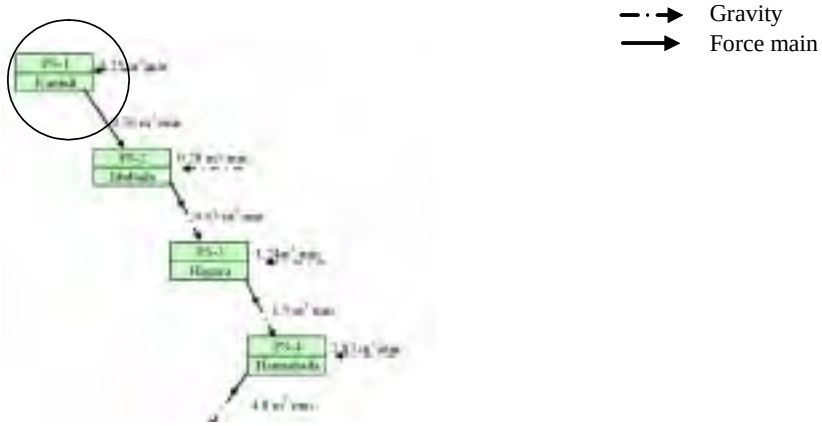
SECTION C1: Calculation Sheets of Mechanical Equipment

C1.1 Calculation Sheets of Pumping Stations

Kanudi Pumping Station (PS-01)



Design Condition

1) Design Flow

Qadf : Daily average flow
Qpdf : Peak flow (Ultimate) Qpdf = 2.0 × Qadf

2) Type of Pumping Station

Type A	Submersible station
Basket	Installed

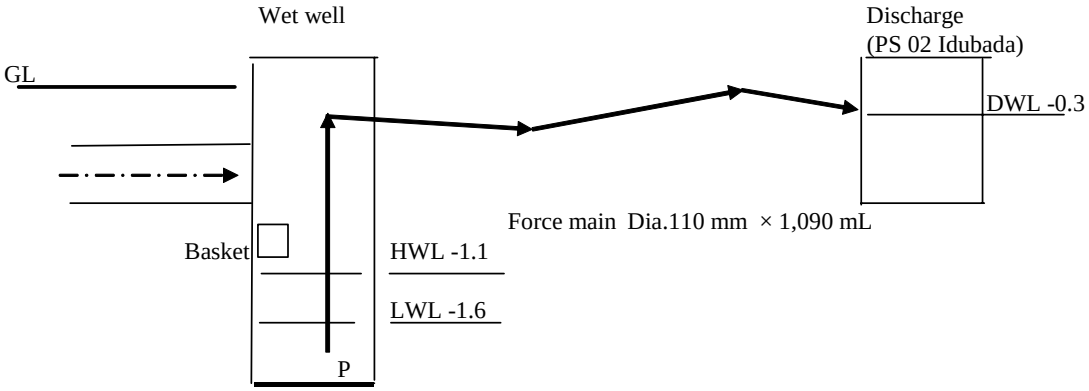
3) Pump Number and capacity

Pump number :	1 duty + 1 standby

4) Force Main

Material :	HDPE
Diameter :	Dia.110 mm
Line number:	1 line

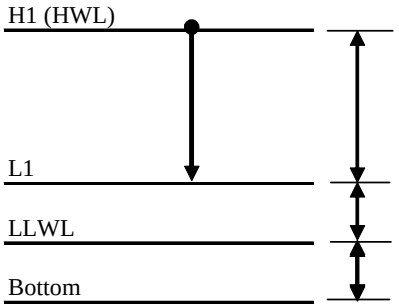
5) Outline (Assume)



Lifting Pump Calculation Sheet (PS-01)

ITEM	SYMBOL	DESIGN		
1.1 Pump Sump Well				
Pump starts per hour	n	Motor 5.5kW < 7.5kW (F.W.)		4 times
Pump capacity	Q			6.0 L/sec/unit
Required volume	v	= 900 × Q / n/1000	≥	1.35 m^3
Sump Well squere	A			4.90 m^2 Dia. 2.5m

Water Level in the Sump Well



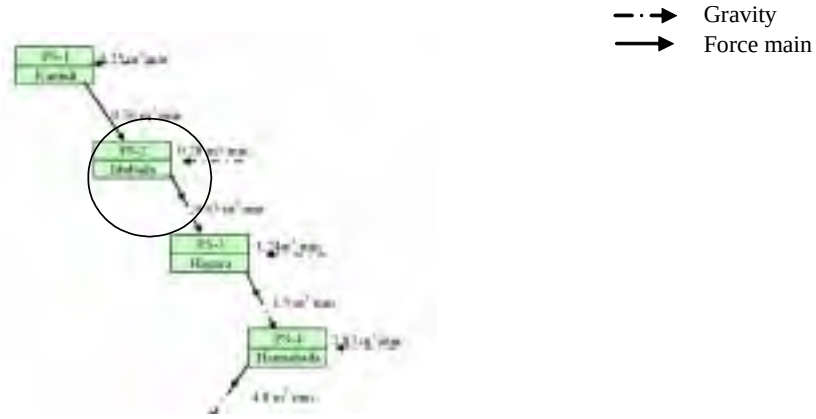
1.2 Lift Pump				
Design flow	Qpdf			0.36 m^3/min
			=	6.0 L/sec
Duty pump number				1 unit
Design flow per unit		Considered pipe velocity > 0.6m/s	⇒	6.0 L/sec/unit
Specification				
Type		**Submersible non-clog sewage pump, automatic coupling type**		
Dia.	**D**		**Approx.**	**100 mm**
Capacity	**Qp**			**6.0 L/sec/unit**
			=	**0.36 m^3/min/unit**
Total head	**H**	**attached Table Pump calculation sheet**		**14.0 m**
Motor	**P**	**attached Table Pump calculation sheet**	**Approx.**	**5.5 kW**
Number		**Duty**		**1 unit**
		Standby		**1 unit**
		Total		**2 units**
1.3 Monorail Hoist				
Weight of pump	W		Approx.	0.20 Tonf
Required hoist capacity	hc	W × 1.5	≥	0.30 Tonf
Specification				
Type		**Manually Geared trolley**		
Capacity				**0.5 Tonf**
Lift			**Approx.**	**3.0 m**
Number		**Duty**		**1 unit**
		Standby		**0 unit**
		Total		**1 unit**

Lifting Pump Calculation Sheet (PS-01)

1	Equip. No.		**M01-001-01/02**				
	Pump Name		**Lifting Pump-1**				
2	Pump Type		Submersible	Submersible			
3	**q : Capacity (m^3/min)**		**0.36**	**0.36**			
4	**N : Operation number**		**1**	**1**			
	Pump		6.0L/s	6.0L/s			
	Pump Number		1D + 1S	1D + 1S			
	Total Head H=ha+hf1+hf2+hf3+hf4						
5	ha	:Actual head (m)	2.7	1.3			
		=DWL-SWL					
6	DWL	(m)	1.100	-0.300			
7	SWL	(m)	-1.600	-1.600			
8	hf1	: Straight pipe loss (m) =	6.031	9.812			
		(10.666 × Q^1.85) × L × Cc					
		(C^1.85×D^4.87)					
9	Q	: Flow (m^3/sec)	0.006	0.006			
		=q × N/60					
10	C	: Coefficient	**130**	**130**			
			0.11m × 1 line	0.11m × 1 line			
11	D	: Inner Pipe Dia. (m)	0.0964	0.0964			
12	L	: Pipe length (m)	670	1090			
13	Cc	: Correction coefficient	1.0	1.0			
		Water: 1.0					
		Sludge: WT99.2% :					
14	hf2		0.000	0.000			
15	hf3	: Pump around loss (m)	2	2			
16	hf4	:Other head	0	0			
17	H'	=ha+hf1+hf2+hf3+hf4 (m)	10.73	13.11			
18	**H**	**: Total head (m)**	**11.0**	**14.0**			
		Velocity	0.82	0.82			
	Motor Power						
19	BKW	=0.163*SG*q*H/Pe (kW)	2.152	2.738			
20	SG	:Specific gravity	1.0	1.0			
21	Pe	:Pump efficiency	0.3	0.3			
22	kW	=BKW × C	2.474	3.149			
23	C	:Coefficient (1.15)	1.15	1.15			
24	**Motor Power (kW)**			**5.5**			

(adoption)

Idubada Pumping Station (PS-02)



Design Condition

1) Design Flow

Qadf : Daily average flow
Qpdf : Peak flow (Ultimate) Qpdf = 2.0 × Qadf

2) Type of Pumping Station

Type A	Submersible station
Basket	Installed

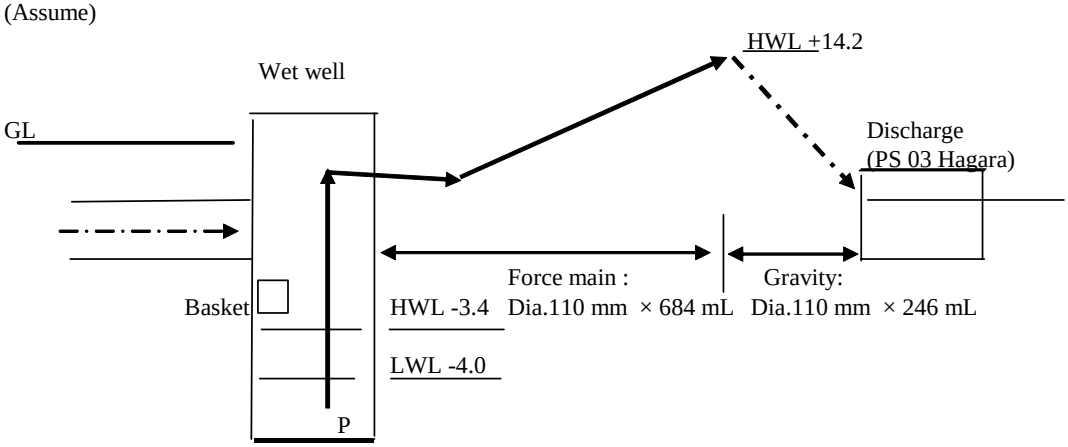
3) Pump Number and capacity

Pump number :	1 duty + 1 standby

4) Force Main

Material :	HDPE
Diameter :	Dia.110 mm
Line number:	1 line

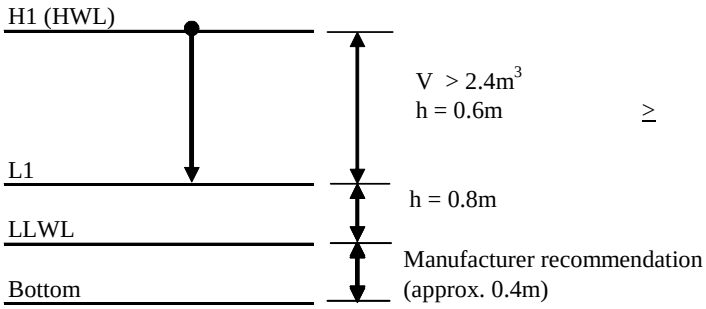
5) Outline (Assume)



Lifting Pump Calculation Sheet (PS-02)

ITEM	SYMBOL	DESIGN			
2.1 Pump Sump Well					
Required cycle time	n	Motor = 22kW (F.W.)		4	times
Pump capacity	Q			10.80	L/sec/unit
Required volume	v	= 900 × Q / n/1000	≥	2.4	m^3
Sump Well squere	A			4.90	m^2 Dia. 2.5m

Water Level in the Sump Well



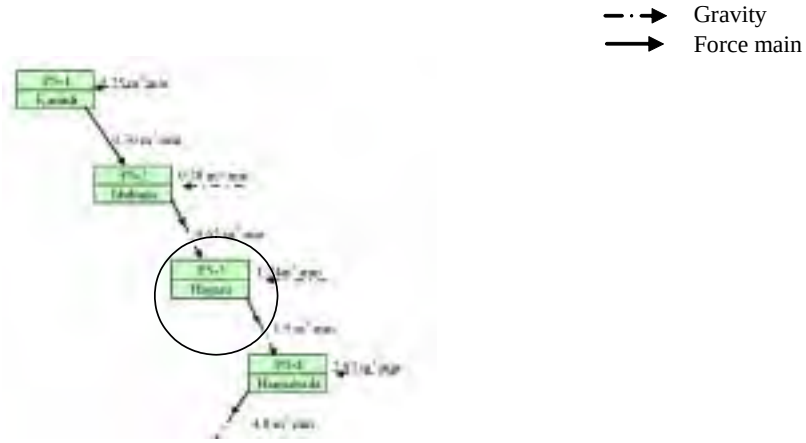
2.2 Lift Pump					
Duty pump number				1	unit
Design flow per unit				10.8	L/sec/unit
Specification					
Type		**Submersible non-clog sewage pump, automatic coupling type**			
Dia.	**D**		**Approx.**	**100**	**mm**
Capacity	**Qp**			**10.8**	**L/sec/unit**
			=	**0.65**	**m^3/min/unit**
Total head	**H**	**attached Table Pump calculation sheet**		**40.0**	**m**
Motor	**P**	**attached Table Pump calculation sheet**	**Approx.**	**22.0**	**kW**
Number		**Duty**		**1**	**unit**
		Standby		**1**	**unit**
		Total		**2**	**units**
2.3 Monorail Hoist					
Weight of pump	W		Approx.	0.50	Tonf
Required hoist capacity	hc	W × 1.5	≥	0.75	Tonf
Specification					
Type		**Manually Geared trolley**			
Capacity				**1.0**	**Tonf**
Lift			**Approx.**	**3.0**	**m**
Number		**Duty**		**1**	**unit**
		Standby		**0**	**unit**
		Total		**1**	**unit**

Lifting Pump Calculation Sheet (PS-02)

1	Equip. No.		**M01-002-01/02**				
	Pump Name		**Lifting Pump-2**				
2	Pump Type		Submersible	Submersible			
3	**q : Capacity (m^3/min)**		**0.65**	**0.65**			
4	**N : Operation number**		**1**	**1**			
	Pump		10.8L/s	10.8L/s			
	Pump Number		1D + 1S	1D + 1S			
	Total Head H=ha+hf1+hf2+hf3+hf4						
5	ha	:Actual head (m)	4.2	18.2			
		=DWL-SWL					
6	DWL	(m)	0.200	14.200			
7	SWL	(m)	-4.000	-4.000			
8	hf1	: Straight pipe loss (m) =	24.977	18.370			
		(10.666 × Q^1.85) × L × Cc					
		(C^1.85×D^4.87)					
9	Q	: Flow (m^3/sec)	0.011	0.011			
		=q × N/60					
10	C	: Coefficient	**130**	**130**			
			0.11m × 1 line	0.11m × 1 line			
11	D	: Inner Pipe Dia. (m)	0.0964	0.0964			
12	L	: Pipe length (m)	930	684			
13	Cc	: Correction coefficient	1.0	1.0			
		Water: 1.0					
		Sludge: WT99.2% :					
14	hf2		0.000	0.000			
15	hf3	: Pump around loss (m)	2	2			
16	hf4	:Other head	0	0			
17	H'	=ha+hf1+hf2+hf3+hf4 (m)	31.18	38.57			
18	**H**	**: Total head (m)**	**30.0**	**40.0**			
		Velocity	1.49	1.49			
	Motor Power						
19	BKW	=0.163*SG*q*H/Pe (kW)	10.595	14.127			
20	SG	:Specific gravity	1.0	1.0			
21	Pe	:Pump efficiency	0.3	0.3			
22	kW	=BKW × C	12.184	16.246			
23	C	:Coefficient (1.15)	1.15	1.15			
24	**Motor Power (kW)**			**22**			

(adoption)

Hagara Pumping Station (PS-03)



Design Condition

1) Design Flow

Qadf : Daily average flow
Qpdf : Peak flow (Ultimate) Qpdf = 2.0 × Qadf

2) Type of Pumping Station

Type A	Submersible station
Basket	Installed

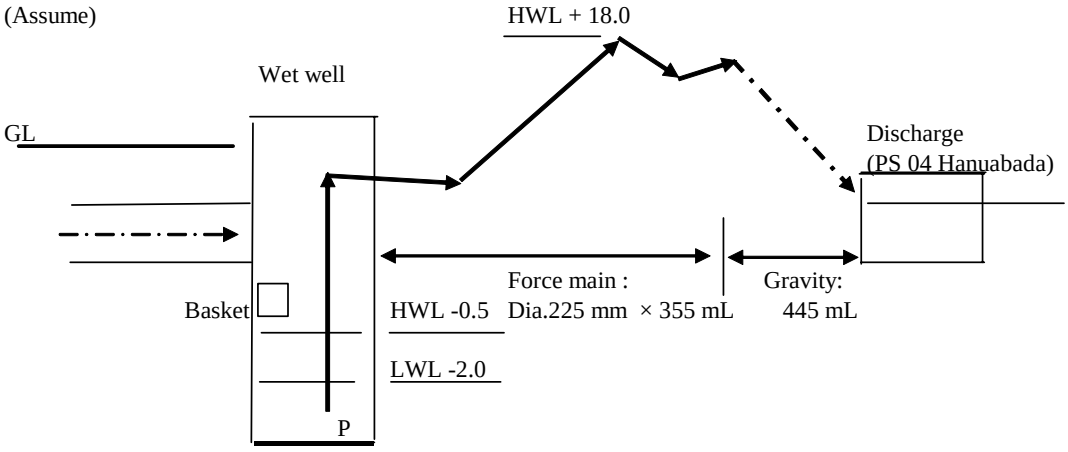
3) Pump Number and capacity

Pump number :	1 duty + 1 standby

4) Force Main

Material :	HDPE
Diameter :	Dia.225 mm
Line number:	1 line

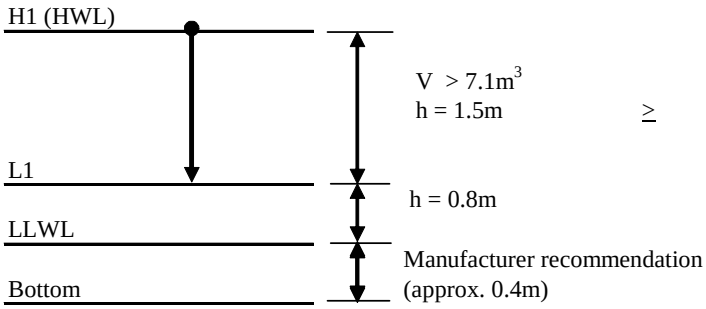
5) Outline (Assume)



Lifting Pump Calculation Sheet (PS-03)

ITEM	SYMBOL	DESIGN			
3.1 Pump Sump Well					
Required cycle time	n	Motor =22kW (F.W.)		4	times
Pump capacity	Q			31.6	L/sec/unit
Required volume	v	= 900 × Q / n/1000	≥	7.1	m^3
Sump Well squere	A			4.90	m^2 Dia. 2.5m

Water Level in the Sump Well



3.2 Lift Pump					
Duty pump number				1	unit
Design flow per unit				31.6	L/sec/unit
Specification					
Type		**Submersible non-clog sewage pump, automatic coupling type**			
Dia.	**D**		**Approx.**	**100**	**mm**
Capacity	**Qp**			**31.6**	**L/sec/unit**
			=	**1.9**	**m^3/min/unit**
Total head	**H**	**attached Table Pump calculation sheet**		**25.0**	**m**
Motor	**P**	**attached Table Pump calculation sheet**	**Approx.**	**22.0**	**kW**
Number		**Duty**		**1**	**unit**
		Standby		**1**	**unit**
		Total		**2**	**units**
3.3 Monorail Hoist					
Weight of pump	W		Approx.	0.50	Tonf
Required hoist capacity	hc	W × 1.5	≥	0.75	Tonf
Specification					
Type		**Manually Geared trolley**			
Capacity				**1.0**	**Tonf**
Lift			**Approx.**	**3.0**	**m**
Number		**Duty**		**1**	**unit**
		Standby		**0**	**unit**
		Total		**1**	**unit**

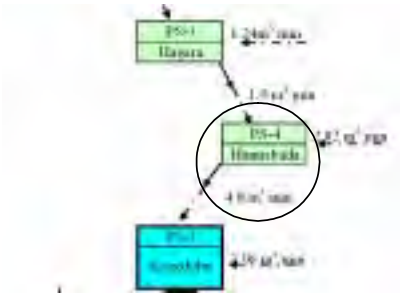
Lifting Pump Calculation Sheet (PS-03)

1	Equip. No.		**M01-003-01/02**				
	Pump Name		**Lifting Pump-3**				
2	Pump Type		Submersible	Submersible			
3	**q : Capacity (m^3/min)**		**1.9**	**1.9**			
4	**N : Operation number**		**1**	**1**			
	Pump		31.6L/s	31.6L/s			
	Pump Number		1D + 1S	1D + 1S			
	Total Head H=ha+hf1+hf2+hf3+hf4						
5	ha	:Actual head (m)	20.0	11.2			
		=DWL-SWL					
6	DWL	(m)	18.000	9.200			
7	SWL	(m)	-2.000	-2.000			
8	hf1	: Straight pipe loss (m) =	2.104	4.742			
		(10.666 × Q^1.85) × L × Cc					
		(C^1.85×D^4.87)					
9	Q	: Flow (m^3/sec)	0.032	0.032			
		=q × N/60					
10	C	: Coefficient	**130**	**130**			
			0.225m × 1 lin	0.225m × 1 line			
11	D	: Inner Pipe Dia. (m)	0.1976	0.1976			
12	L	: Pipe length (m)	355	800			
13	Cc	: Correction coefficient	1.0	1.0			
		Water: 1.0					
		Sludge: WT99.2% :					
14	hf2		0.000	0.000			
15	hf3	: Pump around loss (m)	2	2			
16	hf4	:Other head	0	0			
17	H'	=ha+hf1+hf2+hf3+hf4 (m)	24.10	17.94			
18	**H**	**: Total head (m)**	**25.0**	**18.0**			
		Velocity	1.03	1.03			
	Motor Power						
19	BKW	=0.163*SG*q*H/Pe (kW)	15.485	11.149			
20	SG	:Specific gravity	1.0	1.0			
21	Pe	:Pump efficiency	0.5	0.5			
22	kW	=BKW × C	17.808	12.822			
23	C	:Coefficient (1.15)	1.15	1.15			
24	**Motor Power (kW)**		**22**				

(adoption)

Hanuabada Pumping Station (PS-04)

Gravity
Force main



Design Condition

1) Design Flow

Qadf : Daily average flow
Qpdf : Peak flow (Ultimate) Qpdf = 2.0 × Qadf

2) Type of Pumping Station

Type B	Submersible station
Basket	Installed

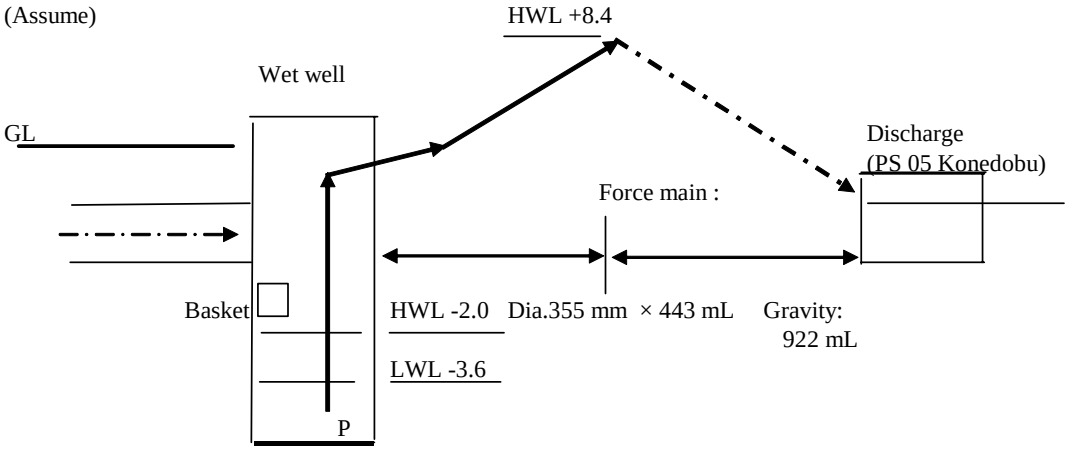
3) Pump Number and capacity

Pump number :	1 duty + 1 standby

4) Force Main

Material :	HDPE
Diameter :	Dia.355 mm
Line number:	1 line

5) Outline (Assume)



Lifting Pump Calculation Sheet (PS-04)

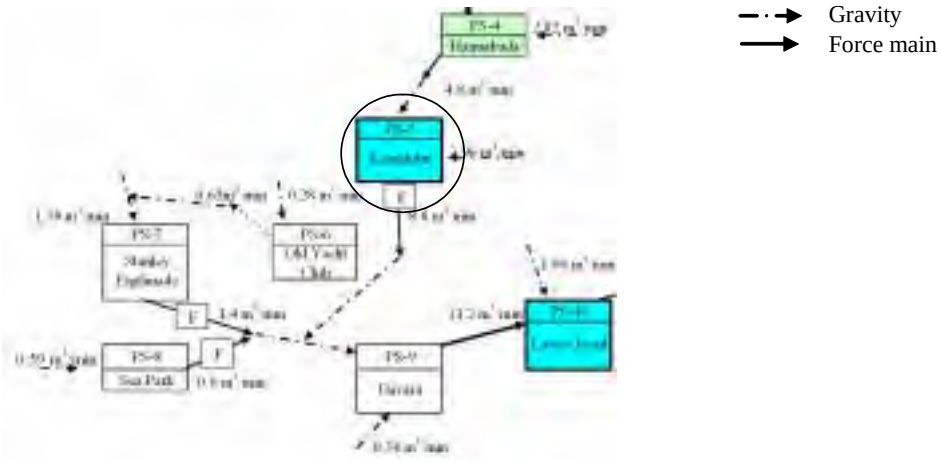
ITEM	SYMBOL	DESIGN			
4.1 Pump Sump Well					
Required cycle time	n	Motor = 22kW (F.W.)		4	times
Pump capacity	Q			80.0	L/sec/unit
Required volume	v	= 900 × Q / n/1000	≥	18.0	m^3
Sump Well squere	A			12.00	m^2 4.0m × 3.0m
Water Level in the Sump Well					
H1 (HWL)		V > 18m^3			
		h = 1.6m	≥	1.50	m
L1		h = 0.45m			
LLWL		Manufacturer recommendation			
Bottom		(approx. 0.55m)			
4.2 Lift Pump					
Duty pump number				1	unit
Design flow per unit				63.3	L/sec/unit
Specification					
Type		**Submersible non-clog sewage pump, automatic coupling type**			
Dia.	**D**		**Approx.**	**200**	**mm**
Capacity	**Qp**			**80.0**	**L/sec/unit**
			=	**4.8**	**m^3/min/unit**
Total head	**H**	**attached Table Pump calculation sheet**		**17.0**	**m**
Motor	**P**	**attached Table Pump calculation sheet**	**Approx.**	**22.0**	**kW**
Number		**Duty**		**1**	**unit**
		Standby		**1**	**unit**
		Total		**2**	**units**
4.3 Monorail Hoist					
Weight of pump	W		Approx.	1.00	Tonf
Required hoist capacity	hc	W × 1.5	≥	1.50	Tonf
Specification					
Type		**Manually Geared trolley**			
Capacity				**2.0**	**Tonf**
Lift			**Approx.**	**3.0**	**m**
Number		**Duty**		**1**	**unit**
		Standby		**0**	**unit**
		Total		**1**	**unit**

Lifting Pump Calculation Sheet (PS-04)

1	Equip. No.		**M01-004-01/02**				
	Pump Name		**Lifting Pump-4**				
2	Pump Type		Submersible	Submersible			
3	**q : Capacity (m^3/min)**		**4.8**	**4.8**			
4	**N : Operation number**		**1**	**1**			
	Pump		80.0 L/s	80.0 L/s			
	Pump Number		1D + 1S	1D + 1S			
	Total Head H=ha+hf1+hf2+hf3+hf4						
5	ha	:Actual head (m)	3.7	12.1			
		=DWL-SWL					
6	DWL	(m)	0.000	8.400			
7	SWL	(m)	-3.700	-3.700			
8	hf1	: Straight pipe loss (m) =	4.859	1.577			
		(10.666 × Q^1.85) × L × Cc					
		(C^1.85×D^4.87)					
9	Q	: Flow (m^3/sec)	0.080	0.080			
		=q × N/60					
10	C	: Coefficient	**130**	**130**			
			0.355m × 1 lin	0.355m × 1 line			
11	D	: Inner Pipe Dia. (m)	0.312	0.312			
12	L	: Pipe length (m)	1365	443			
13	Cc	: Correction coefficient	1.0	1.0			
		Water: 1.0					
		Sludge: WT99.2% :					
14	hf2		0.000	0.000			
15	hf3	: Pump around loss (m)	2	2			
16	hf4	:Other head	0	0			
17	H'	=ha+hf1+hf2+hf3+hf4 (m)	10.56	15.68			
18	**H**	**: Total head (m)**	**12.0**	**17.0**			
		Velocity	1.05	1.05			
	Motor Power						
19	BKW	=0.163*SG*q*H/Pe (kW)	13.413	19.001			
20	SG	:Specific gravity	1.0	1.0			
21	Pe	:Pump efficiency	0.7	0.7			
22	kW	=BKW × C	15.424	21.851			
23	C	:Coefficient (1.15)	1.15	1.15			
24	**Motor Power (kW)**			**22**			

(adoption)

Konedobu Pumping Station (PS-05)



Design Condition

1) Design Flow

Qadf : Daily average flow
Qpdf : Peak flow (Ultimate) Qpdf = 2.0 × Qadf

2) Type of Pumping Station

Type C Submersible station
Basket Installed

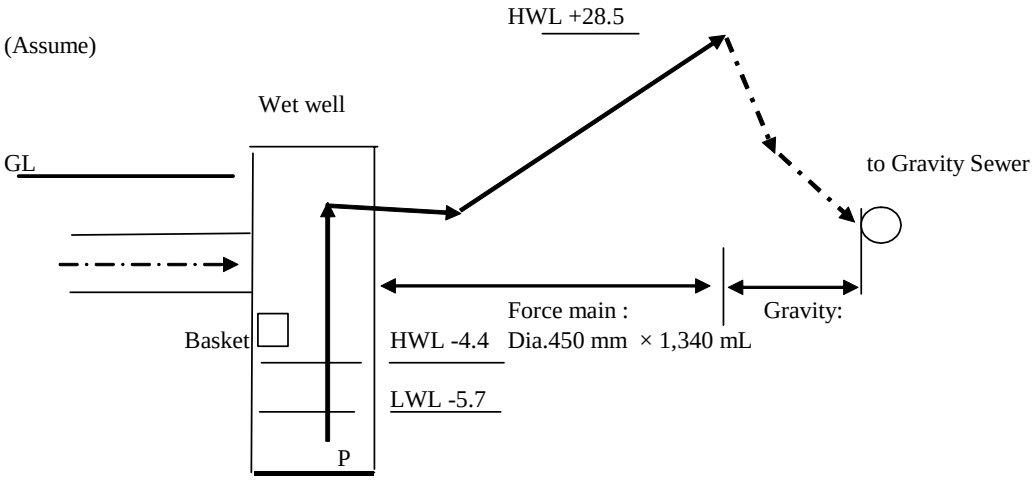
3) Pump Number and capacity

Pump number : 2 duty + 1 standby

4) Force Main

Material : HDPE
Diameter : Dia.450 mm
Line number: 1 line

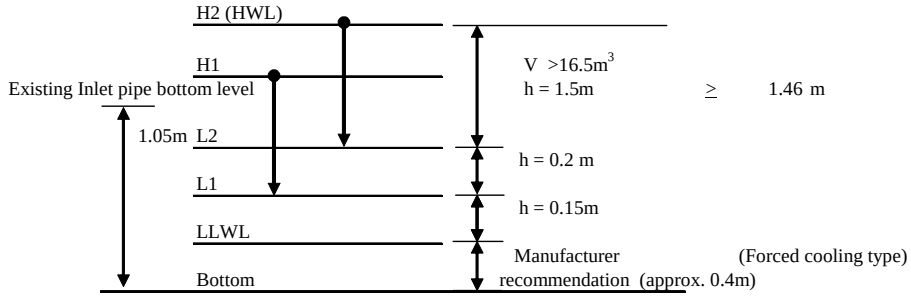
5) Outline (Assume)



Lifting Pump Calculation Sheet (PS-05)

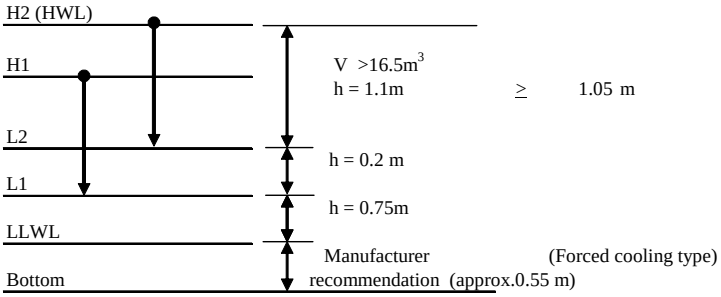
ITEM	SYMBOL	DESIGN			
5.1 Pump Sump Well (Existing)					
Existing Sump Well can not be available because Inlet pipe bottom level is much lower than required water depth.					
Required cycle time	n	Motor 55kW < 75kW (F.W.)		4	times
Pump capacity	Q			73.3	L/sec/unit
Required volume	v	= 900 × Q / n/1000	≥	16.5	m^3
Sump Well squere	A			11.33	m^2 Dia.3.8m

Water Level in the Sump Well



New Sump Well will be installed.					
Required cycle time	n	Motor 55kW < 75kW (F.W.)		4	times
Pump capacity	Q			73.3	L/sec/unit
Required volume	v	= 900 × Q / n/1000	≥	16.5	m^3
Sump Well squere	A			15.75	m^2 4.5m × 3.5m

Water Level in the Sump Well

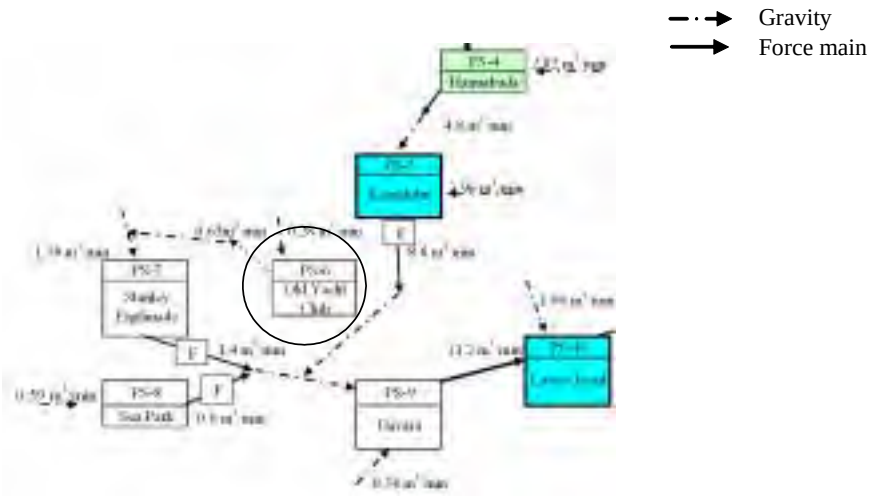


5.2 Lift Pump					
Duty pump number				2	units
Design flow per unit				73.3	L/sec/unit
Specification					
Type		**Submersible non-clog sewage pump, automatic coupling type**			
Dia.	**D**		**Approx.**	**200**	**mm**
Capacity	**Qp**			**73.3**	**L/sec/unit**
			=	**4.4**	**m^3/min/unit**
Total head	**H**	**attached Table Pump calculation sheet**		**42.0**	**m**
Motor	**P**	**attached Table Pump calculation sheet**	**Approx.**	**55.0**	**kW**
Number		**Duty**		**2**	**units**
		Standby		**1**	**unit**
		Stock		**1**	**unit**
		Total		**4**	**units**
5.3 Monorail Hoist					
Weight of pump	W		Approx.	1.60	Tonf
Required hoist capacity	hc	W × 1.5	≥	2.40	Tonf
Specification					
Type		**Manually Geared trolley**			
Capacity				**2.5**	**Tonf**
Lift			**Approx.**	**3.0**	**m**
Number		**Duty**		**1**	**unit**
		Standby		**0**	**unit**
		Total		**1**	**unit**

Lifting Pump Calculation Sheet (PS-05)

1	Equip. No.		**M01-005-01/04**		**1 pump operation**		
	Pump Name		**Lifting Pump-5**		**100%**	**120%**	
2	Pump Type		Submersible				
3	**q : Capacity (m^3/min)**		**4.4**		**4.4**	**5.28**	
4	**N : Operation number**		**2**		**1**	**1**	
	Pump		73.3L/s				
	Pump Number		2D + 1S				
	Total Head H=ha+hf1+hf2+hf3+hf4						
5	ha	:Actual head (m)	34.2		34.2	34.2	
		=DWL-SWL					
6	DWL	(m)	28.500		28.500	28.500	
7	SWL	(m)	-5.700		-5.700	-5.700	
8	hf1	: Straight pipe loss (m) =	4.607		1.278	1.790	
		(10.666 × Q^1.85) × L × Cc					
		(C^1.85×D^4.87)					
9	Q	: Flow (m^3/sec)	0.147		0.073	0.088	
		=q × N/60					
10	C	: Coefficient	**130**		130	130	
			0.45m × 1 line		0.45m × 1 line	0.45m × 1 line	
11	D	: Inner Pipe Dia. (m)	0.3956		0.3956	0.3956	
12	L	: Pipe length (m)	1340		1340	1340	
13	Cc	: Correction coefficient	1.0		1.0	1.0	
		Water: 1.0					
		Sludge: WT99.2% :					
14	hf2		0.000		0.000	0.000	
15	hf3	: Pump around loss (m)	2		2	2	
16	hf4	:Other head	0		0	0	
17	H'	=ha+hf1+hf2+hf3+hf4 (m)	40.81		37.48	37.99	
18	**H**	**: Total head (m)**	**42.0**				
		Velocity	1.19		0.60	0.72	
						> 0.60 m/sec	
	Motor Power						
19	BKW	=0.163*SG*q*H/Pe (kW)	46.342				
20	SG	:Specific gravity	1.0				
21	Pe	:Pump efficiency	0.65				
22	kW	=BKW × C	53.293				
23	C	:Coefficient (1.15)	1.15				
24	**Motor Power (kW)**		**55**				

Old Yacht Club Pumping Station (PS-06) Rehabilitation



Design Condition

1) Design Flow

Qadf : Daily average flow
Qpdf : Peak flow (Ultimate) Qpdf = 2.0 × Qadf

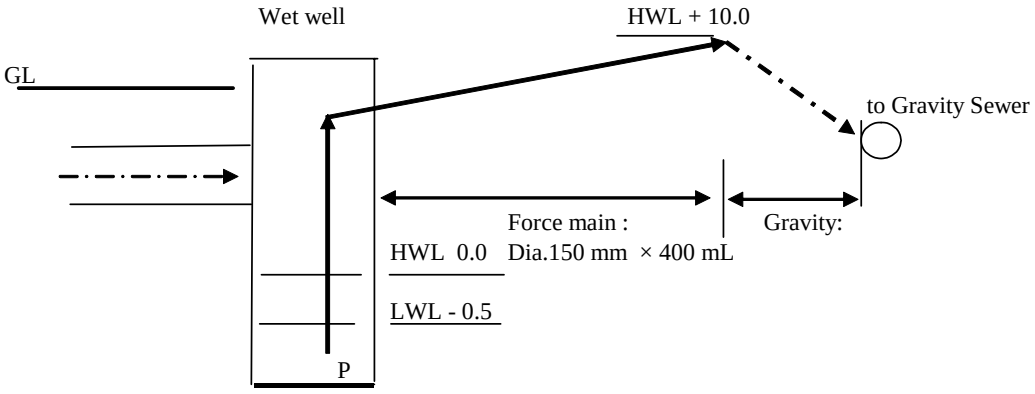
2) Type of Pumping Station
Circular type E×isting Submersible station
Basket Not Installed

3) Pump Number and capacity

Pump number : 1 duty + 1 standby

4) Force Main
Material : DCIP (E×isting Pipe)
Diameter : Dia.150 mm
Line number: 1 line

5) Outline (Assume)



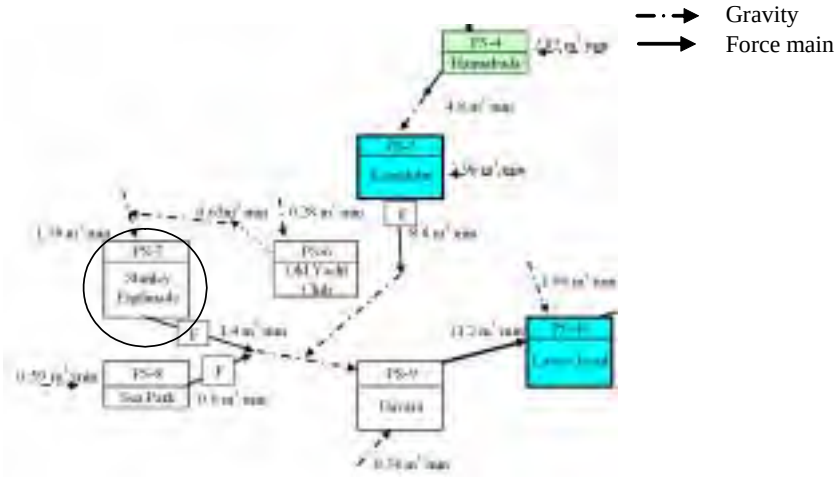
Lifting Pump Calculation Sheet (PS-06)

ITEM	SYMBOL	DESIGN			
6.1 Pump Sump Well (Rehabilitation)					
Required cycle time	n	Motor 5.5kW < 7.5kW		10	times
Pump capacity	Q			10.80	L/sec/unit
Required volume	v	= 900 × Q / n/1000	≥	1.0	m^3
Sump Well squere	A			2.83	m^2 Dia. 1.9m
Water Level in the Sump Well					
Inlet pipe bottom level					
(Existing)		H1 (HWL)			
				V > 1.0m^3	
				h = 0.5m ≥	0.34 m
1.43m		L1			
				h = 0.4 m	
		LLWL			
				Manufacturer recommendati (Forced cooling type)	
		Bottom		(approx. 0.3m)	
6.2 Lift Pump					
Design flow	Qpdf			0.65	m^3/min
			=	10.8	L/sec
Duty pump number				1	unit
Design flow per unit		Considered pipe velocity > 0.6m/s (Existing Pipe Available)	⇒	10.8	L/sec/unit
Specification					
Type		**Submersible non-clog sewage pump, automatic coupling type**			
Dia.	**D**		**Approx.**	**100**	**mm**
Capacity	**Qp**			**10.8**	**L/sec/unit**
			=	**0.65**	**m^3/min/unit**
Total head	**H**	**attached Table Pump calculation sheet**		**17.0**	**m**
Motor	**P**	**attached Table Pump calculation sheet**	**Approx.**	**5.5**	**kW**
Number		**Duty**		**1**	**unit**
		Standby		**1**	**unit**
		Total		**2**	**units**
6.3 Monorail Hoist					
Weight of pump	W		Approx.	0.10	Tonf
Required hoist capacity	hc	W × 1.5	≥	0.15	Tonf
Specification					
Type		**Manually Geared trolley**			
Capacity				**0.5**	**Tonf**
Lift			**Approx.**	**3.0**	**m**
Number		**Duty**		**1**	**unit**
		Standby		**0**	**unit**
		Total		**1**	**unit**

Lifting Pump Calculation Sheet (PS-06)

1	Equip. No.		**M01-006-01/02**				
	Pump Name		**Lifting Pump-6**				
2	Pump Type		Submersible				
3	**q : Capacity (m^3/min)**		**0.65**				
4	**N : Operation number**		**1**				
	Pump		10.8L/s				
	Pump Number		1D + 1S				
	Total Head H=ha+hf1+hf2+hf3+hf4						
5	ha	:Actual head (m)	10.5				
		=DWL-SWL					
6	DWL	(m)	10.000				
7	SWL	(m)	-0.500				
8	hf1	: Straight pipe loss (m) =	3.063				
		(10.666 × Q^1.85) × L × Cc					
		(C^1.85×D^4.87)					
9	Q	: Flow (m^3/sec)	0.011				
		=q × N/60					
10	C	: Coefficient	**80**				
			Existing DIP Pipe				
			0.15m × 1 line				
11	D	: Inner Pipe Dia. (m)	0.15				
12	L	: Pipe length (m)	400				
13	Cc	: Correction coefficient	1.0				
		Water: 1.0					
		Sludge: WT99.2% :					
14	hf2		0.000				
15	hf3	: Pump around loss (m)	2				
16	hf4	:Other head	0				
17	H'	=ha+hf1+hf2+hf3+hf4 (m)	15.56				
18	**H**	**: Total head (m)**	**17.0**				
		Velocity	0.61				
	Motor Power						
19	BKW	=0.163*SG*q*H/Pe (kW)	4.503				
20	SG	:Specific gravity	1.0				
21	Pe	:Pump efficiency	0.4				
22	kW	=BKW × C	5.178				
23	C	:Coefficient (1.15)	1.15				
24	**Motor Power (kW)**		**5.5**				

Stanley Esplanade Pumping Station (PS-07) Rehabilitation



Design Condition

1) Design Flow

Qadf : Daily average flow
Qpdf : Peak flow (Ultimate) Qpdf = 2.0 × Qadf

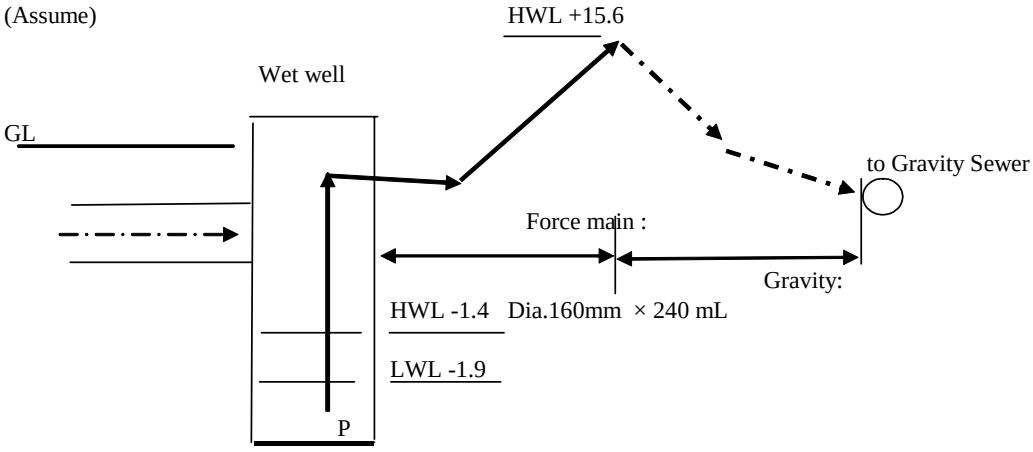
2) Type of Pumping Station
Circular type E×isting Submersible station
Basket Not installed

3) Pump Number and capacity

Pump number : 1 duty + 1 standby

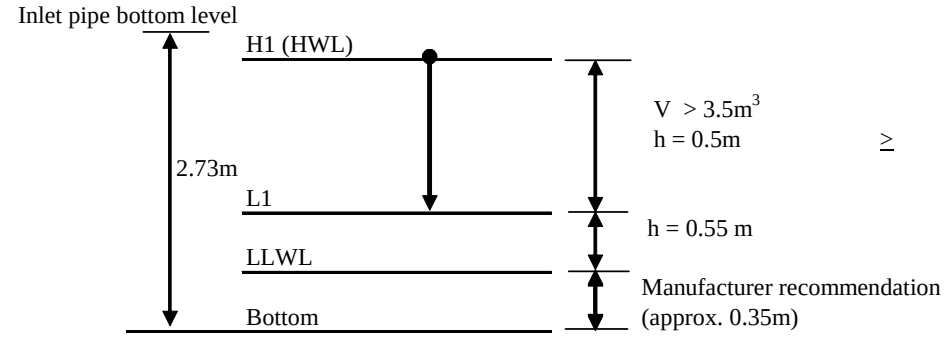
4) Force Main
Material : HDPE
Diameter : Dia.160 mm
Line number: 1 line

5) Outline (Assume)



Lifting Pump Calculation Sheet (PS-07)

ITEM	SYMBOL	DESIGN			
7.1 Pump Sump Well (Rehabilitation)					
Required cycle time	n	Motor 15kW < 22kW		4	times
Pump capacity	Q			23.3	L/sec/unit
Required volume	v	= 900 × Q / n/1000	≥	5.2	m^3
Sump Well squere	A			11.33	m^2 Dia. 3.8m



