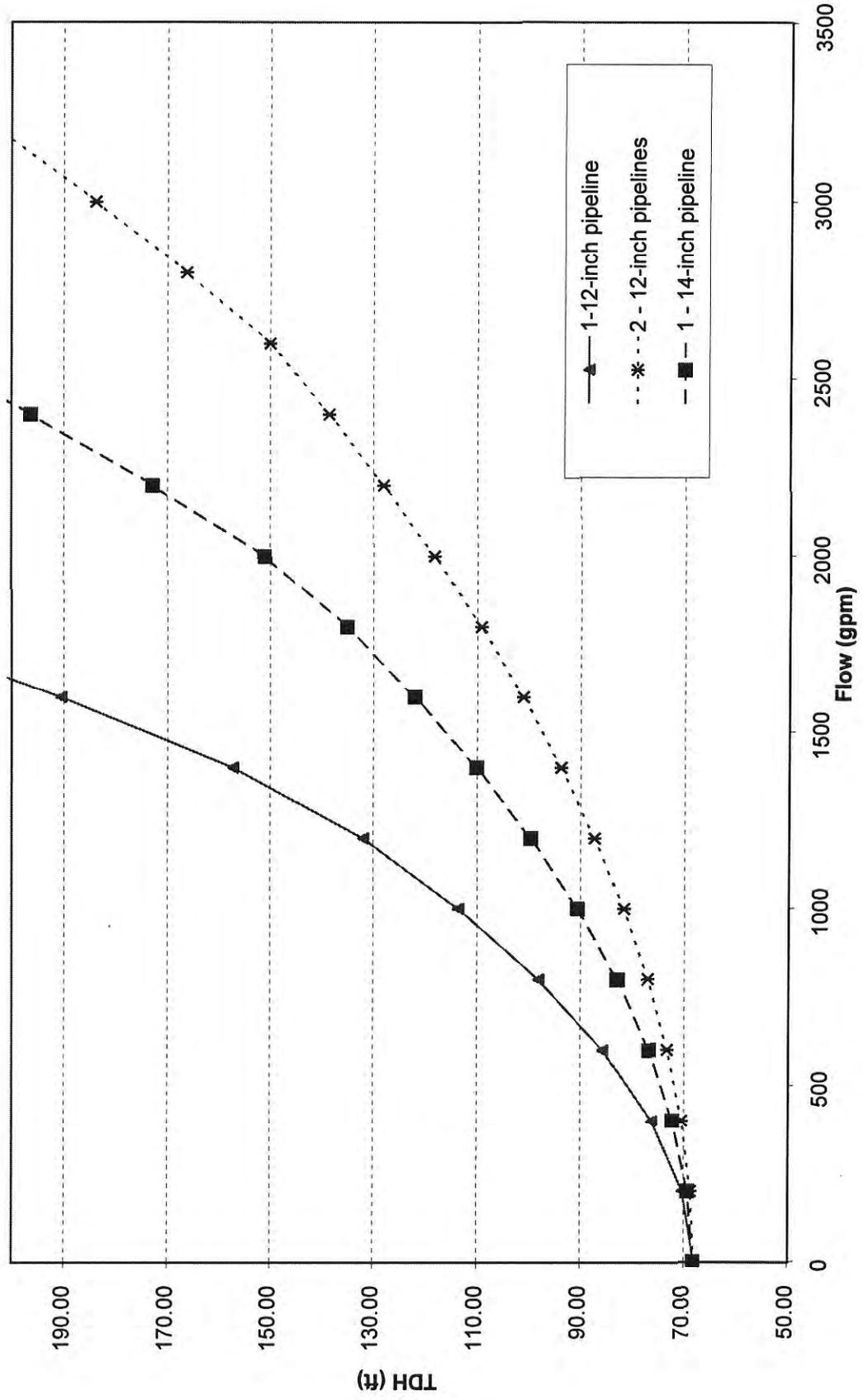
Pump eff = 0.6
 Motor eff = 0.85

		Diameter 6		6" Pipeline Redwood to RI-24				TDH = 112							
		C= 120		Number of Pipes = 1											
Q, gpd	Q, gpm	Location	Distance	Distance from Redwood	Pipe hl	Vel, fps	V ² /2g	Fittings	K	Fitting, hl	Cumulative fitting hl	Dynamic Pipeline Headloss	Pipeline elevation	HGL	Pressure Head
432,000	300	Redwood	0	0	0.000	3.404	0.1799	PS Fittings*	*	7.000	7.000	7.000	870.0	982.3	112.3
432,000	300	RI-1	420	420	3.909	3.404	0.1799	22.5	0.08	0.014	7.014	10.923	872	971.4	99.4
432,000	300		2540	2960	27.547	3.404	0.1799	11.25	0.05	0.009	7.023	34.570	876.0	947.7	71.7
432,000	300		1030	3990	37.133	3.404	0.1799	11.25	0.05	0.009	7.032	44.165	883.0	938.1	
432,000	300		1380	5370	49.976	3.404	0.1799	45, 11.25, AV	0.38	0.068	7.101	57.076	887.0	925.2	
432,000	300	Westwood	290	5660	52.674	3.404	0.1799	22.5, 11.25	0.13	0.023	7.124	59.799	881.0	922.5	41.5
432,000	300	Westwood	1000	6660	61.981	3.404	0.1799	22.5	0.08	0.014	7.139	69.119	879.0	913.2	
432,000	300		170	6830	63.563	3.404	0.1799	22.5	0.08	0.014	7.153	70.716	880.0	911.6	31.6
432,000	300		910	7740	72.032	3.404	0.1799			0.000	7.153	79.185	883.0	903.1	
432,000	300	RI-24	1710	9450	87.946	3.404	0.1799	Exit	1.00	0.180	7.333	95.279	887.0	887.0	0.0

Formulas from Cameron Hydraulics Handbook, 16 ed, pages 3-7, 3-110; K values from 3-111 to 3-116.
 $K = (894 \times d^4) / (Cv^2)$

* Fittings at Pump Station		K	Total
Check valves	1	4.00	4
Plug Valves	2	1.00	2
Entrance	1	0.50	0.5
90 Elbow	2	0.25	0.5
		Total	7

**System Curves
(RI-24 to Grants Pass WWTP)**



Hydraulics for 12" Forcemain from RI-24 to Grants Pass along Leonard Road

Use Darcy for Fittings, entrance
 $hl = K (v^2/2g)$

Use Hazen Williams for pipe losses
Hazen-Williams Formula
 $hl = 0.002083 L (100)^{1.85} (Q)^{1.85} / C^{1.85} d^{4.8655}$

hl = head loss, ft
 L = pipe length, ft
 Q = flow, gpm
 d = pipe dia, inches
 C = roughness coefficient

88.176523

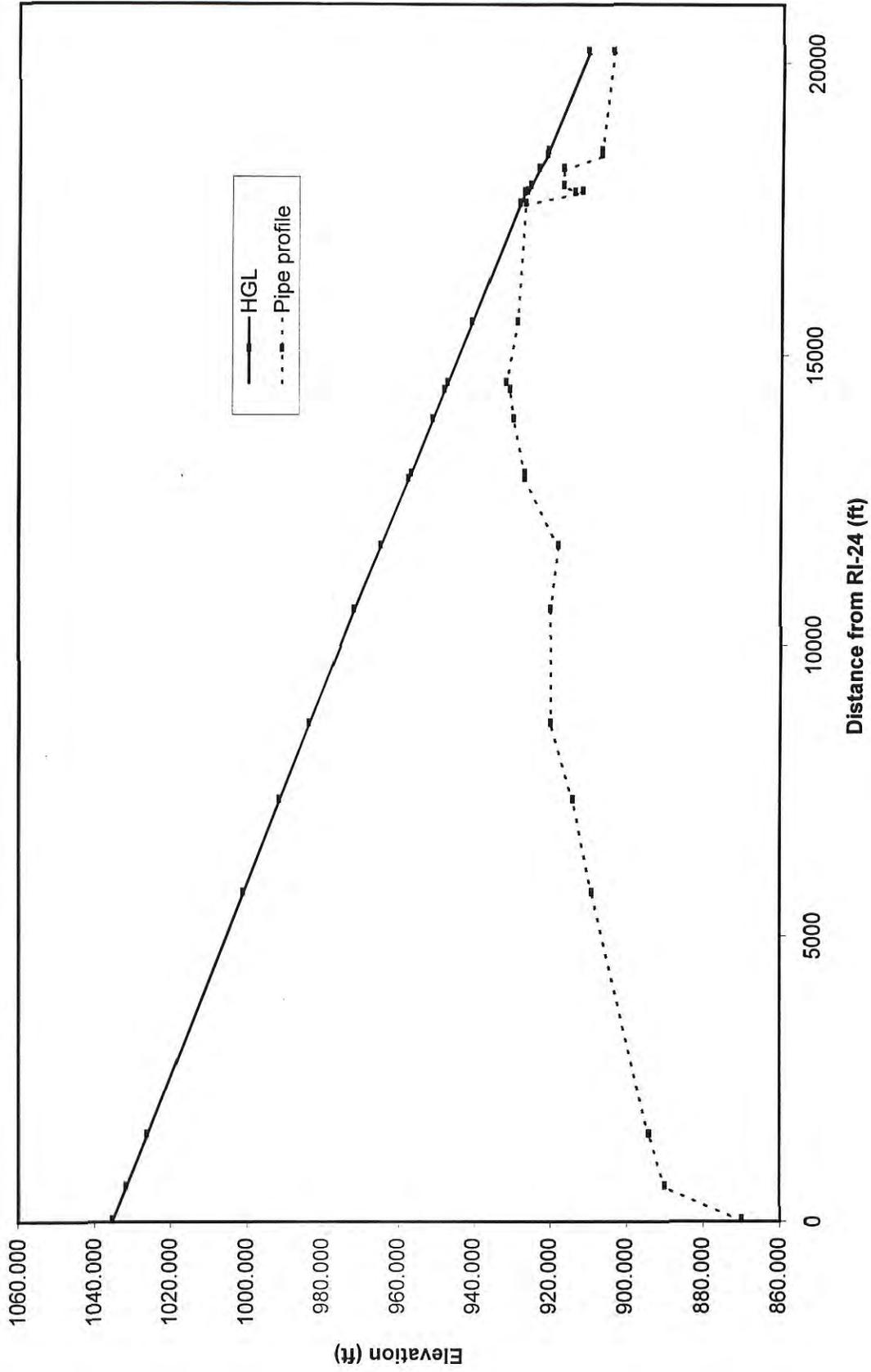
Increment		Diam, inches		12" Pipeline RI-24 to GP WWTP		Discharge Elevation		TDH		Flow per Pump		BHP	
Q, gpd	Total Flow	C =	12	140	Number of Pipes =	1	904	Static Head	Low Level	High Level	# pumps	Effic =	0.6
			L, ft	Pipe hl	Vel, fps	V ² /2g	K	hl	Headloss	Dynamic	Low Level	High Level	
331,200	230	20,160	2.960	0.191	0.652	0.0066	28.9	0.191	3.151	865.0	37.15	230	4
489,600	340	20160	6.100	0.418	0.965	0.0144	28.9	0.418	6.518	39.0	40.52	340	7
648,000	450	20160	10.245	0.732	1.277	0.0253	28.9	0.732	10.977	39.0	44.98	450	9
806,400	560	20160	15.354	1.134	1.589	0.0392	28.9	1.134	16.488	39.0	50.49	560	13
964,800	670	20160	21.396	1.623	1.901	0.0561	28.9	1.623	23.018	39.0	57.02	670	17
1,123,200	780	20160	28.344	2.199	2.213	0.0760	28.9	2.199	30.543	39.0	64.54	780	23
1,281,600	890	20160	36.179	2.864	2.525	0.0990	28.9	2.864	39.043	39.0	73.04	890	29
1,440,000	1,000	20160	44.883	3.615	2.837	0.1250	28.9	3.615	48.499	39.0	82.50	1,000	37
1,598,400	1,110	20160	54.442	4.454	3.149	0.1540	28.9	4.454	58.896	39.0	92.90	1,110	46
1,756,800	1,220	20160	64.841	5.381	3.461	0.1860	28.9	5.381	70.222	39.0	104.22	1,220	56