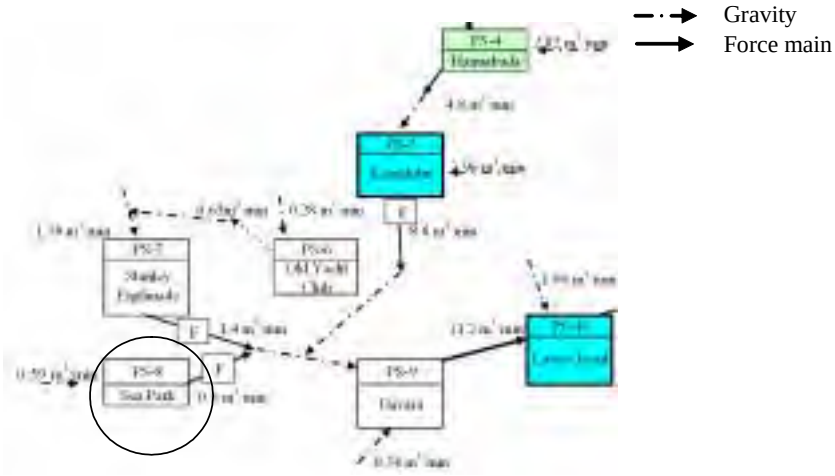
7.2 Lift Pump					
Duty pump number				1	unit
Design flow per unit				23.3	L/sec/unit
Specification					
Type		**Submersible non-clog sewage pump, automatic coupling type**			
Dia.	**D**		**Approx.**	**100**	**mm**
Capacity	**Qp**			**23.3**	**L/sec/unit**
			=	**1.4**	**m^3/min/unit**
Total head	**H**	**attached Table Pump calculation sheet**		**24.0**	**m**
Motor	**P**	**attached Table Pump calculation sheet**	**Approx.**	**15.0**	**kW**
Number		**Duty**		**1**	**unit**
		Standby		**1**	**unit**
		Total		**2**	**units**
7.3 Monorail Hoist					
Weight of pump	W		Approx.	0.45	Tonf
Required hoist capacity	hc	W × 1.5	≥	0.68	Tonf
Specification					
Type		**Manually Geared trolley**			
Capacity				**1.0**	**Tonf**
Lift			**Approx.**	**3.0**	**m**
Number		**Duty**		**1**	**unit**
		Standby		**0**	**unit**
		Total		**1**	**unit**

Lifting Pump Calculation Sheet (PS-07)

1	Equip. No.		**M01-007-01/02**				
	Pump Name		**Lifting Pump-7**				
2	Pump Type		Submersible	Submersible			
3	**q : Capacity (m^3/min)**		**1.4**	**1.4**			
4	**N : Operation number**		**1**	**1**			
	Pump		23.3L/s	23.3L/s			
	Pump Number		1D + 1S	1D + 1S			
	Total Head H=ha+hf1+hf2+hf3+hf4						
5	ha	:Actual head (m)	17.5	3.9			
		=DWL-SWL					
6	DWL	(m)	15.600	2.000			
7	SWL	(m)	-1.900	-1.900			
8	hf1	: Straight pipe loss (m) =	4.241	7.422			
		(10.666 × Q^1.85) × L × Cc					
		(C^1.85×D^4.87)					
9	Q	: Flow (m^3/sec)	0.023	0.023			
		=q × N/60					
10	C	: Coefficient	**130**	**130**			
			0.16m × 1 line	0.16m × 1 line			
11	D	: Inner Pipe Dia. (m)	0.1406	0.1406			
12	L	: Pipe length (m)	240	420			
13	Cc	: Correction coefficient	1.0	1.0			
		Water: 1.0					
		Sludge: WT99.2% :					
14	hf2		0.000	0.000			
15	hf3	: Pump around loss (m)	2	2			
16	hf4	:Other head	0	0			
17	H'	=ha+hf1+hf2+hf3+hf4 (m)	23.74	13.32			
18	**H**	**: Total head (m)**	**24.0**	**14.0**			
		Velocity	1.50	1.50			
	Motor Power						
19	BKW	=0.163*SG*q*H/Pe (kW)	10.954	6.390			
20	SG	:Specific gravity	1.0	1.0			
21	Pe	:Pump efficiency	0.5	0.5			
22	kW	=BKW × C	12.597	7.348			
23	C	:Coefficient (1.15)	1.15	1.15			
24	**Motor Power (kW)**		**15**				

(adoption)

Sea Park Pumping Station (PS-08) Rehabilitation



Design Condition

1) Design Flow

Qadf : Daily average flow
Qpdf : Peak flow (Ultimate) Qpdf = 2.0 × Qadf

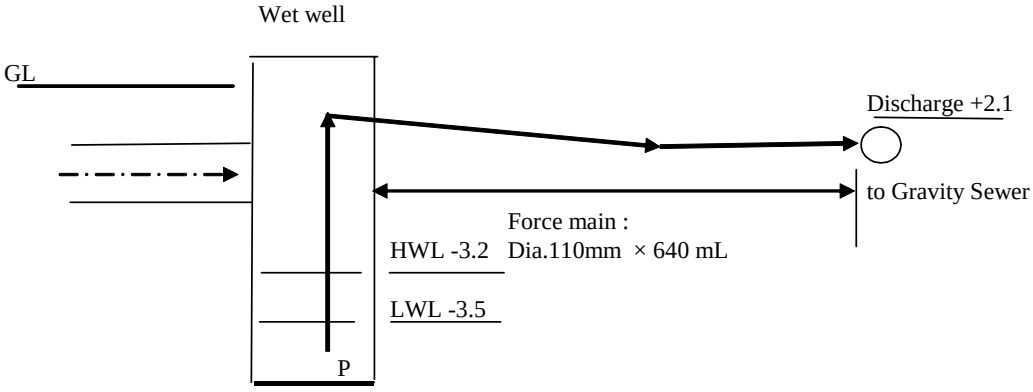
2) Type of Pumping Station
Rectangular type , E×isting Submersible station
Basket Not installed

3) Pump Number and capacity

Pump number : 1 duty + 1 standby

4) Force Main
Material : HDPE
Diameter : Dia.110 mm
Line number: 1 line

5) Outline (Assume)



Lifting Pump Calculation Sheet (PS-08)

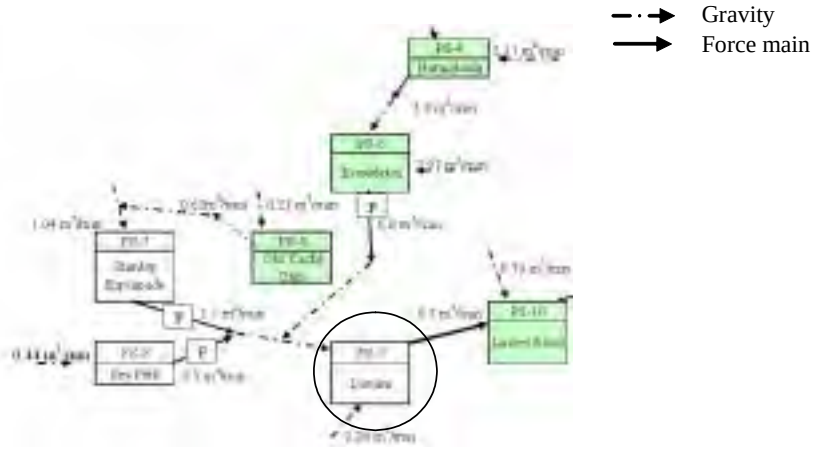
ITEM	SYMBOL	DESIGN			
8.1 Pump Sump Well(Rehabilitation)					
Required cycle time	n	Motor = 7.5kW (F.W.)		4	times
Pump capacity	Q			10.0	L/sec/unit
Required volume	v	= 900 × Q / n/1000	≥	2.3	m^3
Sump Well squere	A			11.50	m^2 3.5m × 3.3
Water Level in the Sump Well					
Inlet pipe bottom level					
H1 (HWL)					
		V > 2.3m^3			
		h = 0.3m	≥	0.20	m
3.122m					
L1					
		h = 0.2 m			
LLWL					
		Manufacturer recommendation			
Bottom		(approx. 0.8m)			
8.2 Lift Pump					
Duty pump number				1	unit
Design flow per unit				10.0	L/sec/unit
Specification					
Type		**Submersible non-clog sewage pump, automatic coupling type**			
Dia.	**D**		**Approx.**	**100**	**mm**
Capacity	**Qp**			**10.0**	**L/sec/unit**
			=	**0.60**	**m^3/min/unit**
Total head	**H**	**attached Table Pump calculation sheet**		**24.0**	**m**
Motor	**P**	**attached Table Pump calculation sheet**	**Approx.**	**7.5**	**kW**
Number		**Duty**		**1**	**unit**
		Standby		**1**	**unit**
		Total		**2**	**units**
8.3 Monorail Hoist					
Weight of pump	W		Approx.	0.20	Tonf
Required hoist capacity	hc	W × 1.5	≥	0.30	Tonf
Specification					
Type		**Manually Geared trolley**			
Capacity				**0.5**	**Tonf**
Lift			**Approx.**	**3.0**	**m**
Number		**Duty**		**1**	**unit**
		Standby		**0**	**unit**
		Total		**1**	**unit**

Lifting Pump Calculation Sheet (PS-08)

1	Equip. No.		**M01-008-01/02**				
	Pump Name		**Lifting Pump-8**				
2	Pump Type		Submersible	Submersible			
3	**q : Capacity (m^3/min)**		**0.6**	**0.6**			
4	**N : Operation number**		**1**	**1**			
	Pump		10.0L/s	10.0L/s			
	Pump Number		1D + 1S	1D + 1S			
	Total Head H=ha+hf1+hf2+hf3+hf4						
5	ha	:Actual head (m)	5.6	6.0			
		=DWL-SWL					
6	DWL	(m)	2.100	2.500			
7	SWL	(m)	-3.500	-3.500			
8	hf1	: Straight pipe loss (m) =	14.823	12.275			
		(10.666 × Q^1.85) × L × Cc					
		(C^1.85×D^4.87)					
9	Q	: Flow (m^3/sec)	0.010	0.010			
		=q × N/60					
10	C	: Coefficient	**130**	**130**			
			0.11m × 1 line	0.11m × 1 line			
11	D	: Inner Pipe Dia. (m)	0.0964	0.0964			
12	L	: Pipe length (m)	640	530			
13	Cc	: Correction coefficient	1.0	1.0			
		Water: 1.0					
		Sludge: WT99.2% :					
14	hf2		0.000	0.000			
15	hf3	: Pump around loss (m)	2	2			
16	hf4	:Other head	0	0			
17	H'	=ha+hf1+hf2+hf3+hf4 (m)	22.42	20.28			
18	**H**	**: Total head (m)**	**24.0**	**21.0**			
		Velocity	1.37	1.37			
	Motor Power						
19	BKW	=0.163*SG*q*H/Pe (kW)	5.868	5.135			
20	SG	:Specific gravity	1.0	1.0			
21	Pe	:Pump efficiency	0.4	0.4			
22	kW	=BKW × C	6.748	5.905			
23	C	:Coefficient (1.15)	1.15	1.15			
24	**Motor Power (kW)**		**7.5**				

(adoption)

Davara Pumping Station (PS-09) Rehabilitation



Design Condition

1) Design Flow

Qadf : Daily average flow
Qpdf : Peak flow (Ultimate) Qpdf = 2.0 × Qadf

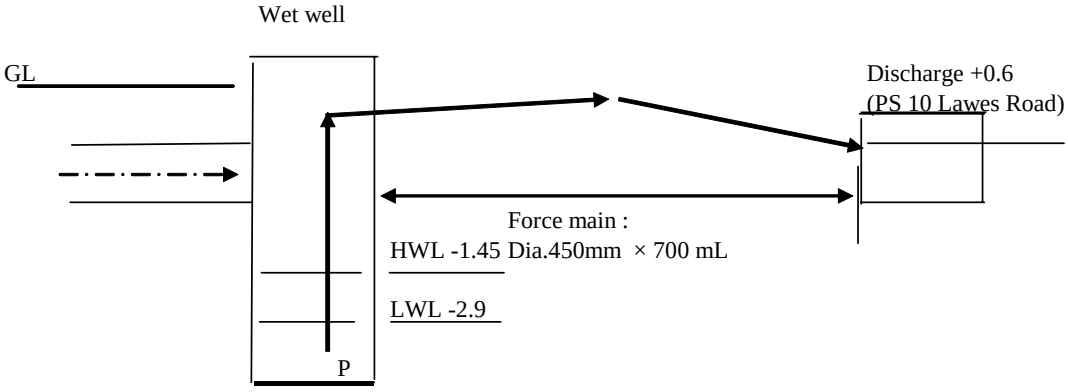
2) Type of Pumping Station
Circular type , E×isting Submersible station
Basket Not installed

3) Pump Number and capacity

Pump number : 2 duty + 1 standby

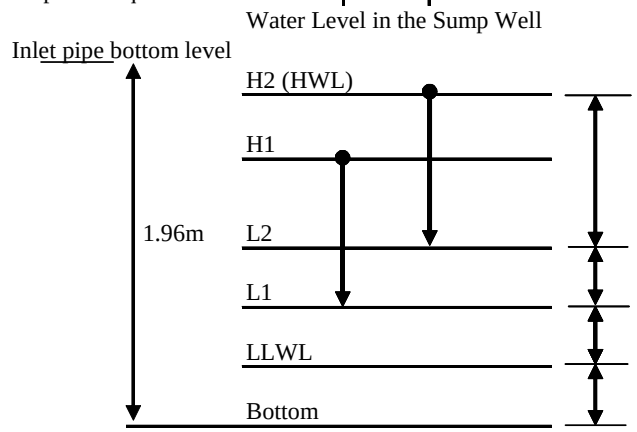
4) Force Main
Material : HDPE
Diameter : Dia.450 mm
Line number: 1 line

5) Outline (Assume)



Lifting Pump Calculation Sheet (PS-09)

ITEM	SYMBOL	DESIGN			
9.1 Pump Sump Well (Rehabilitation)					
Required cycle time	n	Motor 15kW < 22kW		6	times
Pump capacity	Q			93.3	L/sec/unit
Required volume	v	= 900 × Q / n/1000	≥	14.0	m^3
Sump Well squere	A			10.74	m^2 Dia. 3.7m

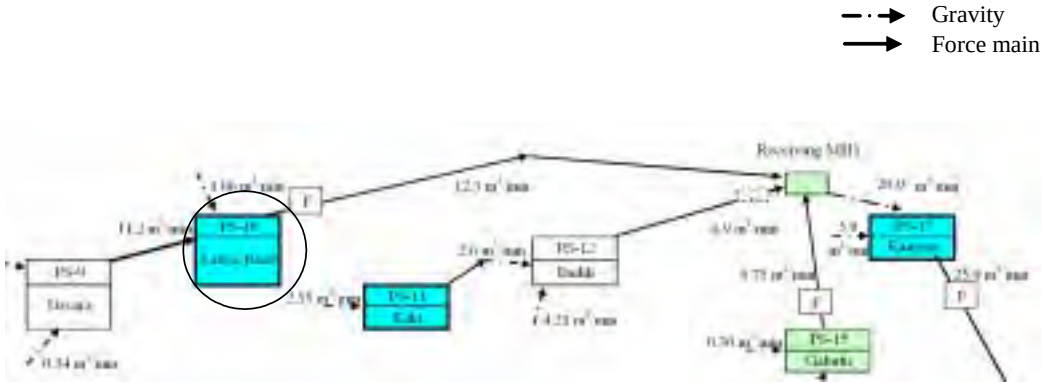


9.2 Lift Pump					
Duty pump number				2	units
Design flow per unit				93.3	L/sec/unit
Specification					
Type		**Submersible non-clog sewage pump, automatic coupling type**			
Dia.	**D**		**Approx.**	**200**	**mm**
Capacity	**Qp**			**93.3**	**L/sec/unit**
			=	**5.6**	**m^3/min/unit**
Total head	**H**	**attached Table Pump calculation sheet**		**11.0**	**m**
Motor	**P**	**attached Table Pump calculation sheet**	**Approx.**	**15.0**	**kW**
Number		**Duty**		**2**	**units**
		Standby		**1**	**unit**
		Stock		**1**	**unit**
		Total		**4**	**units**
9.3 Monorail Hoist					
Weight of pump	W		Approx.	0.45	Tonf
Required hoist capacity	hc	W × 1.5	≥	0.68	Tonf
Specification					
Type		**Manually Geared trolley**			
Capacity				**1.0**	**Tonf**
Lift			**Approx.**	**3.0**	**m**
Number		**Duty**		**1**	**unit**
		Standby		**0**	**unit**
		Total		**1**	**unit**

Lifting Pump Calculation Sheet (PS-09)

1	Equip. No.		**M01-009-01/04**		**1 pump operation**		
	Pump Name		**Lifting Pump-9**		**100%**	**120%**	
2	Pump Type		Submersible				
3	**q : Capacity (m^3/min)**		**5.6**		**5.6**	**6.72**	
4	**N : Operation number**		**2**		**1**	**1**	
	Pump		93.3L/s				
	Pump Number		2D + 1S				
	Total Head H=ha+hf1+hf2+hf3+hf4						
5	ha	:Actual head (m)	3.5		3.5	3.5	
		=DWL-SWL					
6	DWL	(m)	0.600		0.600	0.600	
7	SWL	(m)	-2.900		-2.900	-2.900	
8	hf1	: Straight pipe loss (m) =	3.760		1.043	1.461	
		(10.666 × Q^1.85) × L × Cc					
		(C^1.85×D^4.87)					
9	Q	: Flow (m^3/sec)	0.187		0.093	0.112	
		=q × N/60					
10	C	: Coefficient	**130**		130	130	
			0.45m × 1 line		0.45m × 1 line	0.45m × 1 line	
11	D	: Inner Pipe Dia. (m)	0.3956		0.3956	0.3956	
12	L	: Pipe length (m)	700		700	700	
13	Cc	: Correction coefficient	1.0		1.0	1.0	
		Water: 1.0					
		Sludge: WT99.2% :					
14	hf2		0.000		0.000	0.000	
15	hf3	: Pump around loss (m)	2		2	2	
16	hf4	:Other head	0		0	0	
17	H'	=ha+hf1+hf2+hf3+hf4 (m)	9.26		6.54	6.96	
18	**H**	**: Total head (m)**	**11.0**				
		Velocity	1.52		0.76	0.91	
						> 0.60 m/sec	
	Motor Power						
19	BKW	=0.163*SG*q*H/Pe (kW)	12.873				
20	SG	:Specific gravity	1.0				
21	Pe	:Pump efficiency	0.78				
22	kW	=BKW × C	14.804				
23	C	:Coefficient (1.15)	1.15				
24	**Motor Power (kW)**		**15**				

Lawes Road Pumping Station (PS-10)



Design Condition

1) Design Flow

Qadf : Daily average flow
Qpdf : Peak flow (Ultimate) Qpdf = 2.0 × Qadf

2) Type of Pumping Station

Type C	Submersible station
Basket	Installed

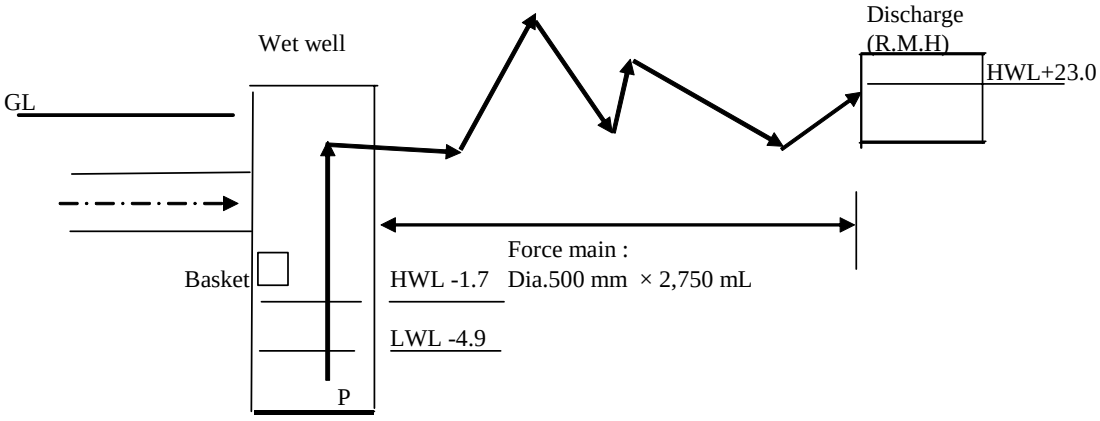
3) Pump Number and capacity

Pump number :	2 duty + 1 standby

4) Force Main

Material :	HDPE
Diameter :	Dia.500 mm
Line number:	1 line

5) Outline (Assume)



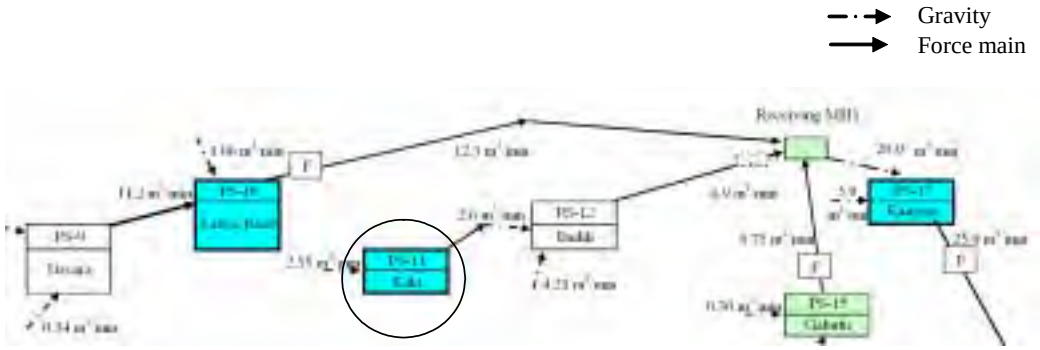
Lifting Pump Calculation Sheet (PS-10)

ITEM	SYMBOL	DESIGN			
10.1 Pump Sump Well (New)					
Existing Sump Well can not be available because Inlet pipe bottom level is much lower than required water depth.					
Required cycle time	n	Motor 75kW > 55kW		2	times
Pump capacity	Q			103.3	L/sec/unit
Required volume	v	= 900 × Q / n/1000	≥	46.5	m^3
Sump Well squere	A			11.33	m^2 Dia.3.6m
Water Level in the Sump Well					
H2 (HWL)					
H1		V >46.5m^3			
Inlet pipe bottom level (Existing)		h = 4.5m	≥	4.10	m
L2					
0.03 m		h = 0.2 m			
L1		h = 0.15m			
LLWL					
		Manufacturer recommendati (Forced cooling type)			
Bottom		(approx. 0.5 m)			
New Sump Well will be installed.					
Required cycle time	n	Motor 75kW > 55kW		2	times
Pump capacity	Q			103.3	L/sec/unit
Required volume	v	= 900 × Q / n/1000	≥	46.5	m^3
Sump Well squere	A			15.75	m^2 4.5m × 3.5m
Water Level in the Sump Well					
H2 (HWL)					
H1		V >46.5m^3			
		h = 3.0m	≥	2.95	m
L2					
		h = 0.2 m			
L1					
		h = 0.15m			
LLWL					
		Manufacturer recommendati (Forced Cooling type)			
Bottom		(approx. 0.5m)			
10.2 Lift Pump					
Duty pump number				2	units
Design flow per unit				103.3	L/sec/unit
Specification					
Type		**Submersible non-clog sewage pump, automatic coupling type**			
Dia.	**D**		**Approx.**	**250**	**mm**
Capacity	**Qp**			**103.3**	**L/sec/unit**
			=	**6.2**	**m^3/min/unit**
Total head	**H**	**attached Table Pump calculation sheet**		**42.0**	**m**
Motor	**P**	**attached Table Pump calculation sheet**	**Approx.**	**75.0**	**kW**
Number		**Duty**		**2**	**units**
		Standby		**1**	**unit**
		Stock		**1**	**unit**
		Total		**4**	**units**
10.3 Monorail Hoist					
Weight of pump	W		Approx.	1.50	Tonf
Required hoist capacity	hc	W × 1.5	≥	2.25	Tonf
Specification					
Type		**Manually Geared trolley**			
Capacity				**2.5**	**Tonf**
Lift			**Approx.**	**3.0**	**m**
Number		**Duty**		**1**	**unit**
		Standby		**0**	**unit**
		Total		**1**	**unit**

Lifting Pump Calculation Sheet (PS-10)

1	Equip. No.		**M01-010-01/04**			**1 pump operation**		
	Pump Name		**Lifting Pump-10**			**100%**	**120%**	
2	Pump Type		Submersible					
3	**q : Capacity (m^3/min)**		**6.2**			**6.2**	**7.44**	
4	**N : Operation number**		**2**			**1**	**1**	
	Pump		103.3L/s					
	Pump Number		2D + 1S					
	Total Head H=ha+hf1+hf2+hf3+hf4							
5	ha	:Actual head (m)	27.9			27.9	27.9	
		=DWL-SWL						
6	DWL	(m)	23.000			23.000	23.000	
7	SWL	(m)	-4.900			-4.900	-4.900	
8	hf1	: Straight pipe loss (m) =	10.657			2.956	4.142	
		(10.666 × Q^1.85) × L × Cc						
		(C^1.85×D^4.87)						
9	Q	: Flow (m^3/sec)	0.207			0.103	0.124	
		=q × N/60						
10	C	: Coefficient	**130**			130	130	
			0.5m × 1 line			0.5 m × 1 line	0.5 m × 1 line	
11	D	: Inner Pipe Dia. (m)	0.4397			0.4397	0.4397	
12	L	: Pipe length (m)	2750			2750	2750	
13	Cc	: Correction coefficient	1.0			1.0	1.0	
		Water: 1.0						
		Sludge: WT99.2% :						
14	hf2		0.000			0.000	0.000	
15	hf3	: Pump around loss (m)	2			2	2	
16	hf4	:Other head	0			0	0	
17	H'	=ha+hf1+hf2+hf3+hf4 (m)	40.56			32.86	34.04	
18	**H**	**: Total head (m)**	**42.0**					
		Velocity	1.36			0.68	0.82	
							> 0.60 m/sec	
	Motor Power							
19	BKW	=0.163*SG*q*H/Pe (kW)	60.636					
20	SG	:Specific gravity	1.0					
21	Pe	:Pump efficiency	0.7					
22	kW	=BKW × C	69.731					
23	C	:Coefficient (1.15)	1.15					
24	**Motor Power (kW)**		**75**					

Koki Pumping Station (PS-11)



Design Condition

1) Design Flow

Qadf : Daily average flow
Qpdf : Peak flow (Ultimate) Qpdf = 2.0 × Qadf

2) Type of Pumping Station

Type B Submersible station
Basket Installed

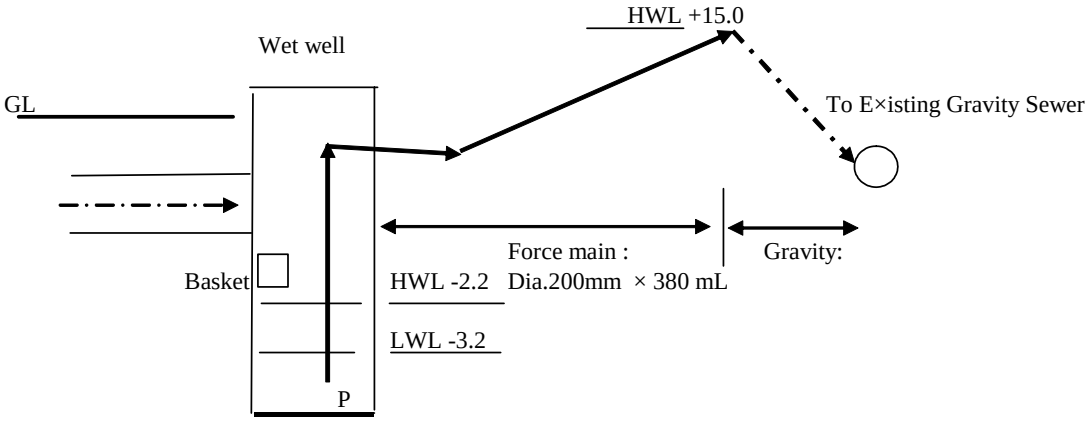
3) Pump Number and capacity

Pump number : 1 duty + 1 standby

4) Force Main

Material : DCIP (E×isting Pipe)
Diameter : Dia.200 mm
Line number: 1 line

5) Outline (Assume)



Lifting Pump Calculation Sheet (PS-11)

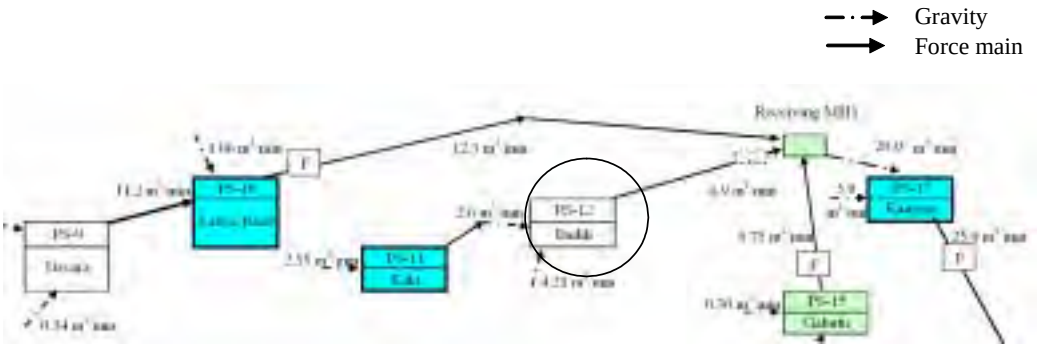
ITEM	SYMBOL	DESIGN			
11.1 Pump Sump Well (New)					
Existing Sump Well can not be available because Inlet pipe bottom level is much lower than required water depth.					
Required cycle time	n	Motor 37kW< 55kW (F.W.)		4	times
Pump capacity	Q			43.3	L/sec/unit
Required volume	v	= 900 × Q / n/1000	≥	9.7	m^3
Sump Well squere	A			8.03	m^2 Dia. 3.2m
Water Level in the Sump Well					
Inlet pipe bottom level (Existing)	H1 (HWL)	V > 9.7m^3			
		h = 1.3m	≥	1.21	m
1.2m	L1	h = 0.15 m			
	LLWL	Manufacturer recommendati (Forced cooling type)			
	Bottom	(approx. 0.4m)			
New Sump Well will be installed.					
Required cycle time	n	Motor 37kW< 55kW (F.W.)		4	times
Pump capacity	Q			43.3	L/sec/unit
Required volume	v	= 900 × Q / n/1000	≥	9.7	m^3
Sump Well squere	A			12.00	m^2 3mW × 4mL
Water Level in the Sump Well					
	H1 (HWL)	V > 9.7m^3			
		h = 1.0m	≥	0.81	m
	L1	h = 0.2 m			
	LLWL	Manufacturer recommendation			
	Bottom	(approx. 1.0m)			
11.2 Lift Pump					
Duty pump number				1	unit
Design flow per unit				43.3	L/sec/unit
Specification					
Type		**Submersible non-clog sewage pump, automatic coupling type**			
Dia.	**D**		**Approx.**	**200**	**mm**
Capacity	**Qp**			**43.3**	**L/sec/unit**
			=	**2.6**	**m^3/min/unit**
Total head	**H**	**attached Table Pump calculation sheet**		**31.0**	**m**
Motor	**P**	**attached Table Pump calculation sheet**	**Approx.**	**37.0**	**kW**
Number		**Duty**		**1**	**unit**
		Standby		**1**	**unit**
		Total		**2**	**units**
11.3 Monorail Hoist					
Weight of pump	W		Approx.	0.70	Tonf
Required hoist capacity	hc	W × 1.5	≥	1.05	Tonf
Specification					
Type		**Manually Geared trolley**			
Capacity				**1.5**	**Tonf**
Lift			**Approx.**	**3.0**	**m**
Number		**Duty**		**1**	**unit**
		Standby		**0**	**unit**
		Total		**1**	**unit**

Lifting Pump Calculation Sheet (PS-11)

1	Equip. No.		**M01-011-01/02**				
	Pump Name		**Lifting Pump-11**				
2	Pump Type		Submersible	Submersible			
3	**q : Capacity (m^3/min)**		**2.6**	**2.6**			
4	**N : Operation number**		**1**	**1**			
	Pump		43.3L/s	43.3L/s			
	Pump Number		1D + 1S	1D + 1S			
	Total Head H=ha+hf1+hf2+hf3+hf4						
5	ha	:Actual head (m)	18.2	11.2			
		=DWL-SWL					
6	DWL	(m)	15.000	8.000			
7	SWL	(m)	-3.200	-3.200			
8	hf1	: Straight pipe loss (m) =	9.315	14.217			
		(10.666 × Q^1.85) × L × Cc					
		(C^1.85×D^4.87)					
9	Q	: Flow (m^3/sec)	0.043	0.043			
		=q × N/60					
10	C	: Coefficient	**80**	**80**			
			Existing DIP Pipe	Existing DIP Pipe			
			0.2m × 1 line	0.2m × 1 line			
11	D	: Inner Pipe Dia. (m)	0.2	0.2			
12	L	: Pipe length (m)	380	580			
13	Cc	: Correction coefficient	1.0	1.0			
		Water: 1.0					
		Sludge: WT99.2% :					
14	hf2		0.000	0.000			
15	hf3	: Pump around loss (m)	2	2			
16	hf4	:Other head	0	0			
17	H'	=ha+hf1+hf2+hf3+hf4 (m)	29.51	27.42			
18	**H**	**: Total head (m)**	**31.0**	**29.0**			
		Velocity	1.38	1.38			
	Motor Power						
19	BKW	=0.163*SG*q*H/Pe (kW)	21.896	20.484			
20	SG	:Specific gravity	1.0	1.0			
21	Pe	:Pump efficiency	0.6	0.6			
22	kW	=BKW × C	25.181	23.556			
23	C	:Coefficient (1.15)	1.15	1.15			
24	**Motor Power (kW)**		**37**				

(adoption)

Badili Pumping Station (PS-12) Rehabilitation



Design Condition

1) Design Flow

Qadf : Daily average flow
Qpdf : Peak flow (Ultimate) Qpdf = 2.0 × Qadf

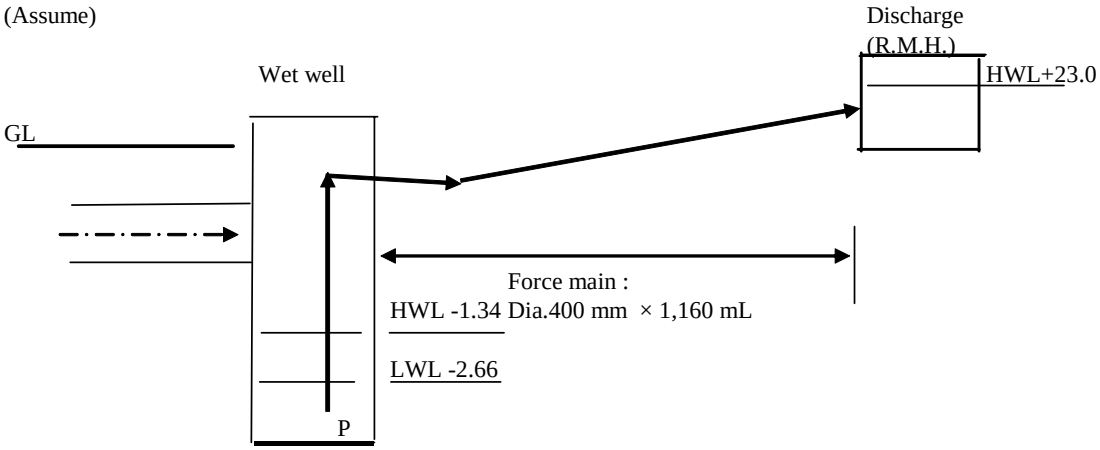
2) Type of Pumping Station
Circular type , E×isting Submersible station
Basket Not installed

3) Pump Number and capacity

Pump number : 2 duty + 1 standby

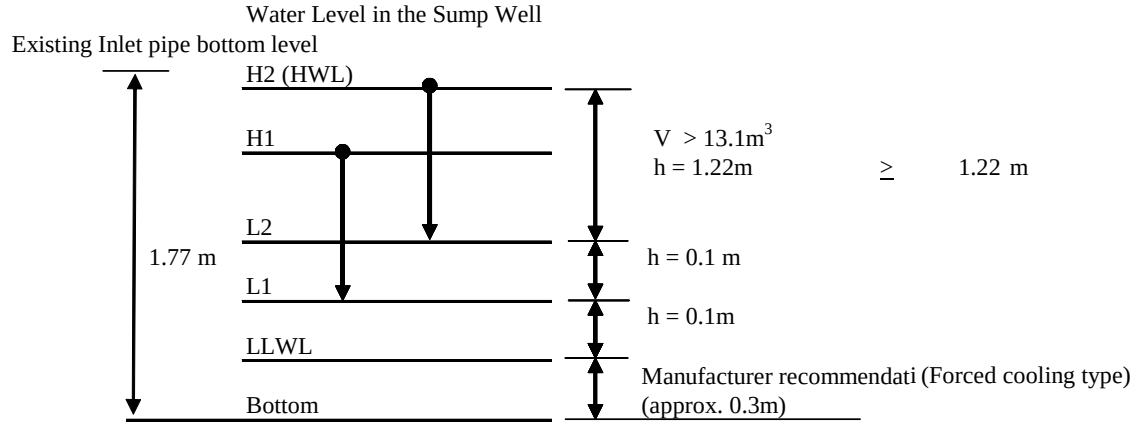
4) Force Main
Material : HDPE
Diameter : Dia.400 mm
Line number: 1 line

5) Outline (Assume)



Lifting Pump Calculation Sheet (PS-12)

ITEM	SYMBOL	DESIGN			
12.1 Pump Sump Well (Rehabilitation)					
Required cycle time	n	Motor 45kW < 55kW (F.W.)		4	times
Pump capacity	Q			58.3	L/sec/unit
Required volume	v	= 900 × Q / n/1000	≥	13.1	m^3
Sump Well squere	A			10.74	m^2 Dia. 3.7m

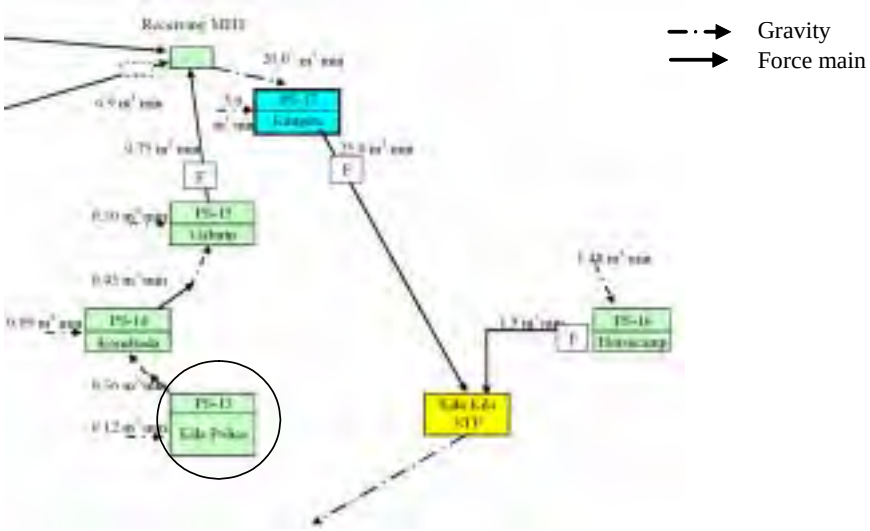


12.2 Lift Pump					
Duty pump number				2	units
Design flow per unit				58.3	L/sec/unit
Specification					
Type		**Submersible non-clog sewage pump, automatic coupling type**			
Dia.	**D**		**Approx.**	**200**	**mm**
Capacity	**Qp**			**58.3**	**L/sec/unit**
			=	**3.5**	**m^3/min/unit**
Total head	**H**	**attached Table Pump calculation sheet**		**33.0**	**m**
Motor	**P**	**attached Table Pump calculation sheet**	**Approx.**	**45.0**	**kW**
Number		**Duty**		**2**	**units**
		Standby		**1**	**unit**
		Stock		**1**	**unit**
		Total		**4**	**units**
12.3 Monorail Hoist					
Weight of pump	W		Approx.	1.60	Tonf
Required hoist capacity	hc	W × 1.5	≥	2.40	Tonf
Specification					
Type		**Manually Geared trolley**			
Capacity				**2.5**	**Tonf**
Lift			**Approx.**	**3.0**	**m**
Number		**Duty**		**1**	**unit**
		Standby		**0**	**unit**
		Total		**1**	**unit**

Lifting Pump Calculation Sheet (PS-12)

1	Equip. No.		**M01-012-01/04**		**1 pump operation**		
	Pump Name		**Lifting Pump-12**		**100%**	**120%**	
2	Pump Type		Submersible				
3	**q : Capacity (m^3/min)**		**3.5**		**3.5**	**4.2**	
4	**N : Operation number**		**2**		**1**	**1**	
	Pump		58.3L/s				
	Pump Number		2D + 1S				
	Total Head H=ha+hf1+hf2+hf3+hf4						
5	ha	:Actual head (m)	25.7		25.7	25.7	
		=DWL-SWL					
6	DWL	(m)	23.000		23.000	23.000	
7	SWL	(m)	-2.660		-2.660	-2.660	
8	hf1	: Straight pipe loss (m) =	4.631		1.285	1.800	
		(10.666 × Q^1.85) × L × Cc					
		(C^1.85×D^4.87)					
9	Q	: Flow (m^3/sec)	0.117		0.058	0.070	
		=q × N/60					
10	C	: Coefficient	**130**		130	130	
			0.40m × 1 line		0.40m × 1 line	0.40m × 1 line	
11	D	: Inner Pipe Dia. (m)	0.3517		0.3517	0.3517	
12	L	: Pipe length (m)	1160		1160	1160	
13	Cc	: Correction coefficient	1.0		1.0	1.0	
		Water: 1.0					
		Sludge: WT99.2% :					
14	hf2		0.000		0.000	0.000	
15	hf3	: Pump around loss (m)	2		2	2	
16	hf4	:Other head	0		0	0	
17	H'	=ha+hf1+hf2+hf3+hf4 (m)	32.29		28.94	29.46	
18	**H**	**: Total head (m)**	**33.0**				
		Velocity	1.20		0.60	0.72	
						> 0.60 m/sec	
	Motor Power						
19	BKW	=0.163*SG*q*H/Pe (kW)	34.230				
20	SG	:Specific gravity	1.0				
21	Pe	:Pump efficiency	0.55				
22	kW	=BKW × C	39.365				
23	C	:Coefficient (1.15)	1.15				
24	**Motor Power (kW)**		**45**				

Kila Police Pumping Station (PS-13)



Design Condition

1) Design Flow

Qadf : Daily average flow
Qpdf : Peak flow (Ultimate) Qpdf = 2.0 × Qadf

2) Type of Pumping Station

Type A	Submersible station
Basket	Installed

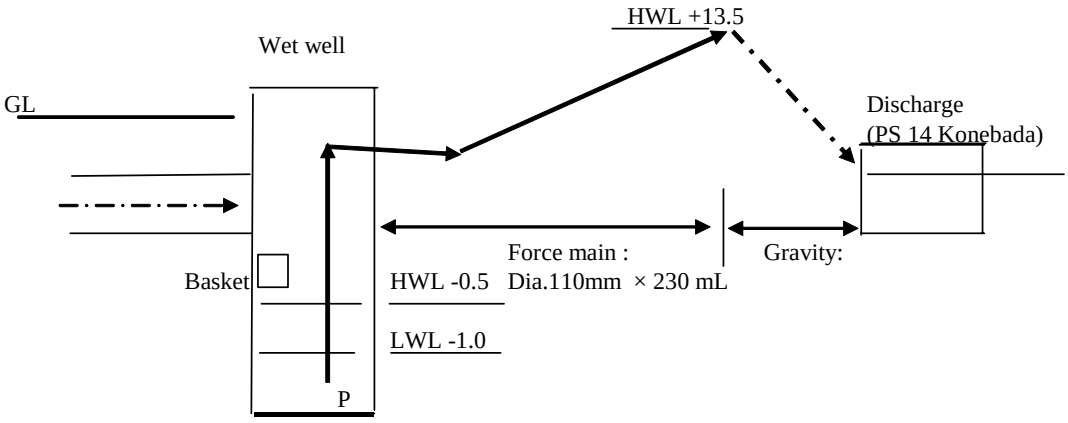
3) Pump Number and capacity

Pump number :	1 duty + 1 standby

4) Force Main

Material :	HDPE
Diameter :	Dia.110 mm
Line number:	1 line

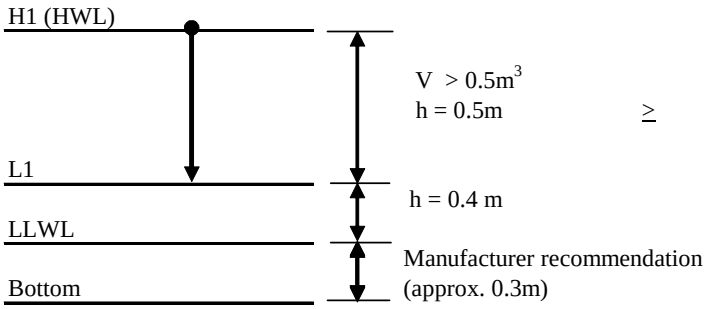
5) Outline (Assume)



Lifting Pump Calculation Sheet (PS-13)

ITEM	SYMBOL	DESIGN			
13.1 Pump Sump Well (New)					
Required cycle time	n	Motor 5.5kW < 7.5kW		10	times
Pump capacity	Q			6.0	L/sec/unit
Required volume	v	= 900 × Q / n/1000	≥	0.5	m^3
Sump Well squere	A			4.90	m^2 Dia. 2.5m

Water Level in the Sump Well

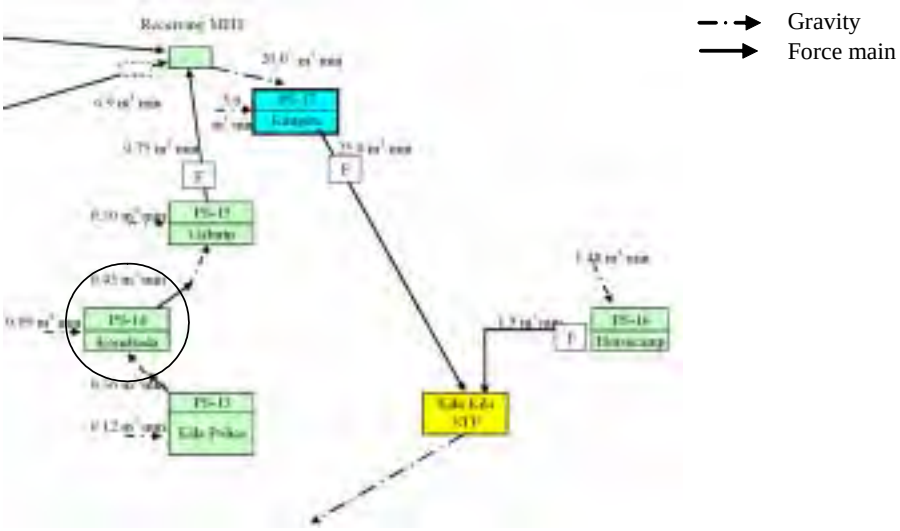


13.2 Lift Pump					
Design flow	Qpdf			0.36	m^3/miin
			=	6.0	L/sec
Duty pump number				1	unit
Design flow per unit		Considered pipe velocity > 0.6m/s	⇒	6.0	L/sec/unit
Specification					
Type		**Submersible non-clog sewage pump, automatic coupling type**			
Dia.	**D**		**Approx.**	**100**	**mm**
Capacity	**Qp**			**6.0**	**L/sec/unit**
			=	**0.36**	**m^3/min/unit**
Total head	**H**	**attached Table Pump calculation sheet**		**20.0**	**m**
Motor	**P**	**attached Table Pump calculation sheet**	**Approx.**	**5.5**	**kW**
Number		**Duty**		**1**	**unit**
		Standby		**1**	**unit**
		Total		**2**	**units**
13.3 Monorail Hoist					
Weight of pump	W		Approx.	0.10	Tonf
Required hoist capacity	hc	W × 1.5	≥	0.15	Tonf
Specification					
Type		**Manually Geared trolley**			
Capacity				**0.5**	**Tonf**
Lift			**Approx.**	**3.0**	**m**
Number		**Duty**		**1**	**unit**
		Standby		**0**	**unit**
		Total		**1**	**unit**