1,915,200	1,330	20160	76.070	6.395	3.773	0.2210	28.9	6.395	82.465	39.0	121.46	1,330	68
2,073,600	1,440	20160	88.116	7.496	4.085	0.2591	28.9	7.496	95.613	39.0	134.61	1,440	82
2,232,000	1,550	20160	100.972	8.685	4.397	0.3002	28.9	8.685	109.657	39.0	148.66	1,550	97
2,390,400	1,660	20160	114.627	9.962	4.709	0.3443	28.9	9.962	124.589	39.0	163.59	1,660	114
2,548,800	1,770	20160	129.074	11.326	5.021	0.3915	28.9	11.326	140.399	39.0	179.40	1,770	134
2,707,200	1,880	20160	144.304	12.777	5.333	0.4417	28.9	12.777	157.081	39.0	196.08	1,880	155
2,865,600	1,990	20160	160.312	14.316	5.645	0.4949	28.9	14.316	174.628	39.0	213.63	1,990	179
3,024,000	2,100	20160	177.089	15.943	5.957	0.5511	28.9	15.943	193.032	39.0	227.03	2,100	205

Type	K	Quantity	Total	Type	K	Quantity	Total	Type	K	Quantity	Total
FITTINGS:				TEE, straight thru	0.30	0	0	VELOCITY HEAD	1.00	1	0.5
90 Deg Elbow	0.25	2	0.5	Tee, branch to line	1.20	2	2.4	ENTRANCE LOSS	0.50	1	0.5
90 Deg Elbow (5 piece)	0.30	0	0	Tee, line to branch	1.20	0	0	ENTRANCE LOSS (fla	0.04	1	0
75 Deg Elbow (2 piece)	0.30	0	0	Incraser	0.25	1	0.25	EXIT LOSS	1.00	1	1
67 Deg Elbow (3 piece)	0.23	0	0	Reducer	0.03	0	0				
60 Deg Elbow (4 piece)	0.20	0	0	Ball Joint	0.10	0	0				
45 Deg Elbow	0.18	56	10.08	VALVES:							
45 Deg Elbow (3 piece)	0.15	0	0	Air Vac. Assembly	0.15	6	0.9				
30 Deg Bend (2 elbows)	0.10	0	0	Butterfly Valve (3" - 8")	0.69	0	0				
25 Deg Elbow	0.08	15	1.2	Butterfly Valve (10"-20")	0.45	0	0				
22.5 Deg Elbow (2 piec	0.08	2	0.5	Gate Valve	0.30	2	0.6				
Wye, straight through	0.25	0	0	Swing Check Va. w/ Lever	2.50	0	0				
Wye, branch to line	0.50	0	0	Swing Check Va. w/ Spring	4.00	2	8				
Wye, line to branch	0.60	0	0	Plug Valve	1.00	3	3				
Stub in (@ 45-deg)	0.50	0	0					Total			28.93

Formulas from Cameron Hydraulics Handbook, 16 ed, pages 3-7, 3-110; K values from 3-111 to 3-116.

K = (894 x d^4)/(Cv^2)

Hydraulic Grade Line (from RI-24 to GPWWTP)



Hydraulic Grade Line Calculations for 12" Forcemain from RI-24 to Grants Pass along Leonard Road

Use Darcy for Fittings, entrance
 $h_l = K (v^2/2g)$

	K		K
FITTINGS:			
90 Deg Elbow	0.25	Plug Valve	1.00
45 Deg Elbow	0.18	Gate Valve	0.30
22.5 Deg Elbow	0.08	Swing Check Va. w/ Sprin	4.00
11 Deg Elbow	0.05	Air Vac. Assembly	0.15
Tee, straight thru	0.30		
Wye, straight through	0.25	VELOCITY HEAD	1.00
		ENTRANCE LOSS	0.50
		ENTRANCE LOSS (flared)	0.04
		EXIT LOSS	1.00

Use Hazen Williams for pipe losses
Hazen-Williams Formula
 $h_l = \frac{0.002083 L (100 \wedge 1.85 (Q) \wedge 1.85)}{C \wedge 1.85 d \wedge 4.8655}$

h_l = head loss, ft
 L = pipe length, ft
 Q = flow, gpm
 d = pipe dia, inches
 C = roughness coefficient