Lifting Pump Calculation Sheet (PS-13)

1	Equip. No.		**M01-013-01/02**				
	Pump Name		**Lifting Pump-13**				
2	Pump Type		Submersible				
3	**q : Capacity (m^3/min)**		**0.36**				
4	**N : Operation number**		**1**				
	Pump		6.0L/s				
	Pump Number		1D + 1S				
	Total Head H=ha+hf1+hf2+hf3+hf4						
5	ha	:Actual head (m)	14.5				
		=DWL-SWL					
6	DWL	(m)	13.500				
7	SWL	(m)	-1.000				
8	hf1	: Straight pipe loss (m) =	2.070				
		(10.666 × Q^1.85) × L × Cc					
		(C^1.85×D^4.87)					
9	Q	: Flow (m^3/sec)	0.006				
		=q × N/60					
10	C	: Coefficient	**130**				
			0.11m × 1 line				
11	D	: Inner Pipe Dia. (m)	0.0964				
12	L	: Pipe length (m)	230				
13	Cc	: Correction coefficient	1.0				
		Water: 1.0					
		Sludge: WT99.2% :					
14	hf2		0.000				
15	hf3	: Pump around loss (m)	2				
16	hf4	:Other head	0				
17	H'	=ha+hf1+hf2+hf3+hf4 (m)	18.57				
18	**H**	**: Total head (m)**	**20.0**				
		Velocity	0.82				
	Motor Power						
19	BKW	=0.163*SG*q*H/Pe (kW)	3.912				
20	SG	:Specific gravity	1.0				
21	Pe	:Pump efficiency	0.3				
22	kW	=BKW × C	4.499				
23	C	:Coefficient (1.15)	1.15				
24	**Motor Power (kW)**		**5.5**				

Konebada Pumping Station (PS-14)



Design Condition

1) Design Flow

Qadf : Daily average flow
Qpdf : Peak flow (Ultimate) Qpdf = 2.0 × Qadf

2) Type of Pumping Station

Type A	Submersible station
Basket	Installed

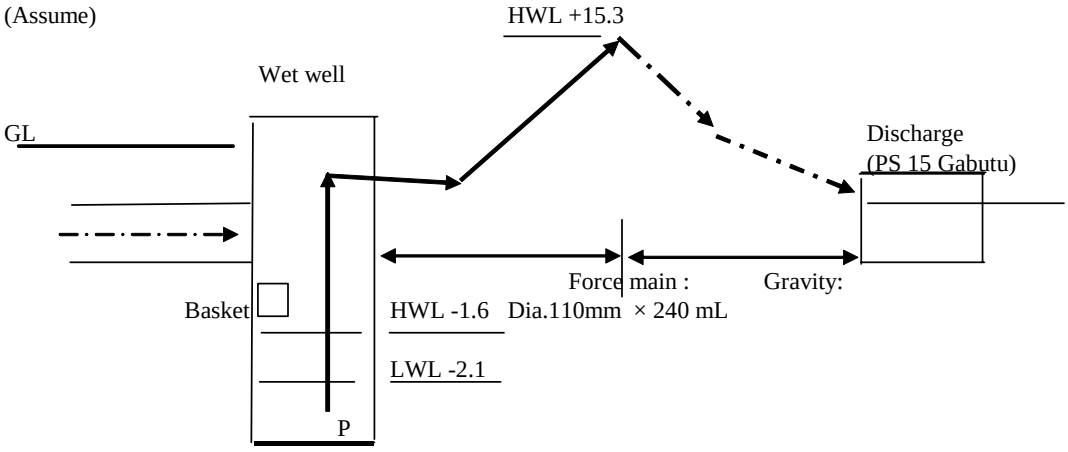
3) Pump Number and capacity

Pump number :	1 duty + 1 standby

4) Force Main

Material :	HDPE
Diameter :	Dia.110 mm
Line number:	1 line

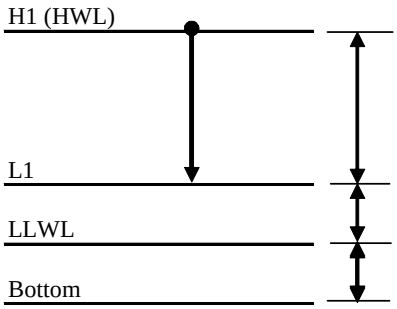
5) Outline (Assume)



Lifting Pump Calculation Sheet (PS-14)

ITEM	SYMBOL	DESIGN			
14.1 Pump Sump Well (New)					
Required cycle time	n	Motor = 7.5kW		4	times
Pump capacity	Q			7.5	L/sec/unit
Required volume	v	= 900 × Q / n/1000	≥	1.7	m^3
Sump Well squere	A			4.90	m^2 Dia. 2.5m

Water Level in the Sump Well

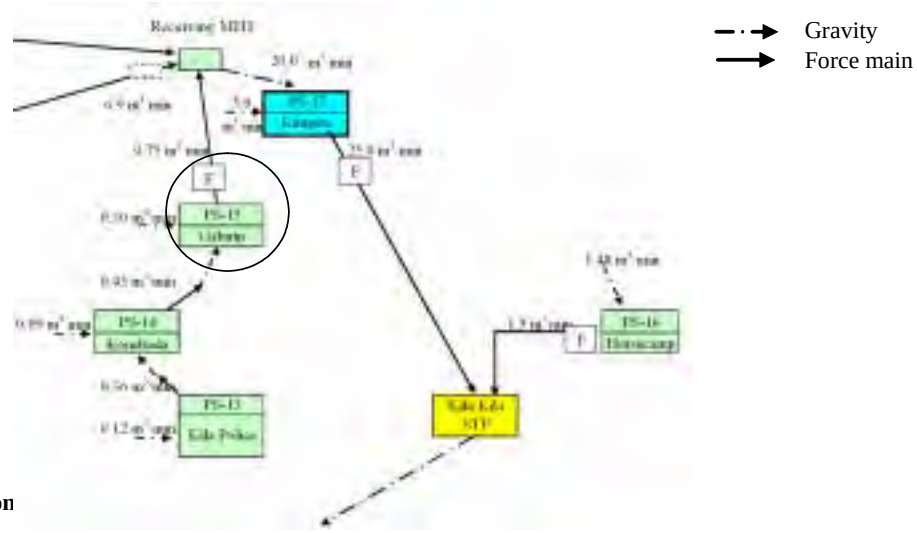


14.2 Lift Pump					
Duty pump number				1	unit
Design flow per unit				7.5	L/sec/unit
Specification					
Type		**Submersible non-clog sewage pump, automatic coupling type**			
Dia.	**D**		**Approx.**	**100**	**mm**
Capacity	**Qp**			**7.5**	**L/sec/unit**
			=	**0.45**	**m^3/min/unit**
Total head	**H**	**attached Table Pump calculation sheet**		**24.0**	**m**
Motor	**P**	**attached Table Pump calculation sheet**	**Approx.**	**7.5**	**kW**
Number		**Duty**		**1**	**unit**
		Standby		**1**	**unit**
		Total		**2**	**units**
14.3 Monorail Hoist					
Weight of pump	W		Approx.	0.20	Tonf
Required hoist capacity	hc	W × 1.5	≥	0.30	Tonf
Specification					
Type		**Manually Geared trolley**			
Capacity				**0.5**	**Tonf**
Lift			**Approx.**	**3.0**	**m**
Number		**Duty**		**1**	**unit**
		Standby		**0**	**unit**
		Total		**1**	**unit**

Lifting Pump Calculation Sheet (PS-14)

1	Equip. No.		**M01-014-01/02**				
	Pump Name		**Lifting Pump-14**				
2	Pump Type		Submersible				
3	**q : Capacity (m^3/min)**		**0.45**				
4	**N : Operation number**		**1**				
	Pump		7.5L/s				
	Pump Number		1D + 1S				
	Total Head H=ha+hf1+hf2+hf3+hf4						
5	ha	:Actual head (m)	17.4				
		=DWL-SWL					
6	DWL	(m)	15.300				
7	SWL	(m)	-2.100				
8	hf1	: Straight pipe loss (m) =	3.129				
		(10.666 × Q^1.85) × L × Cc					
		(C^1.85×D^4.87)					
9	Q	: Flow (m^3/sec)	0.008				
		=q × N/60					
10	C	: Coefficient	**130**				
			0.11m × 1 line				
11	D	: Inner Pipe Dia. (m)	0.0964				
12	L	: Pipe length (m)	230				
13	Cc	: Correction coefficient	1.0				
		Water: 1.0					
		Sludge: WT99.2% :					
14	hf2		0.000				
15	hf3	: Pump around loss (m)	2				
16	hf4	:Other head	0				
17	H'	=ha+hf1+hf2+hf3+hf4 (m)	22.53				
18	**H**	**: Total head (m)**	**24.0**				
		Velocity	1.03				
	Motor Power						
19	BKW	=0.163*SG*q*H/Pe (kW)	5.030				
20	SG	:Specific gravity	1.0				
21	Pe	:Pump efficiency	0.35				
22	kW	=BKW × C	5.784				
23	C	:Coefficient (1.15)	1.15				
24	**Motor Power (kW)**		**7.5**				

Gabutu Pumping Station (PS-15)



Design Condition

1) Design Flow

Qadf : Daily average flow
Qpdf : Peak flow (Ultimate) Qpdf = 2.0 × Qadf

2) Type of Pumping Station

Type A Submersible station
Basket Installed

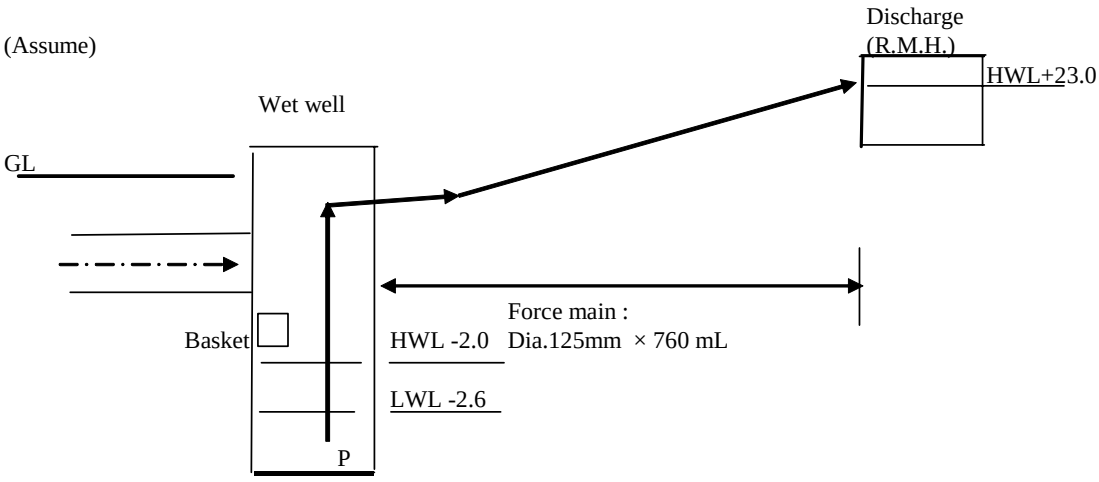
3) Pump Number and capacity

Pump number : 1 duty + 1 standby

4) Force Main

Material : HDPE
Diameter : Dia.125 mm
Line number: 1 line

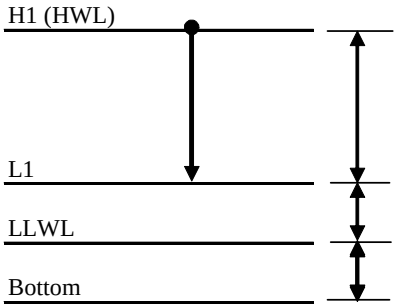
5) Outline (Assume)



Lifting Pump Calculation Sheet (PS-15)

ITEM	SYMBOL	DESIGN			
15.1 Pump Sump Well					
Required cycle time	n	Motor = 22kW (F.W.)		4	times
Pump capacity	Q			12.5	L/sec/unit
Required volume	v	= 900 × Q / n/1000	≥	2.8	m^3
Sump Well squere	A			4.90	m^2 Dia. 2.5m

Water Level in the Sump Well



V > 2.8m^3
h = 0.6m ≥ 0.57 m

h = 0.2 m

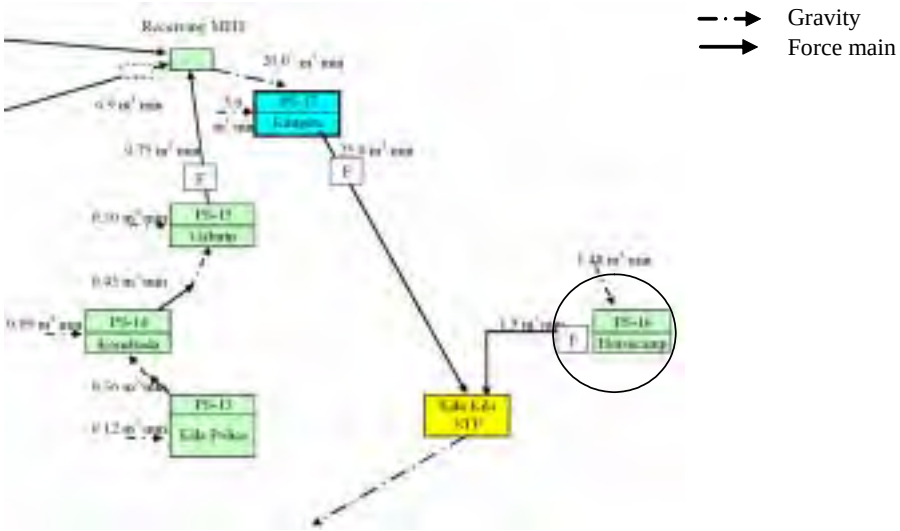
Manufacturer recommendation
(approx. 1.0m)

15.2 Lift Pump					
Duty pump number				1	unit
Design flow per unit				12.5	L/sec/unit
Specification					
Type		**Submersible non-clog sewage pump, automatic coupling type**			
Dia.	**D**		**Approx.**	**100**	**mm**
Capacity	**Qp**			**12.5**	**L/sec/unit**
			=	**0.75**	**m^3/min/unit**
Total head	**H**	**attached Table Pump calculation sheet**		**43.0**	**m**
Motor	**P**	**attached Table Pump calculation sheet**	**Approx.**	**22.0**	**kW**
Number		**Duty**		**1**	**unit**
		Standby		**1**	**unit**
		Total		**2**	**units**
15.3 Monorail Hoist					
Weight of pump	W		Approx.	0.50	Tonf
Required hoist capacity	hc	W × 1.5	≥	0.75	Tonf
Specification					
Type		**Manually Geared trolley**			
Capacity				**1.0**	**Tonf**
Lift			**Approx.**	**3.0**	**m**
Number		**Duty**		**1**	**unit**
		Standby		**0**	**unit**
		Total		**1**	**unit**

Lifting Pump Calculation Sheet (PS-15)

1	Equip. No.		**M01-015-01/02**				
	Pump Name		**Lifting Pump-15**				
2	Pump Type		Submersible				
3	**q : Capacity (m^3/min)**		**0.75**				
4	**N : Operation number**		**1**				
	Pump		12.5L/s				
	Pump Number		1D + 1S				
	Total Head H=ha+hf1+hf2+hf3+hf4						
5	ha	:Actual head (m)	25.6				
		=DWL-SWL					
6	DWL	(m)	23.000				
7	SWL	(m)	-2.600				
8	hf1	: Straight pipe loss (m) =	14.111				
		(10.666 × Q^1.85) × L × Cc					
		(C^1.85×D^4.87)					
9	Q	: Flow (m^3/sec)	0.013				
		=q × N/60					
10	C	: Coefficient	**130**				
			0.125m × 1 line				
11	D	: Inner Pipe Dia. (m)	0.1098				
12	L	: Pipe length (m)	760				
13	Cc	: Correction coefficient	1.0				
		Water: 1.0					
		Sludge: WT99.2% :					
14	hf2		0.000				
15	hf3	: Pump around loss (m)	2				
16	hf4	:Other head	0				
17	H'	=ha+hf1+hf2+hf3+hf4 (m)	41.71				
18	**H**	**: Total head (m)**	**43.0**				
		Velocity	1.32				
	Motor Power						
19	BKW	=0.163*SG*q*H/Pe (kW)	17.523				
20	SG	:Specific gravity	1.0				
21	Pe	:Pump efficiency	0.3				
22	kW	=BKW × C	20.151				
23	C	:Coefficient (1.15)	1.15				
24	**Motor Power (kW)**		**22**				

Horsecamp Pumping Station (PS-16)



Design Condition

1) Design Flow

Qadf : Daily average flow
Qpdf : Peak flow (Ultimate) Qpdf = 2.0 × Qadf

2) Type of Pumping Station

Type A	Submersible station
Basket	Installed

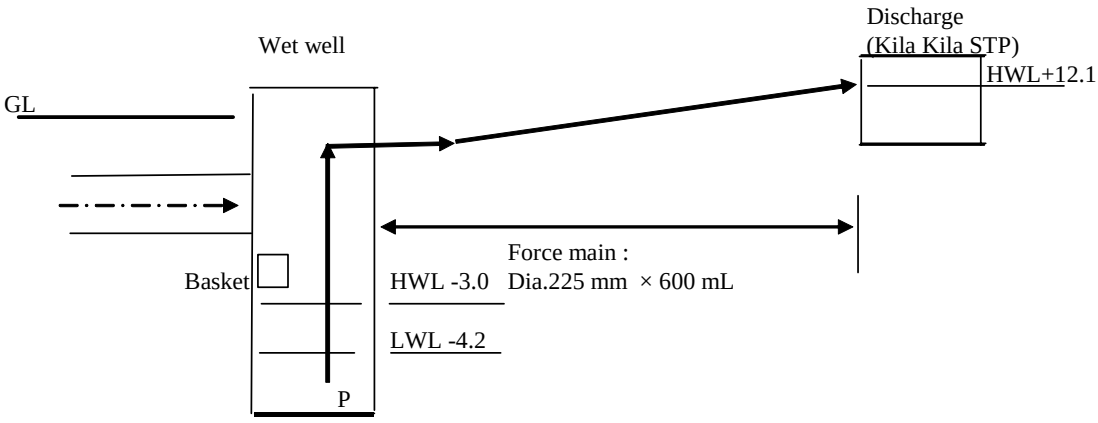
3) Pump Number and capacity

Pump number :	1 duty + 1 standby

4) Force Main

Material :	HDPE
Diameter :	Dia.225 mm
Line number:	1 line

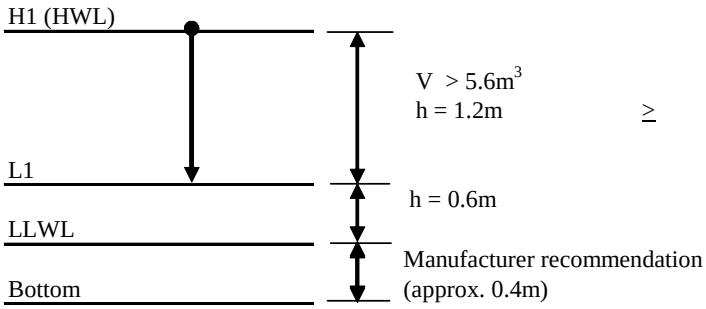
5) Outline (Assume)



Lifting Pump Calculation Sheet (PS-16)

ITEM	SYMBOL	DESIGN			
16.1 Pump Sump Well (New)					
Required cycle time	n	Motor 11kW < 22kW		4	times
Pump capacity	Q			25.0	L/sec/unit
Required volume	v	= 900 × Q / n/1000	≥	5.6	m^3
Sump Well squere	A			4.90	m^2 Dia. 2.5m

Water Level in the Sump Well

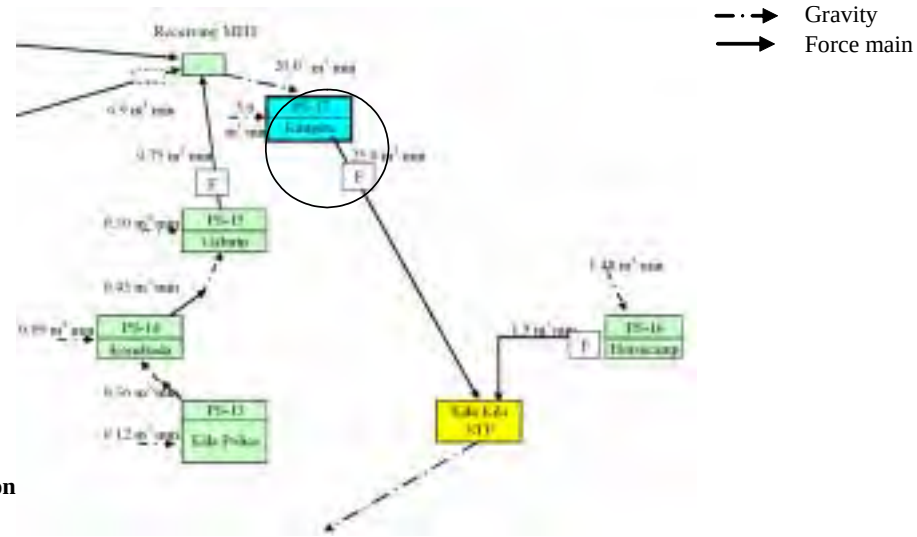


16.2 Lift Pump					
Duty pump number				1	unit
Design flow per unit				25.0	L/sec/unit
Specification					
Type		**Submersible non-clog sewage pump, automatic coupling type**			
Dia.	**D**		**Approx.**	**100**	**mm**
Capacity	**Qp**			**25.0**	**L/sec/unit**
			=	**1.5**	**m^3/min/unit**
Total head	**H**	**attached Table Pump calculation sheet**		**21.0**	**m**
Motor	**P**	**attached Table Pump calculation sheet**	**Approx.**	**11.0**	**kW**
Number		**Duty**		**1**	**unit**
		Standby		**1**	**unit**
		Total		**2**	**units**
16.3 Monorail Hoist					
Weight of pump	W		Approx.	0.25	Tonf
Required hoist capacity	hc	W × 1.5	≥	0.38	Tonf
Specification					
Type		**Manually Geared trolley**			
Capacity				**0.5**	**Tonf**
Lift			**Approx.**	**3.0**	**m**
Number		**Duty**		**1**	**unit**
		Standby		**0**	**unit**
		Total		**1**	**unit**

Lifting Pump Calculation Sheet (PS-16)

1	Equip. No.		**M01-016-01/02**				
	Pump Name		**Lifting Pump-16**				
2	Pump Type		Submersible				
3	**q : Capacity (m^3/min)**		**1.5**				
4	**N : Operation number**		**1**				
	Pump		25.0L/s				
	Pump Number		1D + 1S				
	Total Head H=ha+hf1+hf2+hf3+hf4						
5	ha	:Actual head (m)	16.3				
		=DWL-SWL					
6	DWL	(m)	12.100				
7	SWL	(m)	-4.200				
8	hf1	: Straight pipe loss (m) =	2.296				
		(10.666 × Q^1.85) × L × Cc					
		(C^1.85×D^4.87)					
9	Q	: Flow (m^3/sec)	0.025				
		=q × N/60					
10	C	: Coefficient	**130**				
			0.225m × 1 line				
11	D	: Inner Pipe Dia. (m)	0.1976				
12	L	: Pipe length (m)	600				
13	Cc	: Correction coefficient	1.0				
		Water: 1.0					
		Sludge: WT99.2% :					
14	hf2		0.000				
15	hf3	: Pump around loss (m)	2				
16	hf4	:Other head	0				
17	H'	=ha+hf1+hf2+hf3+hf4 (m)	20.60				
18	**H**	**: Total head (m)**	**21.0**				
		Velocity	0.82				
	Motor Power						
19	BKW	=0.163*SG*q*H/Pe (kW)	8.558				
20	SG	:Specific gravity	1.0				
21	Pe	:Pump efficiency	0.6				
22	kW	=BKW × C	9.841				
23	C	:Coefficient (1.15)	1.15				
24	**Motor Power (kW)**		**11**				

Kaugere Pumping Station (PS-17)



Design Condition

1) Design Flow

Qadf : Daily average flow
Qpdf : Peak flow (Ultimate) Qpdf = 2.0 × Qadf

2) Type of Pumping Station

Type D Submersible station
Basket Installed

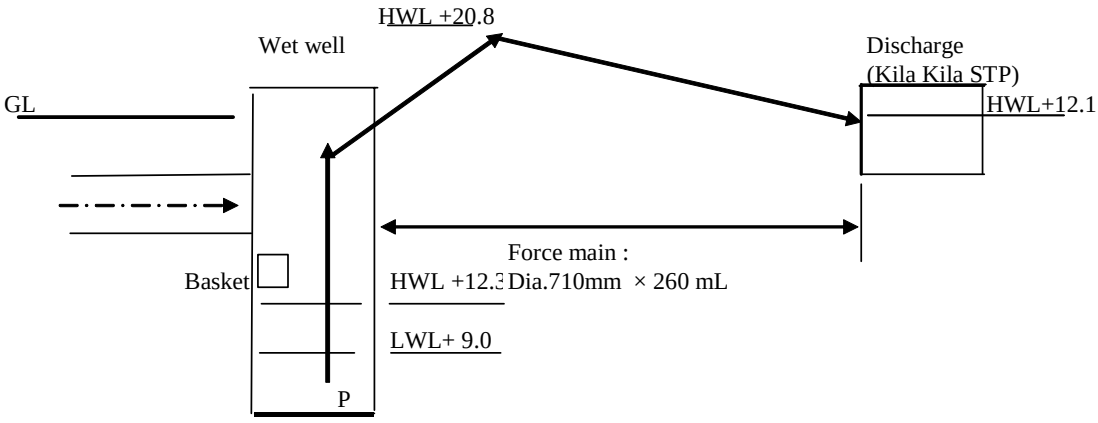
3) Pump Number and capacity

Pump number : 2 duty + 1 standby

4) Force Main

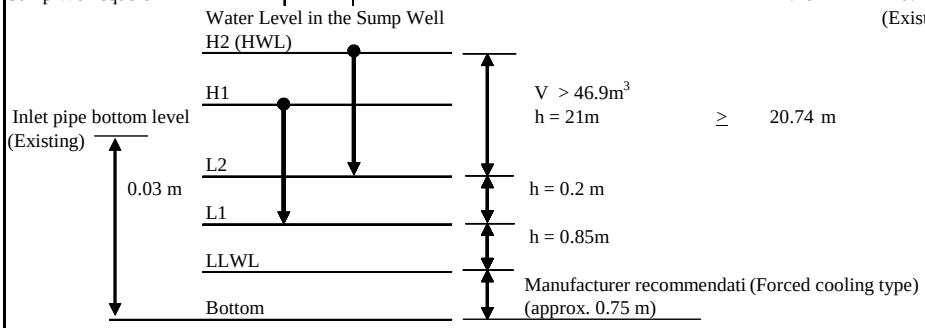
Material : HDPE
Diameter : Dia.710 mm
Line number: 1 line

5) Outline (Assume)



Lifting Pump Calculation Sheet (PS-17)

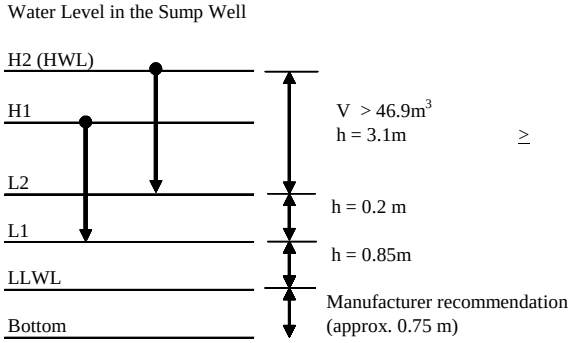
ITEM	SYMBOL	DESIGN			
17.1 Pump Sump Well					
Required cycle time	n	Motor 55kW < 75kW		4	times
Pump capacity	Q			208.3	L/sec/unit
Required volume	v	= 900 × Q / n/1000	≥	46.9	m^3
Sump Well squere	A			2.26	m^2 Dia. 1.7m (Existing)



≥	20.74	m			

New Sump Well will be installed.

Required cycle time	n	Motor 55kW < 75kW		4	times
Pump capacity	Q			208.3	L/sec/unit
Required volume	v	= 900 × Q / n/1000	≥	46.9	m^3
Sump Well squere	A			15.75	m^2 4.5m × 3.5m



≥	2.98	m			

17.2 Lift Pump					
Duty pump number				1	units
Design flow per unit				208.3	L/sec/unit
Specification					
Type		**Submersible non-clog sewage pump, automatic coupling type**			
Dia.	**D**		**Approx.**	**350**	**mm**
Capacity	**Qp**			**208.3**	**L/sec/unit**
			=	**12.5**	**m^3/min/unit**
Total head	**H**	**attached Table Pump calculation sheet**		**15.0**	**m**
Motor	**P**	**attached Table Pump calculation sheet**	**Approx.**	**55.0**	**kW**
Number		**Duty**		**2**	**units**
		Standby		**1**	**unit**
		Stock		**1**	**unit**
		Total		**4**	**units**
17.3 Monorail Hoist					
Weight of pump	W		Approx.	1.40	Tonf
Required hoist capacity	hc	W × 1.5	≥	2.10	Tonf
Specification					
Type		**Manually Geared trolley**			
Capacity				**2.5**	**Tonf**
Lift			**Approx.**	**3.0**	**m**
Number		**Duty**		**1**	**unit**
		Standby		**0**	**unit**
		Total		**1**	**unit**

Lifting Pump Calculation Sheet (PS-17)

1	Equip. No.		**M01-017-01/04**			**1 pump operation**		
	Pump Name		**Lifting Pump-17**			**100%**	**120%**	
2	Pump Type		Submersible	Submersible				
3	**q : Capacity (m^3/min)**		**12.5**	**12.5**		**12.5**	**15.0**	
4	**N : Operation number**		**2**	**2**		**1**	**1**	
	Pump		208.3L/s	208.3L/s				
	Pump Number		2D + 1S	2D + 1S				
	Total Head H=ha+hf1+hf2+hf3+hf4							
5	ha	:Actual head (m)	11.8	3.1		10.6	10.6	
		=DWL-SWL						
6	DWL	(m)	20.800	12.100		19.600	19.600	
7	SWL	(m)	9.000	9.000		9.000	9.000	
8	hf1	: Straight pipe loss (m) =	0.669	5.144		0.185	0.260	
		(10.666 × Q^1.85) × L × Cc						
		(C^1.85×D^4.87)						
9	Q	: Flow (m^3/sec)	0.417	0.417		0.208	0.250	
		=q × N/60						
10	C	: Coefficient	**130**	**130**		130	130	
			0.71m × 1 line	0.71m × 1 line		0.71m × 1 line	0.71m × 1 line	
11	D	: Inner Pipe Dia. (m)	0.6243	0.6243		0.6243	0.6243	
12	L	: Pipe length (m)	260	2000		260	260	
13	Cc	: Correction coefficient	1.0	1.0		1.0	1.0	
		Water: 1.0						
		Sludge: WT99.2% :						
14	hf2		0.000	0.000		0.000	0.000	
15	hf3	: Pump around loss (m)	2	2		2	2	
16	hf4	:Other head	0	0		0	0	
17	H'	=ha+hf1+hf2+hf3+hf4 (m)	14.47	10.24		12.79	12.86	
18	**H**	**: Total head (m)**	**15.0**	**11.0**				
		Velocity	1.36	1.36		0.68	0.82	
							> 0.60 m/sec	
	Motor Power							
19	BKW	=0.163*SG*q*H/Pe (kW)	43.661	32.018				
20	SG	:Specific gravity	1.0	1.0				
21	Pe	:Pump efficiency	0.7	0.7				
22	kW	=BKW × C	50.210	36.821				
23	C	:Coefficient (1.15)	1.15	1.15				
24	**Motor Power (kW)**		**55**					

(adoption)

C1.2 Calculation Sheets of STP

M02 Grit Chamber Facility

ITEM	SYMBOL	DESIGN
1 Grit Chamber Inlet Gate		
1.Design Condition		
Design Flow	$Q_{2'-D}$	36,800 m^3/day (Hourly Maximum)
	$Q_{2'-S}$	0.426 m^3/sec (Hourly Maximum)
Type		Manually Operated Cast Iron Gate
Unit Number	UN	Ope. 2 units / Stand-by 0 unit / Total 2 units
2.Design Criteria		
Average Velocity	V1	Less than 1.0 m/sec
3.Calculation		
Dimension Depth	H	Arrangement 0.5 m
Width	W	H : W = 1 : 1 or 1.5 : 1 therefore 0.5 m
Velocity	V2	Q2'-S × 1 / (H × W × 2） = 0.85 m/sec Less than 1.0m/sec …OK
4.Specification		W 500mm × H 750mm × 2units (proposed)
2 Medium Screen		
1.Design Condition		
Design Flow	$Q_{2'-D}$	36,800 m^3/day (Hourly Maximum)
	$Q_{2'-S}$	0.426 m^3/sec (Hourly Maximum)
Type		Automatic Drum Screen
Unit Number	UN	Ope. 2 unit / Stand-by 0 unit / Total 2 unit
Opening	OP	20 mm
Flow Per Unit	Qu	$Q_{2'-S}$ / UN = 0.213 m^3/sec = 18,400 m^3/day
Cannel Width		Width 1.6 m
2.Specification		Dia.1,400 mm × OP.20 mm × 2.2 kW × 2 units (proposed) (Based on Manufacturer's Information)

ITEM	SYMBOL	DESIGN
3 Screenings Container		
1.Design Condition		
Design Flow	$Q_{1\text{-}D}$	36,800 m^3/day (Hourly Maximum)
Type		Container (with handcart)
Unit Number	UN	Ope. 1 unit / Stand-by 3 units / Total 4 units
Storage days	SD	3 days
2.Design Criteria		
Unit Screenings Generation Volume	Vo1	0.001 m^3/1000m^3 to 0.015 m^3/1000m^3
3.Calculation		
Design Screening Volume	Vo2	Q1-D × 10-3 × Vo1 = 0.04 m^3/day to 0.55 m^3/day However dehydrate to 70% water content (Raw Screening water content : 85%) therefore 0.018 m^3/day to 0.28 m^3/day
Container Volume	Vo3	Vo2 × SD = 0.06 m^3 to 0.83 m^3
4.Specification		0.5 m^3 × 4 units (proposed)
4 Grit Collector		
1.Design Condition		
Design Flow	$Q_{2'\text{-}D}$	36,800 m^3/day (Hourly Maximum)
	$Q_{2'\text{-}S}$	0.426 m^3/sec (Hourly Maximum)
Type		Vorte× Type
Unit Number	UN	Ope. 2 units / Stand-by 0 unit / Total 2 units
Grit Chamber Dimension		Dia 1.6m
Channel Number		2 channels
Flow Per Unit	Qu	$Q_{2'\text{-}S}$ / (UN)= 0.213 m^3/sec = 18,400 m^3/d
2.Specification		Dia.1,600 mm × 0.75 kW × 2 units (proposed) (Based on Manufacturer's Information)

ITEM	SYMBOL	DESIGN
5 Grit Pump		
1.Design Condition		
Type		Centrifugal Pump
Unit Number	UN	Ope. 1 units / Stand-by 1 unit / Total 2 units
Sand Pit Volume	Vo	2 m^3
2.Design Criteria		
Operation Time	T	Appro×imately 5 min Against Sand Pit Volume
3.Calculation		
Discharge Flow Per Unit	QU	Vo/T = 0.5 m^3/min
Total Pump Head	H	From Calculation Sheet of Pumps (STP) 7 m
4.Specification		Dia.80 mm × 0.5 m^3/ min × 7 m × 2.2 kW × 2 units (proposed)
6 Grit Separator		
1.Design Condition		
Type		Screw Conveyor Type
Unit Number	UN	Ope. 1 unit / Stand-by 0 unit / Total 1 unit
Grit Pump Discharge Flow	QU	0.5 m^3/min
2.Design Criteria		
Retention Time	T	More Than 30 sec Against Grit Removal Pump Discharge Flow
3.Calculation		
Tank Volume	Vo	QU × T= more than 0.25 m^3
4.Specification		0.5 m^3/ min × 0.75 kW × 1 unit (proposed)

ITEM	SYMBOL	DESIGN
7 Grit Container		
1.Design Condition		
Design Flow	$Q_{1'-D}$	36,800 m^3/day (Hourly Maximum)
Type		Container (with handcart)
Unit Number	UN	Ope. 1 unit Stand-by 3 units Total 4 units
Storage days	SD	3 days
2.Design Criteria		
Unit Grit Sedimentation Volume	Vo1	0.001 m^3/1000m^3 to 0.02 m^3/1000m^3
3.Calculation		
Design Grit Volume	Vo2	Q1'-D × 10-3 × Vo1 = 0.04 m^3/day to 0.74 m^3/day
Container Volume	Vo3	Vo2 × SD = 0.11 m^3 to 2.2 m^3
4.Specification		0.5 m^3 × 4 units (proposed)

M03 Distribution Chamber Facility

ITEM	SYMBOL	DESIGN
1 Distribution Weir		
1.Design Condition		
Design Flow	$Q_{2'-D}$	36,800 m^3/day (Hourly Maximum)
Design Flow	$Q_{2'-S}$	0.426 m^3/sec (Hourly Maximum)
Type		Adjustable Weir, Cast Iron
Unit Number	UN	Ope. 4 units; Stand-by 0 unit; Total 4 units
2.Design Criteria		
Effluent Height	H1	0.10 m to 0.30 m
3.Calculation		
Weir Width	W	$(Q_{2'-S})/UN/1.84/H1^{3/2}$=
		= 1.8 m to 0.35 m
		therefore 0.8 m
Check		(Q2'/N/1.84/W')^2/3 0.17
4.Specification		W 800 mm × ST 400mm × 4 units (proposed)

M04 O×idation Ditch Facility

ITEM	SYMBOL	DESIGN
1 Outlet Gate		
1.Design Condition		
Ma×. Design Flow	$Q_{2'-D}$	18,400 m^3/day (Daily Average + Return Sludge Flow + Bypass Frow)
	$Q_{2'-S}$	0.213 m^3/sec
Type		Manually Operated Cast Iron Gate
Unit Number	UN	Ope. 1 unit/train Stand-by 0 unit Total 1 unit/train
2.Design Criteria		
Average Velocity	V1	Less than 1 m/sec
3.Calculation		
Dimension Depth	H	Arrangement 0.5 m
Width	W	H : W = 1 : 1 or 1.5 : 1 therefore 0.5 m
Velocity	V2	Q2'-S / (H × W)/ UN = 0.95 m/sec
		Less than 1.0m/sec …OK
4.Specification		W 500 mm × H 500 mm × 3 units (proposed)

ITEM	SYMBOL	DESIGN			
2 Air diffuser					
1.Required Air Content					
a) Oxygen Demand					
For Removed BOD	D_B	A × [(Sc-Sc,out)-2N,Rm] ×10-3 × Q3-D =		270	kgO_2/day
		Design Flow (Daily Average)/ train	$Q_{3-D=}$	4,600	m^3/day
		Oxygen demand per removed BOD	A =	0.6	kgO_2/kgBOD
		Inlet BOD Quality	Sc =	190	mg/L
		Outlet BOD Quality	Sc,out =	20	mg/L
		Inlet Nitrogen Quality	T-N =	45	mg/L
		BOD consumption ratio for Denitrification	=	2	kgBOD/kgN
		Nitrogen removal N,Rm =T-N × N-R=		36	mg/L
		Denitrification ratio	N-R=	80	%
For Endogenous Respiration	D_E	B × MLVSS × 10-3 × VA × R =		552	kgO_2/day
		O×ygen demand for unit endogenous respiration			
			B = 0.1		kgO_2/kgMLVSS-day
		Organic MLSS (MLSS × 80%)	MLVSS =	2,400	mg/L
		Aerated Zone Volume			
			VA =	4,600	m^3
		R : Ratio of Aerobic	R =	0.5	
For Nitrification	D_N	C × T-N × α × Q3-D × 10-3 =		757	kgO_2/day
		O×ygen consumed by Nitrification Reaction	C=	4.57	kgO_2/kgN
		Influent Nitrogen Quality	T-N =	45	mg/L
			α=	0.80	mg/L
For Residual Dissolved Oxygen					
	D_{DO}	CA × Q3-D × 10-3 =		7	kgO_2/day
		Residual dissolved oxygen concentration	CA=	1.5	mg/L

ITEM	SYMBOL	DESIGN
Actual Oxygen Demand	AOR	$D_B + D_E + D_N + D_{DO}$= 1,586 kgO_2/day
Standard Oxygen Demand	SOR	SOR=(AOR×Csw × r) / (1.024(T-20) ×α×(β× Cs × r-CA))/t
		= 194.71 kgO_2/hr
		Csw: Oxygen saturation concentration in clean water at
		temperature 20℃ Csw= 8.84 mg/l
		T: Temperature of Water T= 28 ℃
		α: Ratio of Oxygen transfer rate in the waste to that in clear water
		at the same temperature α= 0.83
		β: Ratio of Oxygen saturation concentration in the waste to that
		in clean water β= 0.95
		Cs: Oxygen saturation concentration in clean water at Temperature T
		Cs= 7.53 mg/l
		CA: Residual dissolved oxygen concentration in the waste water
		C_A= 1.5 mg/l
		r : Correction of Cs from water depth
		r=1+(H/2)/10.24= 1.28
		H : Design Water Depth of Diffuser H= 5.7 m
		t : Aeration time per day t= 12 hr/day
2.Design Condition		
Type		Air diffuser
Dissolutive Efficiency	Ea	31 %
OD Train Number	TN	1 trains
Unit Number	UN	10 units/train
		Air Density ρ= 1.293 kg air/Nm^3
		O×ygen weight per unit Air Ow= 0.233 kg O2/kg air
3.Calculation		An example which calculates the quantity of Diffuser is shown below.
(For example)		
Air Volume per Diffuser	Da	117 L/min
Air Demand	Qa	SOR/(Ea×10^{-2}×ρ×Ow) /TN/60×(293/273)= 36.9 Sm^3/min/train
Safety Factor	α	α= 1.10
Designed Air Demand		Qa × α= 40.6 Sm^3/min/train
Required Diffuser Numbe	n	Qa / Da × 10^3 = 346.7 pieces
		therefore 360 pieces/train
4.Specification		Approx. 36 pieces / unit × 10 units × 3 trains (proposed)

ITEM	SYMBOL	DESIGN
3 Aeration Blower		
1.Design Condition		
Type		Rotary Type Blower
OD Train Number	TN	4 trains (Ultimate)
Unit Number	UN	Ope. 4 units / Stand-by 2 unit / Total 6 units (Ultimate)
Air Demand	Qa	40.6 Sm^3/min/train
2.Design Criteria		
Allowance	AL	10 %
3.Calculation		
Air Demand	Q	Qa × (1+AL/100) = 40.6 Sm^3/min/train therefore 42 Sm^3/min/train
Total Blower Head		70.0 kPa
4.Specification		Dia 200 mm × 42 Sm^3/min × 70 kPa × 75 kW × 5 units (proposed)
4 Reactor Tank Mixer		
1.Design Condition		
Type		Submersible Propeller Type Mixer
OD Train Number	TN	4 trains (Ultimate)
Unit Number	UN	Ope. 4 units/ train / Stand-by 0 unit / Total 4 units/ train
OD Tank Volume	V	4,600 m^3/tank
2.Design Criteria	W	1.5 w/m^3
3.Calculation		V × W / TN / UN /1000= 1.73 kW therefore 2.3 kW Approx.
4.Specification		Dia. Approx. 2.4 m × Approx. 2.3 kW × 12 units (4 units/train × 3 trains, proposed) (Based on Manufacture's Information)

ITEM	SYMBOL	DESIGN
5 Waste Sludge Pump		
1.Design Condition		
Type		Submersible Sewage Pump (Non-clog)
Unit Number	UN	Ope. 4 units Stand-by 4 units Total (Ultimate) 8 units
Sludge volume	V	1,434 m^3/day
2.Design Criteria		
Operation Time	T	5.4 hr/day/unit
3.Calculation		
Discharge Flow	QU	V/ (T× 60) / UN= 1.11 m^3/min
		therefore 1.1 m^3/min
Total Pump Head	H	From Calculation Sheet of Pumps (STP) 14 m
4.Specification		Dia.100 mm × 1.1 m^3/min × 14 m × 5.5 kW × 6 units (proposed)

M05 Clarifier Facility

ITEM	SYMBOL	DESIGN
1 Clarifier		
1.Design Condition		
Design Flow	$Q_{2'-D}$	18,400 m^3/day (Ultimate Daily Average)
Type		Center Driven Column Type
Unit Number	UN	4 units (Ultimate)
Dimension		Dia.25 m × WD 3.5 m × 4 units
2.Specification		Dia.25 m × WD3.5 m × 0.75 kW × 3 units (proposed) (Based on Manufacture's Information)
2 Return Sludge Pump		
1.Design Condition		
Type		Centrifugal Pump (Screw type)
Unit Number	UN	Ope. 4 units; Stand-by 4 units; Total (Ultimate) 8 units
Design Flow	$Q_{3'-D}$	18,400 m^3/day (Ultimate Daily Average)
	$Q_{3'-M}$	12.8 m^3/min
2.Design Criteria		
Return Sludge Ratio	RSR	100 %、(Max.200%)
Operation Time	T	24 hr/day
3.Calculation		
Discharge Flow	QU	Q3'-M × (RSR/100) /UN= 3.19 m^3/min therefore 3.2 m^3/min
Total Pump Head	H	From Calculation Sheet of Pumps (STP) 9 m
4.Specification		Dia.150 mm × 3.2 m^3/min × 9 m × 11 kW × 6 units (proposed)

M06 Utility and Disinfection Facility

ITEM	SYMBOL	DESIGN
1 Disinfection Inlet Gate		
1.Design Condition		
Design Flow	$Q_{2'-D}$	36,800 m^3/day (Hourly Maximum)
	$Q_{2'-S}$	0.426 m^3/sec (Hourly Maximum)
Type		Manually Operated Cast Iron Gate
Unit Number	UN	Ope. 2 units / Stand-by 0 unit / Total 2 units
2.Design Criteria		
Average Velocity	V1	Less than 1 m/sec
3.Calculation		
Dimension Depth	H	Arrangement 0.6 m
Width	W	H : W = 1 : 1 or 1.5 : 1 therefore 0.4 m
Velocity	V2	Q2'-S × 1 / (H × W) = 0.89 m/sec
		Less than 1.0m/sec …OK
4.Specification		W 400 mm × H 600 mm × 2 units (proposed)
2 Ultra Violet Disinfection Unit		
1.Design Condition		
Type		Medium Pressure Type
Unit Number	UN	Ope. 2 lots / Stand-by 0 lot / Total 2 lots
Design Flow	$Q_{2'-S}$	36,800 m^3/ day (Hourly Maximum)
Coliform Reduction	%	99 %
UV Transmittance	%	70 %
2.Design Criteria		
Flow rate per Unit	QN	$Q_{3'-D}$ / UN = 18,400 m^3/day
Capacity per UV Lump	Q_{UV}	490 m^3 / day / lamp (Based on Manufacture's Information)
3.Calculation		
UV Lamp Number	UN	Q_N / Q_{UV} = 37.6 lamps per Unit
		therefore 42 lamps per Unit
4.Specification		18,400 m^3/day × Approx.15.0 kW × (42 lamps/ lot) × 2 lots

ITEM	SYMBOL	DESIGN

3 Chlorine Facility (for back up)

1) Dosing ratio

Powder chlorine : effective 60%

Design flow : 18,400 m^3/ day

Effec. CL rate (mg/L)	Powder chlorine (mg/L)	Powder CL (kg/day)	Remarks
2	3.33	61.3	
3	5.00	92.0	Average
4	6.67	122.7	Maximum

Average dosing rate	Aav		mg/L	3	
Dosing quantity per day	Dq	for 18,400m^3/d	kg/D	92.0	
Solution ratio	Sr		%	2	
Dosing flow per day	Df	Dq × 1/Sr × 100/1000	m^3/d	4.60	
Dosing quantity per year	Dqy		kg/y	2,760	(Assumption 30 days)
Required bag per year		45kg Chlorine per drum	bags/y	61	

2) Chlorine Solution Tank and Mi×er

Retention time	Rt		day	1		more
Required tank volume	Rv	Df × Rt	m^3	4.6		more
Tank quantity	n		No.	1		tank
Required volume for one tank	Rvn	Rv / n	m^3	4.6		more
Tank type		Cylindrical PE tank with Mixer				
Dimension	φ		m	2.0		
	ED	Effective water depth	m	2.0		
	V	Effective volume	m^3	5.5		
			therefore	7.0	m^3	
			kW	1.5		