BHP
 $BHP = (Flow) \cdot (TDH) / (3960 \cdot 0.6) = 113.549$

Generator Size
 2 pumps @ 102 = 227.09736 hp
 Convert hp to kw = 199.23118 KW

Pump eff = 0.6
 Motor eff = 0.85

C= 120		Diameter 12	12" Pipeline RI-25 to Grants Pass WWTP				Assume								
Diameter on bridge		15	Number of Pipes = 2				TDH= 185								
Flow per pipe Q, gpd	gpm	Location	Distance	Distance from RI-24	Pipe hl	Vel, fps	V ² /2g	Fittings	K	Fitting, hl	Cumulative fitting hl	Dynamic Headloss	Pipeline elevation	HGL	Pressure Head
4,200,000	1,458	RI-24	0	0	0.000	4.137	0.2658	PS Fittings*	*	14.400	14.400	14.400	865.0	1050.0	185.0
4,200,000	1,458	Darnielle	590	590	3.511	4.137	0.2658	45, 22	0.26	0.069	14.469	17.980	890	1031.8	141.8
4,200,000	1,458		910	1500	8.926	4.137	0.2658	2-45	0.36	0.096	14.565	23.491	894.0	1026.2	132.2
4,200,000	1,458	S. River	1480	2980	17.734	4.137	0.2658			0.000	14.565	32.298		1017.4	
4,200,000	1,458		1400	4380	26.065	4.137	0.2658	2-45	0.36	0.096	14.660	40.725		1009.0	
4,200,000	1,458	Shroeder	1330	5710	33.980	4.137	0.2658			0.000	14.660	48.640	909.0	1001.1	92.1
4,200,000	1,458	Leonard	360	6070	36.122	4.137	0.2658			0.000	14.660	50.782		999.0	
4,200,000	1,458	Leonard	1240	7310	43.501	4.137	0.2658	2-45	0.36	0.096	14.756	58.257	914.0	991.5	77.5
4,200,000	1,458	Leonard	110	7420	44.156	4.137	0.2658			0.000	14.756	58.912		990.8	
4,200,000	1,458	Leonard	1100	8520	50.702	4.137	0.2658	45	0.18	0.048	14.804	65.506		984.2	
4,200,000	1,458	Leonard	100	8620	51.297	4.137	0.2658	45	0.18	0.048	14.852	66.149	920.0	983.6	63.6
4,200,000	1,458	Leonard	1460	10080	59.985	4.137	0.2658			0.000	14.852	74.837		974.9	
4,200,000	1,458	Anabelle	500	10580	62.961	4.137	0.2658	2-45	0.36	0.096	14.947	77.908	920.0	971.8	51.8
4,200,000	1,458		145	10725	63.823	4.137	0.2658	2-45	0.36	0.096	15.043	78.867		970.9	
4,200,000	1,458		250	10975	65.311	4.137	0.2658	11.25	0.05	0.013	15.056	80.368		969.4	
4,200,000	1,458		230	11205	66.680	4.137	0.2658	45	0.18	0.048	15.104	81.784		968.0	
4,200,000	1,458		50	11255	66.977	4.137	0.2658	45, 11.25	0.23	0.061	15.165	82.143		967.6	
4,200,000	1,458		65	11320	67.364	4.137	0.2658	2-45	0.36	0.096	15.261	82.625		967.1	
4,200,000	1,458		95	11415	67.930	4.137	0.2658	45, 11.25	0.23	0.061	15.322	83.252		966.5	
4,200,000	1,458	Wineteer	260	11675	69.477	4.137	0.2658	45	0.18	0.048	15.370	84.847	918	964.9	46.9
4,200,000	1,458	Wineteer	260	11935	71.024	4.137	0.2658	45, 22.5	0.26	0.069	15.439	86.463		963.3	
4,200,000	1,458	Wineteer	160	12095	71.976	4.137	0.2658	22.5	0.08	0.021	15.460	87.437		962.3	
4,200,000	1,458	Wineteer	135	12230	72.780	4.137	0.2658	2-45	0.36	0.096	15.556	88.336		961.4	
4,200,000	1,458		160	12390	73.732	4.137	0.2658	2-45	0.36	0.096	15.652	89.383		960.4	
4,200,000	1,458		100	12490	74.327	4.137	0.2658	2-45	0.36	0.096	15.747	90.074		959.7	
4,200,000	1,458		330	12820	76.291	4.137	0.2658	2-45	0.36	0.096	15.843	92.134	927	957.6	30.6
4,200,000	1,458	Shady Ln	95	12915	76.856	4.137	0.2658	2-45	0.36	0.096	15.939	92.795	927	956.9	29.9
4,200,000	1,458		770	13685	81.438	4.137	0.2658	45	0.18	0.048	15.987	97.425		952.3	
4,200,000	1,458	Redwood	170	13855	82.450	4.137	0.2658	22.5, 11.25	0.13	0.035	16.021	98.471	930	951.3	21.3
4,200,000	1,458		260	14115	83.997	4.137	0.2658	45	0.18	0.048	16.069	100.066		949.7	
4,200,000	1,458		250	14365	85.485	4.137	0.2658	22.5	0.08	0.021	16.090	101.575	931	948.2	17.2
4,200,000	1,458		90	14455	86.020	4.137	0.2658	45	0.18	0.048	16.138	102.158		947.6	
4,200,000	1,458	Daisy Ln	30	14485	86.199	4.137	0.2658	45	0.18	0.048	16.186	102.385	932	947.3	15.3
4,200,000	1,458		610	15095	89.829	4.137	0.2658	2-45	0.36	0.096	16.282	106.110		943.6	
4,200,000	1,458	Pansy Ln	440	15535	92.447	4.137	0.2658	2-45	0.36	0.096	16.377	108.824	929	940.9	11.9
4,200,000	1,458		470	16005	95.244	4.137	0.2658	45, 11.25	0.23	0.061	16.438	111.683		938.1	
4,200,000	1,458	Fairgrounds	260	16265	96.791	4.137	0.2658	22.5, 11.25	0.13	0.035	16.473	113.264		936.5	
4,200,000	1,458		160	16425	97.744	4.137	0.2658	22.5	0.08	0.021	16.494	114.238		935.5	
4,200,000	1,458		130	16555	98.517	4.137	0.2658	22.5, 11.25	0.13	0.035	16.529	115.046		934.7	
4,200,000	1,458	West Park	560	17115	101.850	4.137	0.2658	22.5, 11.25	0.13	0.035	16.563	118.413		931.3	
4,200,000	1,458		250	17365	103.337	4.137	0.2658	45	0.18	0.048	16.611	119.948		929.8	
4,200,000	1,458		200	17565	104.528	4.137	0.2658	45, 11.25	0.23	0.061	16.672	121.200	927	928.5	1.5
4,200,000	1,458		50	17615	104.825	4.137	0.2658	45, 11.25	0.23	0.061	16.733	121.558		928.2	
4,200,000	1,458		135	17750	105.628	4.137	0.2658	45, 11.25	0.23	0.061	16.794	122.423	914	927.3	13.3
4,200,000	2,917	S. Abutment	20	17770	105.773	5.295	0.4354	2-45, 2-22.5, GV, Y	1.07	0.466	17.260	123.034	912	926.5	14.5
4,200,000	2,917	Pier	100	17870	106.498	5.295	0.4354	11.25, AV	0.2	0.087	17.347	123.845	917	925.7	8.7
4,200,000	2,917	Pier	290	18160	108.598	5.295	0.4354	11.25, AV	0.2	0.087	17.435	126.033	917	923.5	6.5
4,200,000	2,917	N. Abutment	240	18400	110.337	5.295	0.4354	2-45, 2-22.5, GV, Y	1.07	0.466	17.900	128.237	907	921.3	14.3
4,200,000	1,458		60	18460	110.694	4.137	0.2658	45	0.18	0.048	17.948	128.642	907	921.1	14.1
4,200,000	1,458	All Sports P.	170	18630	111.706	4.137	0.2658	45, 22.5	0.26	0.069	18.017	129.723		920.0	
4,200,000	1,458		740	19370	116.109	4.137	0.2658	45, 22.5	0.26	0.069	18.086	134.196		915.5	
4,200,000	1,458		320	19690	118.014	4.137	0.2658	2-45	0.36	0.096	18.182	136.196		913.5	
4,200,000	1,458		370	20060	120.216	4.137	0.2658	2-45	0.36	0.096	18.278	138.493		911.2	
4,200,000	1,458	GP WWTP	100	20160	120.811	4.137	0.2658	2-45	0.36	0.096	18.373	139.184	904	910.6	6.6