3) Chlorine Dosing Charger

Design flow	q.av	Df/24	0.19	m^3/hr	Average
	q.max		0.51	m^3/hr	Max.
Type		Manual flow control and gravity type, PVC			
Unit Number	N	Duty	1	unit	
		Standby	1	unit	
		Total	2	units	
Capacity	C		0 to 0.3	m^3/hr	

4) Specification

7 m^3 × 1 unit, 0 to 0.3 m^3/ hr × 2 units (proposed)

(Mixer 1.5kw)

ITEM	SYMBOL	DESIGN
4 Utility TE Water Supply Unit		
1.Design Condition		
Type		Two Submersible Pumps + Pressure Tank with Control Panel
Unit Number	UN	Ope. 1 unit / Stand-by 0 unit / Total 1 unit
2.Design Criteria		
Required Water Volume	QU2	From Calculation of the Capacity of TE Unit 0.6 m^3/min
3.Calculation		
Discharge Flow Per Unit	QU	0.6 m^3/min
Total Pump Head	H	From Calculation Sheet of Pumps (STP) 42 m
4.Specification		Dia.50mm × 0.6 m^3/min × 42 m × 7.4kW × 1 lot (proposed) (2 pumps/ lot)
5 Defoaming Pump		
1.Design Condition		
Type		Submersible Turbine Pump
Unit Number	UN	Ope. 1 unit / Stand-by 1 unit / Total 2 units
Nozzle Number	UN1	12 units/train × 4 trains (Ultimate)
2.Design Criteria		From Calculation of the Capacity of Defoaming Pump
Required Nozzle Water Volume	Vo	8 L/min/nozzle
3.Calculation		
Discharge Flow Per Unit	QU1	0.6 m^3/min
Total Pump Head	H	From Calculation Sheet of Pumps (STP) 29 m
4.Specification		Dia.100 mm × 0.6 m^3/min × 29 m × 3.7 kW × 2 units (proposed)

M07 Sludge Treatment Facility

ITEM	SYMBOL	DESIGN
1 Sludge Dewatering Unit		
1.Design Condition		
Type		Multi-Diskplate Screw Press
Inlet SS Load	S	2,397 kg/ day
Inlet Sludge Volume	Vo	799 m^3/ day
Sludge Solids Content	Ssc	0.3 %
2.Design Criteria		
Solid Load per Unit	SL	179 kg-DS/hr
Operation Time	T1	94 hr/week (104hr × 0.9)
	T2	22 hours/day (24hr × 0.9)
2.Calculation		
Unit Number	UN	S × (7 / T1) /SL = 1.0 unit therefore 1 unit Ope. 1 units / Stand-by 1 unit / Total 2 units
3.Specification		180 kg-DS/ hr × Approx.6 kW × 2 units (proposed)

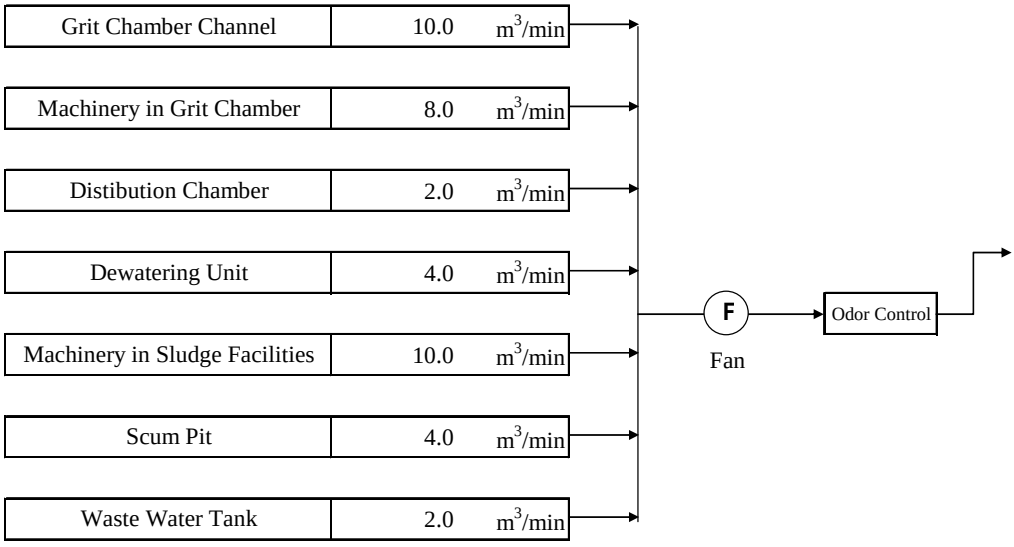
ITEM	SYMBOL	DESIGN
2 Polymer Dissolving Tank		
1.Design Condition		
		These tanks are used for sludge dewatering unit
Type		Cylindrical Steel Tank
Unit Number	UN	2 units
Inlet SS Load(Dewatering)	S2	2,397 kg/ day
Unit Number (Dewatering)	UNd	1 unit
Sludge Dewatering Unit Capacity	SLd	179 kg-DS/ hr
2.Design Criteria		
Dosage rate per DS(Dewatering)	Ird	1.5 %
Dissolving Concentration	DC	0.2 %
3.Calculation		
Polymer Consumption Weight(Dewatering)	W2	S2 × Ird × 7/5 = 64 kg/ day
Tank Volume	Vo	W2 × 100 /DC × 10-3/UN = 16.1 m^3/ tank
		therefore 17 m^3/ tank
Polymer Consumption Weight	C	Vo × DC = 34.0 kg/ tank
4.Specification		17 m^3 × Dia.2,700 mm × Height 3.6 m × 2 units (proposed)
		(Agitator 11kw)

ITEM	SYMBOL	DESIGN
3 Polymer Feeder		
1.Design Condition		
Type		Constant Chemical Feeder
Unit Number	UN	2 units
Polymer Consumption Weight	C	34.0 kg/tank
Polymer Consumption Weight (Dewatering)	W2	64 kg/day
Polymer Density	η1	0.5 kg/L
2.Design Criteria		
Feeding Time	T	20 min/tank
Allowance	AL	30 %
Storage Days (Hopper)	SD	more than 1 day
3.Calculation		
Feeder Capacity	Q	C / T × (100 + AL) / 100 = 2.21 kg/min
Hopper Volume	Vo	(W1+W2) × SD / UN /η1 = 64 L
		Therefore 100 L
4.Specification		2.3 kg/ min × 0.4 kW × 2 units (proposed)
4 Polymer Feed Pump For Dewatering		
1.Design Condition		
Type		Progressive Cavity Pump
Unit Number	UN	Ope. Stand-by Total
		1 units 1 unit 2 units
Dewatring Solid Load	SL	179 kg-DS/hr
2.Design Criteria		
Dosage rate per DS	Ir	1.5 %
Dissolution Concentration	DC	0.2 %
Control range	CR	50% to 150%
3.Calculation		
Discharge Flow per Unit	QU	SL × Ir / DC × 10-3 × CR=
		0.7 m^3/hr to 2.0 m^3/hr
Total Pump Head	H	20 m
		(Based on Manufacturer's Information)
4.Specification		Dia.50mm × 0.7- 2.0 m^3/hr × 20 m × 1.5 kW × 2 units (proposed)

ITEM	SYMBOL	DESIGN
5 Waste Water Tank Mixer		
1.Design Condition		
Type		Submersible Propeller Mixer
Unit Number	UN	Ope. 1 unit / Stand-by 0 units / Total 1 unit
Tank Number	TN	1 tank
Tank Volume	V	113 m^3/tank (W 5m ×L 5m × WD4.5m)
2.Design Criteria	W	5 w/m^3
3.Calculation		V × TN × W / UN /1000= 0.6 kW therefore 1.5 kW
4.Specification		1.5 kW × 1 unit (proposed) (Based on Manufacture's Information)
6 Waste Water Pump		
1.Design Condition		
Type		Non-clog Type Sludge Pump
Unit Number	UN	Ope. 1 units / Stand-by 1 units / Total 2 units
Waste Water Tank Volume	Vo	113 m^3
2.Design Criteria		
Operation Time	T	60 min Against Waste Water Volume
3.Calculation		
Discharge Flow Per Unit	QU	Vo /T / UN × (1+AL/100) = 1.9 m^3/min
Total Pump Head	H	From Table1. Friction Loss Calculation Sheet 14 m
4.Specification		Dia.100 mm × 2.0 m^3/ min × 14 m × 11 kW × 2 units (proposed)

7 Sludge Cake Hopper		
1.Design Condition		
Type		Motor Driven Cutgate Type
Unit Number	UN	1 unit
Sludge Volume (Solid)	Vo	27 m^3/day (Ultimate)
2.Specification		15 m^3 × (2.2 × 2) kW × 1unit (proposed)
3.Number Of Dump Trip (Ultimate)		2 to 3 Times/day (Approx.)

ITEM	SYMBOL	DESIGN
8 Biological Odor Control		
1.Design Condition		
Type		Biological Odor Control
Unit Number	UN	Ope. 1 unit; Stand-by 0 unit; Total 1 unit
Odor Gas Flow	Q	m^3/min therefore 40 m^3/min



2.Design Criteria		
Gas Velocity	LV	0.1 m/sec
	SV	200 $m^3/m^3/h$
3.Calculation		
Required Section Area	A	Q/LV/60= More than 6.67 m^2
Required Media Volume	V	Q×60/SV= Appro×. 12 m^3
4. Specification		40 m^3/ min × 1 unit

ITEM	SYMBOL	DESIGN		
9 Deodorization Fan				
1.Design Condition				
Type		Centrifugal Fan		
Unit Number	UN	Ope.	Stand-by	Total
		1 unit	1 unit	2 unit
Odor Gas Flow	Q	40 m^3/min		
2.Calculation				
Total Fan Head	H			2.5 kPa
3. Specification		40 m^3/ min × 2.5 kPa × 5.5 kW × 2 units		

Calculation sheet of pumps (STP)

1	Equip. No.												
	Pump Name		**Grit Pump**	**Oil Discharge Pump**	**Sump Drain Pump**	**Scum Pump**	**Sump Drain Pump**	**Return Sludge Pump**	**Waste Sludge Pump**	**Utility Water Supply Unit**	**Deforming Pump**	**Waste Water Pump**	**Sump Drain Pump**
2	Pump Type		Sub.	Sub.	Sub.	Sub.	Sub.	Hor.	Sub.	Sub.	Sub.	Sub.	Sub.
3	**q : Capacity (m^3/min)**		**0.5**	**0.2**	**0.3**	**0.5**	**0.3**	**3.2**	**1.1**	**0.6**	**0.6**	**2.0**	**0.3**
4	**N : Operation number**		**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**1**
	Total Head												
	H=ha+hf1+hf2+hf3+hf4												
5	ha	:Actual head (m)	5.0	3.3	5.0	10.5	5.0	2.78	7.8	5.0	5.0	9.5	1.0
		=DWL-SWL											
6	DWL	(m)				13.5		10.2				13.5	
7	SWL	(m)				3.0		7.42				4.0	
8	hf1	: Straight pipe loss (m =	0.828	1.178	0.151	1.420	0.163	2.428	2.828	0.992	0.744	1.262	1.444
		(10.666 × Q^1.85) × L × Cc											
		(C^1.85×D^4.85)											
9	Q	: Flow (m3/sec)	0.008	0.003	0.005	0.008	0.005	0.107	0.018	0.010	0.010	0.033	0.005
		=q × N/60											
10	C	: Coefficient	110	100	130	130	130	130	130	130	130	130	110
		DCIP:110											
		Steel pipe : 100											
		HDPE : 130											
11	D	: Pipe Dia. (m)	0.08	0.0657	0.08	0.0964	0.0788	0.2462	0.1406	0.1406	0.1406	0.1976	0.08
12	L	: Pipe length (m)	12	30	10	90	10	100	200	280	210	200	70
13	Cc	: Correction coefficient	1.3	1.3	1.0	1.0	1.0	1.3	1.3	1.0	1.0	1.0	1.0
		Water: 1.0											
		Sludge: WT99.2% : 1.3											
14	hf2	: Bend and others loss (m)	0.248	0.353	0.045	0.426	0.049	0.728	0.848	0.298	0.223	0.379	0.433
		=hf1 × 0.3 (in the building)											
15	hf3	: Pump around loss (m)	0.7	0.7	0.7	0.7	0.7	2	0.7	0.7	0.7	0.7	0.7
		Horizontal type : 2.0m											
		Submersible type : 0.7m											
16	hf4	:Other head	0	0	0	0	0	0	0	30	20	0	0
17	H'	=ha+hf1+hf2+hf3+hf4 (m)	6.78	5.53	5.90	13.05	5.91	7.94	12.18	36.99	26.67	11.84	3.58
18	**H**	**: Total head (m)**	**7.0**	**6.0**	**6.0**	**14.0**	**6.0**	**9.0**	**14.0**	**42.0**	**29.0**	**14.0**	**5.0**
	V	Velocity	1.66	0.98	1.00	1.14	1.03	2.24	1.18	0.64	0.64	1.09	1.00
								Ma×.					
	Motor Power												
19	BKW	=0.163*SG*q*H/Pe (kW)	1.90	0.49	0.77	3.00	0.77	7.58	4.18	6.32	3.55	7.61	0.64
20	SG	:Specific gravity	1.0	1.0	1.05	1.05	1.05	1.05	1.0	1.0	1.0	1.0	1.05
21	Pe	:Pump efficiency	0.3	0.4	0.4	0.4	0.4	0.65	0.6	0.65	0.8	0.6	0.4
22	kW	=BKW × C	2.187	0.562	0.886	3.444	0.886	8.721	4.811	7.267	4.077	8.748	0.738
23	C	:Coefficient (1.15)	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
24	**Motor Power (kW)**		**2.2**	**0.75**	**1.5**	**3.7**	**1.5**	**11**	**5.5**	**7.4**	**3.7**	**11**	**1.5**

		80	65	80	100	80	250	150	150	150	200	80
	Above ground	304 SS	304 SS	DIP	DIP	DIP	DIP	DIP	SGPW	SGPW	DIP	DIP
	Under ground	-	HDPE		HDPE	HDPE	HDPE	HDPE	HDPE	HDPE	HDPE	-
	Φ		75	90	110	90	280	160	160	160	225	

Calculation of the Capacity of Utility TE Water Supply Unit

Facility	Purpose of Use		①	②	③	④	⑤	⑥	⑦	Remarks
		Total Number of Unit	Number of Duty Operation	Number of Simultaneous Operation	Water Supply Amount per Unit	Water Supply Hours	Ma×imum Instantaneous Water Supply Amount	Hourly Ma×imum Water Supply Amount	Daily Water Supply Amount	
		unit	unit	unit	L/min･unit	Hr/d･unit	L/min	m^3/h	m^3/d	
Grit Chamber										
	Washing Water for Screen	2	2	2	20	4.0	40	2.4	9.6	
	Washing Water for Grit Separator	1	1	1	40	0.5	40	1.2	1.2	
	Washing Water for Scum Screen	1	1	1	25	1.5	25	1.5	2.3	
	Spray Water for Oil Skimmer	1	1	1	32	0.3	32	0.6	0.6	8L/min/pc × 4pcs=32L/min
	Pressure Water for Grit Collector	2	2	1	50	0.2	50	0.6	1.2	
	Sub-Total						187			
Final Sedimentation Tank										
	Defoaming Water	4	4	4	32	3	128	7.7	23.0	8L/min/pc × 4pcs/train = 32L/min/train
	Sub-Total						128			
Sludge Treatment										
	Washing Water for Dewatering	2	1	1	20	24	20	1.2	28.8	
	Biological Odor Control	1	1	1	100	3	100	6.0	18.0	
	Sub-Total						120			
Others										
	Washing Water for Pipings, Cleaning Water	Each pipe	2	2	50	0.2	100	1.2	1.2	
	Sub-Total						100			
TOTAL										
	Strainer Water Supply Amount						535		86	⇒ Utility TE Supply Water Unit 0.6m^3/min

Calculation of the Capacity of Defoaming Pump

Facility	Purpose of Use	Total Number of Unit	① Number of Duty Operation	② Number of Simultaneous Operation	③ Water Supply Amount per Unit	④ Water Supply Hours	⑤ Ma×imum Instantaneous Water Supply Amount	⑥ Hourly Ma×imum Water Supply Amount	⑦ Daily Water Supply Amount	Remarks
		unit	unit	unit	L/min･unit	Hr/d･unit	L/min	m^3/h	m^3/d	
O×idation Ditch										
	Defoaming Water for OD Tank	4	4	4	96	3	384	23.0	69.1	8L/min/pc × 12pcs/train = 96L/min
TOTAL										
	Strainer Water Supply Amount						384		69	⇒ Defoaming Pump 0.6m^3/min

Calculation of the Capacity of Potable Water Consumption for Chemical Dissolving

Facility	Purpose of Use	Total Number of Unit	① Number of Duty Operation	② Number of Simultaneous Operation	③ Water Supply Amount per Unit	④ Water Supply Hours	⑤ Ma×imum Instantaneous Water Supply Amount	⑥ Hourly Ma×imum Water Supply Amount	⑦ Daily Water Supply Amount	Remarks
		unit	unit	unit	L/min･unit	Hr/d･unit	L/min	m^3/h	m^3/d	
Sludge Treatment										
	Polymer Dissolving Water	2	2	1	300	1	300	18.0	36.0	17m^3 × 2 tanks
Chlorine Room										
	Calcium Hypochlorite Dissolving Water	1	1	1	150	1	150	9.0	9.0	8m^3 × 1 tanks
TOTAL										
	Potable Water Supply Amount						450		45	
									Max.	

SECTION C2: Calculation Sheets for Water Hammer in the pressure mains

C2.1 Input data and Conclusion of Water Hammer

PS-1 Condition of surge analysis

Pump spec.

Rated flow	6	Liter/sec/unit
Rated head	14	m
Pump output	5.5	kW
Duty pump unit	1	unit
Rated speed	1500	min^{-1}
Standard inertia	0.5	Nm^2
Force main dia.;	96.4	mm φ
Length of force main;	1090	m
Number of force main;	1	unit
Material of force main;	HDPE	(C = 130)
Elevation of pump;	-2.7	m
Grade level of sump well;	-1.6	m (LWL)
Elevation of discharge point;	-0.35	m
Grade level of discharge point	-0.3	m

Node No.	Length of force main from pump pit (m)	Center level of force main (m)	Others
Pump	0	-1.6	LWL
1	80	0.5	
2	80	1.1	
3	130	0.1	
4	60	0.0	
5	210	0.5	
6	130	1.0	
7	150	0.0	
8	75	0.0	
9	75	0.0	
10	50	-0.1	
Discharge Point	50	-0.3	

Result of surge analysis; (refer to attached sheet of surge analysis)

min. head	More than -9.4 m	>	-7 m	⇒	required fly-wheel
Required inertia (WR^2)	More than 2.0 Nm^2				
min. head	-6.98 m	<	-7 m	⇒	O.K.(with flywheel)

PS-2 Condition of surge analysis

Pump spec.

Rated flow	10.8	Liter/sec/unit
Rated head	40	m
Pump output	22	kW
Duty pump unit	1	unit
Rated speed	1500	min^{-1}
Standard inertia	3.7	Nm^2
Force main dia.;	96.4	mm φ
Length of force main;	684	m
Number of force main;	1	unit
Material of force main;	HDPE	(C = 130)
Elevation of pump;	-5.2	m
Grade level of sump well;	-4.0	m (LWL)
Elevation of discharge point;	13.7	m
Grade level of discharge point	14.2	m (Max. level)

Node No.	Length of force main from pump pit (m)	Center level of force main (m)	Others
Pump	0	-4.0	LWL
1	36	-0.6	
2	50	-0.3	
3	86	0.1	
4	58	0.2	
5	135	0.0	
6	30	0.2	
7	100	2.0	
8	28	3.7	
9	45	6.0	
10	44	12.2	
Discharge Point	72	14.2	Max. level

Result of surge analysis; (refer to attached sheet of surge analysis)

min. head	More than -7.2	m	>	-7 m	⇒	required fly-wheel
Required inertia (WR^2)	More than 15	Nm^2				
min. head	-3.17	m	<	-7 m	⇒	O.K.(with flywheel)

PS-3 Condition of surge analysis

Pump spec.

Rated flow	31.6	Liter/sec/unit
Rated head	25	m
Pump output	22	kW
Duty pump unit	1	unit
Rated speed	1500	min^{-1}
Standard inertia	3.7	Nm^2
Force main dia.;	197.6	mm φ
Length of force main;	355	m
Number of force main;	1	unit
Material of force main;	HDPE	(C = 130)
Elevation of pump;	-3.2	m
Grade level of sump well;	-2.0	m (LWL)
Elevation of discharge point;	17.9	m
Grade level of discharge point	18	m (Max. level)

Node No.	Length of force main from pump pit (m)	Center level of force main (m)	Others
Pump	0	-2.0	LWL
1	25	2.0	
2	93	5.3	
3	32	6.7	
4	15	7.0	
5	15	10.0	
6	15	11.0	
7	15	12.0	
8	15	13.0	
9	15	14.0	
10	15	15.0	
11	15	16.0	
12	15	16.6	
13	30	17.0	
Discharge Point	40	18.0	Max. level

Result of surge analysis; (refer to attached sheet of surge analysis)

min. head	-10	m	>	-7 m	⇒	required fly-wheel
Required inertia (WR^2)	More than 6.2	Nm^2				
min. head	-6.46	m	<	-7 m	⇒	O.K.(with flywheel)

PS-4 Condition of surge analysis

Pump spec.

Rated flow	80	Liter/sec/unit
Rated head	17	m
Pump output	22	kW
Duty pump unit	1	unit
Rated speed	1500	min^{-1}
Standard inertia	3.7	Nm^2
Force main dia.;	312	mm φ
Length of force main;	443	m
Number of force main;	1	unit
Material of force main;	HDPE	(C = 130)
Elevation of pump;	-4.6	m
Grade level of sump well;	-3.6	m (LWL)
Elevation of discharge point;	8.25	m
Grade level of discharge point	8.4	m (Max. level)

Node No.	Length of force main from pump pit (m)	Center level of force main (m)	Others
Pump	0	-3.6	LWL
1	25	2.0	
2	25	4.3	
3	40	5.4	
4	60	4.2	
5	50	3.0	
6	20	3.0	
7	30	4.0	
8	30	5.0	
9	35	6.0	
10	35	7.0	
Discharge Point	93	8.4	Max. level

Result of surge analysis; (refer to attached sheet of surge analysis)

min. head	More than -10	m	>	-7 m	⇒	required fly-wheel
Required inertia (WR^2)	More than 20	Nm^2				
min. head	-6.41	m	<	-7 m	⇒	O.K.(with flywheel)

PS-5 Condition of surge analysis

Pump spec.

Rated flow	73.3	Liter/sec/unit
Rated head	42	m
Pump output	55	kW
Duty pump unit	2	unit
Rated speed	1500	min^{-1}
Standard inertia	12.9	Nm^2
Force main dia.;	395.6	mm φ
Length of force main;	1340	m
Number of force main;	1	unit
Material of force main;	HDPE	(C = 130)
Elevation of pump;	-7	m
Grade level of sump well;	-5.7	m (LWL)
Elevation of discharge point;	27	m
Grade level of discharge point	28.5	m (HWL)

Node No.	Length of force main from pump pit (m)	Center level of force main (m)	Others
Pump	0	-5.7	LWL
1	245	0.5	
2	245	1.3	
3	135	-0.1	
4	100	-0.2	
5	100	-0.1	
6	100	-0.6	
7	100	5.7	
8	117	6.3	
9	33	11.3	
10	20	13.4	
11	30	17.8	
12	50	24.5	
13	20	27.1	
14	33	28.0	
Discharge Point	12	28.5	HWL

Result of surge analysis; (refer to attached sheet of surge analysis)

min. head	More than -10	m	>	-7 m	⇒	required fly-wheel
Required inertia (WR^2)	More than 37	Nm^2				
min. head	-5.31	m	<	-7 m	⇒	O.K.(with flywheel)

PS-6 Condition of surge analysis (No profile of existing force main)

Pump spec.

Rated flow	10.8	Liter/sec/unit	
Rated head	17	m	
Pump output	5.5	kW	
Duty pump unit	1	unit	
Rated speed	1500	min^{-1}	
Standard inertia	0.75	Nm^2	
Force main dia.;	150	mm φ	connect to existing pipe
Length of force main;	400	m	
Number of force main;	1	unit	
Material of force main;	DCIP	(C = 80)	
Elevation of pump;	-1.4	m	
Grade level of sump well;	-0.5	m (LWL)	
Elevation of discharge point;	9.25	m	
Grade level of discharge point	10	m (Max. level)	

⇒ No need fly-wheel due to more gradual condition than PS 11.

PS-7 Condition of surge analysis

Pump spec.

Rated flow	23.3	Liter/sec/unit
Rated head	24	m
Pump output	15	kW
Duty pump unit	1	unit
Rated speed	1500	min^{-1}
Standard inertia	1.5	Nm^2
Force main dia.;	140.6	mm φ
Length of force main;	240	m
Number of force main;	1	unit
Material of force main;	HDPE	(C = 130)
Elevation of pump;	-3.4	m
Grade level of sump well;	-1.9	m (LWL)
Elevation of discharge point;	14	m
Grade level of discharge point	15.6	m (Max. level)

Node No.	Length of force main from pump pit (m)	Center level of force main (m)	Others
Pump	0	-1.9	LWL
1	21	1.6	
2	10	3.0	
3	18	5.9	
4	25	7.5	
5	25	9.0	
6	25	10.5	
7	34	12.8	
8	41	14.2	
Discharge Point	41	15.6	Max. level

Result of surge analysis; (refer to attached sheet of surge analysis)

min. head	More than -10	m	>	-7 m	⇒	required fly-wheel
Required inertia (WR^2)	More than 5	Nm^2				
min. head	-6.13	m	<	-7 m	⇒	O.K.(with flywheel)

PS-8 Condition of surge analysis

Pump spec.

Rated flow	10	Liter/sec/unit
Rated head	24	m
Pump output	7.5	kW
Duty pump unit	1	unit
Rated speed	1500	min^{-1}
Standard inertia	1.0	Nm^2
Force main dia.;	96.4	mm φ
Length of force main;	640	m
Number of force main;	1	unit
Material of force main;	HDPE	(C = 130)
Elevation of pump;	-4.5	m
Grade level of sump well;	-3.5	m (LWL)
Elevation of discharge point;	0	m
Grade level of discharge point	2.1	m (HWL)

Node No.	Length of force main from pump pit (m)	Center level of force main (m)	Others
Pump	0	-2.5	LWL
1	49	0.2	
2	55	0.1	
3	58	0.3	
4	18	0.5	
5	39	0.2	
6	95	1.1	
7	66	0.5	
8	100	1.9	
9	50	2.5	
10	50	1.9	
Discharge Point	60	2.1	HWL

Result of surge analysis; (refer to attached sheet of surge analysis)

min. head	More than -10	m	>	-7 m	⇒	required fly-wheel
Required inertia (WR^2)	More than 4.5	Nm^2				
min. head	-6.92	m	<	-7 m	⇒	O.K.(with flywheel)

PS-9 Condition of surge analysis

Pump spec.

Rated flow	93.3	Liter/sec/unit
Rated head	11	m
Pump output	15	kW
Duty pump unit	2	unit
Rated speed	1500	min^{-1}
Standard inertia	2.3	Nm^2
Force main dia.;	395.6	mm φ
Length of force main;	700	m
Number of force main;	1	unit
Material of force main;	HDPE	(C = 130)
Elevation of pump;	-3.5	m
Grade level of sump well;	-2.9	m (LWL)
Elevation of discharge point;	0.4	m
Grade level of discharge point	0.6	m (HWL)

Node No.	Length of force main from pump pit (m)	Center level of force main (m)	Others
Pump	0	-2.9	LWL
1	50	0.5	
2	100	0.6	
3	110	0.6	
4	87	-0.1	
5	79	-0.1	
6	74	-0.1	
7	100	0.0	
8	40	0.1	
9	30	0.4	
Discharge Point	30	0.6	HWL

Result of surge analysis; (refer to attached sheet of surge analysis)

min. head -7.44 m > -7 m ⇒ No need fly-wheel (With air valve)

PS-10 Condition of surge analysis

Pump spec.

Rated flow	103.3	Liter/sec/unit
Rated head	42	m
Pump output	75	kW
Duty pump unit	2	unit
Rated speed	1500	min^{-1}
Standard inertia	23	Nm^2
Force main dia.;	439.7	mm φ
Length of force main;	2750	m
Number of force main;	1	unit
Material of force main;	HDPE	(C = 130)
Elevation of pump;	-6.2	m
Grade level of sump well;	-4.9	m (LWL)
Elevation of discharge point;	21	m
Grade level of discharge point	23	m (HWL)

Node No.	Length of force main from pump pit (m)	Center level of force main (m)	Others
Pump	0	-4.9	LWL
1	10	2.5	
2	185	5.2	
3	115	15.7	
4	137	17.1	
5	63	21.1	
6	183	23.5	A.V.
7	167	13.9	
8	220	5.7	
9	130	9.1	
10	250	5.4	
11	227	14.4	
12	373	5.9	
Discharge Point	700	23.0	HWL

	min. head	More than -10 m	>	-7 m	⇒	required closed surge tank
Required inertia (WR^2)		— Nm^2				
	min. head	-6.6 m	<	-7 m	⇒	O.K. (With closed surge tank) only flywheel is not enough.

PS-11 Condition of surge analysis

Pump spec.

Rated flow	43.3	Liter/sec/unit
Rated head	31	m
Pump output	37	kW
Duty pump unit	1	unit
Rated speed	1500	min^{-1}
Standard inertia	6.1	Nm^2
Force main dia.;	200	mm φ
Length of force main;	380	m
Number of force main;	1	unit
Material of force main;	DIP	(C = 80)
Elevation of pump;	-4.4	m
Grade level of sump well;	-3.2	m (LWL)
Elevation of discharge point;	14	m
Grade level of discharge point	15	m (Max. level)

Node No.	Length of force main from pump pit (m)	Center level of force main (m)	Others
Pump	0	-3.2	LWL
1	40	0.0	
2	40	1.0	
3	40	2.0	
4	20	2.5	
5	20	3.0	
6	35	5.0	
7	35	7.0	
8	35	9.0	
9	35	12.0	
10	40	13.5	
Discharge point	40	15.0	Max. level

Result of surge analysis; (refer to attached sheet of surge analysis)

min. head -5.77 m < -7 m ⇒ No Need fly-wheel

PS-12 Condition of surge analysis

Pump spec.

Rated flow	58.3	Liter/sec/unit
Rated head	33	m
Pump output	45	kW
Duty pump unit	2	unit
Rated speed	1500	min^{-1}
Standard inertia	5.6	Nm^2
Force main dia.;	351.7	mm φ
Length of force main;	1160	m
Number of force main;	1	unit
Material of force main;	HDPE	(C = 130)
Elevation of pump;	-3.1	m
Grade level of sump well;	-2.66	m (LWL)
Elevation of discharge point;	21	m
Grade level of discharge point	23	m (HWL)

Node No.	Length of force main from pump pit (m)	Center level of force main (m)	Others
Pump	0	-1.4	LWL
1	100	1.6	
2	45	2.1	
3	25	2.6	
4	50	3.8	
5	35	4.1	
6	40	5.4	
7	52	6.5	
8	53	6.8	
9	60	6.1	
10	270	7.5	
11	150	10.0	
12	40	11.1	
13	60	15.9	
14	50	18.4	
15	60	20.4	
Discharge Point	70	23.0	HWL

Result of surge analysis; (refer to attached sheet of surge analysis)

min. head	More than -10	m	>	-7 m	⇒	required fly-wheel
Required inertia (WR^2)	More than 45	Nm^2				
min. head	-6.66	m	<	-7 m	⇒	O.K.(with flywheel)

PS-13 Condition of surge analysis

Pump spec.

Rated flow	6	Liter/sec/unit
Rated head	20	m
Pump output	5.5	kW
Duty pump unit	1	unit
Rated speed	1500	min^{-1}
Standard inertia	0.5	Nm^2
Force main dia.;	96.4	mm φ
Length of force main;	230	m
Number of force main;	1	unit
Material of force main;	HDPE	(C = 130)
Elevation of pump;	-1.7	m
Grade level of sump well;	-1.0	m (LWL)
Elevation of discharge point;	13.4	m
Grade level of discharge point	13.5	m (Max. level)

Node No.	Length of force main from pump pit (m)	Center level of force main (m)	Others
Pump	0	-1.0	LWL
1	10	0.7	
2	20	1.1	
3	20	1.2	
4	20	1.0	
5	15	2.4	
6	15	2.8	
7	15	3.0	
8	15	3.5	
9	27	6.0	
10	28	8.5	
11	30	13.5	
Discharge Point	15	13.5	Max. level

Result of surge analysis; (refer to attached sheet of surge analysis)

min. head -6.94 m < -7 m ⇒ No need fly-wheel

PS-14 Condition of surge analysis

Pump spec.

Rated flow	7.5	Liter/sec/unit
Rated head	24	m
Pump output	7.5	kW
Duty pump unit	1	unit
Rated speed	1500	min^{-1}
Standard inertia	1.0	Nm^2
Force main dia.;	96.4	mm φ
Length of force main;	230	m
Number of force main;	1	unit
Material of force main;	HDPE	(C = 130)
Elevation of pump;	-2.8	m
Grade level of sump well;	-2.1	m (LWL)
Elevation of discharge point;	15.2	m
Grade level of discharge point	15.3	m (Max. level)

Node No.	Length of force main from pump pit (m)	Center level of force main (m)	Others
Pump	0	-2.1	LWL
1	20	3.3	
2	20	3.7	
3	20	4.3	
4	20	4.9	
5	30	6.2	
6	35	7.7	
7	20	9.2	
8	20	10.7	
9	20	12.2	
10	15	14.8	
Discharge Point	10	15.3	Max. level

Result of surge analysis; (refer to attached sheet of surge analysis)

min. head -8.11 m > -7 m ⇒ No need fly-wheel (with Air Valve)

PS-15 Condition of surge analysis

Pump spec.

Rated flow	12.5	Liter/sec/unit
Rated head	43	m
Pump output	22	kW
Duty pump unit	1	unit
Rated speed	1500	min^{-1}
Standard inertia	3.7	Nm^2
Force main dia.;	109.8	mm φ
Length of force main;	760	m
Number of force main;	1	unit
Material of force main;	HDPE	(C = 130)
Elevation of pump;	-3.8	m
Grade level of sump well;	-2.6	m (LWL)
Elevation of discharge point;	21	m
Grade level of discharge point	23	m (HWL)

Node No.	Length of force main from pump pit (m)	Center level of force main (m)	Others
Pump	0	-2.6	LWL
1	50	1.0	
2	50	1.1	
3	80	2.3	
4	45	3.2	
5	55	4.6	
6	117	8.5	
7	68	13.0	
8	55	17.2	
9	110	21.8	
10	40	22.9	
Discharge Point	90	23.0	HWL

Result of surge analysis; (refer to attached sheet of surge analysis)

min. head	More than -10	m	>	-7 m	⇒	required fly-wheel
Required inertia (WR^2)	More than 25	Nm^2				
min. head	-4.35	m	<	-7 m	⇒	O.K.(with flywheel)

PS-16 Condition of surge analysis

Pump spec.

Rated flow	25	Liter/sec/unit
Rated head	21	m
Pump output	11	kW
Duty pump unit	1	unit
Rated speed	1500	min^{-1}
Standard inertia	1.3	Nm^2
Force main dia.;	197.6	mm φ
Length of force main;	600	m
Number of force main;	1	unit
Material of force main;	HDPE	(C = 130)
Elevation of pump;	-5.2	m
Grade level of sump well;	-4.2	m (LWL)
Elevation of discharge point;	10	m
Grade level of discharge point	12.1	m (HWL)

Node No.	Length of force main from pump pit (m)	Center level of force main (m)	Others
Pump	0	-3.8	LWL
1	10	1.5	
2	30	-0.7	
3	30	-0.7	
4	37	-0.6	
5	38	-0.5	
6	33	0.2	
7	32	2.0	
8	55	2.0	
9	50	1.7	
10	100	2.3	
Discharge Point	165	12.1	HWL in STP

Result of surge analysis; (refer to attached sheet of surge analysis)

min. head -7.9 m > -7 m ⇒ No need fly-wheel (with Air Valve)

PS-17 Condition of surge analysis

Pump spec.

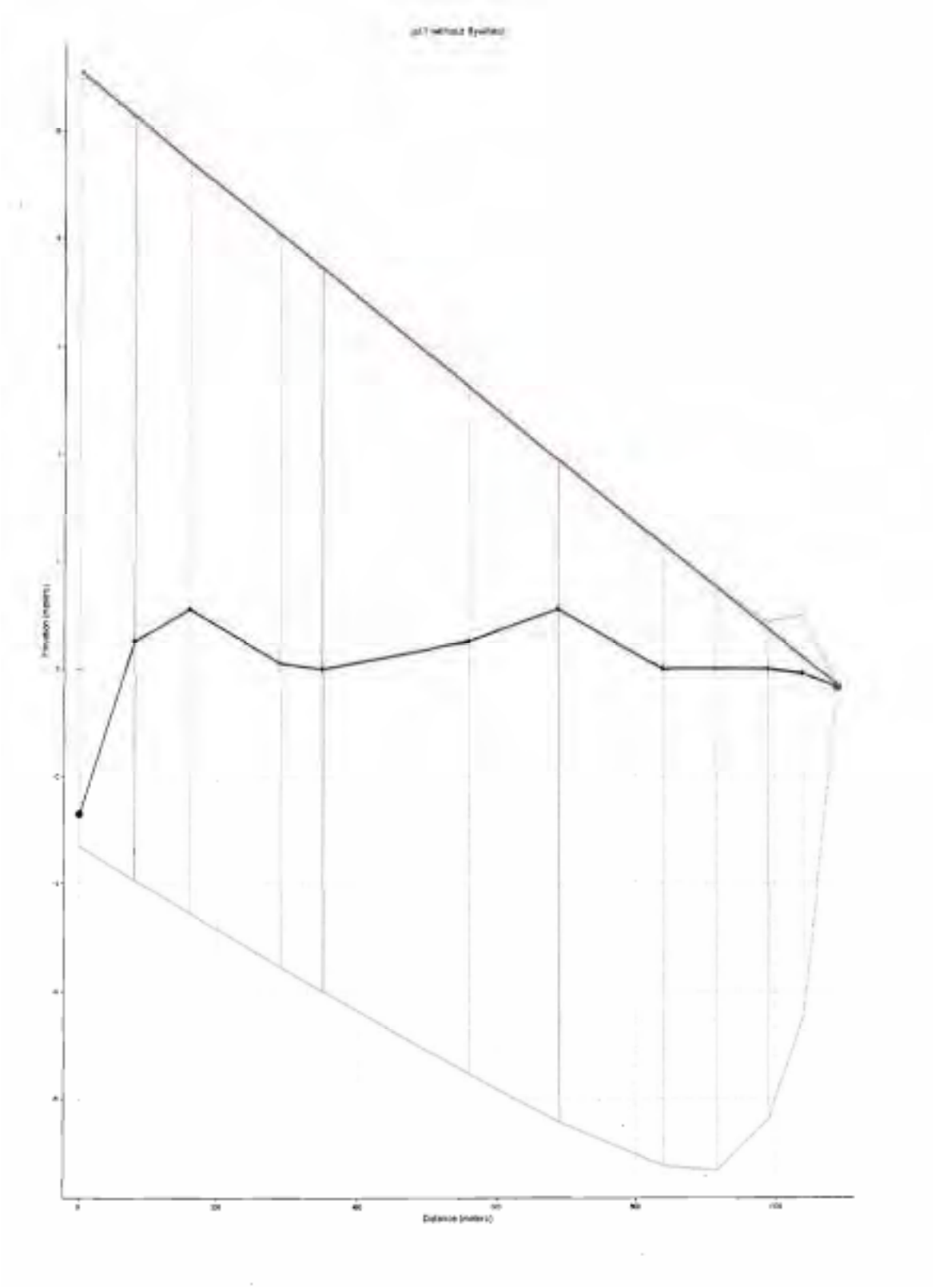
Rated flow	208.3	Liter/sec/unit		
Rated head	15	m		
Pump output	55	kW		
Duty pump unit	1	unit		
Rated speed	1500	min^{-1}	or	1000 min^{-1}
Standard inertia	25.7	Nm^2		
Force main dia.;	624.3	mm φ		
Length of force main;	260	m		
Number of force main;	2	unit		
Material of force main;	HDPE	(C = 130)		
Elevation of pump;	7.4	m		
Grade level of sump well;	9	m (LWL)		
Elevation of discharge point;	20.6	m		
Grade level of discharge point	20.8	m (Max. level)		

Node No.	Length of force main from pump pit (m)	Center level of force main (m)	Others
Pump	0	9.0	LWL
1	5	16.5	
2	25	15.0	
3	10	13.6	
4	25	16.0	
5	25	16.9	
6	35	17.8	
7	35	18.6	
8	35	19.5	
9	35	20.4	
Discharge Point	30	20.8	Max. level

Result of surge analysis; (refer to attached sheet of surge analysis)

min. head	-6.72 m	<	-7 m	⇒	No need fly-wheel in case of 1500 rpm
min. head	-8.78 m	>	-7 m	⇒	required fly-wheel in case of 1000 rpm
Required inertia (WR^2)	More than 50 Nm^2				
min. head	-7 m	<	-7 m	⇒	O.K.(with flywheel)

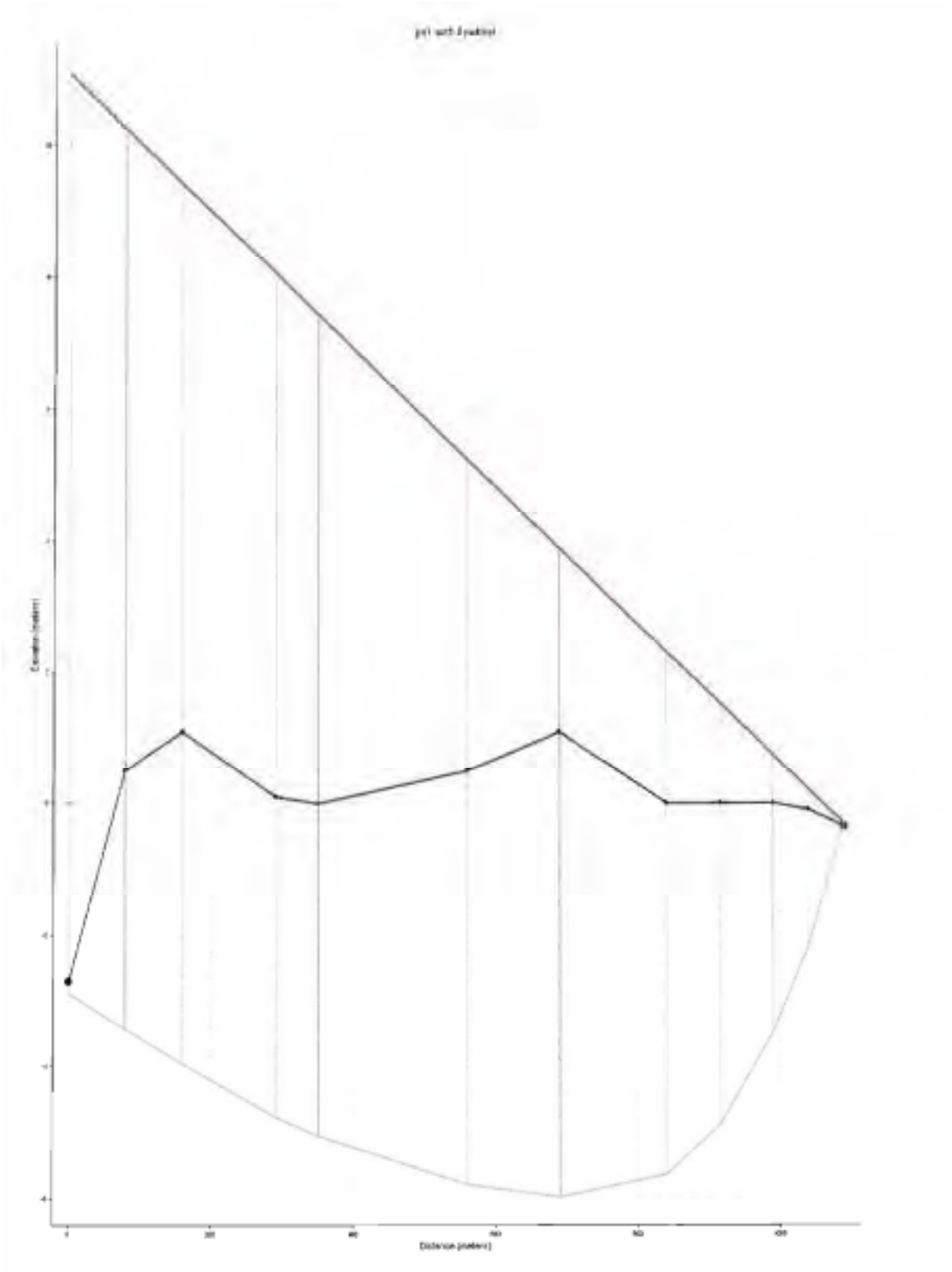
C2.2 Simulation Data of Water Hammer in Pumping Stations



psl without flywheel

SUMMARY OF MAXIMUM AND MINIMUM HEADS:

Position no.	MaxHead (m)	MinHead (m)	Time Reverse Grad.	MaxPressure [kPa]	MinPressure [kPa]	MaxTime (sec)	MinTime (sec)
J-1	9.77	-4.43	265.099	95.843	-43.450	0.03687	14.82049
J-2	8.33	-5.63	287.993	81.744	-55.266	0.03687	14.63615
J-3	7.97	-5.65	211.092	78.207	-55.433	0.03687	14.15680
J-4	7.44	-6.01	196.714	73.029	-58.913	0.14747	14.19375
J-5	4.75	-8.04	273.505	46.564	-78.835	0.03687	13.38267
J-6	2.79	-9.54	284.300	27.332	-93.562	0.03687	13.41954
J-7	2.32	-9.24	205.488	22.723	-90.658	0.03687	13.08773
J-8	1.53	-9.32	240.621	15.023	-91.403	0.03687	12.90340
J-9	0.86	-8.36	257.874	8.463	-82.057	47.59457	12.71906
J-10	1.08	-6.34	264.141	10.585	-62.147	47.70517	12.60846
O-Pump-1	13.81	-0.61	3.687	135.448	-5.971	9.99089	15.00482
R-1	0.05	0.05	0.000	0.490	0.490	0.03687	0.03687
O-Pump-1	1.10	1.10	0.000	10.790	10.790	0.03687	0.03687



psl with flywheel

SUMMARY OF MAXIMUM AND MINIMUM HEADS:

Position no.	MaxHead (m)	MinHead (m)	Time Reverse Grad.	MaxPressure (kPa)	MinPressure (kPa)	MaxTime (sec)	MinTime (sec)
J-1	9.77	-3.92	258.021	95.843	-38.477	0.03687	14.82049
J-2	8.33	-5.05	288.656	81.744	-49.531	0.03687	14.63615
J-3	7.97	-4.87	193.802	78.207	-47.733	0.03687	14.34122
J-4	7.44	-5.06	196.825	73.029	-49.593	0.14747	14.19375
J-5	4.75	-6.30	268.933	46.564	-61.765	0.03687	13.71447
J-6	2.89	-6.98	287.255	28.313	-68.474	0.03687	13.41954
J-7	2.32	-5.64	246.556	22.723	-55.367	0.03687	13.08773
J-8	1.53	-4.88	253.118	15.023	-47.858	0.03687	12.90340
J-9	0.75	-3.47	268.086	7.323	-34.032	0.03687	12.71906
J-10	0.32	-2.08	278.297	3.171	-20.368	0.03687	12.60846
O-Pump-1	13.81	-0.18	0.737	135.448	-1.739	9.99089	15.00482
R-1	0.05	0.05	0.000	0.490	0.490	0.03687	0.03687
O-Pump-1	1.10	1.10	0.000	10.790	10.790	0.03687	0.03687