APPENDIX D

PRELIMINARY CONSTRUCTION COST OPINIONS

Estimate Of Most Probable Construction Costs				
Based on Preliminary Design Documents				
Redwood Pump Station				
Description	Qty	Unit	Unit Price	Estimated Cost
DIVISION 1				
Mobilization/demobilization for listed items	1	LS	8%	\$15,500
DIVISION 2 - SITE WORK/DEMOLITION/ETC				
Demolition and equipment removal	1	LS	\$5,000	\$5,000
Dewatering	1	LS	\$1,000	\$1,000
Earthwork				
Clearing, grubbing, and stripping	1	LS	\$1,000.00	\$1,000
Grading	1	LS	\$1,000.00	\$1,000
Trench and Structure Excavation	85	CY	\$16.80	\$1,430
Pipe Bedding/Structural base	16	CY	\$30.00	\$472
Subsequent Backfill	20	CY	\$20.00	\$407
Pea gravel for filling abandoned pump chambe	24	CY	\$9.00	\$220
Landscaping	1	LS	\$500.00	\$500
Temporary By-Pass Pumping	1	LS	\$20,000	\$20,000
DIVISION 3 - CONCRETE				
Precast conc. structures				
9' x 5' precast conc vault	1	EA	\$2,590	\$2,590
7' x 7' precast conc vault	1	EA	\$2,320	\$2,320
DIVISION 5 - METAL				
Pipe Cradles	3	EA	\$200	\$600
Pipe Supports	2	EA	\$1,200	\$2,400
DIVISION 10 - SPECIALTIES				
Odor Control	2	EA	\$1,500	\$3,000
DIVISION 11 - EQUIPMENT				
Pumps, installed 300 gpm, 15 HP	2	EA	\$15,000	\$30,000
Pumps Guide Rails	2	EA	\$1,200	\$2,400
DIVISION 13 - SPECIAL				
4" Magnetic Flow Meter w/ remote readout	1	LS	\$4,500	\$4,500
DIVISION 15 - MECHANICAL				
Pressure gauges w/ appurtenances	2	EA	\$500	\$1,000
Piping w/o earthwork:				
3" CIP	45	LF	\$23	\$1,035
4" DIP	60	LF	\$25	\$1,500
6" DIP	30	LF	\$30	\$900
6" DIP Pig Port Assembly	1	LS	\$1,000	\$1,000
Fittings:				
3" 45 deg Elbow (MJ)	2	EA	\$100	\$200
4" 45 deg Elbow (MJ)	2	EA	\$150	\$300
6" 45 deg Elbow (MJ)	2	EA	\$200	\$400
3" 90 deg Elbow (MJ)	2	EA	\$125	\$250
4" 90 deg Elbow (FL)	2	EA	\$175	\$350
6"x3" Tee (MJ)	1	EA	\$200	\$200
6"x4" Tee (MJ)	1	EA	\$250	\$250
3" Wye (MJ)	2	EA	\$125	\$250
Valves:				
3" Tide Flex Valve	1	EA	\$500	\$500
3" Plug Valve (MJ)	2	EA	\$400	\$800
4" Plug Valve (FL)	2	EA	\$500	\$1,000
6" Plug Valve (FL)	1	EA	\$600	\$600

Estimate Of Most Probable Construction Costs				
Based on Preliminary Design Documents				
Redwood Pump Station				
Description	Qty	Unit	Unit Price	Estimated Cost
4" Swing Check Valve (FL)	2	EA	\$750	\$1,500
3" Vacuum Release Valve Assembly	1	EA	\$600	\$600
2" Air Release Valve Assembly	1	EA	\$400	\$400
Floor Drains	2	EA	\$200	\$400
3" Clean-out	2	EA	\$250	\$500
Vent piping	1	LS	\$800	\$800
DIVISION 16 - ELECTRICAL (See Note 1)				
Service, Distribution, 2 variable frequency drives (6-pulse w/filter) and 50 kW Generator	1	LS	\$65,000	\$65,000
Instrumentation and Control	1	LS	\$35,000	\$35,000
Total				\$209,100
Note 1: Estimated electrical and instrumentation cost from similar project; costs can be variable and is subject to complexity of options selected.				

Estimate Of Most Probable Construction Costs				
Based on Preliminary Design Documents				
RI-24 Pump Station				
Description	Qty	Unit	Unit Price	Estimated Cost
DIVISION 1				
Mobilization/demobilization for listed items	1	LS	8%	\$91,700
DIVISION 2 - SITE WORK/DEMOLITION/ETC				
Dewatering - for 45 days	45	days	\$1,000	\$45,000
Earthwork				
Clearing, grubbing, and stripping	1	LS	\$1,000	\$1,000
Grading	1	LS	\$1,000	\$1,000
Trench and Structure Excavation	1120	CY	\$16.80	\$18,820
Shoring - (33*25 + 32*25 + 25*16)*2	4050	SF	\$20	\$81,000
Pipe Bedding/Structural base	75	CY	\$36	\$2,700
Subsequent Backfill	440	CY	\$20	\$8,800
Crushed Surfacing	259	CY	\$30	\$7,780
Adjust Upstream Manhole	1	LS	\$500	\$500
Landscaping (See Note 1)	1	LS	\$5,000	\$5,000
Fencing	215	LF	\$30	\$6,450
Gate - 30'	1	EA	\$1,750	\$1,750
DIVISION 3 - CONCRETE				
Conc. structures w/o earthwork				
Cast-in-place conc vault	210	CY	\$500	\$105,000
DIVISIONS 3-9 - BUILDING				
Building	1080	SF	\$150	\$162,000
DIVISION 5 - METAL				
Pipe Cradles	3	EA	\$200	\$600
Pipe Supports	2	EA	\$1,200	\$2,400
Stairs	28	Riser	\$140	\$3,920
Ladder	10	LF	\$86	\$860
Aluminum Handrail	60	LF	\$40	\$2,400
Aluminum Grating	24	SF	\$18	\$432
DIVISION 8 - DOORS & WINDOWS				
Building cost includes doors				
Valve Vault Door 4'x4'	16	SF	\$180	\$2,880
Valve Vault Door 5'x5'	25	SF	\$180	\$4,500
DIVISION 10 - SPECIALTIES				
Louvers	33	SF	\$92	\$3,036
Louver Motorized Operator	1	EA	\$300	\$300
Fire Extinguisher	1	EA	\$135	\$135
Water Closet	1	EA	\$600	\$600
Water Heater	1	EA	\$570	\$570
Sink	1	EA	\$600	\$600
DIVISION 11 - EQUIPMENT				
Pumps, installed 1500 gpm, 125 HP	3	EA	\$32,000	\$96,000
Sump Pump	1	EA	\$1,320	\$1,320
Air Gap Unit	1	EA	\$3,000	\$3,000
DIVISION 13 - SPECIAL				
Magnetic Flow Meter w/ remote readout	2	EA	\$6,500	\$13,000
DIVISION 14 -				
Monorail	1	EA	\$20,000	\$20,000
DIVISION 15 - MECHANICAL				
Pressure gauges w/ appurtenances	3	EA	\$500	\$1,500
Piping w/o earthwork:				
Misc small piping	1	LS	\$5,000	\$5,000

Estimate Of Most Probable Construction Costs				
Based on Preliminary Design Documents				
RI-24 Pump Station				
Description	Qty	Unit	Unit Price	Estimated Cost
8" DIP (FL)	75	LF	\$40	\$3,000
10" DIP (FL)	25	LF	\$50	\$1,250
12" DIP (MJ)	90	LF	\$43	\$3,870
12" DIP Pig Port Assembly	1	LS	\$2,500	\$2,500
Fittings:				
8" 45 deg Elbow (FL)	2	EA	\$175	\$350
8" 90 deg Elbow (FL)	7	EA	\$200	\$1,400
8" TEE (FL)	3	EA	\$270	\$810
6"x8" eccemtric reducer (FL)	3	EA	\$210	\$630
8"x10" eccentric reducer (FL)	3	EA	\$382	\$1,146
10" 90 deg Elbow (FL)	3	EA	\$350	\$1,050
12" 90 deg Elbow (MJ)	2	EA	\$380	\$760
12" 45 deg Elbow (MJ)	2	EA	\$350	\$700
16" Suction Bell (FL)	3	EA	\$600	\$1,800
Valves:				
8" Plug Valve (FL)	3	EA	\$1,500	\$4,500
8" Swing Check Valve (FL)	3	EA	\$1,350	\$4,050
8" Electrically controlled plug valve	2	EA	\$3,780	\$7,560
10" Knife Gate Valve	3	EA	\$1,700	\$5,100
12" Resilient Seated Gate Valve	2	EA	\$2,000	\$4,000
3" Vacuum Release Valve Assembly	2	EA	\$600	\$1,200
2" Air Release Valve Assembly	2	EA	\$400	\$800
12" Sluice Gate	1	EA	\$2,500	\$2,500
Vent piping	1	LS	\$600	\$600
Water Meter	1	LS	\$500	\$500
Outdoor Hose Bibb Station	1	LS	\$900	\$900
Heating and Ventilation	1	LS	\$15,000	\$15,000
Noise Panels	5	EA	\$300	\$1,500
DIVISION 16 - ELECTRICAL (See Note 2)				
Incoming Service Cabinet	1	LS	\$10,000	\$10,000
Main Service Disconnect	1	LS	\$25,000	\$25,000
Emergency Generator Circuit Breaker	1	LS	\$20,000	\$20,000
Data IQ Unit	1	LS	\$3,500	\$3,500
300 KW Generator and ATS	1	LS	\$60,000	\$60,000
Main Power Distribution Panel	1	LS	\$25,000	\$25,000
Active Filter System	1	LS	\$40,000	\$40,000
Transformer	1	LS	\$3,000	\$3,000
Lighting, Switches, Receptacles	1	LS	\$22,000	\$22,000
MCC	1	LS	\$28,800	\$28,800
VFDs (6-pulse)	3	EA	\$27,114	\$81,342
Control Panels	1	LS	\$44,570	\$44,570
Junction Boxes	2	EA	\$4,300	\$8,600
Instruments	1	LS	\$28,800	\$28,800
Conduit	1	LS	\$53,500	\$53,500
Wirefill	1	LS	\$15,000	\$15,000
Total				\$1,238,100
Notes:				
1. Landscape cost is highly variable - depends on owner preference.				
2. Estimated electrical and instrumentation cost from similar project; costs can be variable and is subject to complexity of options selected.				

FORCE MAINS - RWWTP TO RI-24 TO GPWRP

PREDESIGN OPINION OF PROBABLE CONSTRUCTION COST GREEN/RED/GREEN - RWWTP PUMP STATION, ON EXISTING EASEMENTS TO RI-24 PUMP STATION, LEONARD RD TO PEDESTRIAN BRIDGE, TO GPWRP

Item	Item Description	Units	Estimated Quantity	Unit Price	Total
1	Mobilization	LS	8%	\$191,700.00	\$191,700
2	General Conditions ¹	LS	5%	\$119,800.00	\$119,800
3	6" C-900 Pipe	LF	9,200	\$11.00	\$101,200
4	Excavation and Backfill for 6" pipe	CY	5,137	\$8.10	\$41,610
5	Bedding for 6" pipe	CY	2,120	\$28.82	\$61,098
6	Restoration - Road for 6" pipe	LF	1,900	\$7.00	\$13,300
7	Restoration - Unimproved for 6" pipe	LF	6,545	\$2.00	\$13,090
8	Restoration - Landscaping for 6" pipe	LF	360	\$17.00	\$6,120
9	Ductile Iron Fittings for 6" pipe	EACH	17	\$224.00	\$3,808
10	6" Gate Valve	EACH	2	\$650.00	\$1,300
11	Creek Crossing-Jacking - 24" Dia Casing	LF	425	\$370.00	\$157,250
12	Dual 12" C-900 Pipe	LF	19,270	\$43.00	\$828,610
13	Excavation and Backfill for dual 12" pipe	CY	21,411	\$8.10	\$173,429
14	Bedding for dual 12" pipe	CY	9,813	\$28.92	\$283,792
15	Restoration - Whole Lane for dual 12" pipe	LF	5,570	\$36.34	\$202,414
16	Restoration - Road for dual 12" pipe	LF	7,600	\$12.21	\$92,796
17	Restoration - Unimproved for dual 12" pipe	LF	4,620	\$2.05	\$9,471
18	Restoration - Landscaping for dual 12" pipe	LF	1,480	\$17.00	\$25,160
19	Ductile Iron Fittings for dual 12" pipe	EACH	102	\$556.00	\$56,712
20	Creek Crossing-Jacking - 36" Dia Casing	LF	140	\$465.00	\$65,100
21	12" Gate Valve	EACH	6	\$1,500.00	\$9,000
22	14" Ductile Iron Pipe	LF	850	\$99.00	\$84,150
23	14" Gate Valve	EACH	2	\$4,700.00	\$9,400
24	2" Air Release Valve, Carbon Cannister, and Vault	EACH	10	\$5,800.00	\$58,000
25	3" Vacuum Release Valve and Vault	EACH	9	\$5,000.00	\$45,000
26	Carbon Cannister on Pedestrian Bridge	EACH	2	\$4,200.00	\$8,400
27	Traffic Control	LS	1	\$35,840.00	\$35,840
28	Potential Utility Conflicts	LS	1	\$10,000.00	\$10,000
Total					\$2,707,550

Notes:

(1) General Conditions includes bonds, insurance etc.