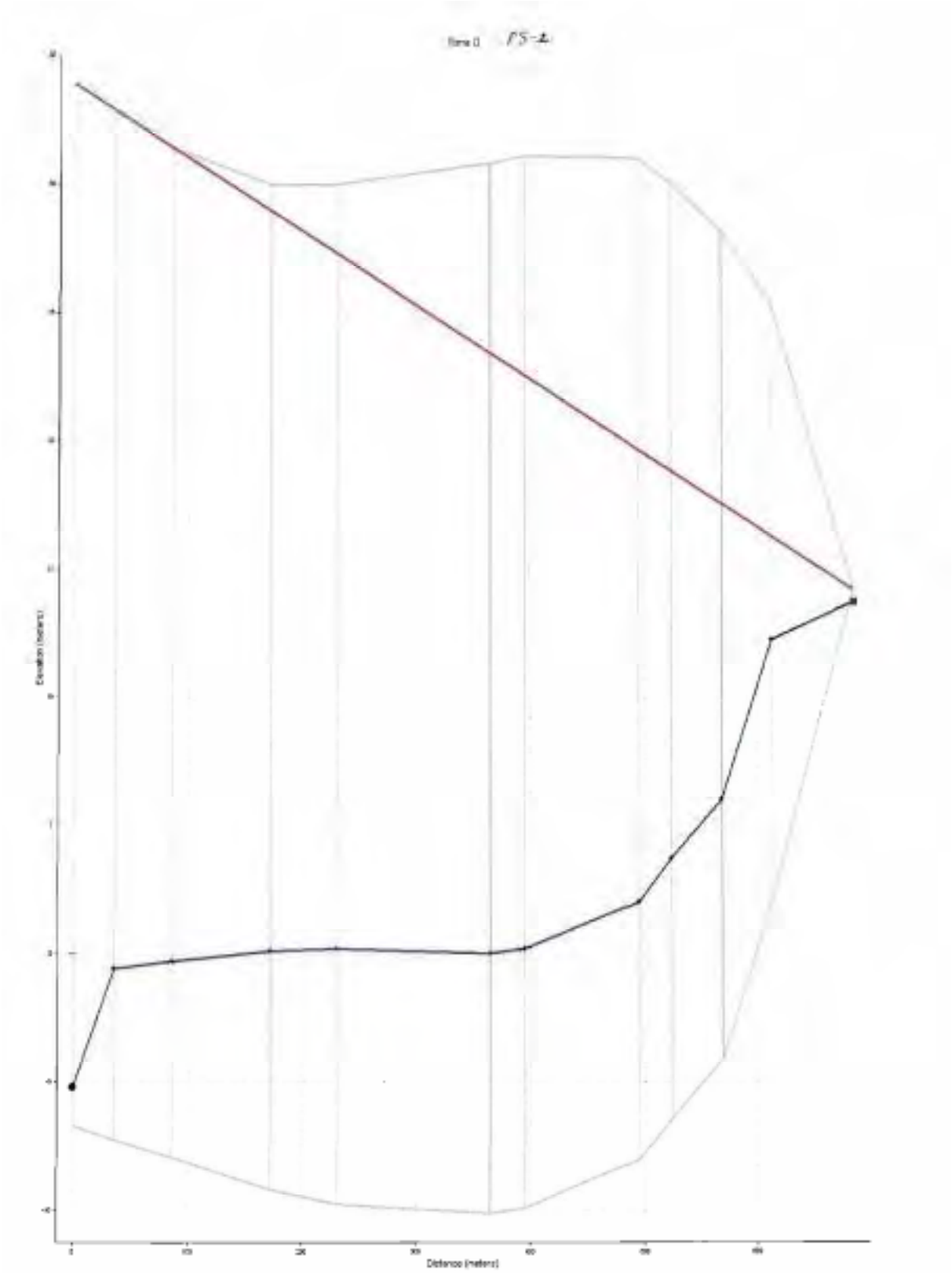
psl with flywheel

SUMMARY OF MAX/MIN LINE PRESSURES:

START NODE	END NODE	MAX PRESS. psi or kPa	MIN PRESS. psi or kPa	Steady Press. at end nodes		MaxPrDrop at end nodes		LowestPress at end nodes	
O-Pump-1	J-1	135.45	-38.48	135.45	95.84	137.19	134.51	-1.74	-41.34
J-1	J-2	95.84	-49.53	95.84	81.74	134.32	131.27	-38.48	-52.58
J-2	J-3	81.74	-49.53	81.74	78.21	131.27	125.94	-49.53	-53.07
J-3	J-4	78.21	-49.59	78.21	73.03	125.94	122.62	-47.73	-52.91
J-4	J-5	73.03	-61.77	73.03	46.56	122.62	108.33	-49.59	-76.06
J-5	J-6	46.56	-68.47	46.56	28.31	108.33	96.79	-61.77	-80.02
J-6	J-7	28.31	-68.47	28.31	22.72	96.79	78.09	-68.47	-74.06
J-7	J-8	22.72	-55.37	22.72	15.02	78.09	62.88	-55.37	-63.07
J-8	J-9	15.02	-47.86	15.02	7.32	62.88	41.36	-47.86	-55.56
J-9	J-10	7.32	-34.03	7.32	3.17	41.36	23.54	-34.03	-38.18
J-10	R-1	3.17	-20.37	3.17	0.49	23.54	0.00	-20.37	-23.05

***** END OF THIS SIMULATION *****

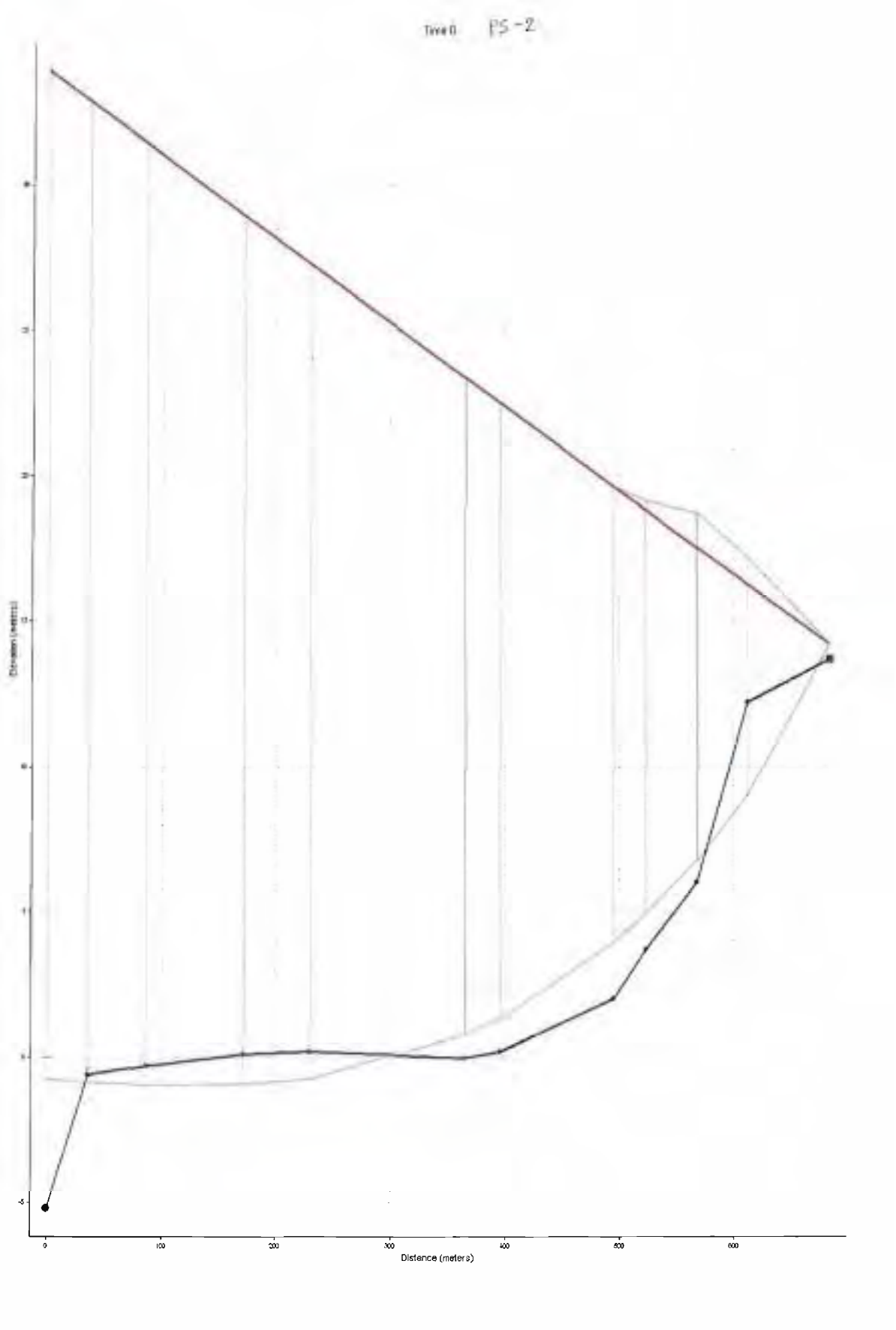
END RUN AT TIME 09:41:52


Distance (meters)

ps2 without flywheel

SUMMARY OF MAXIMUM AND MINIMUM HEADS:

Position no.	MaxHead (m)	MinHead (m)	Time Reverse Grad.	MaxPressure (kPa)	MinPressure (kPa)	MaxTime (sec)	MinTime (sec)
J-1	33.47	-6.67	4.890	328.332	-65.395	7.36611	12.72040
J-2	31.73	-7.66	4.766	311.256	-75.137	4.64260	12.59660
J-3	29.88	-9.31	4.240	293.088	-91.301	18.53960	12.41090
J-4	29.75	-9.98	3.745	291.892	-97.915	17.30098	12.28711
J-5	30.76	-10.12	2.662	301.716	-99.326	17.61049	11.97761
J-6	30.87	-10.12	2.445	302.875	-99.326	17.67239	11.91571
J-7	29.00	-10.04	2.259	284.492	-98.537	17.88904	11.73001
J-8	26.33	-10.12	2.600	258.336	-99.326	17.73429	11.66811
J-9	22.14	-10.11	2.755	217.150	-99.225	17.79619	11.63716
J-10	13.13	-10.12	11.761	128.807	-99.326	17.91999	11.54432
O-Pump-1	39.11	-1.53	1.424	383.630	-15.040	6.00431	12.81325
R-1	0.50	0.50	0.000	4.905	4.905	0.03095	0.03095
O-Pump-1	1.20	1.20	0.000	11.769	11.769	0.03095	0.03095


PS-2
Distance (meters)

pe2 with flywheel

SUMMARY OF MAXIMUM AND MINIMUM HEADS:

Position no.	MaxHead (m)	MinHead (m)	Time Reverse Grad.	MaxPressure (kPa)	MinPressure (kPa)	MaxTime (sec)	MinTime (sec)
J-1	33.47	-0.27	0.093	328.332	-2.654	7.36611	12.93705
J-2	31.73	-0.64	0.186	311.256	-6.282	4.64250	12.81325
J-3	28.85	-1.04	0.248	283.027	-10.162	5.47816	12.62755
J-4	27.08	-0.95	0.186	265.654	-9.281	10.02779	12.50375
J-5	23.39	0.81	0.000	229.461	7.981	10.77058	12.19426
J-6	22.33	1.13	0.000	219.019	11.090	10.80153	12.13236
J-7	17.65	1.93	0.000	173.099	18.908	2.47600	11.91571
J-8	15.45	1.26	0.000	151.524	12.318	20.79839	11.85381
J-9	12.75	0.76	0.000	125.125	7.469	20.86029	11.76096
J-10	5.00	-3.17	3.590	49.002	-31.107	20.76744	11.66811
O-Pump-1	39.11	4.44	0.000	383.630	43.515	6.00431	13.02990
R-1	0.50	0.50	0.000	4.905	4.905	0.03095	0.03095
O-Pump-1	1.20	1.20	0.000	11.769	11.769	0.03095	0.03095

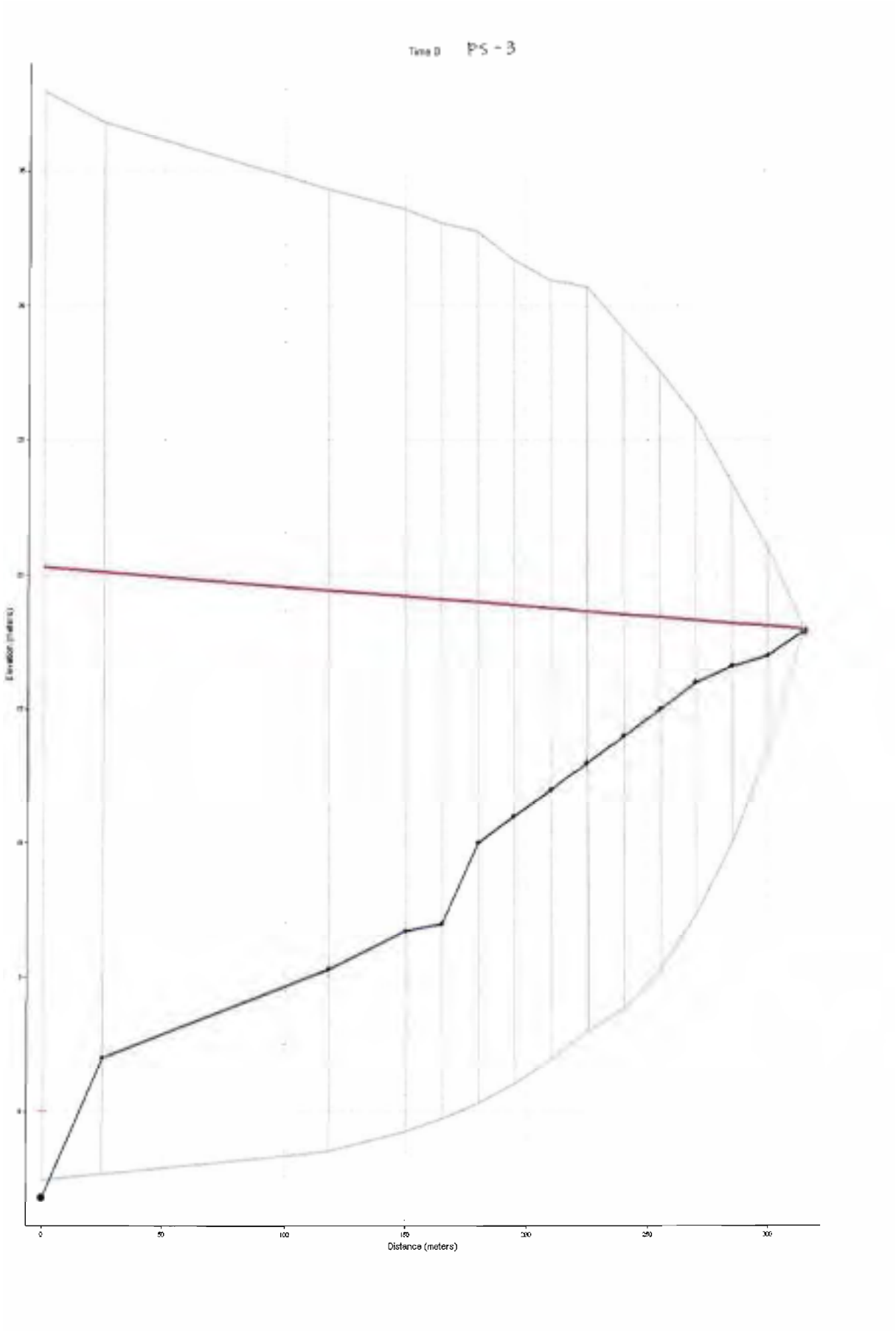
psi with flywheel

SUMMARY OF MAX/MIN LINE PRESSURES:

START NODE	END NODE	MAX PRESS. psi or kPa	MIN PRESS. psi or kPa	Steady Press. at end nodes		MaxPrDrop at end nodes		LowestPress at end nodes	
0-Pump-1	J-1	383.63	-2.65	383.63	328.33	340.11	330.98	43.52	-11.79
J-2	J-3	311.26	-10.16	311.25	283.02	317.54	293.19	-6.28	-34.51
J-1	J-2	328.33	-6.28	328.33	311.25	330.98	317.54	-2.65	-19.73
J-4	J-5	265.65	-9.28	265.65	229.46	274.93	221.48	-9.28	-45.47
J-3	J-4	283.03	-10.16	283.02	265.65	293.19	274.93	-10.16	-27.54
J-6	J-7	219.02	11.09	219.02	173.10	207.93	154.19	11.09	-34.83
J-5	J-6	229.46	7.98	229.46	219.02	221.48	207.93	7.98	-2.06
J-8	J-9	151.52	7.47	148.51	113.23	136.19	105.76	12.32	-22.96
J-7	J-8	173.10	12.32	173.10	148.51	154.19	136.19	18.91	-5.68
J-10	R-1	49.00	-31.11	39.97	4.90	71.08	0.00	-31.11	-66.17
J-9	J-10	135.13	-31.11	113.23	39.97	105.76	71.08	7.47	-65.79

***** END OF THIS SIMULATION *****

END RUN AT TIME 09:53:40

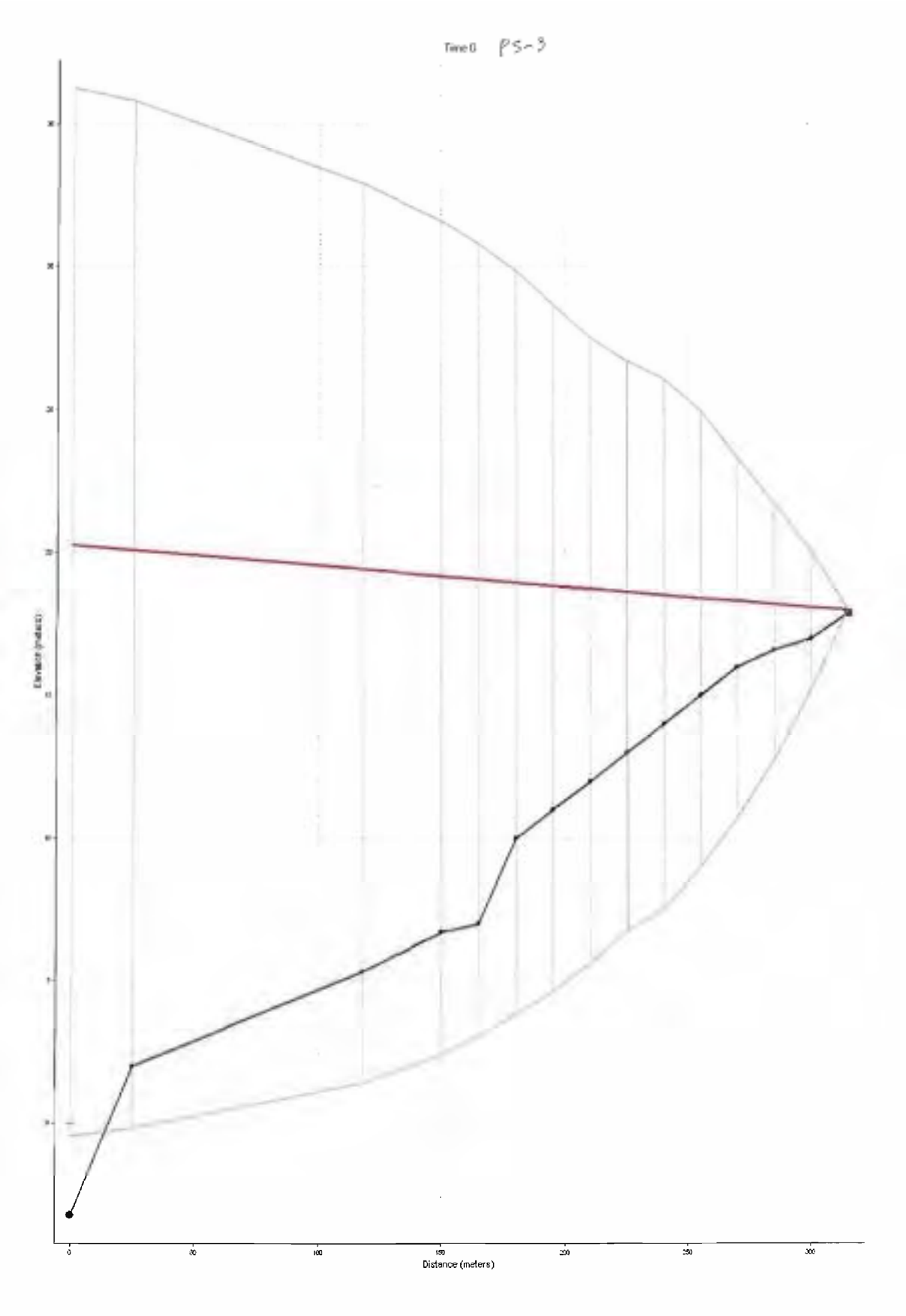

PS - 3
Distance (meters)

ps3 without flywheel

SUMMARY OF MAXIMUM AND MINIMUM HEADS:

Position no.	MaxHead (m)	MinHead (m)	Time Reverse Grad.	MaxPressure (kPa)	MinPressure (kPa)	MaxTime (sec)	MinTime (sec)
J-1	34.82	-4.33	3.550	341.619	-42.473	22.92525	11.38740
J-2	29.04	-6.77	3.588	284.930	-66.400	13.78736	11.17490
J-3	26.88	-7.45	4.650	263.704	-73.055	13.86236	11.11240
J-4	26.09	-7.27	4.300	255.927	-71.281	13.89986	11.07490
J-5	22.77	-9.70	10.737	223.412	-95.124	19.60005	11.03740
J-6	20.70	-9.97	12.862	203.116	-97.796	19.56254	10.99990
J-7	18.94	-10.06	15.162	185.823	-98.721	13.77486	10.96240
J-8	17.70	-9.97	16.900	173.681	-97.803	13.81236	10.93740
J-9	15.18	-10.12	20.775	148.945	-99.326	13.79986	10.91241
J-10	12.60	-9.67	26.350	123.585	-94.857	13.81236	10.87491
J-11	9.87	-8.63	35.814	96.863	-84.663	13.78736	10.83741
J-12	6.83	-6.57	34.601	67.047	-64.412	13.76236	10.79991
J-13	3.98	-3.41	17.050	39.020	-33.436	16.77487	10.76241
O-Pump-1	41.17	0.67	0.000	403.915	6.565	22.92525	11.44990
R-1	0.10	0.10	0.000	0.981	0.981	0.01250	0.01250
O-Pump-1	1.20	1.20	0.000	11.770	11.770	0.01250	0.01250

KYPIPE PIPE2016


Time 0
PS-9
Distance (meters)

pa5 with flywheel

SUMMARY OF MAXIMUM AND MINIMUM HEADS:

Position no.	MaxHead (m)	MinHead (m)	Time Reverse Grad.	MaxPressure (kPa)	MinPressure (kPa)	MaxTime (sec)	MinTime (sec)
J-1	33.85	-2.17	2.475	332.020	-21.314	20.02507	11.39990
J-2	27.64	-3.93	2.700	271.194	-38.581	14.06236	11.18740
J-3	24.93	-4.29	3.000	244.579	-42.089	14.01236	11.11240
J-4	23.83	-3.95	1.925	233.799	-38.718	13.97486	11.07490
J-5	19.87	-6.21	9.125	194.936	-60.955	13.98736	11.03740
J-6	17.69	-6.36	10.975	173.587	-62.433	13.92486	10.99990
J-7	15.55	-6.37	12.350	152.584	-62.503	13.88736	10.96240
J-8	13.72	-6.22	14.500	134.595	-60.991	13.82486	10.92490
J-9	12.08	-6.46	18.650	118.521	-63.359	13.81236	10.91241
J-10	9.96	-6.01	22.313	97.688	-58.961	13.82486	10.87491
J-11	7.36	-5.28	29.363	72.156	-51.813	13.81236	10.83741
J-12	5.14	-3.82	25.713	50.400	-37.476	13.74986	10.79991
J-13	3.06	-1.77	11.825	29.974	-17.376	13.73736	10.78741
O-Pump-1	39.47	2.73	0.000	387.226	26.810	22.95025	11.44990
R-1	0.10	0.10	0.000	0.981	0.981	0.01250	0.01250
O-Pump-1	1.20	1.20	0.000	11.770	11.770	0.01250	0.01250

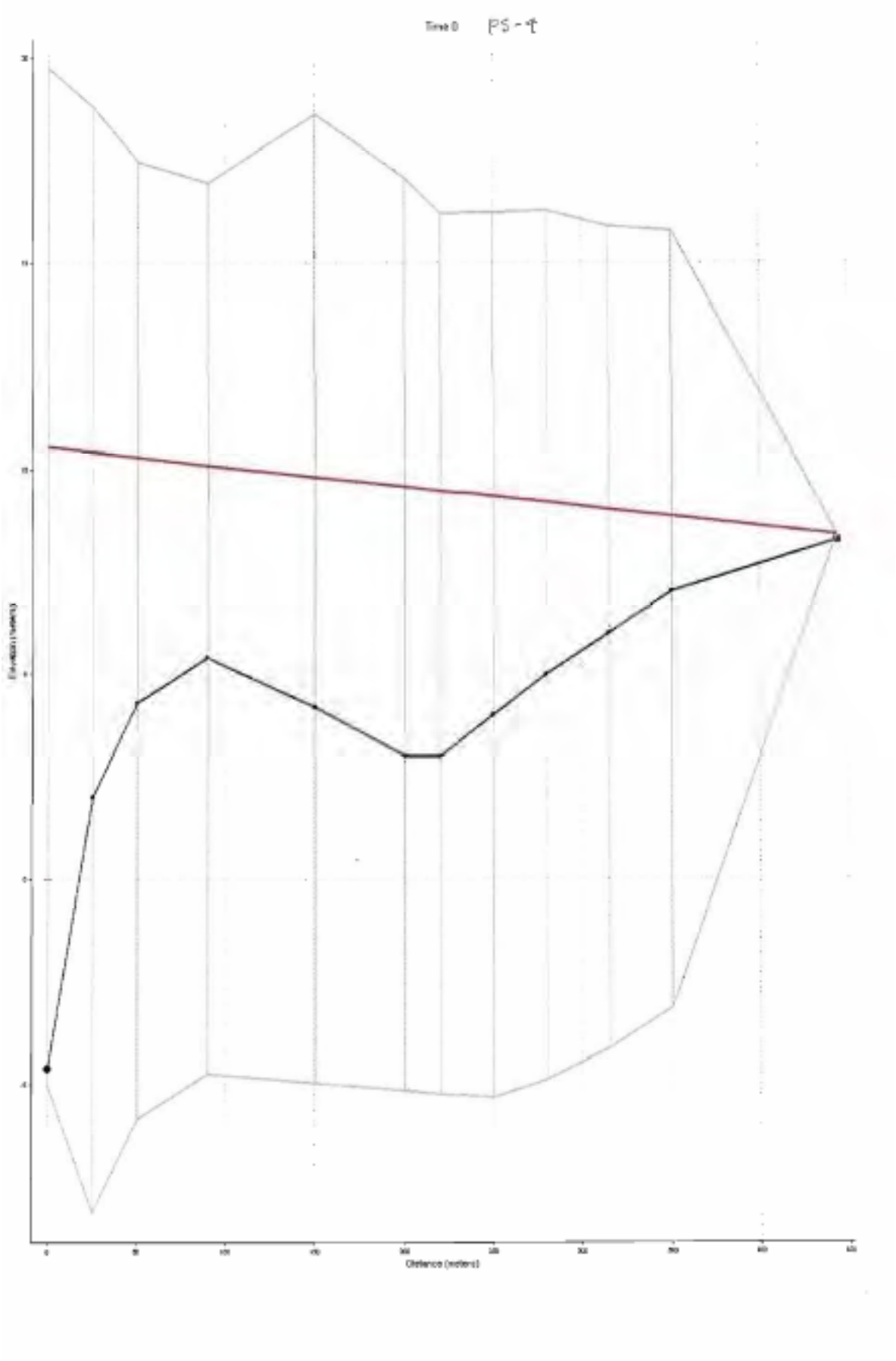
pe3 with flywheel

SUMMARY OF MAX/MIN LINK PRESSURES:

START NODE	END NODE	MAX PRESS. psi or kPa	MIN PRESS. psi or kPa	Steady Press. at end nodes		MaxPrDrop at end nodes		LowestPress at end nodes	
O-Pump-1	J-1	387.23	-21.31	230.33	177.54	203.52	198.86	26.81	-25.90
J-1	J-2	332.02	-38.50	177.54	130.57	198.86	177.15	-21.31	-60.29
J-2	J-3	271.19	-42.09	130.57	122.57	177.15	164.65	-38.58	-54.59
J-3	J-4	264.58	-42.09	122.57	118.56	164.65	157.28	-42.09	-46.10
J-4	J-5	233.80	-60.85	118.56	88.06	157.28	149.02	-38.72	-69.21
J-5	J-6	194.94	-62.43	88.06	77.19	149.02	139.62	-60.95	-71.83
J-6	J-7	173.59	-62.50	77.19	66.31	139.62	128.82	-62.43	-73.31
J-7	J-8	152.58	-62.50	66.31	55.44	128.82	116.43	-62.50	-73.38
J-8	J-9	134.60	-63.36	55.44	44.56	116.43	107.92	-60.99	-71.87
J-9	J-10	118.52	-63.36	44.56	33.69	107.92	92.65	-63.36	-74.23
J-10	J-11	97.69	-58.96	33.69	22.81	92.65	74.63	-58.96	-69.84
J-11	J-12	72.16	-51.81	22.81	15.86	74.63	53.34	-51.81	-58.76
J-12	J-13	50.40	-37.48	15.86	10.87	53.34	28.25	-37.48	-42.47
J-13	R-1	29.97	-17.38	10.87	0.98	28.25	0.00	-17.38	-27.27

***** END OF THIS SIMULATION *****

END RUN AT TIME 10:04:20

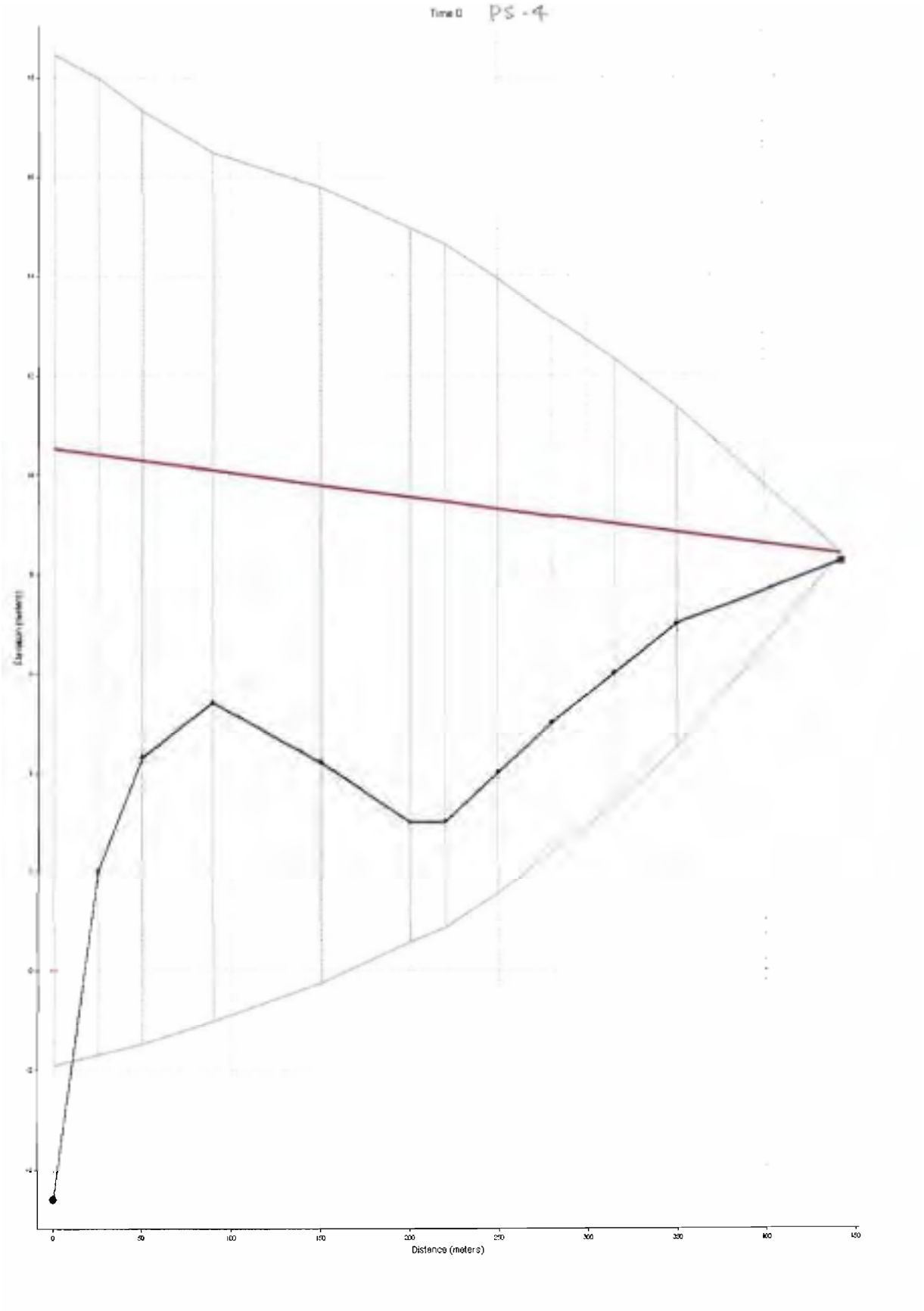

Time 0
PS - 1

ps4 without flywheel

SUMMARY OF MAXIMUM AND MINIMUM HEADS:

Position no.	MaxHead (m)	MinHead (m)	Time Reverse Grad.	MaxPressure (kPa)	MinPressure (kPa)	MaxTime (sec)	MinTime (sec)
J-1	16.80	-10.12	12.077	164.763	-99.326	16.73884	14.11925
J-2	13.18	-10.12	38.894	129.341	-99.326	16.60565	12.92044
J-3	11.57	-10.12	80.320	113.544	-99.326	16.87204	11.10003
J-4	14.43	-9.16	39.427	141.595	-89.821	17.00524	11.72164
J-5	14.08	-8.14	13.187	138.162	-79.884	17.13844	11.58844
J-6	13.23	-8.22	12.077	129.793	-80.633	17.18284	11.54403
J-7	12.24	-9.31	26.640	120.106	-91.346	17.27164	11.49963
J-8	11.27	-9.89	37.562	110.576	-97.062	17.36043	11.41083
J-9	9.88	-10.12	42.535	96.902	-99.326	17.44923	11.32203
J-10	8.79	-10.12	74.015	86.182	-99.326	17.13844	11.27763
O-Pump-1	24.35	-0.39	1.376	238.906	-3.870	16.69444	11.98804
R-1	0.15	0.15	0.000	1.471	1.471	0.04440	0.04440
O-Pump-1	1.00	1.00	0.000	9.809	9.809	0.04440	0.04440

KYPIPE


Time 0
PS-4
Distance (meters)

ps4 with flywheel

SUMMARY OF MAXIMUM AND MINIMUM HEADS:

Position no.	MaxHead (m)	MinHead (m)	Time Reverse Grad.	MaxPressure (kPa)	MinPressure (kPa)	MaxTime (sec)	MinTime (sec)
J-1	15.97	-3.68	19.350	156.691	-36.127	18.73681	16.33925
J-2	13.02	-5.77	61.405	127.734	-56.635	18.78121	16.29485
J-3	11.09	-6.41	87.158	108.839	-62.858	18.55921	16.20605
J-4	11.60	-4.44	52.000	113.823	-43.550	18.42602	13.94165
J-5	11.96	-2.40	7.992	117.349	-23.518	18.29282	11.67724
J-6	11.65	-2.11	5.417	114.241	-20.688	18.24842	11.63284
J-7	9.96	-2.42	9.146	97.660	-23.739	18.15962	11.54403
J-8	8.19	-2.61	15.718	80.311	-25.598	18.07082	11.45523
J-9	6.33	-2.66	30.192	62.095	-26.062	17.98202	11.36643
J-10	4.37	-2.52	69.042	42.853	-24.763	17.89322	11.27763
O-Pump-1	23.05	2.69	0.000	226.160	26.347	18.73681	16.56125
R-1	0.15	0.15	0.000	1.471	1.471	0.04440	0.04440
O-Pump-1	1.00	1.00	0.000	9.809	9.809	0.04440	0.04440

psd with Djvu1

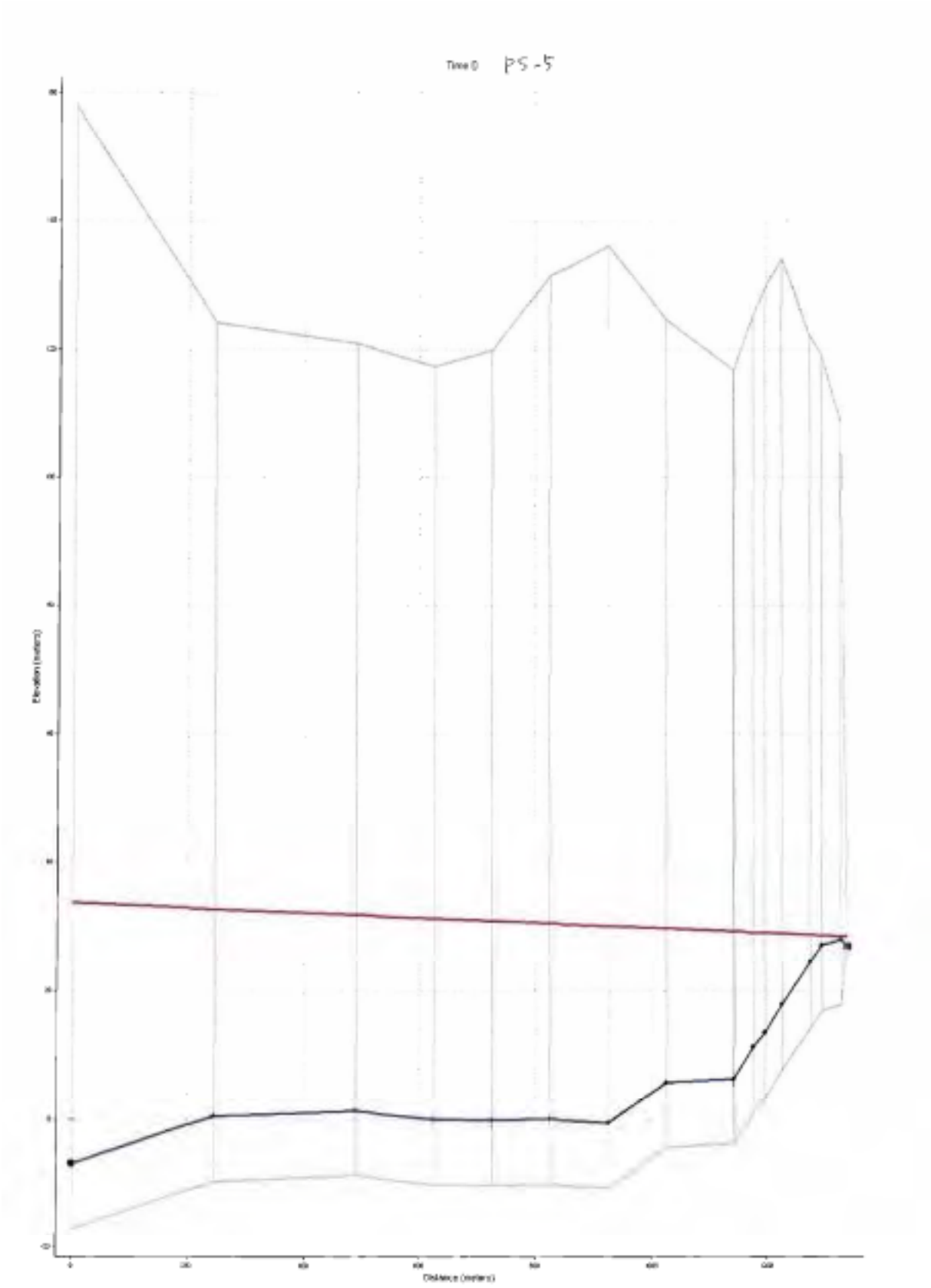
SUMMARY OF MAX/MIN LINE PRESSURES:

START NODE	END NODE	MAX PRESS. psi or kPa	MIN PRESS. psi or kPa	Steady Press. at end node		MaxPressDrop at end node		LowestPress at end node	
O-Pump-1	J-1	226.16	-96.13	148.48	82.55	122.13	118.68	26.35	-39.50
J-1	J-2	156.69	-56.63	82.55	50.80	118.68	115.44	-36.13	-59.87
J-2	J-3	127.73	-62.86	50.80	46.12	115.44	108.98	-56.63	-69.32
J-3	J-4	113.82	-62.86	46.12	55.06	108.98	98.61	-62.86	-53.92
J-4	J-5	117.35	-43.55	55.06	64.46	98.61	87.98	-43.55	-34.14
J-5	J-6	117.35	-23.52	64.46	69.52	87.98	84.21	-23.52	-24.46
J-6	J-7	114.24	-23.74	69.52	52.29	84.21	76.03	-20.69	-31.92
J-7	J-8	97.66	-25.60	52.29	41.06	76.03	66.66	-23.74	-34.97
J-8	J-9	80.31	-26.06	41.06	29.60	66.66	55.66	-25.60	-37.06
J-9	J-10	62.09	-26.06	29.60	18.13	55.66	42.89	-26.06	-37.53
J-10	R-1	42.85	-24.76	18.13	1.47	42.89	0.00	-24.76	-41.42

***** END OF THIS SIMULATION *****

END RUN AT TIME 10:11:45

KYPIPE

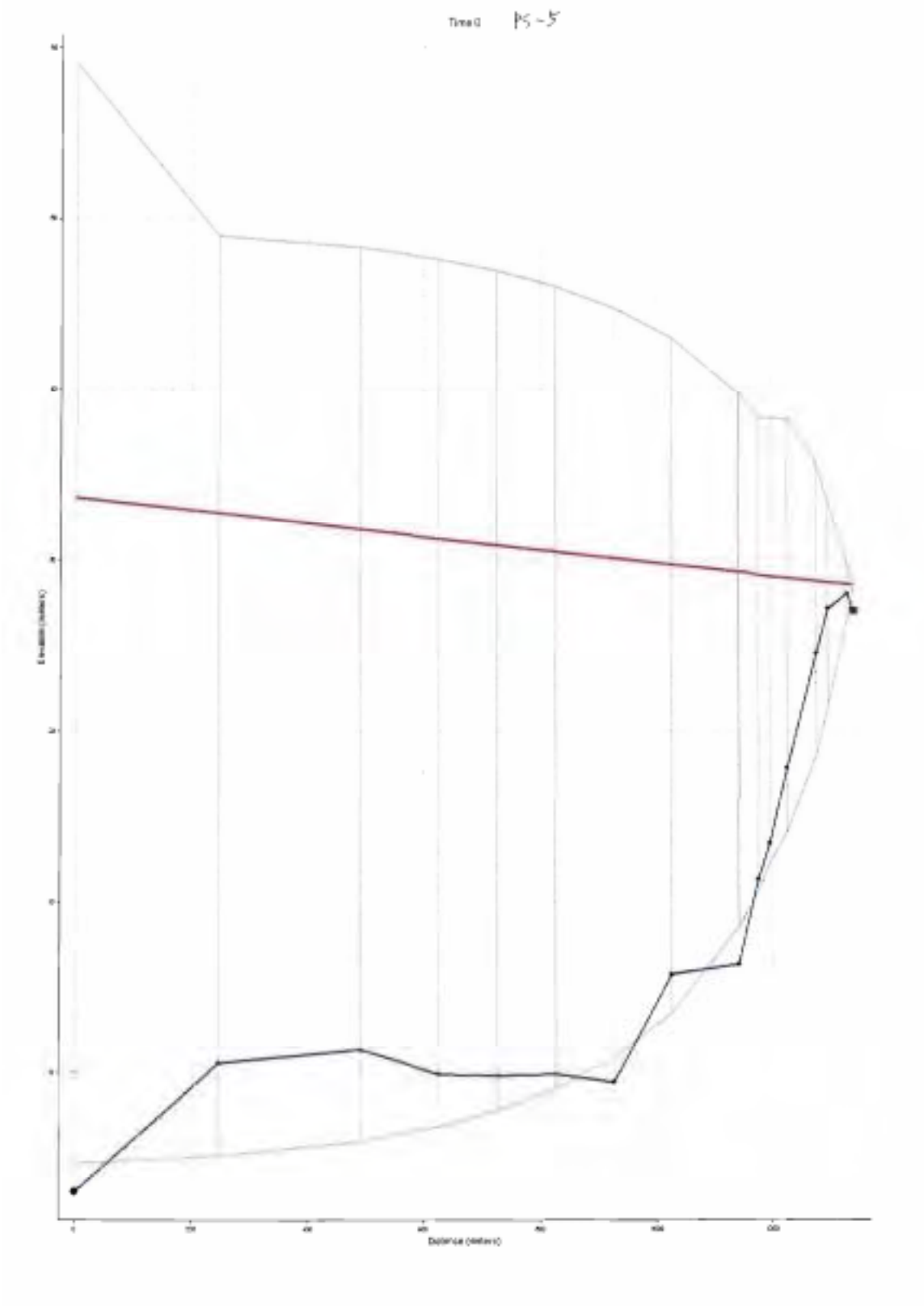

PS-5

pe6 without flywheel

SUMMARY OF MAXIMUM AND MINIMUM HEADS:

Position no.	MaxHead (m)	MinHead (m)	Time Reverse Grad.	MaxPressure (kPa)	MinPressure (kPa)	MaxTime (sec)	MinTime (sec)
J-1	125.77	-10.12	37.017	1233.819	-99.326	292.06448	147.68663
J-2	130.60	-10.12	30.267	1281.183	-99.326	213.65703	159.15857
J-3	133.83	-10.12	29.403	1312.898	-99.326	199.72874	161.77687
J-4	127.51	-10.12	32.859	1250.871	-99.326	204.91136	161.96582
J-5	134.75	-10.12	36.396	1321.912	-99.326	212.82025	162.15477
J-6	135.77	-10.12	32.806	1331.919	-99.326	261.47394	162.37071
J-7	123.92	-10.12	44.362	1215.632	-99.326	212.49634	149.38718
J-8	123.65	-10.12	35.748	1207.087	-99.326	290.09290	149.65710
J-9	117.26	-10.12	47.575	1150.348	-99.326	203.69669	149.73808
J-10	116.79	-10.12	51.085	1145.740	-99.326	203.72368	144.44749
J-11	127.36	-10.12	63.991	1249.361	-99.326	203.80466	13.12207
J-12	95.01	-10.12	90.748	932.035	-99.326	203.69669	13.01407
J-13	91.11	-10.12	101.548	893.747	-99.326	203.64270	13.01407
J-14	72.92	-10.12	94.636	715.368	-99.326	209.36517	72.84701
O-Pump-1	166.58	-10.12	48.034	1634.160	-99.326	214.57478	147.11978
R-1	1.50	1.50	0.000	14.715	14.715	0.02700	0.02700
O-Pump-1	3.00	3.00	0.000	29.426	29.426	0.02700	0.02700

KYPIPE FIPEXBIO


Time 0
P5 - 5

ps5 with flywheel

SUMMARY OF MAXIMUM AND MINIMUM HEADS:

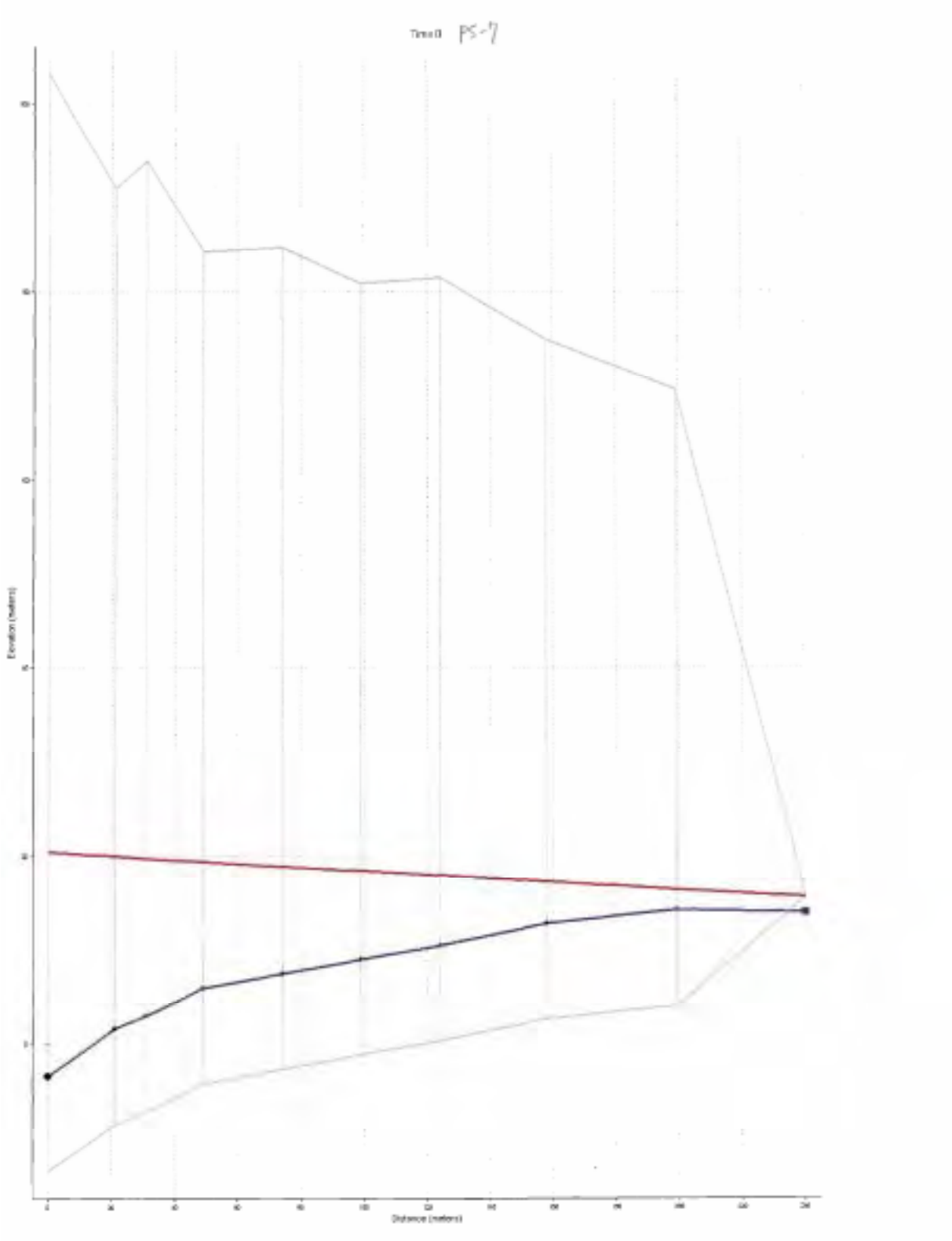
Position no.	MaxHead (m)	MinHead (m)	Time Reverse Grad.	MaxPressure (kPa)	MinPressure (kPa)	MaxTime (sec)	MinTime (sec)
J-1	48.27	-5.17	2.592	473.488	-50.731	21.81621	15.39010
J-2	46.76	-5.01	1.836	458.702	-49.187	21.27620	14.85010
J-3	47.43	-2.68	0.918	465.293	-26.043	20.97919	14.55309
J-4	46.82	-1.56	0.459	459.264	-15.334	20.76319	14.33709
J-5	45.75	-0.31	0.081	448.818	-3.077	20.54719	14.12108
J-6	44.95	2.06	0.000	440.972	20.206	20.33118	13.90508
J-7	36.85	-1.64	0.270	361.480	-16.062	20.11518	13.68908
J-8	33.01	2.82	0.000	323.782	27.625	19.84517	13.41907
J-9	27.24	-0.08	0.027	267.211	-0.805	24.94826	13.33807
J-10	25.09	-0.57	0.081	246.149	-5.558	25.00226	13.28407
J-11	20.64	-3.17	0.351	202.469	-31.114	25.05626	13.23007
J-12	10.89	-5.43	3.834	106.877	-53.304	25.00226	13.12207
J-13	6.03	-5.31	19.035	59.188	-52.130	24.94826	13.06807
J-14	1.71	-1.39	10.962	16.738	-13.597	24.86725	12.98707
O-Pump-1	66.06	1.89	0.000	648.044	18.589	22.35621	15.93011
R-1	1.50	1.50	0.000	14.715	14.715	0.02700	0.02700
O-Pump-1	1.30	1.30	0.000	12.749	12.749	0.02700	0.02700

SUMMARY OF MAX/MIN LINE PRESSURES:

START NODE	END NODE	MAX PRESS. psi or kPa	MIN PRESS. psi or kPa	Steady Press. at end nodes		MaxPrDrop at end nodes		LowestPress at end nodes	
O-Pump-1	J-1	648.04	-50.73	399.49	316.55	380.90	367.28	18.59	-64.35
J-1	J-2	473.49	-50.73	316.55	299.33	367.28	348.52	-50.73	-67.95
J-2	J-3	465.29	-49.19	299.33	307.90	348.52	333.95	-49.19	-40.62
J-3	J-4	465.29	-26.04	307.90	305.06	333.95	320.40	-26.04	-28.89
J-4	J-5	459.26	-15.33	305.06	300.26	320.40	303.33	-15.33	-20.14
J-5	J-6	448.82	-3.08	300.26	301.34	303.33	281.13	-3.08	-2.00
J-6	J-7	440.97	-16.06	301.34	235.71	281.13	251.77	20.21	-65.42
J-7	J-8	361.48	-16.06	235.71	225.35	251.77	197.73	-16.06	-26.42
J-8	J-9	323.78	-0.81	225.35	175.04	197.73	175.85	27.62	-22.69
J-9	J-10	267.21	-5.56	175.04	153.68	175.85	159.23	-0.81	-22.17
J-10	J-11	246.15	-31.11	153.68	109.36	159.23	140.48	-5.56	-49.87
J-11	J-12	202.47	-53.30	109.36	41.73	140.48	95.03	-31.11	-98.75
J-12	J-13	106.88	-53.30	41.73	15.45	95.03	67.58	-53.30	-79.57
J-13	J-14	59.19	-52.13	15.45	5.36	67.58	18.96	-52.13	-62.22
J-14	R-1	16.74	-13.60	5.36	14.72	18.96	0.00	-13.60	-4.25

***** END OF THIS SIMULATION *****

END RUN AT TIME 10:32:08

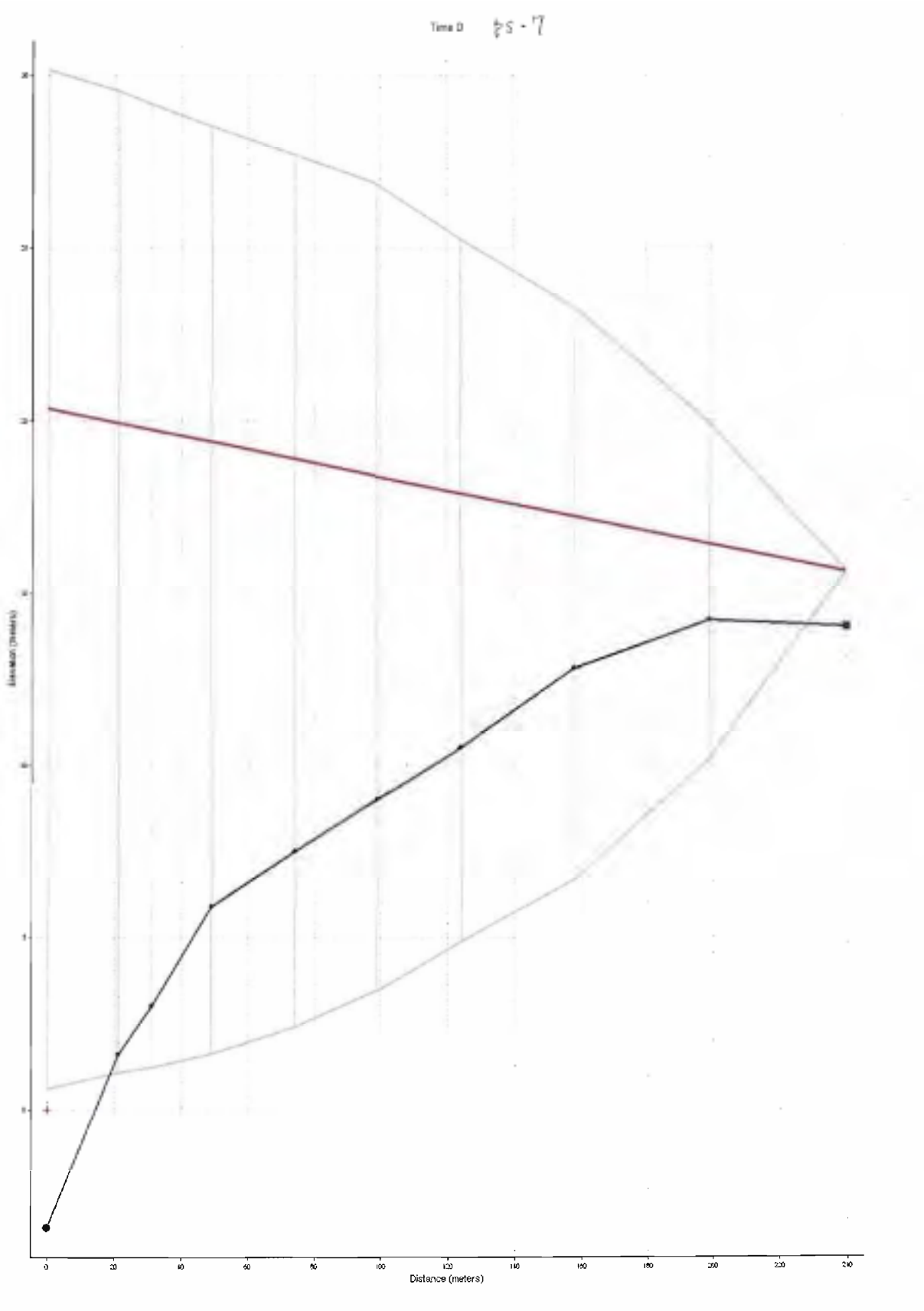

PS-7

ps7 without flywheel

SUMMARY OF MAXIMUM AND MINIMUM HEADS:

Position no.	MaxHead (m)	MinHead (m)	Time Reverse Grad.	MaxPressure (kPa)	MinPressure (kPa)	MaxTime (sec)	MinTime (sec)
J-1	89.40	-10.12	121.196	876.967	-99.326	288.86121	36.85197
J-2	90.96	-10.12	129.499	892.316	-99.326	268.47202	12.07676
J-3	78.37	-10.12	146.949	768.833	-99.326	288.81683	11.69937
J-4	77.17	-10.12	150.679	757.076	-99.326	294.98462	11.74377
J-5	71.80	-10.12	151.168	704.340	-99.326	110.93850	10.58939
J-6	70.96	-10.12	149.947	696.130	-99.326	75.28283	10.56719
J-7	62.13	-10.12	157.340	609.535	-99.326	298.02414	10.54499
J-8	55.37	-10.12	152.100	543.148	-99.326	174.63470	10.61158
O-Pump-1	106.59	-10.12	88.826	1045.692	-99.326	295.18430	36.27473
R-1	1.60	1.60	0.000	15.696	15.696	0.02220	0.02220
O-Pump-1	1.50	1.50	0.000	14.713	14.713	0.02220	0.02220

KYPIPE


Time 0
Distance (meters)

ps7 with flywheel

SUMMARY OF MAXIMUM AND MINIMUM HEADS:

Position no.	MaxHead (m)	MinHead (m)	Time Reverse Grad.	MaxPressure (kPa)	MinPressure (kPa)	MaxTime (sec)	MinTime (sec)
J-1	27.96	-0.51	0.400	274.317	-4.974	14.00813	11.05558
J-2	26.19	-1.76	1.754	256.875	-17.219	14.03033	11.03338
J-3	22.62	-4.28	6.860	221.918	-42.012	14.07473	10.98898
J-4	20.18	-5.12	9.857	197.984	-50.184	14.14133	10.92238
J-5	17.86	-5.53	12.654	175.250	-54.286	14.18573	10.85578
J-6	14.75	-5.61	15.274	144.677	-54.986	14.11913	10.78918
J-7	10.48	-6.13	30.569	102.775	-60.113	14.05253	10.72258
J-8	5.76	-4.02	33.144	56.459	-39.422	13.96373	10.63378
O-Pump-1	33.58	4.01	0.000	329.450	39.355	13.98593	12.85375
R-1	1.60	1.60	0.000	15.696	15.696	0.02220	0.02220
O-Pump-1	1.50	1.50	0.000	14.713	14.713	0.02220	0.02220

KYPIPE

pet edits flynnsol

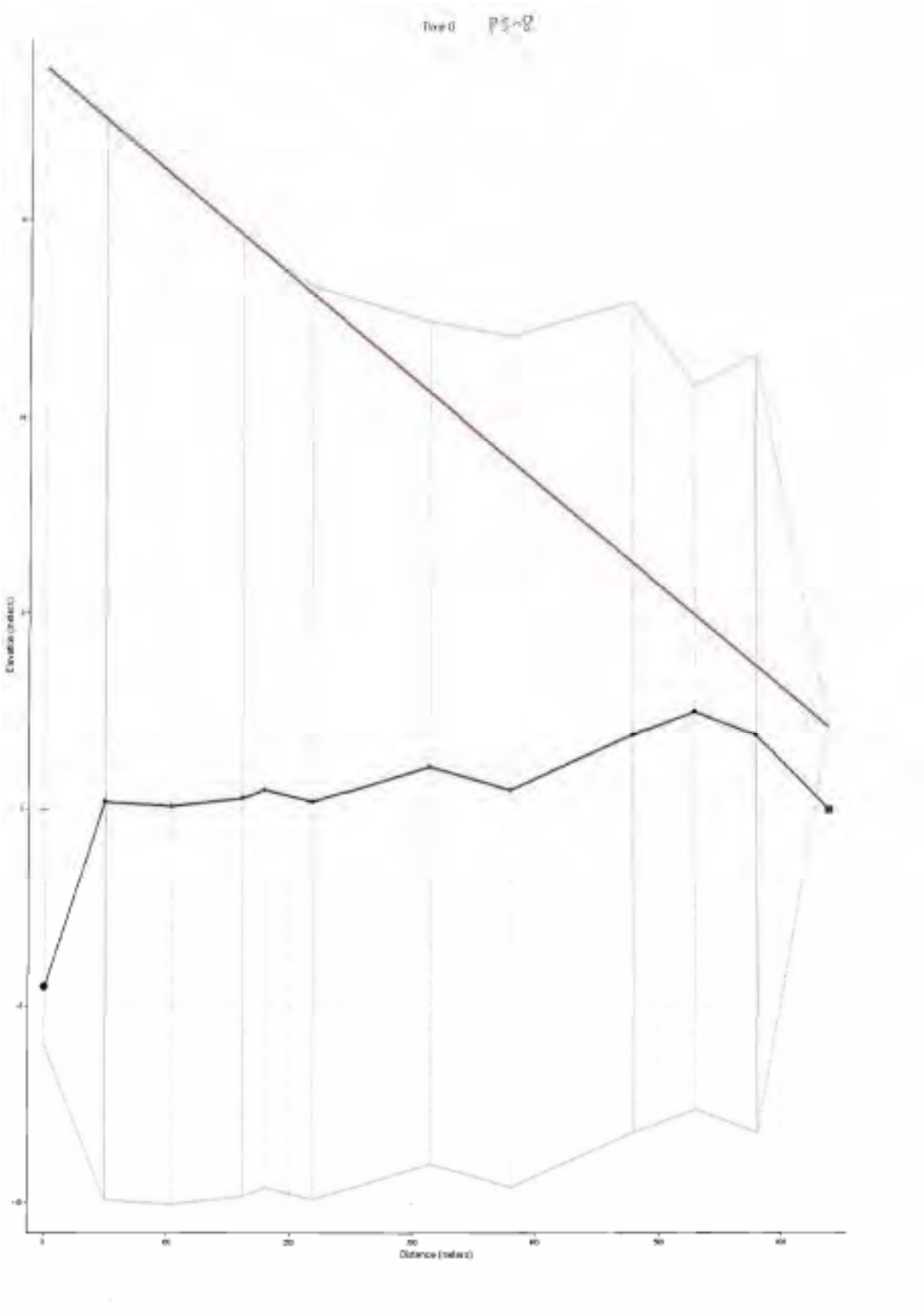
SUMMARY OF MAX/MIN LINE PRESSURES:

START NODE	END NODE	MAX PRESS. psi or kPa	MIN PRESS. psi or kPa	Steady Press. at end nodes		MaxPrDrop at end nodes		Lowest/Least at end nodes	
0-Pump-1	J-1	329.45	-4.97	231.25	160.10	192.90	185.07	33.35	-13.80
J-1	J-2	274.32	-17.22	180.10	164.41	185.07	181.63	-4.97	-20.66
J-2	J-3	256.88	-42.01	164.41	132.45	181.63	174.46	-17.22	-49.18
J-3	J-4	221.92	-50.18	132.45	111.87	174.46	162.06	-42.01	-62.59
J-4	J-5	197.98	-54.29	111.87	92.28	162.06	146.56	-50.18	-69.78
J-5	J-6	175.25	-54.99	92.28	72.68	146.56	127.67	-54.29	-73.88
J-6	J-7	144.68	-60.11	72.68	43.40	127.67	103.59	-54.99	-84.19
J-7	J-8	102.78	-60.11	43.40	21.74	103.59	61.16	-60.11	-81.85
J-8	R-1	56.46	-39.42	21.74	15.70	61.16	0.00	-39.42	-45.47

***** END OF THIS SIMULATION *****

END RUN AT TIME 10:52:48

KYPIPE

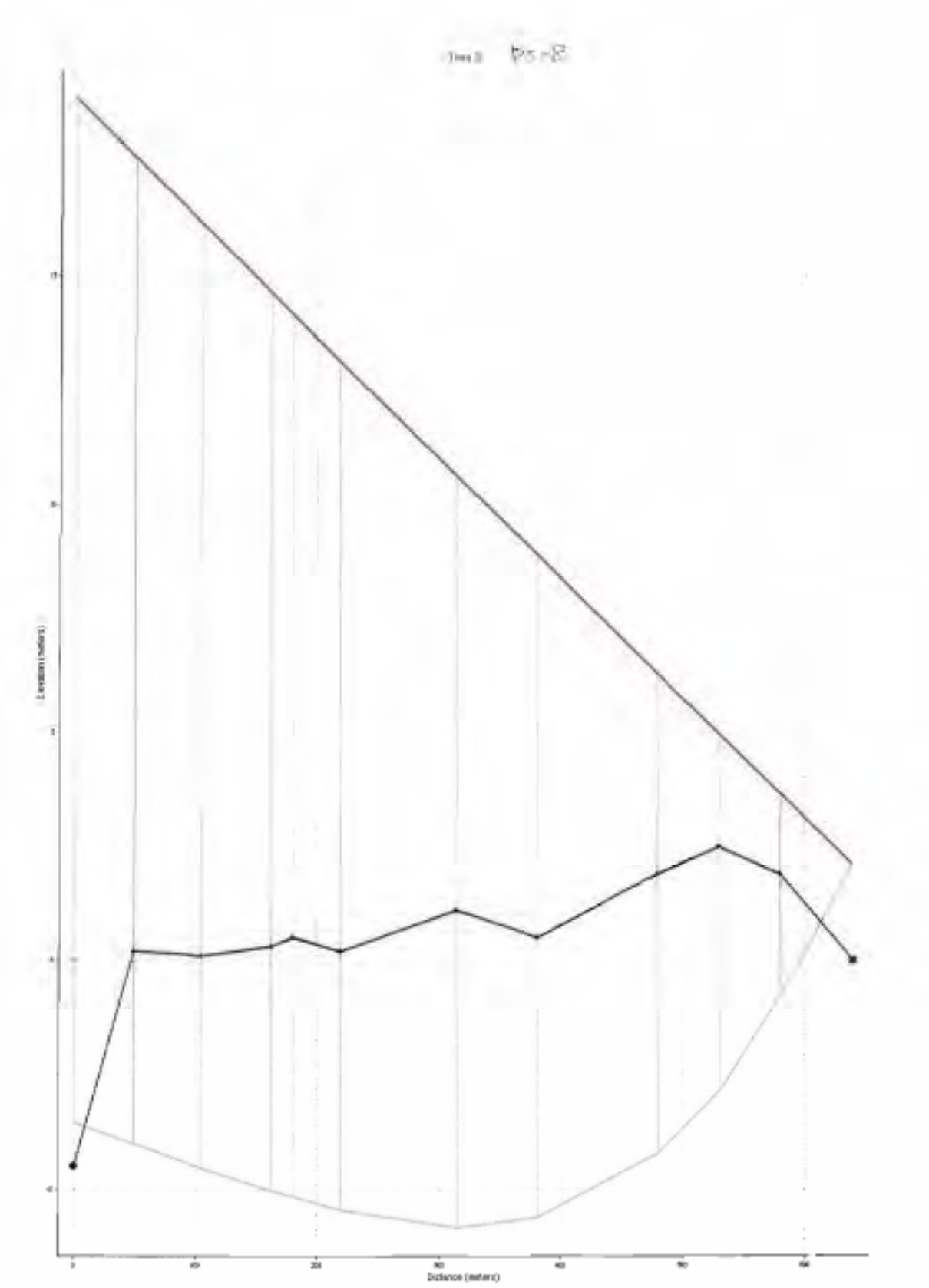


ps03 without flywheel

SUMMARY OF MAXIMUM AND MINIMUM HEADS:

Position no.	MaxHead (m)	MinHead (m)	Time Reverse Grad.	MaxPressure (kPa)	MinPressure (kPa)	MaxTime (sec)	MinTime (sec)
J-1	17.41	-10.12	42.281	170.746	-99.326	6.16000	13.63999
J-2	16.06	-10.12	37.120	157.572	-99.326	4.12000	13.79999
J-3	14.34	-10.12	45.321	140.682	-99.326	4.20000	14.31999
J-4	13.67	-10.12	49.001	134.088	-99.326	4.24000	14.27999
J-5	13.14	-10.12	30.600	128.883	-99.326	13.43999	14.35999
J-6	11.34	-10.12	69.881	111.243	-99.326	13.23999	11.27999
J-7	11.56	-10.12	37.360	113.408	-99.326	13.11999	11.35999
J-8	11.02	-10.12	121.402	108.093	-99.326	19.00006	11.39999
J-9	8.30	-10.12	187.952	81.448	-99.326	12.71999	11.43999
J-10	9.70	-10.12	118.882	95.109	-99.326	12.59999	11.55999
O-Pump-1	23.59	-1.44	2.680	229.464	-14.158	4.96000	11.95999
R-1	2.10	2.10	0.000	20.601	20.601	0.04000	0.04000
O-Pump-1	1.00	1.00	0.000	9.808	9.808	0.04000	0.04000

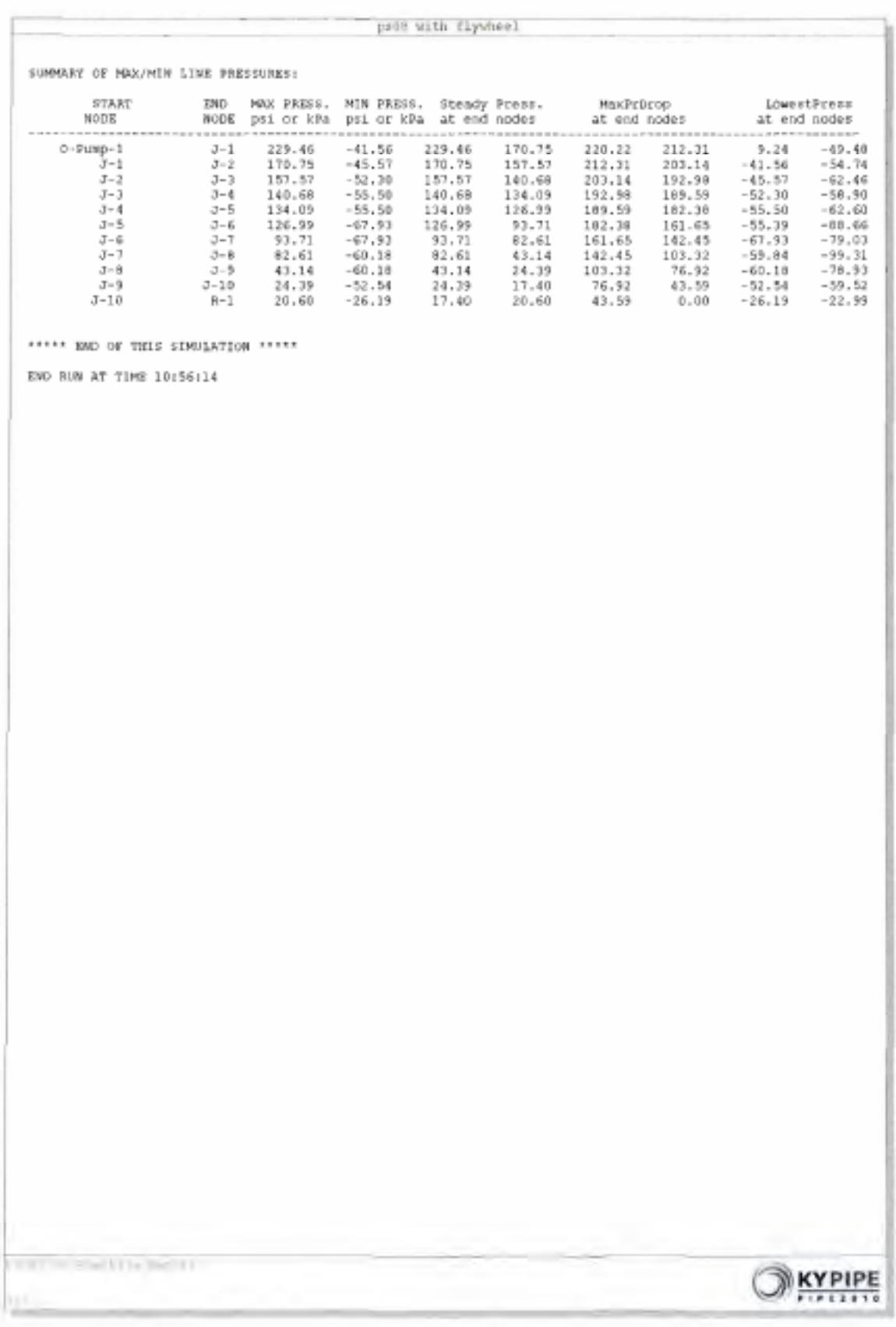
KYPIPE



ps08 with flywheel

SUMMARY OF MAXIMUM AND MINIMUM HEADS:

Position no.	MaxHead (m)	MinHead (m)	Time Reverse Grad.	MaxPressure (kPa)	MinPressure (kPa)	MaxTime (sec)	MinTime (sec)
J-1	17.41	-4.24	36.120	170.746	-41.564	6.16000	12.75999
J-2	16.06	-4.64	29.120	157.572	-45.567	4.12000	12.63999
J-3	14.34	-5.33	30.320	140.682	-52.302	4.20000	12.51999
J-4	13.67	-5.66	37.160	134.088	-55.501	4.24000	12.47999
J-5	12.95	-5.65	18.720	126.993	-55.385	4.36000	12.39999
J-6	9.55	-6.92	64.801	93.713	-67.932	0.04000	12.19999
J-7	8.42	-6.10	13.160	82.613	-59.839	1.48000	12.03999
J-8	4.40	-6.13	129.242	43.142	-60.179	3.80000	11.79999
J-9	2.49	-5.36	223.387	24.387	-52.535	3.88000	11.67999
J-10	1.77	-2.67	73.161	17.405	-26.190	3.76000	11.55999
O-Pump-1	23.39	0.94	0.000	229.464	9.241	4.96000	12.87999
R-1	2.10	2.10	0.000	20.601	20.601	0.04000	0.04000
O-Pump-1	1.00	1.00	0.000	9.808	9.808	0.04000	0.04000



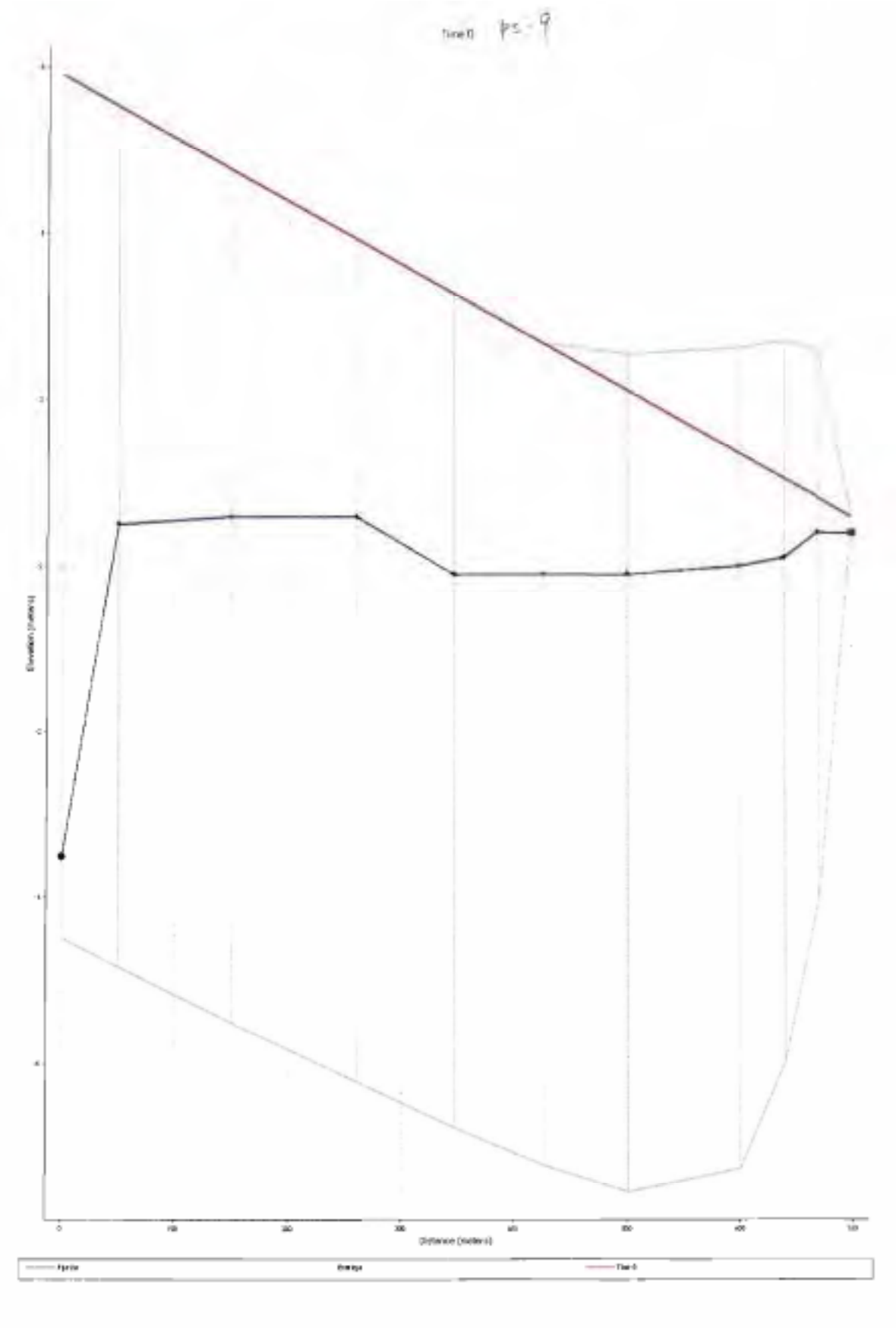
pe08 with flywheel

SUMMARY OF MAX/MIN LINE PRESSURES:

START NODE	END NODE	MAX PRESS. psi or kPa	MIN PRESS. psi or kPa	Steady Press. at end nodes		MaxPrDrop at end nodes		LowestPress at end nodes	
O-Pump-1	J-1	229.46	-41.56	229.46	170.75	220.22	212.31	9.24	-49.40
J-1	J-2	170.75	-45.57	170.75	157.57	212.31	203.14	-41.56	-54.74
J-2	J-3	157.57	-52.30	157.57	140.68	203.14	192.98	-45.57	-62.46
J-3	J-4	140.68	-55.50	140.68	134.09	192.98	189.59	-52.30	-58.90
J-4	J-5	134.09	-55.50	134.09	126.99	189.59	182.38	-55.50	-62.60
J-5	J-6	126.99	-67.93	126.99	93.71	182.38	161.65	-55.39	-88.66
J-6	J-7	93.71	-67.93	93.71	82.61	161.65	142.45	-67.93	-79.03
J-7	J-8	82.61	-60.18	82.61	43.14	142.45	103.32	-59.84	-99.31
J-8	J-9	43.14	-60.18	43.14	24.39	103.32	76.92	-60.18	-78.93
J-9	J-10	24.39	-52.54	24.39	17.40	76.92	43.59	-52.54	-59.52
J-10	R-1	20.60	-26.19	17.40	20.60	43.59	0.00	-26.19	-22.99

***** END OF THIS SIMULATION *****

END RUN AT TIME 10:56:14



pp9 no need flywheel (with air valve)

SUMMARY OF MAXIMUM AND MINIMUM HEADS:

Position no.	MaxHead (m)	MinHead (m)	Time Reverse Grad.	MaxPressure (kPa)	MinPressure (kPa)	MaxTime (sec)	MinTime (sec)
J-1	5.03	-5.33	144.673	49.350	-52.265	0.10005	12.53960
J-2	4.17	-6.10	153.779	40.928	-59.851	0.03335	12.77305
J-3	3.34	-6.82	150.711	32.742	-66.874	0.03335	12.57295
J-4	3.38	-6.66	34.517	33.135	-65.379	0.03335	12.37285
J-5	2.78	-7.12	34.851	27.256	-69.812	0.03335	12.20610
J-6	2.64	-7.44	36.152	25.942	-73.016	37.28559	12.03935
J-7	2.62	-7.26	39.387	25.691	-71.261	39.72028	11.80590
J-8	2.60	-6.08	30.515	25.522	-59.668	39.82034	11.70585
J-9	2.18	-4.43	30.582	21.432	-43.465	39.85369	11.63915
O-Pump-1	9.41	-0.99	6.537	92.311	-9.672	0.06670	13.13990
R-1	0.20	0.20	0.000	1.962	1.962	0.03335	0.03335
O-Pump-1	0.60	0.60	0.000	5.885	5.885	0.03335	0.03335

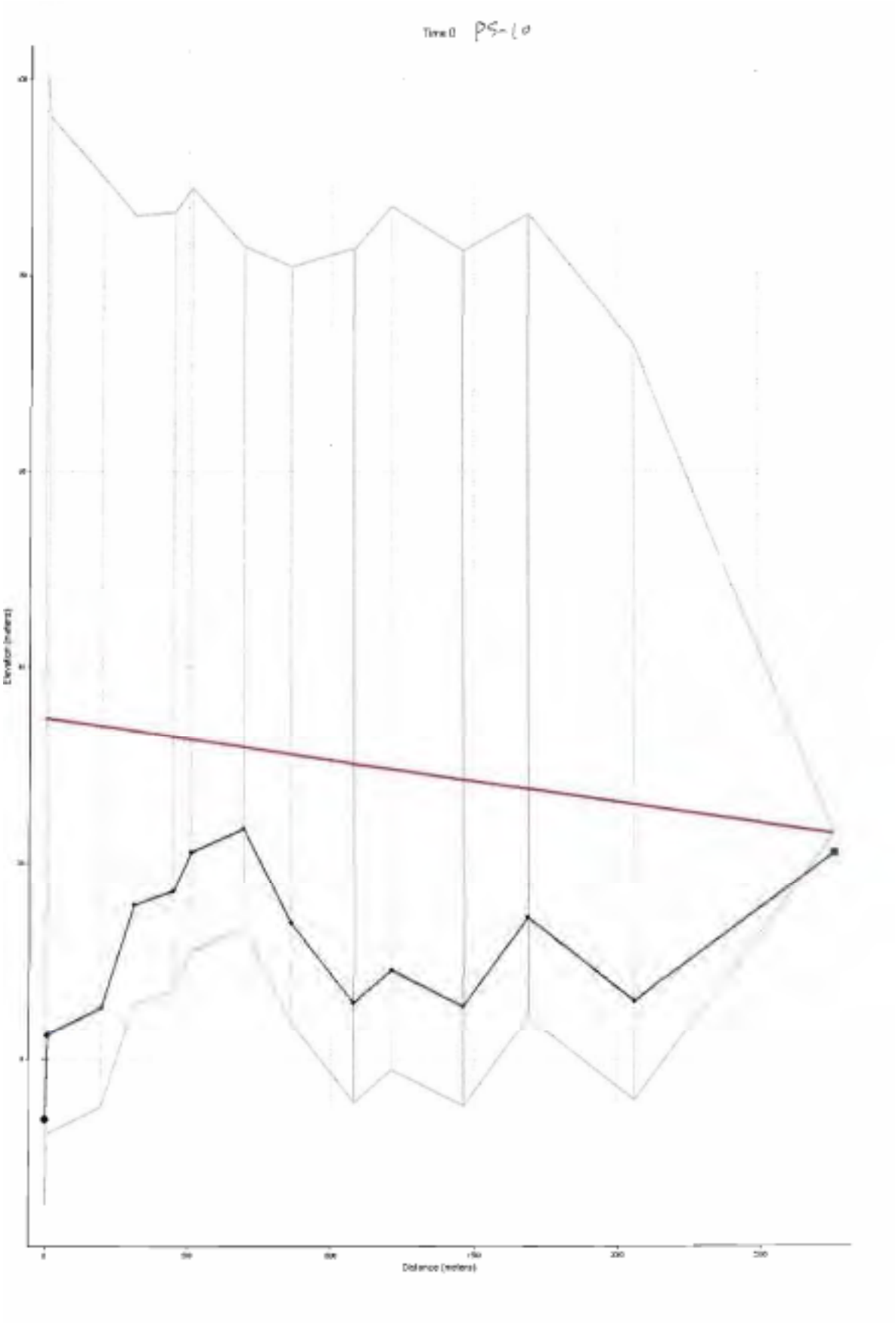
ps9 no need flywheel (with air valve)

SUMMARY OF MAX/MIN LINE PRESSURES:

START NODE	END NODE	MAX PRESS. psi or kPa	MIN PRESS. psi or kPa	Steady Press. at end nodes		MaxPrDrop at end nodes		LowestPress at end nodes	
O-Pump-1	J-1	92.31	-52.26	92.31	49.35	101.98	101.61	-9.67	-52.63
J-1	J-2	49.35	-59.85	49.35	40.93	101.61	100.78	-52.26	-60.69
J-2	J-3	40.93	-66.87	40.93	32.74	100.78	99.62	-59.85	-68.04
J-3	J-4	33.14	-66.87	32.74	33.14	99.62	98.51	-66.87	-66.48
J-4	J-5	33.14	-69.81	33.14	27.26	98.51	97.07	-65.38	-71.26
J-5	J-6	27.26	-73.02	27.26	21.75	97.07	94.77	-69.81	-75.32
J-6	J-7	25.94	-73.02	21.75	13.33	94.77	84.59	-73.02	-81.44
J-7	J-8	25.69	-71.26	13.33	9.37	84.59	69.04	-71.26	-75.22
J-8	J-9	25.52	-59.67	9.37	4.19	69.04	47.66	-59.67	-64.84
J-9	R-1	21.43	-43.46	4.19	1.96	47.66	0.00	-43.46	-45.70

***** END OF THIS SIMULATION *****

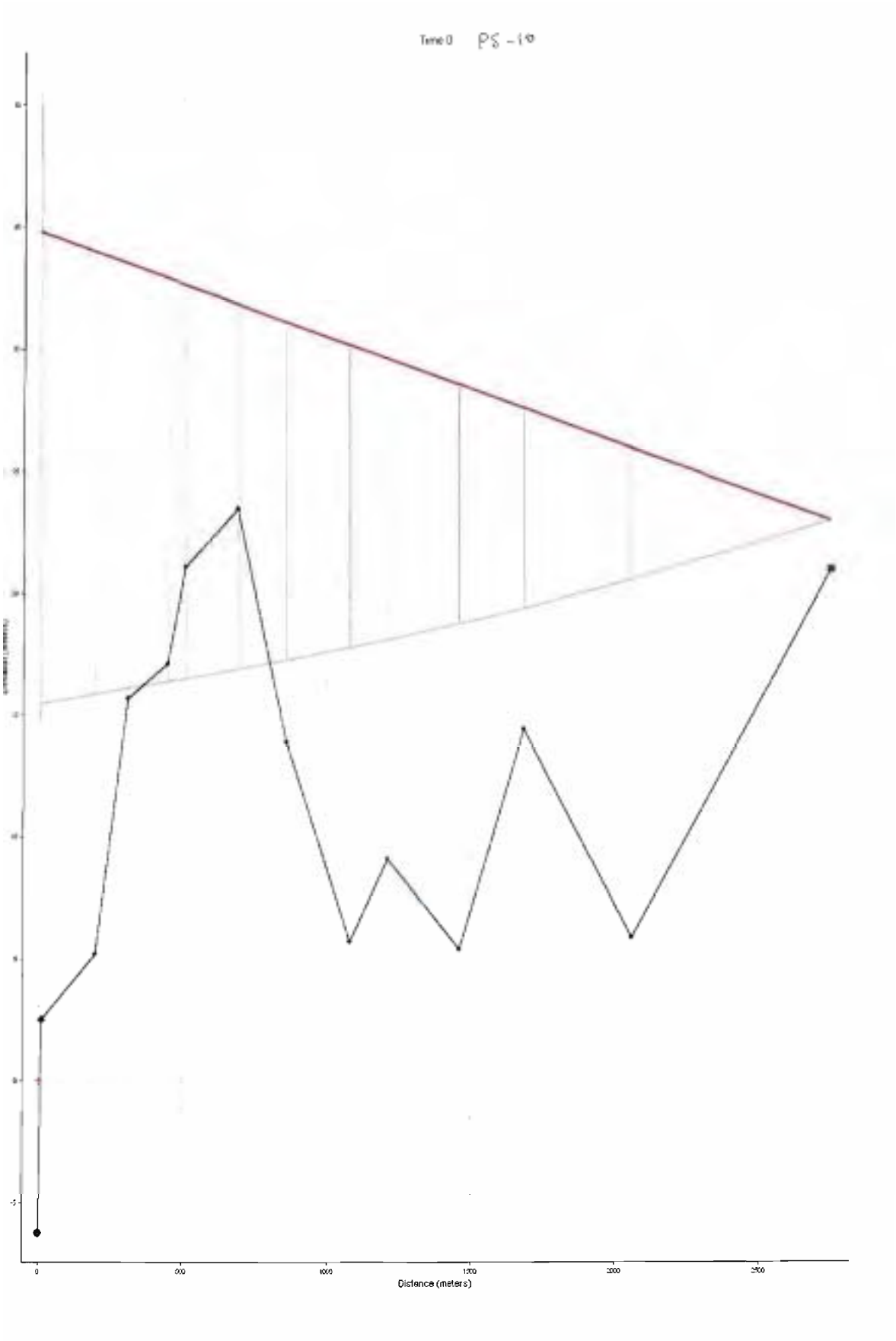
END RUN AT TIME 11:03:19


Time 0
PS-10
Elevation (meters)
Distance (meters)

pe10 without surge tank

SUMMARY OF MAXIMUM AND MINIMUM HEADS:

Position no.	MaxHead (m)	MinHead (m)	Time Reverse Grad.	MaxPressure (kPa)	MinPressure (kPa)	MaxTime (sec)	MinTime (sec)
J-2	70.43	-10.12	150.457	690.946	-99.326	289.65991	11.47737
J-4	69.36	-10.12	162.846	680.376	-99.326	252.05147	11.67717
J-5	67.85	-10.12	197.169	665.648	-99.326	249.83131	11.63277
J-6	59.42	-10.12	215.441	582.916	-99.326	249.43169	11.92136
J-7	67.00	-10.12	135.693	657.260	-99.326	287.15286	79.43452
J-8	77.03	-10.12	24.686	755.667	-99.326	291.27951	95.61944
J-9	78.00	-10.12	38.539	765.168	-99.326	291.65668	86.71662
J-10	77.23	-10.12	19.935	757.608	-99.326	211.62247	151.54510
J-11	71.89	-10.12	96.352	705.218	-99.326	212.13310	79.03489
J-12	67.15	-10.12	18.137	658.754	-99.326	73.68432	132.09656
J-3a	84.00	-10.12	68.356	832.652	-99.326	251.42982	20.26842
O-Pump-1	106.71	-10.12	35.975	1046.842	-99.326	289.08307	23.19878
R-1	2.00	2.00	0.000	19.620	19.620	0.02220	0.02220
SDO-1	93.70	-10.12	65.115	919.197	-99.326	251.00800	20.46822
O-Pump-1	1.30	1.30	0.000	12.749	12.749	0.02220	0.02220


Time 0
PS - 19
Distance (meters)

pol0 with surge tank

SUMMARY OF MAXIMUM AND MINIMUM HEADS:

Position no.	MaxHead (m)	MinHead (m)	Time Reverse Grad.	MaxPressure (kPa)	MinPressure (kPa)	MaxTime (sec)	MinTime (sec)
J-2	17.80	0.39	0.000	174.665	3.874	0.02220	70.57610
J-4	15.82	-0.71	26.018	155.168	-7.006	0.13320	70.35409
J-5	11.55	-4.59	124.437	113.278	-44.993	0.02220	70.22088
J-6	8.36	-6.60	191.197	82.037	-64.723	0.02220	69.82125
J-7	17.25	3.39	0.000	169.189	33.218	0.02220	69.42162
J-8	24.50	12.11	0.000	240.377	118.818	0.48840	68.93319
J-9	20.55	9.02	0.000	201.555	88.509	0.55500	68.66677
J-10	23.17	13.38	0.000	227.337	131.295	0.02220	68.15614
J-11	13.20	5.02	0.000	129.499	49.224	0.51060	67.68990
J-12	20.10	14.65	0.000	197.194	143.679	0.02220	66.82404
J-3a	28.80	10.67	0.000	282.507	104.646	0.02220	70.30968
O-Pump-1	47.18	20.97	0.000	462.875	205.696	10.32299	66.40221
R-1	2.00	2.00	0.000	19.620	19.620	0.02220	0.02220
SDO-1	32.29	12.99	0.000	316.776	127.391	0.02220	66.77964
O-Pump-1	1.30	1.30	0.000	12.749	12.749	0.02220	0.02220

KYPIPE

ps10 with surge tank

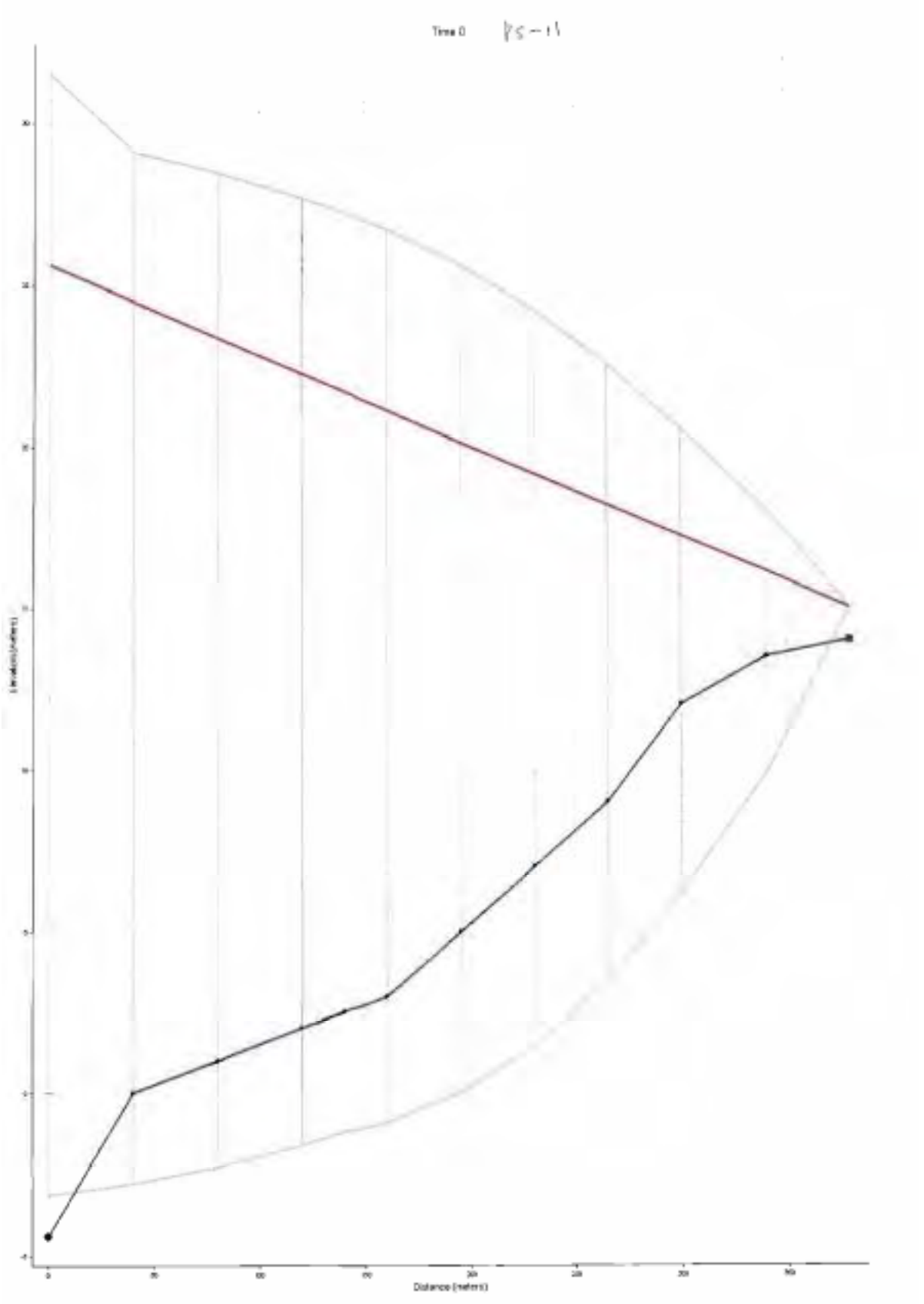
SUMMARY OF MAX/MIN LINE PRESSURES:

START NODE	END NODE	MAX PRESS. psi or kPa	MIN PRESS. psi or kPa	Steady Press. at end nodes		MaxPrDrop at end nodes		LowestPress at end nodes	
0-Pump-1	SDC-1	462.88	127.39	402.54	316.78	198.85	189.38	205.70	119.93
SDC-1_O	J-3a	316.78	104.65	316.78	282.51	189.38	177.86	127.39	93.12
J-3a	J-2	282.51	3.87	282.51	174.66	177.86	170.79	104.65	-3.20
J-2	J-4	174.66	-7.01	174.66	155.17	170.79	162.17	3.87	-15.62
J-4	J-5	155.17	-44.99	155.17	113.28	162.17	158.27	-7.01	-48.90
J-5	J-6	113.28	-64.72	113.28	82.04	158.27	146.76	-44.99	-76.23
J-6	J-7	169.19	-64.72	82.04	169.19	146.76	135.97	-64.72	22.43
J-7	J-8	240.38	33.22	169.19	240.38	135.97	121.56	33.22	104.41
J-8	J-9	240.38	88.51	240.38	201.56	121.56	113.05	118.82	80.00
J-9	J-10	227.34	88.51	201.56	227.34	113.05	96.04	88.51	118.29
J-10	J-11	227.34	49.22	227.34	129.50	96.04	80.27	131.30	33.46
J-11	J-12	197.19	49.22	129.50	197.19	80.27	53.52	49.22	116.92
J-12	R-1	197.19	19.62	197.19	19.62	53.52	0.00	143.68	-33.90

***** END OF THIS SIMULATION *****

END RUN AT TIME 11:17:33

KYPIPE


Time 0
PS-11
Distance (metres)

ps11 no need flywheel

SUMMARY OF MAXIMUM AND MINIMUM HEADS:

Position no.	MaxHead (m)	MinHead (m)	Time Reverse Grad.	MaxPressure (kPa)	MinPressure (kPa)	MaxTime (sec)	MinTime (sec)
J-1	29.14	-2.78	1.808	285.846	-27.275	13.85588	11.24791
J-2	27.48	-3.29	1.440	269.530	-32.258	13.82388	11.21591
J-3	25.68	-3.62	1.232	251.965	-35.505	13.79188	11.18391
J-4	24.73	-3.72	1.120	242.619	-36.505	13.77588	10.52792
J-5	23.74	-3.91	1.008	232.864	-38.381	13.75988	10.51192
J-6	20.61	-4.97	1.216	202.163	-48.711	13.72788	10.47992
J-7	17.26	-5.53	1.776	169.338	-54.236	13.69588	10.44792
J-8	13.57	-5.62	2.624	133.079	-54.110	13.66388	10.41592
J-9	8.53	-5.77	11.520	83.692	-56.579	13.63188	10.38392
J-10	4.54	-3.59	14.896	44.582	-35.257	13.59988	10.35192
O-Pump-1	35.94	1.27	0.000	352.580	12.488	13.88788	11.27991
R-1	1.00	1.00	0.000	9.810	9.810	0.01600	0.01600
O-Pump-1	1.20	1.20	0.000	11.769	11.769	0.01600	0.01600

KYPIPE

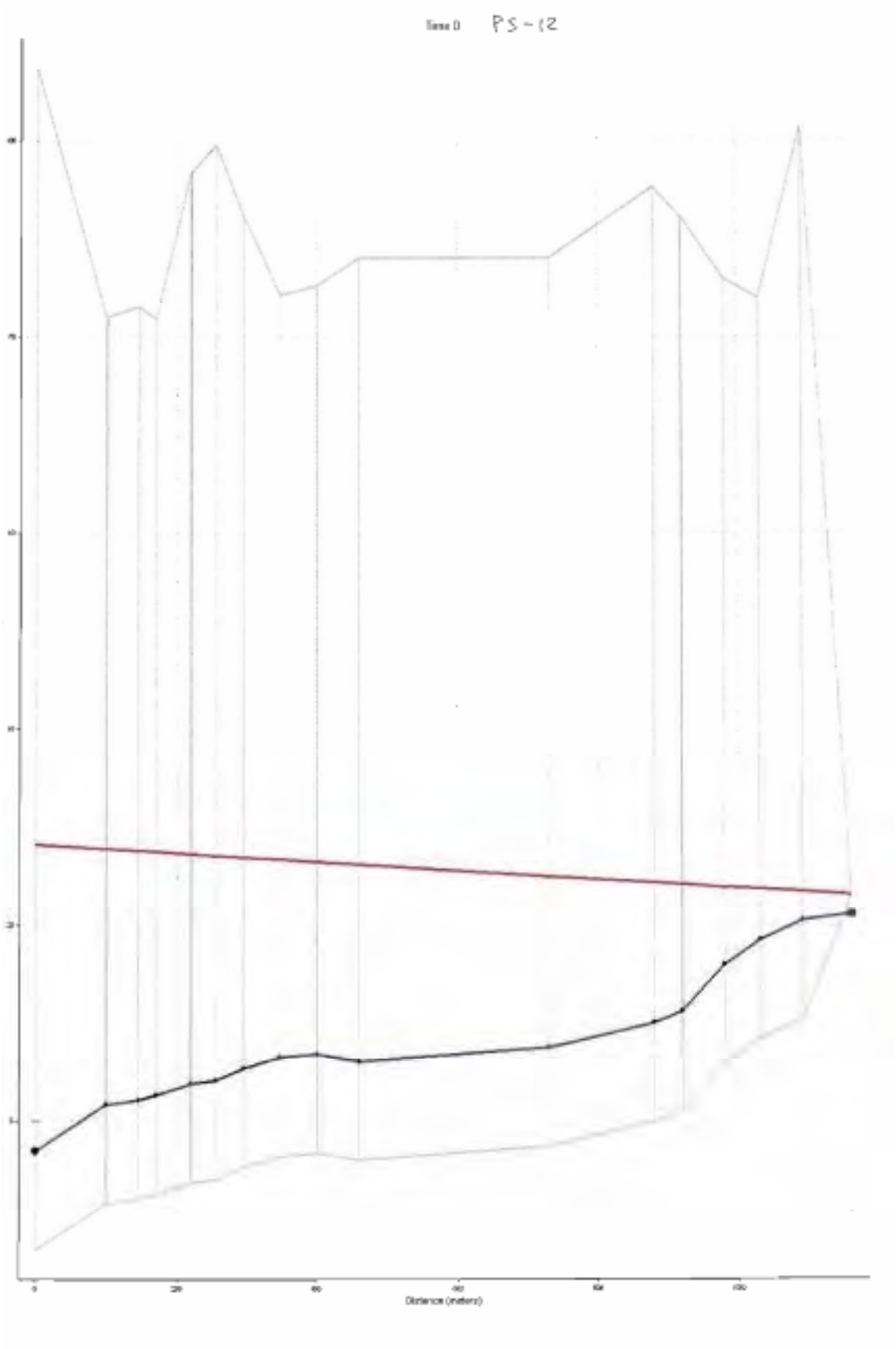
psil no need flywheel

SUMMART OF MAX/MIN LINE PRESSURES:

START NODE	END NODE	MAX PRESS. psi or kPa	MIN PRESS. psi or kPa	Steady Press. at end nodes		MaxPrDrop at end nodes		LowestPress at end nodes	
O-Pump-1	J-1	352.58	-27.27	294.64	240.49	282.15	267.77	12.49	-41.66
J-1	J-2	285.85	-32.26	240.49	219.70	267.77	251.96	-27.27	-48.07
J-2	J-3	269.54	-35.51	219.70	198.91	251.96	234.42	-32.26	-53.05
J-3	J-4	251.96	-36.50	198.91	188.51	234.42	225.02	-35.51	-45.90
J-4	J-5	242.62	-38.38	188.51	178.12	225.02	216.50	-36.50	-46.90
J-5	J-6	232.86	-48.71	178.12	148.89	216.50	197.60	-38.38	-67.61
J-6	J-7	202.16	-54.24	148.89	119.66	197.60	173.90	-48.71	-77.94
J-7	J-8	169.34	-54.24	119.66	90.43	173.90	144.54	-54.24	-83.47
J-8	J-9	133.08	-56.58	90.43	51.39	144.54	107.97	-54.11	-93.15
J-9	J-10	83.69	-56.58	51.39	25.70	107.97	60.95	-56.58	-82.28
J-10	R-1	44.58	-35.26	25.70	9.81	60.95	0.00	-35.26	-51.14

***** END OF THIS SIMULATION *****

END RUN AT TIME 11:19:42

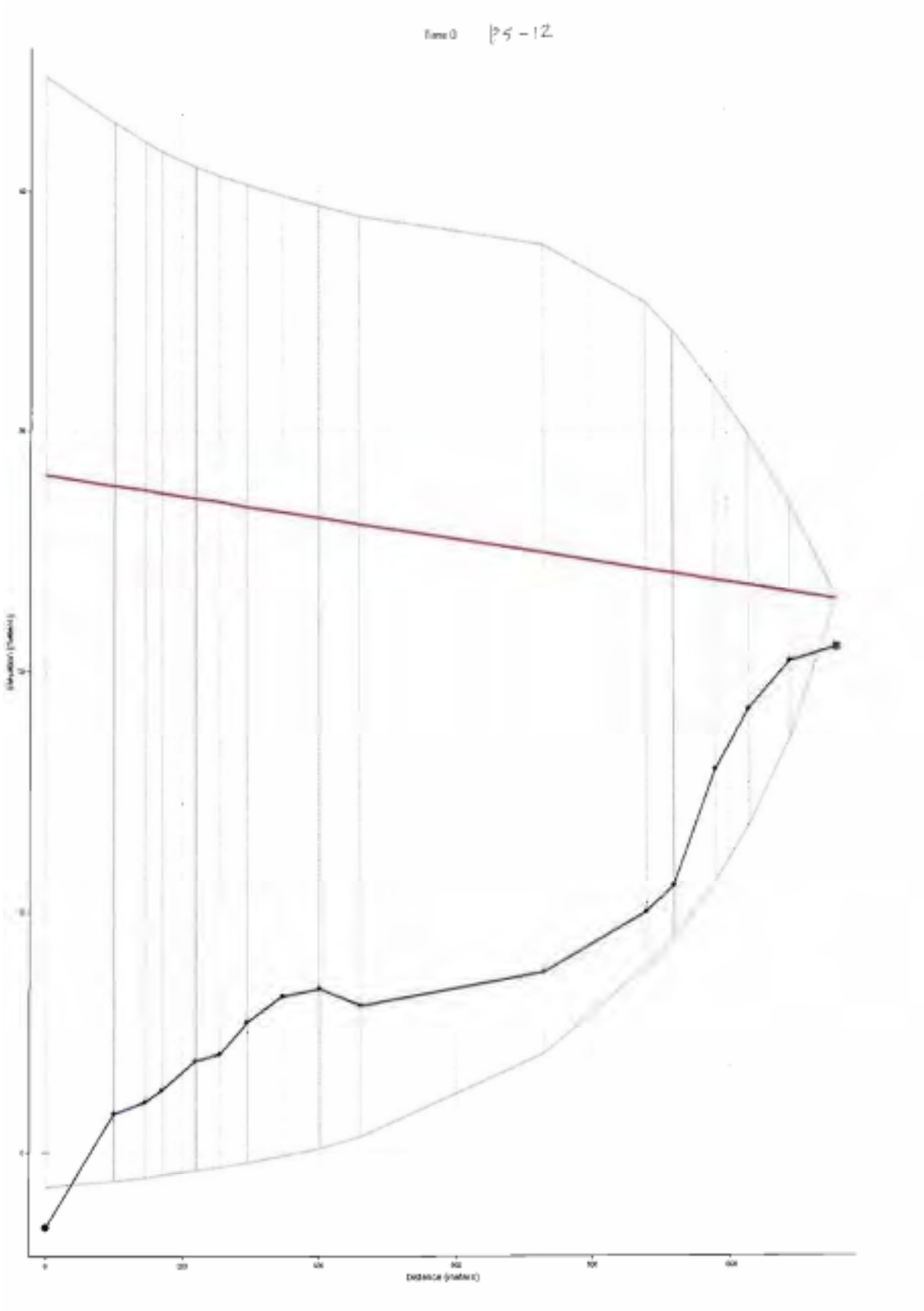

PS-12
Distance (meters)

pe12 without flywheel

SUMMARY OF MAXIMUM AND MINIMUM HEADS:

Position no.	MaxHead (m)	MinHead (m)	Time Reverse Grad.	MaxPressure (kPa)	MinPressure (kPa)	MaxTime (sec)	MinTime (sec)
J-1	80.41	-10.12	9.396	788.790	-99.326	294.16574	269.72821
J-2	80.97	-10.12	8.757	794.325	-99.326	294.19354	280.40399
J-3	79.22	-10.12	9.007	777.190	-99.326	294.30475	276.12256
J-4	93.02	-10.12	9.285	912.536	-99.326	294.52716	276.23376
J-5	95.56	-10.12	9.730	937.437	-99.326	294.44376	275.09390
J-6	86.84	-10.12	11.815	851.912	-99.326	295.69482	270.17303
J-7	77.70	-10.12	13.094	762.229	-99.326	290.66275	11.73156
J-8	78.43	-10.12	13.316	769.408	-99.326	295.38901	11.75936
J-9	81.96	-10.12	11.426	804.008	-99.326	295.16660	14.45592
J-10	80.58	-10.12	11.259	790.473	-99.326	293.08148	12.23196
J-11	85.26	-10.12	17.542	836.413	-99.326	295.88943	12.37095
J-12	81.13	-10.12	22.990	795.969	-99.326	291.88602	12.39875
J-13	69.99	-10.12	54.016	686.586	-99.326	292.08063	12.39875
J-14	65.44	-10.12	73.033	641.971	-99.326	296.13965	12.45435
J-15	81.11	-10.12	81.429	795.717	-99.326	299.36462	12.56555
O-Pump-1	110.43	-10.12	11.787	1083.303	-99.326	293.94333	269.47800
R-1	2.00	2.00	0.000	19.620	19.620	0.02780	0.02780
O-Pump-1	0.44	0.44	0.000	4.313	4.313	0.02780	0.02780

KYPIPE

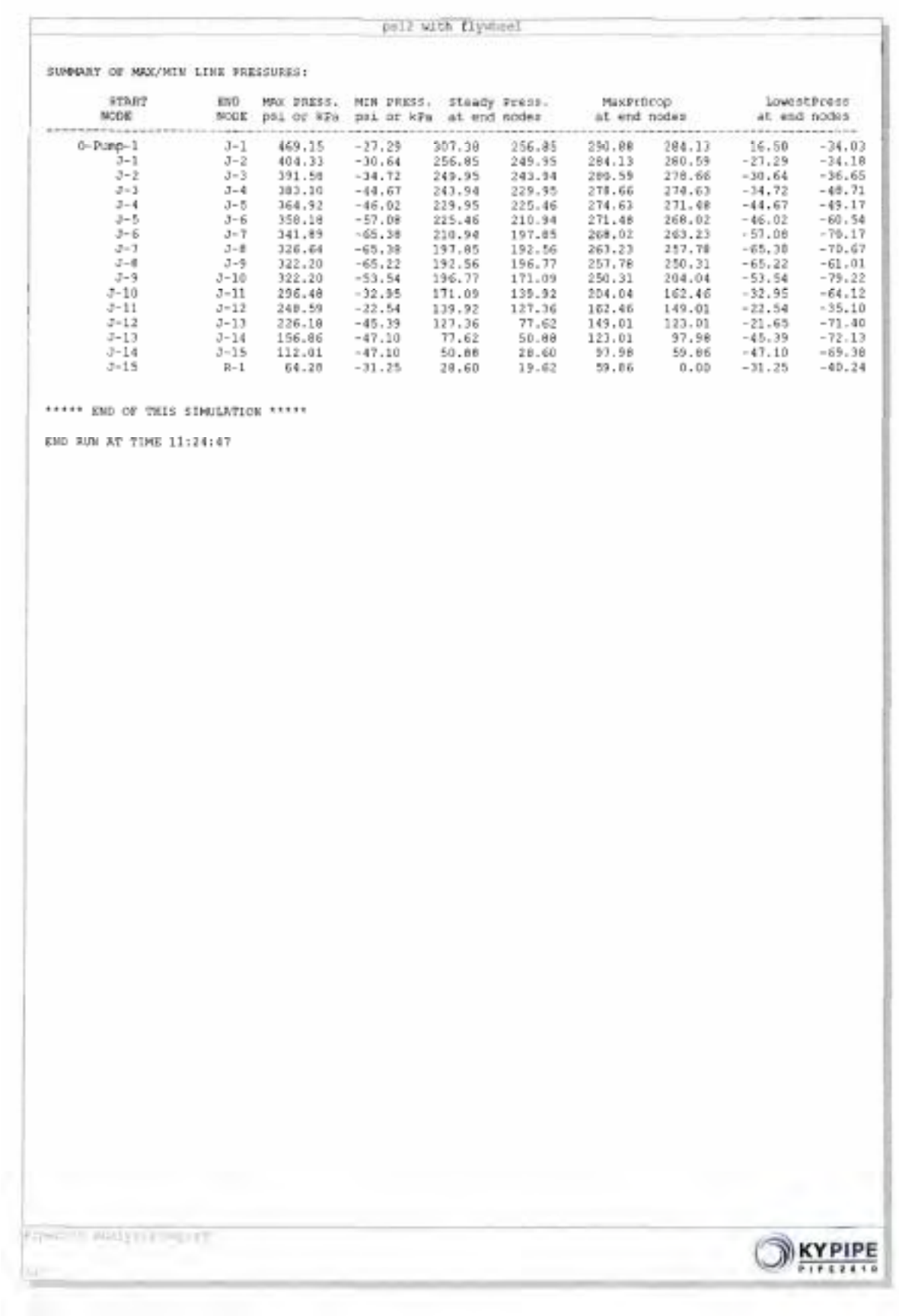

PS - 12

ps12 with flywheel

SUMMARY OF MAXIMUM AND MINIMUM HEADS:

Position no.	MaxHead (m)	MinHead (m)	Time Reverse Grad.	MaxPressure (kPa)	MinPressure (kPa)	MaxTime (sec)	MinTime (sec)
J-1	41.22	-2.78	1.696	404.333	-27.287	22.32321	15.01192
J-2	39.92	-3.12	1.751	391.582	-30.637	22.43441	14.90072
J-3	39.05	-3.54	1.863	383.102	-34.722	22.49001	14.84512
J-4	37.20	-4.55	2.113	364.919	-44.674	22.60121	14.73392
J-5	36.51	-4.69	2.057	358.181	-46.018	22.68461	14.65052
J-6	34.85	-5.02	2.307	341.889	-57.082	22.76801	14.56712
J-7	33.30	-6.66	2.669	326.640	-65.381	22.87921	14.45592
J-8	32.58	-6.65	2.502	319.628	-65.220	22.99040	14.34473
J-9	32.84	-5.46	1.807	322.199	-53.539	23.12940	14.20573
J-10	30.22	-3.36	0.806	296.480	-32.955	23.74099	13.59414
J-11	25.34	-2.30	0.445	248.592	-22.535	23.71319	13.26054
J-12	23.06	-2.21	0.445	226.176	-21.652	23.62980	13.17714
J-13	15.99	-4.63	3.558	156.861	-45.388	23.49080	13.03815
J-14	11.42	-4.80	7.673	112.010	-47.100	23.37960	12.92695
J-15	6.55	-3.19	7.867	64.284	-31.252	23.24060	12.78795
O-Pump-1	47.82	1.68	0.000	469.155	16.498	22.10082	15.23431
R-1	2.00	2.00	0.000	19.620	19.620	0.02780	0.02780
O-Pump-1	0.44	0.44	0.000	4.313	4.313	0.02780	0.02780

KYPIPE



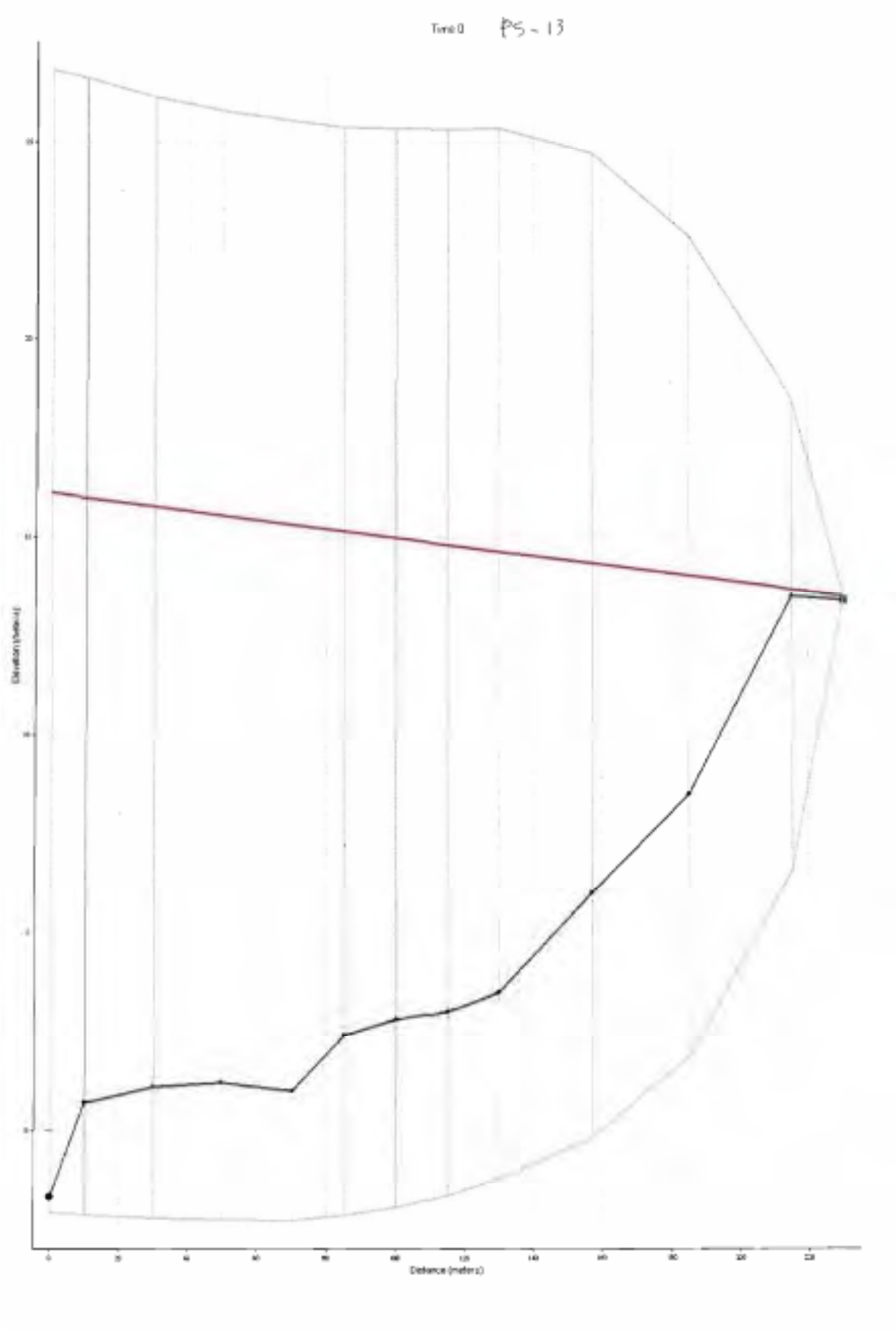
pol2 with flywheel

SUMMARY OF MAX/MIN LINE PRESSURES:

START NODE	END NODE	MAX PRESS. psi or kPa	MIN PRESS. psi or kPa	Steady Press. at end nodes		MaxPrtcop at end nodes		LowestPress at end nodes	
0-Pump-1	J-1	469.15	-27.29	307.30	256.85	290.88	284.13	16.50	-34.03
J-1	J-2	404.33	-30.64	256.85	249.95	284.13	280.59	-27.29	-34.18
J-2	J-3	391.58	-34.72	249.95	243.94	280.59	278.66	-30.64	-36.65
J-3	J-4	383.10	-44.67	243.94	229.95	278.66	274.63	-34.72	-48.71
J-4	J-5	364.92	-46.02	229.95	225.46	274.63	271.48	-44.67	-49.17
J-5	J-6	358.18	-57.08	225.46	210.94	271.48	268.02	-46.02	-60.54
J-6	J-7	341.89	-65.38	210.94	197.85	268.02	263.23	-57.08	-70.17
J-7	J-8	326.64	-65.38	197.85	192.56	263.23	257.78	-65.38	-70.67
J-8	J-9	322.20	-65.22	192.56	196.77	257.78	250.31	-65.22	-61.01
J-9	J-10	322.20	-53.54	196.77	171.09	250.31	204.04	-53.54	-79.22
J-10	J-11	296.48	-32.95	171.09	139.92	204.04	162.46	-32.95	-64.12
J-11	J-12	248.59	-22.54	139.92	127.36	162.46	149.01	-22.54	-35.10
J-12	J-13	226.18	-45.39	127.36	77.62	149.01	123.01	-21.65	-71.40
J-13	J-14	156.86	-47.10	77.62	50.88	123.01	97.98	-45.39	-72.13
J-14	J-15	112.01	-47.10	50.88	28.60	97.98	59.86	-47.10	-69.38
J-15	R-1	64.20	-31.25	28.60	19.62	59.86	0.00	-31.25	-40.24

***** END OF THIS SIMULATION *****

END RUN AT TIME 11:24:47


Time 0
PS - 13
Distance (meters)

ps13 no need flywheel

SUMMARY OF MAXIMUM AND MINIMUM HEADS:

Position no.	MaxHead (m)	MinHead (m)	Time Reverse Grad.	MaxPressure (kPa)	MinPressure (kPa)	MaxTime (sec)	MinTime (sec)
J-1	25.93	-2.85	1.043	254.343	-27.997	12.74275	11.12219
J-2	25.06	-3.32	0.888	245.610	-32.599	12.78715	11.07778
J-3	24.59	-3.47	0.710	241.181	-34.060	12.83155	11.03338
J-4	24.53	-3.29	0.555	240.632	-32.311	12.87595	10.98898
J-5	22.97	-4.57	1.154	225.346	-44.785	12.92035	10.94458
J-6	22.53	-4.76	1.443	221.012	-46.732	12.98695	10.90018
J-7	22.33	-4.66	1.399	219.045	-45.740	13.03134	10.85578
J-8	21.85	-4.73	1.465	214.336	-46.373	13.07574	10.81138
J-9	18.70	-6.19	2.731	183.474	-60.765	13.08354	10.74478
J-10	14.11	-6.63	3.441	138.424	-65.000	12.98695	10.67818
J-11	4.98	-6.94	145.040	48.893	-68.101	12.92035	10.61158
O-Pump-1	28.49	-0.41	0.333	279.507	-4.048	12.74275	11.14438
R-1	0.10	0.10	0.000	0.981	0.981	0.02220	0.02220
O-Pump-1	0.70	0.70	0.000	6.865	6.865	0.02220	0.02220

pol3 no need flywheel

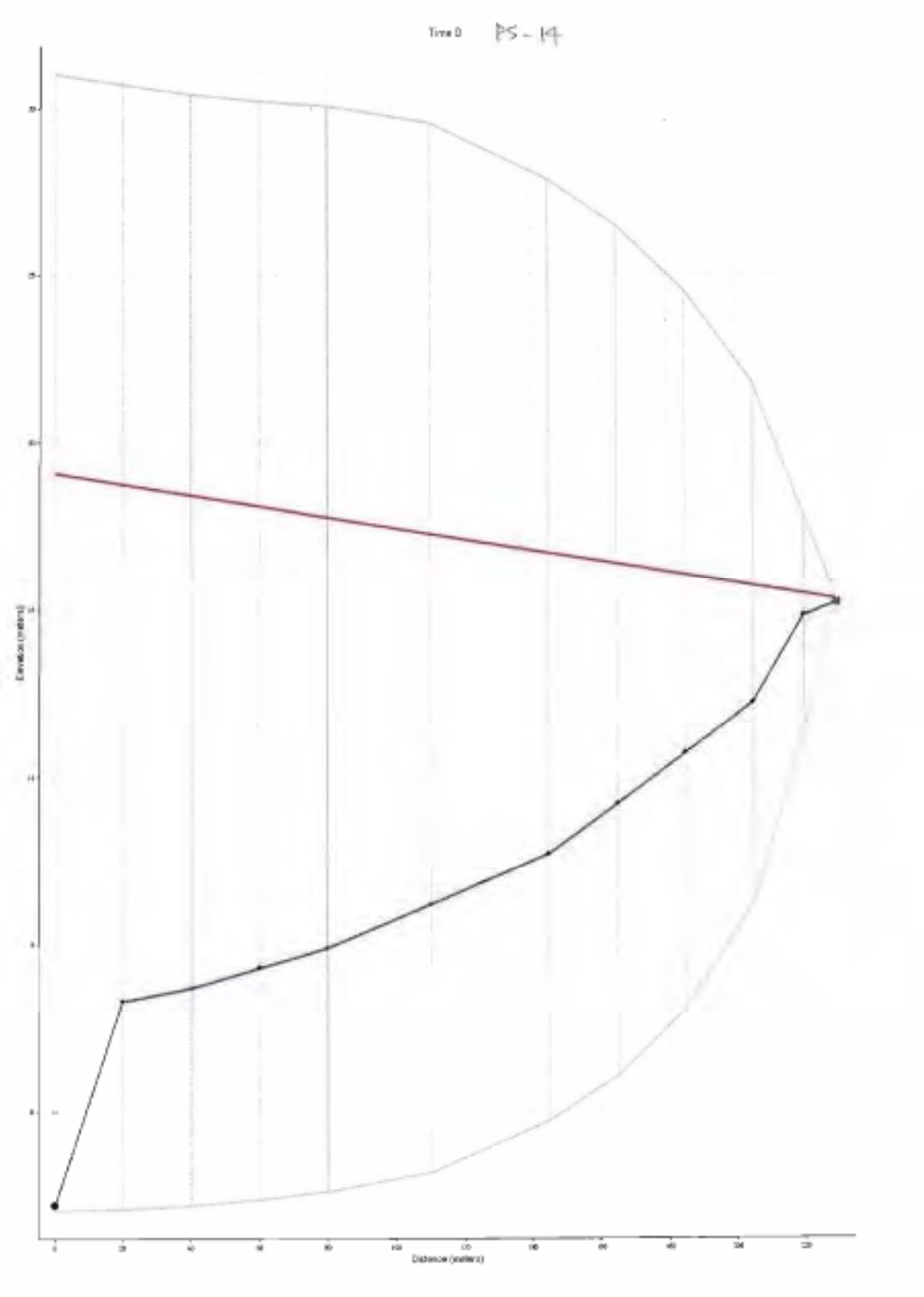
SUMMARY OF MAX/MIN LINE PRESSURES:

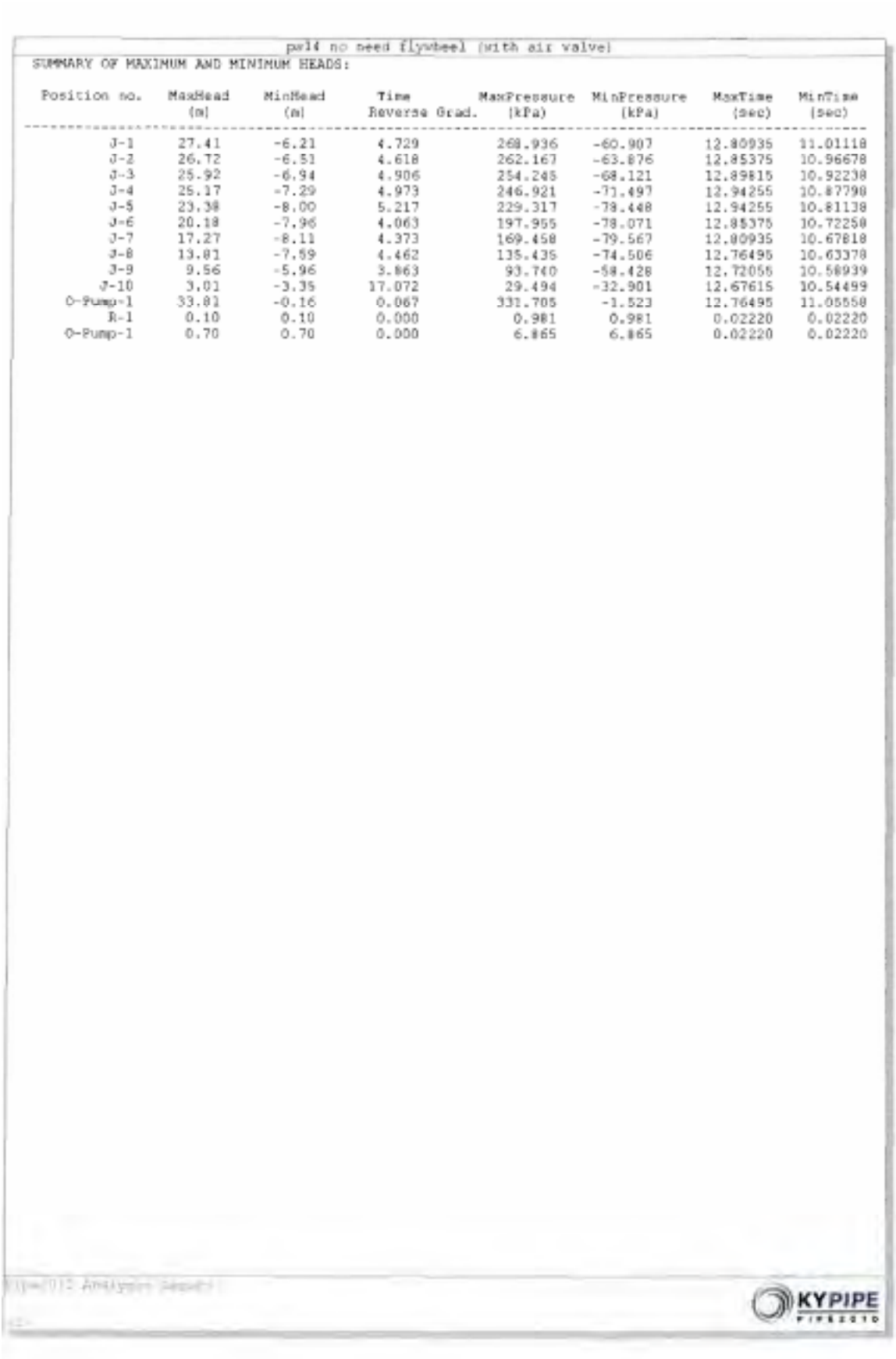
START NODE	END NODE	MAX PRESS. psi or kPa	MIN PRESS. psi or kPa	Steady Press. at end nodes		MaxPressure at end nodes		LowestPress at end nodes		
O-Pump-1	J-1	279.51	-28.00	174.09	150.23	178.94	178.22	-4.05	-28.71	
J-1	J-2	254.34	-32.60	150.23	144.06	178.22	176.66	-26.00	-34.16	
J-2	J-3	249.61	-34.06	144.06	140.84	176.66	174.98	-22.60	-35.82	
J-3	J-4	241.18	-34.06	140.84	140.56	174.98	172.87	-34.06	-34.34	
J-4	J-5	240.63	-44.76	140.56	125.14	172.87	169.93	-32.31	-47.73	
J-5	J-6	225.35	-46.73	125.14	119.54	169.93	166.27	-46.70	-50.39	
J-6	J-7	221.81	-46.73	119.54	115.89	166.27	161.63	-46.73	-50.38	
J-7	J-8	219.85	-46.37	115.89	109.31	161.63	155.68	-45.74	-52.33	
J-8	J-9	218.34	-68.76	109.31	81.76	155.68	182.52	-46.37	-73.98	
J-9	J-10	183.47	-69.80	81.76	56.09	182.52	119.89	-60.76	-88.43	
J-10	J-11	138.42	-68.10	54.09	1.68	119.89	69.78	-65.00	-117.41	Cavitation Potential
J-11	R-1	88.89	-68.10	1.68	0.98	69.78	0.00	-68.10	-88.80	

***** END OF THIS SIMULATION *****

END RUN AT TIME 11:20:38

KYPIPE PIPELINES


Time 0
PS - 14
Elevation (meters)
Distance (meters)



pa14 no need flywheel (with air valve)

SUMMARY OF MAXIMUM AND MINIMUM HEADS:

Position no.	MaxHead (m)	MinHead (m)	Time Reverse Grad.	MaxPressure (kPa)	MinPressure (kPa)	MaxTime (sec)	MinTime (sec)
J-1	27.41	-6.21	4.729	268.936	-60.907	12.80935	11.01118
J-2	26.72	-6.51	4.618	262.167	-63.876	12.85375	10.96678
J-3	25.92	-6.94	4.906	254.245	-68.121	12.89815	10.92238
J-4	25.17	-7.29	4.973	246.921	-71.497	12.94255	10.87798
J-5	23.38	-8.00	5.217	229.317	-78.448	12.94255	10.81138
J-6	20.18	-7.96	4.063	197.955	-78.071	12.85375	10.72258
J-7	17.27	-8.11	4.373	169.458	-79.567	12.80935	10.67818
J-8	13.81	-7.59	4.462	135.435	-74.506	12.76495	10.63378
J-9	9.56	-5.96	3.863	93.740	-58.428	12.72055	10.58939
J-10	3.01	-3.35	17.072	29.494	-32.901	12.67615	10.54499
O-Pump-1	33.81	-0.16	0.067	331.705	-1.523	12.76495	11.05558
R-1	0.10	0.10	0.000	0.981	0.981	0.02220	0.02220
O-Pump-1	0.70	0.70	0.000	6.865	6.865	0.02220	0.02220

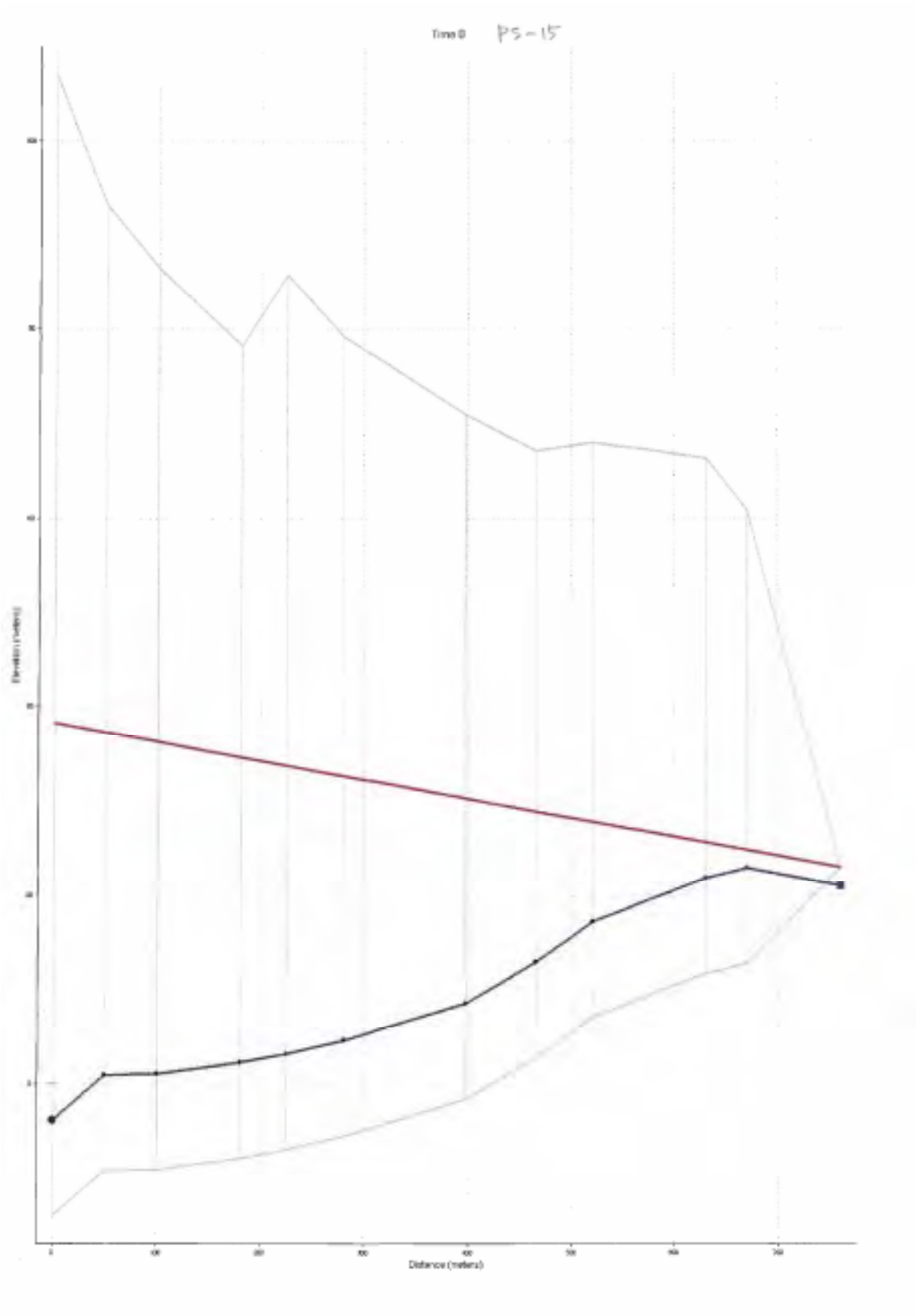
ps14 no need flywheel (with air valve)

SUMMARY OF MAX/MIN LINE PRESSURES:

START NODE	END NODE	MAX PRESS. psi or kPa	MIN PRESS. psi or kPa	Steady Press. at end nodes		MaxPrDrop at end nodes		LowestPress at end nodes	
O-Pump-1	J-1	331.71	-60.91	214.82	151.74	216.35	212.65	-1.52	-64.60
J-1	J-2	268.94	-63.00	151.74	144.58	212.65	208.45	-60.91	-68.03
J-2	J-3	262.17	-68.12	144.58	135.45	208.45	203.57	-63.88	-73.00
J-3	J-4	254.25	-71.50	135.45	126.33	203.57	197.82	-68.12	-77.25
J-4	J-5	246.92	-78.45	126.33	108.71	197.82	187.16	-71.50	-89.11
J-5	J-6	229.32	-78.45	108.71	88.33	187.16	166.40	-78.45	-90.83
J-6	J-7	197.95	-79.57	88.33	70.37	166.40	149.94	-78.07	-96.03
J-7	J-8	169.46	-79.57	70.37	52.42	149.94	126.92	-79.57	-97.52
J-8	J-9	135.44	-74.51	52.42	34.46	126.92	92.89	-74.51	-92.46
J-9	J-10	93.74	-58.43	34.46	6.53	92.89	39.43	-58.43	-86.36
J-10	R-1	29.49	-32.90	6.53	0.98	39.43	0.00	-32.90	-38.45

***** END OF THIS SIMULATION *****

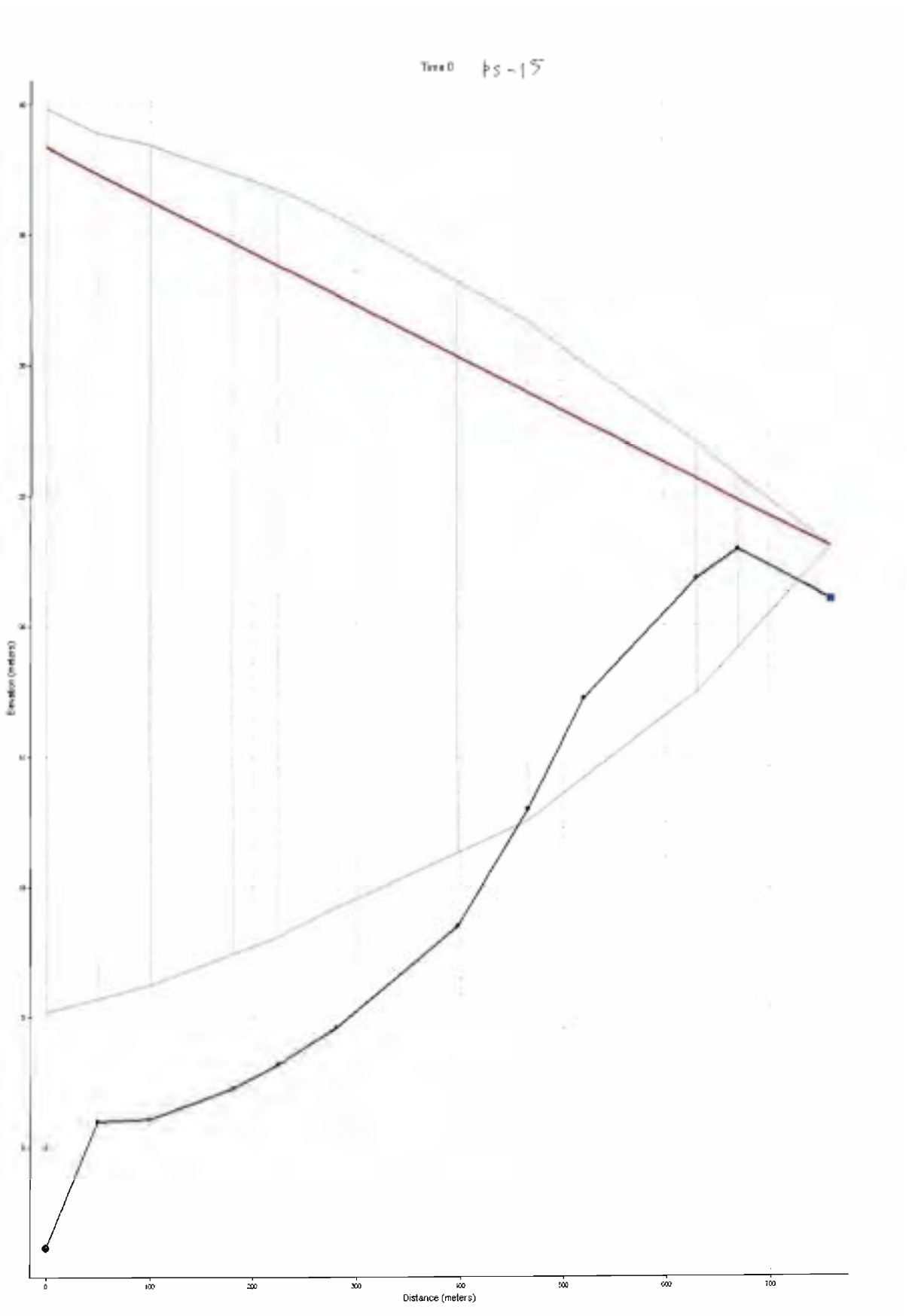
END RUN AT TIME 11:41:33


PS-15
Distance (meters)

ps15 without flywheel

SUMMARY OF MAXIMUM AND MINIMUM HEADS:

Position no.	MaxHead (m)	MinHead (m)	Time Reverse Grad.	MaxPressure (kPa)	MinPressure (kPa)	MaxTime (sec)	MinTime (sec)
J-1	92.06	-10.12	23.025	903.090	-99.326	77.25316	45.82782
J-2	85.37	-10.12	22.492	837.480	-99.326	77.16426	45.96116
J-3	75.96	-10.12	21.825	745.138	-99.326	76.90647	46.18341
J-4	82.48	-10.12	22.936	809.134	-99.326	57.16227	46.49455
J-5	74.65	-10.12	23.470	732.324	-99.326	57.02893	46.31675
J-6	62.54	-10.12	27.559	613.552	-99.326	63.02952	44.80549
J-8	50.86	-10.12	59.563	498.933	-99.326	70.85252	11.42362
J-9	44.59	-10.12	101.611	437.406	-99.326	76.05304	11.51252
J-10	37.94	-10.12	144.149	372.238	-99.326	56.18440	11.55697
J-67	54.16	-10.12	39.605	531.275	-99.326	76.36418	11.42362
O-Pump-1	110.72	-10.12	14.491	1086.211	-99.326	77.34206	45.69447
R-1	2.00	2.00	0.000	19.620	19.620	0.04445	0.04445
O-Pump-1	1.20	1.20	0.000	11.768	11.768	0.04445	0.04445

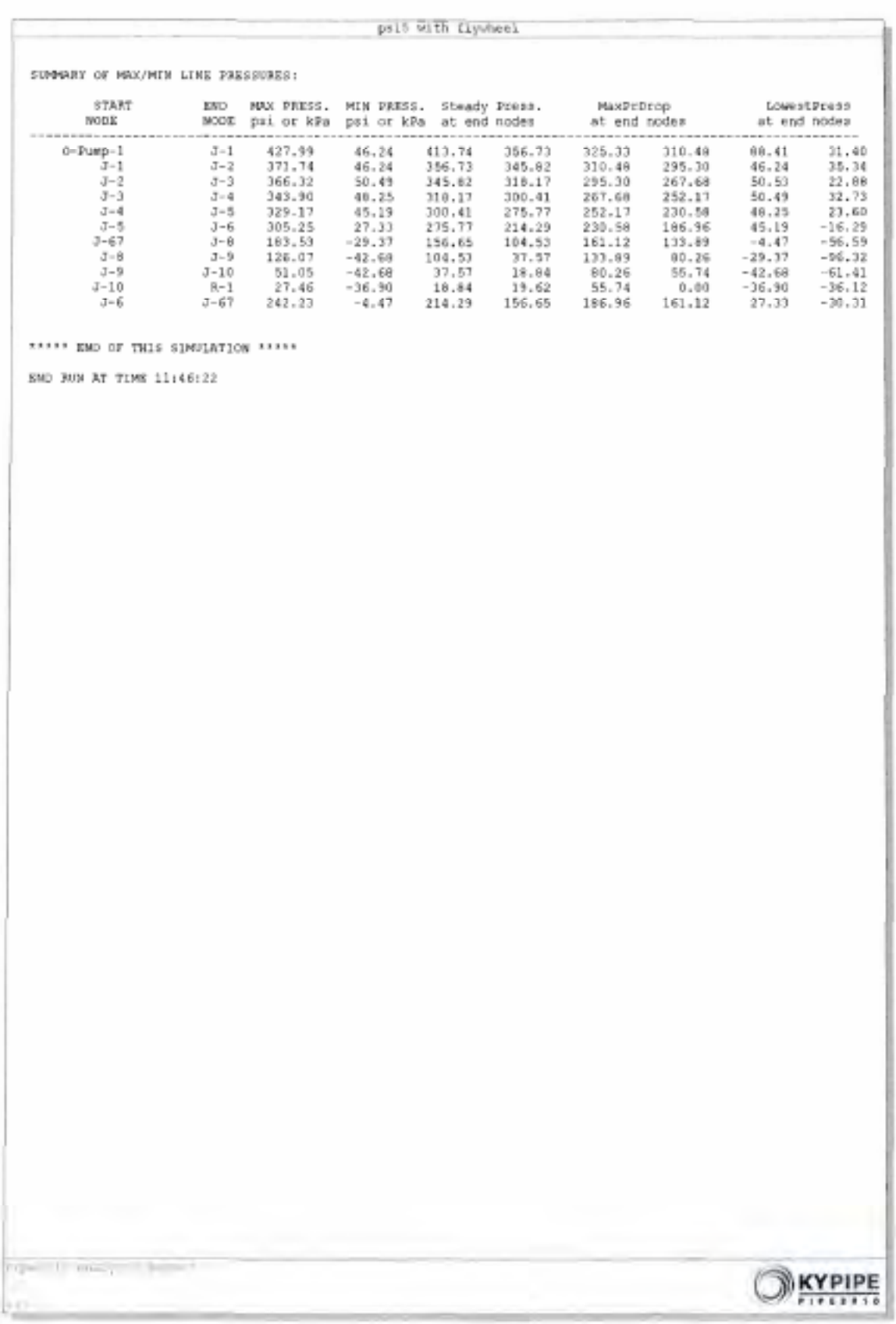

PS-15
Distance (meters)

ps15 with flywheel

SUMMARY OF MAXIMUM AND MINIMUM HEADS:

Position no.	MaxHead (m)	MinHead (m)	Time Reverse Grad.	MaxPressure (kPa)	MinPressure (kPa)	MaxTime (sec)	MinTime (sec)
J-1	37.89	4.71	0.000	371.745	46.242	19.60246	16.31311
J-2	37.34	5.15	0.000	366.321	50.527	19.51356	16.22421
J-3	35.06	5.15	0.000	343.897	50.492	19.33576	16.04640
J-4	33.55	4.92	0.000	329.170	48.246	19.24686	15.95750
J-5	31.12	4.61	0.000	305.247	45.186	19.11350	12.62376
J-6	24.69	2.79	0.000	242.234	27.327	18.84680	12.35707
J-8	12.85	-2.99	3.245	126.072	-29.366	18.58010	12.09037
J-9	5.20	-4.35	39.738	51.052	-42.684	18.40229	11.86812
J-10	2.80	-3.76	140.948	27.457	-36.896	18.53564	11.77922
J-67	18.71	-0.46	0.133	183.530	-4.471	18.71345	12.22372
O-Pump-1	43.63	9.01	0.000	427.991	88.408	19.69136	16.49091
R-1	2.00	2.00	0.000	19.620	19.620	0.04445	0.04445
O-Pump-1	1.20	1.20	0.000	11.768	11.768	0.04445	0.04445

KYPIPE



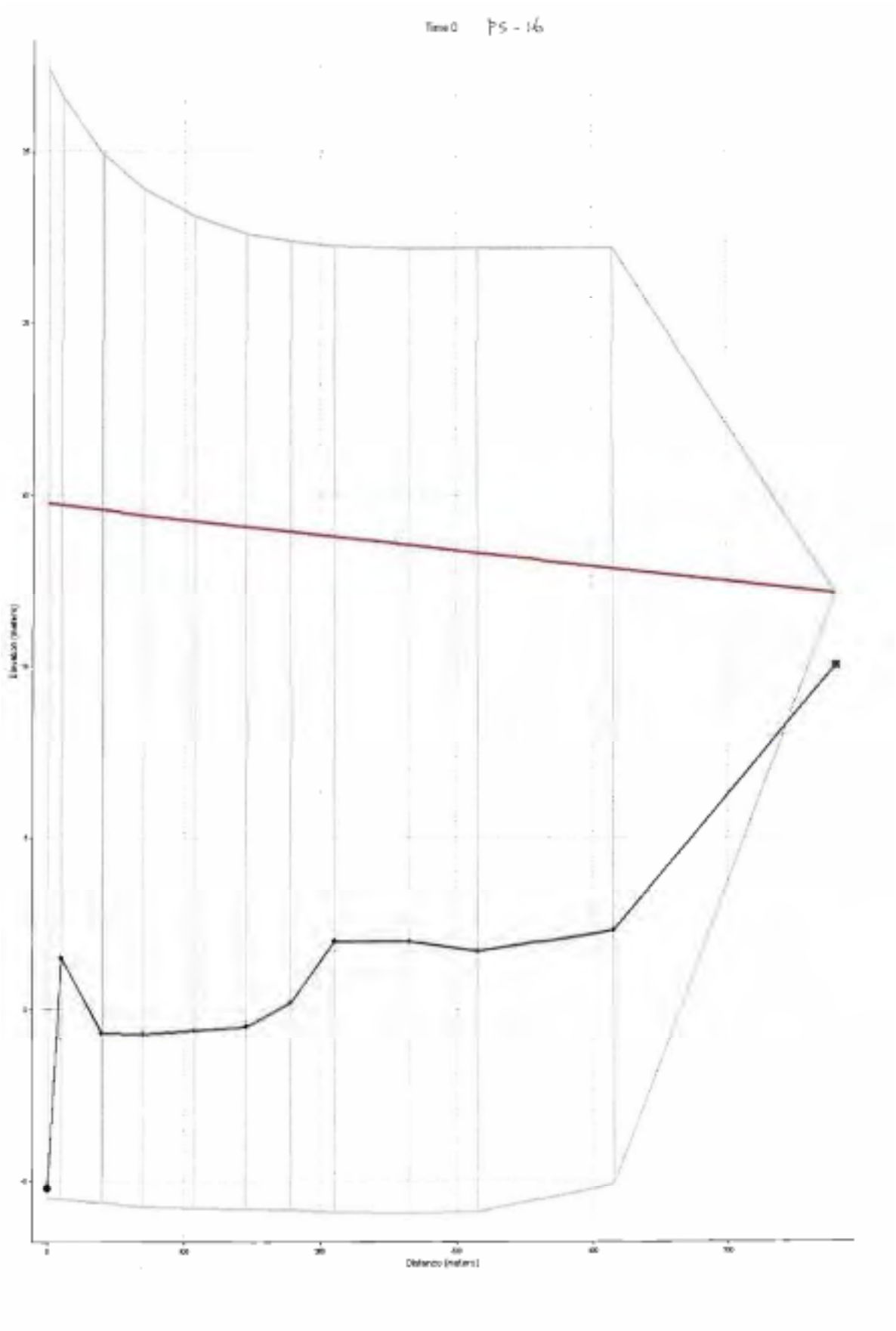
psi5 with flywheel

SUMMARY OF MAX/MIN LINE PRESSURES:

START NODE	END NODE	MAX PRESS. psi or kPa	MIN PRESS. psi or kPa	Steady Press. at end nodes		MaxPrDrop at end nodes		LowestPress at end nodes	
0-Pump-1	J-1	427.99	46.24	413.74	356.73	325.33	310.48	88.41	31.40
J-1	J-2	371.74	46.24	356.73	345.82	310.48	295.30	46.24	35.34
J-2	J-3	366.32	50.49	345.82	318.17	295.30	267.68	50.53	22.88
J-3	J-4	343.90	48.25	318.17	300.41	267.68	252.17	50.49	32.73
J-4	J-5	329.17	45.19	300.41	275.77	252.17	230.58	48.25	23.60
J-5	J-6	305.25	27.33	275.77	214.29	230.58	186.96	45.19	-16.29
J-67	J-8	183.53	-29.37	156.65	104.53	161.12	133.89	-4.47	-56.59
J-8	J-9	126.07	-42.68	104.53	37.57	133.89	80.26	-29.37	-96.32
J-9	J-10	51.05	-42.68	37.57	18.84	80.26	55.74	-42.68	-61.41
J-10	R-1	27.46	-36.90	18.84	19.62	55.74	0.00	-36.90	-36.12
J-6	J-67	242.23	-4.47	214.29	156.65	186.96	161.12	27.33	-30.31

***** END OF THIS SIMULATION *****

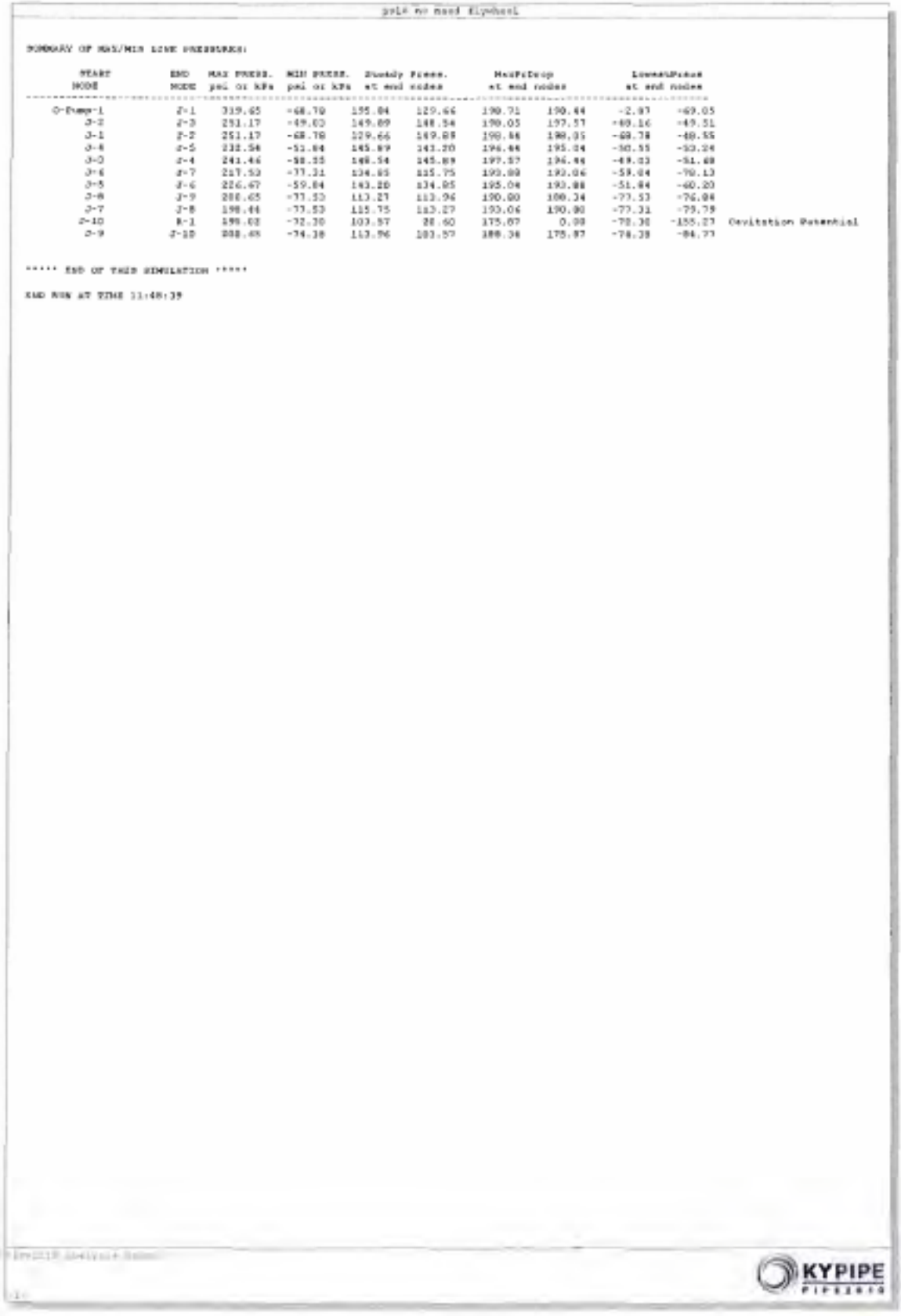
END RUN AT TIME 11:46:22


Time 0
PS - 16

ps16 no need flywheel

SUMMARY OF MAXIMUM AND MINIMUM HEADS:

Position no.	MaxHead (m)	MinHead (m)	Time Reverse Grad.	MaxPressure (kPa)	MinPressure (kPa)	MaxTime (sec)	MinTime (sec)
J-1	25.07	-7.01	4.551	245.933	-68.781	15.61770	12.58735
J-2	25.60	-4.91	2.153	251.160	-48.162	15.58430	12.32096
J-3	24.61	-5.00	2.020	241.456	-49.029	15.65090	12.38756
J-4	23.70	-5.15	1.843	232.544	-50.551	15.73970	12.36536
J-5	23.11	-5.20	1.709	226.670	-51.845	15.82850	12.27656
J-6	22.17	-6.02	1.621	217.530	-59.035	15.89510	12.20996
J-7	20.23	-7.88	1.621	198.438	-77.314	15.96170	12.09896
J-8	20.16	-7.90	1.376	197.764	-77.527	16.09489	12.01016
J-9	20.45	-7.58	1.088	200.652	-74.379	16.20589	11.89916
J-10	19.88	-7.37	0.755	195.023	-72.298	16.42789	11.67717
O-Pump-1	32.58	-0.29	0.977	319.654	-2.872	15.49550	12.60955
R-1	2.10	2.10	0.000	20.601	20.601	0.02220	0.02220
O-Pump-1	1.00	1.00	0.000	9.808	9.808	0.02220	0.02220



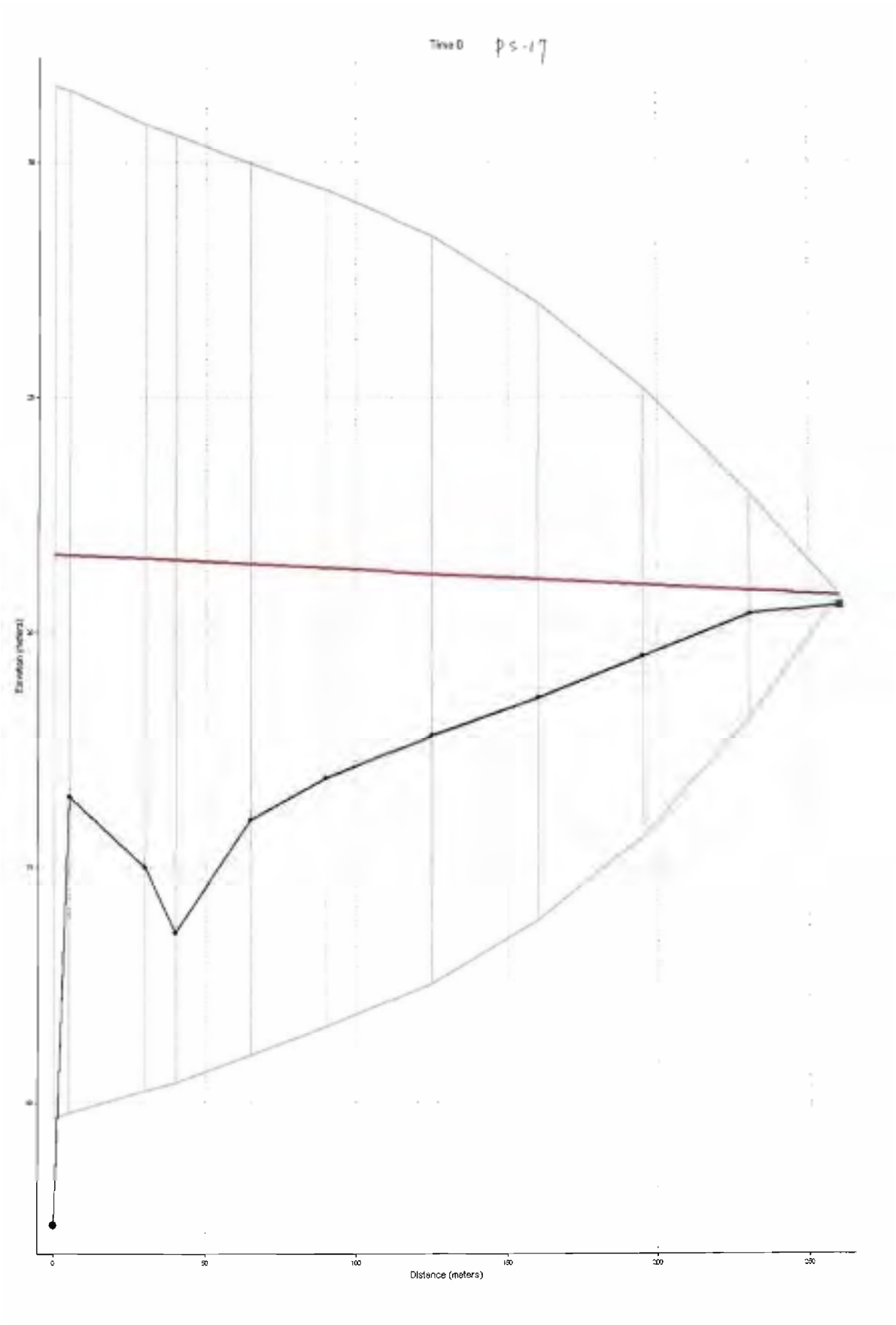
pole no need flywheel

SUMMARY OF MAX/MIN LINE PRESSURES:

YEART NODE	END NODE	MAX PRESS. psi or kPa	MIN PRESS. psi or kPa	Steady Pressure at end nodes		MaxPsDrop at end nodes		LowestPsHead at end nodes		
0-Pump-1	J-1	319.65	-68.70	155.84	129.66	190.71	190.44	-2.87	-69.05	
J-2	J-3	251.17	-49.60	149.89	148.54	190.05	197.57	-40.16	-49.51	
J-1	J-2	251.17	-68.78	129.66	149.88	190.44	190.35	-68.78	-68.55	
J-4	J-5	232.56	-51.84	145.89	143.20	196.46	195.04	-50.55	-53.24	
J-3	J-4	241.46	-58.55	148.54	145.89	197.57	196.46	-49.03	-51.68	
J-6	J-7	217.53	-77.31	134.65	115.75	193.08	192.06	-59.04	-78.13	
J-5	J-6	226.67	-59.84	143.20	134.65	195.04	193.08	-51.84	-60.20	
J-8	J-9	208.65	-77.53	113.27	113.96	190.00	188.34	-77.53	-76.08	
J-7	J-8	198.44	-77.53	115.75	113.27	193.06	190.00	-77.31	-79.79	
J-10	R-1	199.03	-72.30	103.57	28.60	175.87	0.00	-72.30	-155.27	Cavitation Potential
J-9	J-10	208.65	-74.38	113.96	103.57	188.34	175.87	-74.38	-84.77	

***** END OF THIS SIMULATION *****

RUN WAS AT TIME 11:48:39


Time 0
PS-17
Elevation (meters)
0
50
100
150
200
250
Distance (meters)

pa17 no need flywheel (1500rpm)

SUMMARY OF MAXIMUM AND MINIMUM HEADS:

Position no.	MaxHead (m)	MinHead (m)	Time Reverse Grad.	MaxPressure (kPa)	MinPressure (kPa)	MaxTime (sec)	MinTime (sec)
J-1	15.03	-6.72	102.702	147.463	-65.955	16.05050	12.58735
J-2	15.81	-4.75	81.166	155.076	-46.597	16.11709	12.52075
J-3	16.98	-3.18	40.848	166.586	-31.168	16.13929	12.49855
J-4	13.96	-5.00	85.851	136.967	-49.020	16.20589	12.43195
J-5	12.52	-5.31	91.446	122.869	-52.049	16.27249	11.07778
J-6	10.63	-5.26	92.955	104.328	-51.553	18.98085	10.98898
J-7	8.41	-4.73	90.713	82.548	-46.414	18.89205	10.90018
J-8	5.70	-3.85	92.089	55.906	-37.726	18.80325	10.81138
J-9	2.56	-2.24	104.633	25.159	-22.021	16.05050	10.72258
O-Pump-1	24.22	2.27	0.000	237.607	22.273	16.02830	12.60955
R-1	0.20	0.20	0.000	1.962	1.962	0.02220	0.02220
O-Pump-1	1.60	1.60	0.000	15.695	15.695	0.02220	0.02220

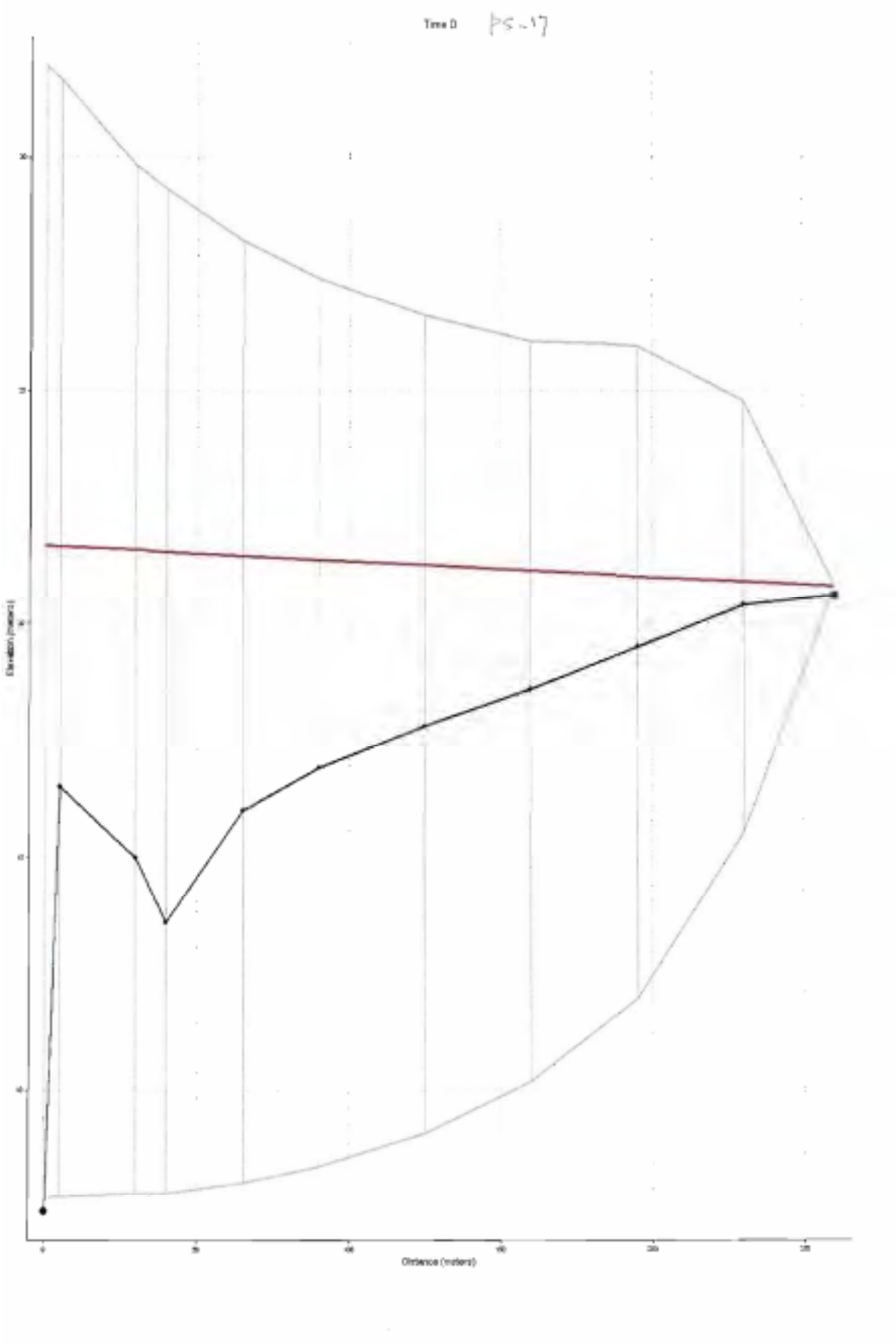
ps17 no need flywheel (1500rpm)

SUMMARY OF MAX/MIN LINE PRESSURES:

START NODE	END NODE	MAX PRESS. psi or kPa	MIN PRESS. psi or kPa	Steady Press. at end nodes		MaxPrDrop at end nodes		Lowestpress at end nodes	
0=Pump-1	J-1	237.61	-65.35	140.16	50.72	117.89	116.68	22.27	-67.17
J-1	J-2	155.08	-65.95	50.72	64.60	116.68	111.20	-65.95	-52.08
J-2	J-3	166.59	-46.60	64.60	78.00	111.20	109.17	-46.60	-33.20
J-3	J-4	166.59	-49.02	78.00	53.62	109.17	102.64	-31.17	-55.56
J-4	J-5	136.97	-52.05	53.62	43.95	102.64	96.00	-49.02	-58.69
J-5	J-6	122.87	-52.05	43.95	33.95	96.00	85.50	-52.05	-62.05
J-6	J-7	104.33	-51.55	33.95	24.93	85.50	71.34	-51.55	-60.57
J-7	J-8	82.55	-46.41	24.93	14.93	71.34	52.66	-46.41	-56.41
J-8	J-9	55.91	-37.73	14.93	4.93	52.66	26.95	-37.73	-47.73
J-9	R-1	25.16	-22.02	4.93	1.96	26.95	0.00	-22.02	-24.99

***** END OF THIS SIMULATION *****

END RUN AT TIME 11:52:40

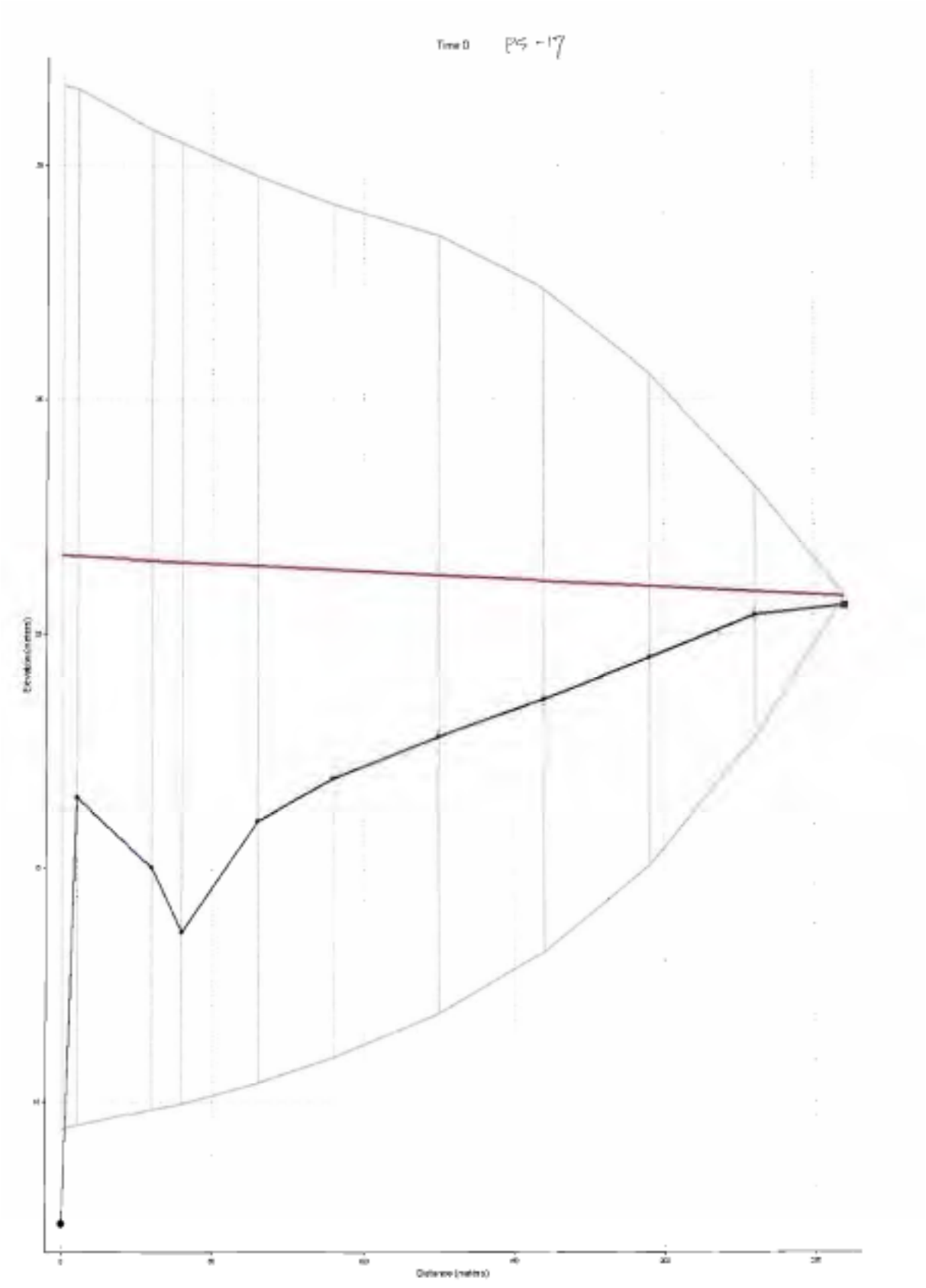

Time 0
PS-17
Distance (meters)

ps17 without flywheel (1000rpm)

SUMMARY OF MAXIMUM AND MINIMUM HEADS:

Position no.	MaxHead (m)	MinHead (m)	Time Reverse Grad.	MaxPressure (kPa)	MinPressure (kPa)	MaxTime (sec)	MinTime (sec)
J-1	15.18	-0.79	58.987	148.927	-86.190	15.47330	11.29977
J-2	14.82	-7.22	34.809	145.356	-70.858	15.53990	11.23317
J-3	15.73	-5.80	9.812	154.351	-56.914	15.58430	11.21097
J-4	12.22	-7.98	40.893	119.871	-78.260	15.65090	11.14438
J-5	10.50	-8.53	48.375	102.992	-83.650	15.71750	11.07778
J-6	8.80	-8.73	74.506	86.321	-85.631	15.80630	10.98898
J-7	7.44	-8.43	81.854	72.970	-82.709	15.89510	10.90018
J-8	6.46	-7.52	91.224	63.358	-73.739	72.66305	10.81138
J-9	4.39	-4.87	114.846	43.047	-47.794	18.71445	10.72258
O-Pump-1	24.56	0.30	0.000	240.949	2.910	15.47330	11.32197
R-1	0.20	0.20	0.000	1.962	1.962	0.02220	0.02220
O-Pump-1	1.60	1.60	0.000	15.695	15.695	0.02220	0.02220

KYPIPE

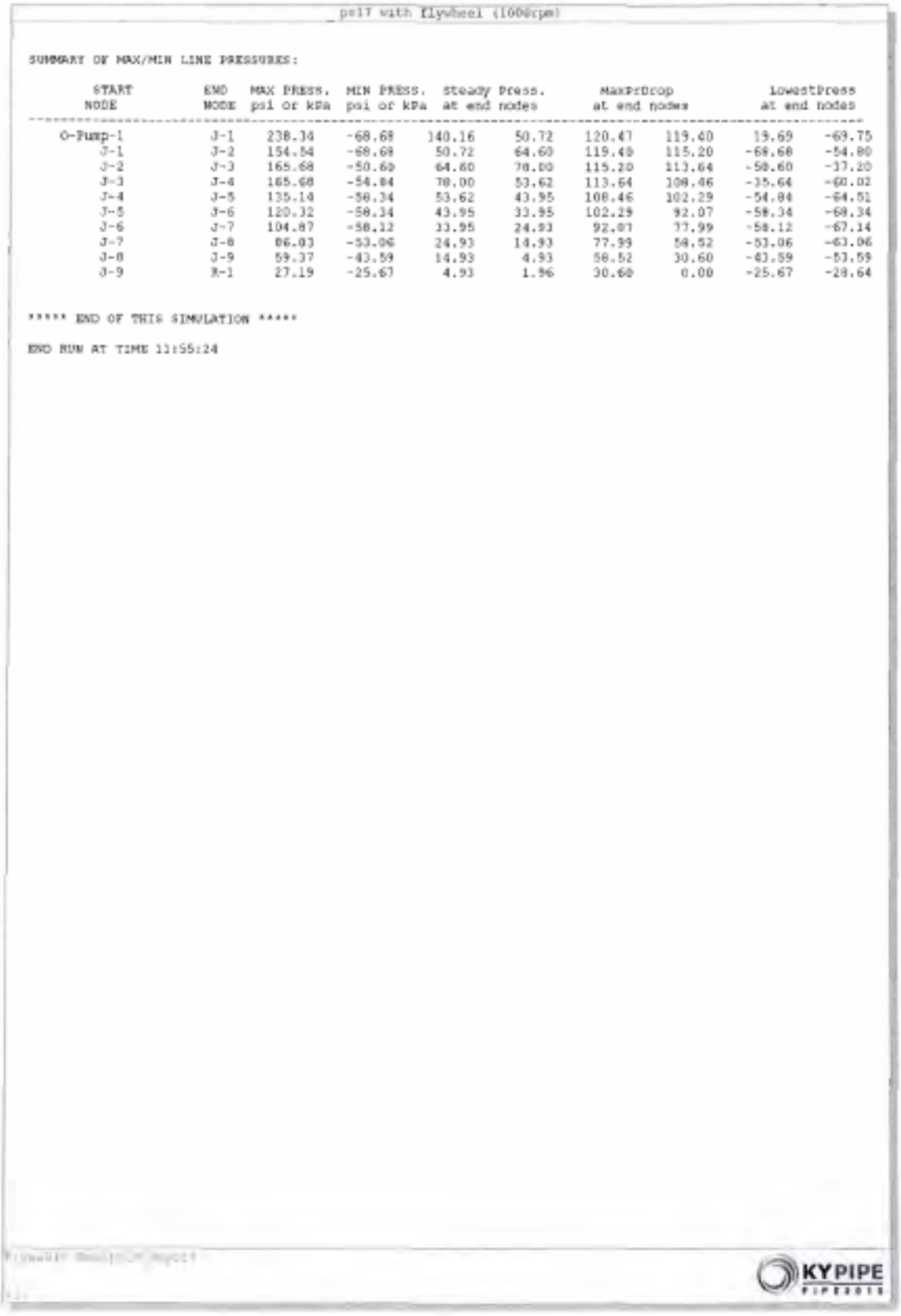

Time 0
PS -17

ps17 with flywheel (1000rpm)

SUMMARY OF MAXIMUN AND MINIMUN HEADS:

Position no.	MaxHead (m)	MinHead (m)	Time Reverse Grad.	MaxPressure (kPa)	MinPressure (kPa)	MaxTime (sec)	MinTime (sec)
J-1	15.12	-7.00	105.699	148.298	-68.680	15.87290	11.29977
J-2	15.75	-5.16	69.866	154.543	-50.600	15.93950	11.23317
J-3	16.89	-3.63	30.613	165.677	-35.643	15.96170	11.21097
J-4	13.78	-5.59	84.119	135.141	-54.842	16.02830	11.14438
J-5	12.26	-5.95	88.826	120.315	-58.338	16.09489	11.07778
J-6	10.69	-5.92	85.451	104.875	-58.119	24.30876	10.98898
J-7	8.77	-5.41	79.879	86.032	-53.062	18.89205	10.90018
J-8	6.05	-4.44	85.962	59.369	-43.586	18.80325	10.81138
J-9	2.77	-2.62	107.963	27.192	-25.675	16.05050	10.72258
O-Pump-1	24.30	2.01	0.000	238.336	19.690	15.85070	11.32197
R-1	0.20	0.20	0.000	1.962	1.962	0.02220	0.02220
O-Pump-1	1.60	1.60	0.000	15.695	15.695	0.02220	0.02220

KYPIPE PIPE2018



psi7 with flywheel (1000rpm)

SUMMARY OF MAX/MIN LINE PRESSURES:

START NODE	END NODE	MAX PRESS. psi or kPa	MIN PRESS. psi or kPa	Steady Press. at end nodes		MaxPrDrop at end nodes		LowestPress at end nodes	
O-Pump-1	J-1	238.14	-68.68	140.16	50.72	120.47	119.40	19.69	-69.75
J-1	J-2	154.54	-68.68	50.72	64.60	119.40	115.20	-68.68	-54.80
J-2	J-3	165.68	-50.60	64.60	78.00	115.20	113.64	-50.60	-17.20
J-3	J-4	165.68	-54.84	78.00	53.62	113.64	108.46	-35.64	-60.02
J-4	J-5	135.14	-58.34	53.62	43.95	108.46	102.29	-54.84	-64.51
J-5	J-6	120.32	-58.34	43.95	33.95	102.29	92.07	-58.34	-68.34
J-6	J-7	104.87	-58.12	33.95	24.93	92.07	77.99	-58.12	-67.14
J-7	J-8	86.03	-53.06	24.93	14.93	77.99	58.52	-53.06	-63.06
J-8	J-9	59.37	-43.59	14.93	4.93	58.52	30.60	-43.59	-53.59
J-9	R-1	27.19	-25.67	4.93	1.96	30.60	0.00	-25.67	-28.64

***** END OF THIS SIMULATION *****

END RUN AT TIME 11:55:24

SECTION C3: List of Mechanical Equipment

C3.1 List of Mechanical Equipment (Pumping Stations)

Item No.	Equipment Name	Specification	kW	Q'ty		Remarks
				duty	standby	
M01	**Pumping Stations**					
M01 -01-01/02	Lifting Pump 1	Submersible Sewage Pump (Non-clog type) Dia.100 mm × 6 L/S × 14 m	5.5	1	1	With Flywheel (WR2= more than 2.0Nm^2)
M01 -01-03	Monorail Hoist Unit	Manual monorail hoist with trolley 0.5 t × 2 unit	-	1	0	With two I beams and Steel Colums Lift more than 3m
M01 -02-01/02	Lifting Pump 2	Submersible Sewage Pump (Non-clog type) Dia.100 mm × 10.8 L/S × 40 m	22	1	1	With Flywheel (WR2= more than 15Nm^2)
M01 -02-03	Monorail Hoist Unit	Manual monorail hoist with trolley 0.5 t × 1 unit, 1 t × 1 unit	-	1	0	With two I beams and Steel Colums Lift more than 3m
M01 -03-01/02	Lifting Pump 3	Submersible Sewage Pump (Non-clog type) Dia.100 mm × 31.6 L/S × 25 m	22	1	1	With Flywheel (WR2= more than 6.2Nm^2)
M01 -03-03	Monorail Hoist Unit	Manual monorail hoist with trolley 0.5 t × 1 unit, 1t × 1unit	-	1	0	With two I beams and Steel Colums Lift more than 3m
M01 -04-01/02	Lifting Pump 4	Submersible Sewage Pump (Non-clog type) Dia.200 mm × 80.0 L/S × 17 m	22	1	1	With Flywheel (WR2= more than 20Nm^2)
M01 -04-03	Monorail Hoist Unit	Manual monorail hoist with trolley 0.5 t × 1 unit, 2 t × 1 unit	-	1	0	With two I beams and Steel Colums Lift more than 3m
M01 -05-01/04	Lifting Pump 5	Submersible Sewage Pump ((Non-clog type) Dia.200 mm × 73.3 L/S × 42 m	55	2	1	With Flywheel (WR2= more than 37Nm^2) With 1 unit stock
M01 -05-05/07	Delivery Valve	Motorized oprated sluice valve φ200 mm	0.4	2	1	With control panel
M01 -05-08	Monorail Hoist Unit	Manual monorail hoist with trolley 0.5 t × 1 unit, 2.5 t × 1 unit	-	1	0	With two I beam and Steel Colums Lift more than 3m

Item No.	Equipment Name	Specification	kW	Q'ty		Remarks
				duty	standby	
M01 -06-01/02	Lifting Pump 6	Submersible Sewage Pump ((Non-clog type) Dia.100 mm × 10.8 L/S × 17 m	5.5	1	1	
M01 -06-03	Monorail Hoist Unit	Manual monorail hoist with trolley 0.5 t × 2 units	-	1	0	With two I beams and Steel Colums Lift more than 3m
M01 -07-01/02	Lifting Pump 7	Submersible Sewage Pump (Non-clog type) Dia.100 mm × 23.3 L/S × 24 m	15	1	1	With Flywheel (WR2= more than 5Nm^2)
M01 -07-03	Monorail Hoist Unit	Manual monorail hoist with trolley 1.0 t × 1 unit	-	1	0	With one I beam and Steel Colums Lift more than 3m
M01 -08-01/02	Lifting Pump 8	Submersible Sewage Pump (Non-clog type) Dia.100 mm × 10.0 L/S × 24 m	7.5	1	1	With Flywheel (WR2= more than 4.5Nm^2)
M01 -08-03	Monorail Hoist Unit	Manual monorail hoist with trolley 0.5 t × 1 unit	-	1	0	With one I beam Lift more than 3m
M01 -09-01/04	Lifting Pump 9	Submersible Sewage Pump (Non-clog type) Dia.200 mm × 93.3 L/S × 11 m	15	2	1	With 1 unit stock
M01 -09-05	Monorail Hoist Unit	Manual monorail hoist with trolley 1.0 t	-	1	0	With one I beam and Steel Colums Lift more than 3m
M01 -10-01/04	Lifting Pump 10	Submersible Sewage Pump (Non-clog type) Dia.250 mm × 103.3 L/S × 42 m	75	2	1	With 20m3 closed surge tank and necessary two compressors,With 1 unit stock
M01 -10-05/07	Delivery Valve	Motorized oprated sluice valve φ200 mm	0.4	2	1	With control panel
M01 -10-08	Monorail Hoist Unit	Manual monorail hoist with trolley 0.5 t × 1 unit, 2.5 t × 1 unit	-	1	0	With I two beams and Steel Colums Lift more than 3m

Item No.	Equipment Name	Specification	kW	Q'ty		Remarks
				duty	standby	
M01 -11-01/02	Lifting Pump 11	Submersible Sewage Pump (Non-clog type) Dia.200 mm × 43.3 L/S × 31 m	37	1	1	
M01 -11-03	Monorail Hoist Unit	Manual monorail hoist with trolley 0.5 t × 1 unit, 1.5 t × 1 unit	-	1	0	With two I beams and Steel Colums Lift more than 3m
M01 -12-01/04	Lifting Pump 12	Submersible Sewage Pump (Non-clog type) Dia.200 mm × 58.3 L/S × 33 m	45	2	1	With Flywheel (WR2= more than 45Nm^2) With 1 unit stock
M01 -12-05	Monorail Hoist Unit	Manual monorail hoist with trolley 2.5 t	-	1	0	With one I beam and Steel Colums Lift more than 3m
M01 -13-01/02	Lifting Pump 13	Submersible Sewage Pump (Non-clog type) Dia.100 mm × 6 L/S × 20 m	5.5	1	1	
M01 -13-03	Monorail Hoist Unit	Manual monorail hoist with trolley 0.5 t × 2 units	-	1	0	With two I beams and Steel Colums Lift more than 3m
M01 -14-01/02	Lifting Pump 14	Submersible Sewage Pump (Non-clog type) Dia.100 mm × 7.5 L/S × 24 m	7.5	1	1	
M01 -14-03	Monorail Hoist Unit	Manual monorail hoist with trolley 0.5 t × 2 units	-	1	0	With two I beams and Steel Colums Lift more than 3m
M01 -15-01/02	Lifting Pump 15	Submersible Sewage Pump (Non-clog type) Dia.100 mm × 12.5 L/S × 43 m	22	1	1	With Flywheel (WR2= more than 25Nm^2)
M01 -15-03	Monorail Hoist Unit	Manual monorail hoist with trolley 0.5 t × 1 unit, 1.0 t × 1 unit	-	1	0	With two I beams and Steel Colums Lift more than 3m

Item No.	Equipment Name	Specification	kW	Q'ty		Remarks
				duty	standby	
M01 -16-01/02	Lifting Pump 16	Submersible Sewage Pump (Non-clog type) Dia.100 mm × 25 L/S × 21 m	11	1	1	
M01 -16-03	Monorail Hoist Unit	Manual monorail hoist with trolley 0.5 t × 2 units	-	1	0	With two I beams and Steel Colums Lift more than 3m
M01 -17-01/04	Lifting Pump 17	Submersible Sewage Pump (Non-clog type) Dia.350 mm × 208.3 L/S × 15 m	55	2	1	With Flywheel in case of 1000rpm WR2= more than 50Nm^2, Without Flywheel in case of 1500rpm, with 1 unit stock
M01 -17-05/07	Delivery Valve	Motorized oprated sluice valve φ300 mm	0.4	2	1	With control panel
M01 -17-08	Monorail Hoist Unit	Manual monorail hoist with trolley 0.5 t × 1 unit, 2.5 t × 1 unit	-	1	0	With two I beams and Steel Colums Lift more than 3m

C3.2 List of Mechanical Equipment (STP)

Item No.	Equipment Name	Specification	kW	Q'ty		Remarks
				duty	standby	
M02	**Grit Chamber Facility**					
M02 -01-01/02	Grit Chamber Inlet Gate	Manual Operated Cast Iron Gate W 500 mm × H 750 mm	0	2	0	Design depth 2,450mm (Bottom to floor)
M02 -02-01/02	Medium Screen	Automatic Drum Screen Dia. 1400 mm, openings 20 mm, with Container	2.2	2	0	Water channel depth 1,900mm
M02 -03-01/02	Grit Collector	Vorte× type Dia. 1600mm With Pressure Nozzles	0.75	2	0	Water channel depth 2,200mm Sand Pit bottom depth 2,000mm
M02 -04-01/02	Grit Pump	Centrifugal Sludge Pump (Non-clog type) Dia.80 mm × 0.5 m^3/ min × 7 m	2.2	2	0	
M02 -05-01/02	Sump Drain Pump	Non-clog Submersible Sludge Pump Dia.80 mm × 0.3 m^3/min × 6 m	1.5	1	1	
M02 -06	Grit Separator	Screw Conveyor Type (Compact type) 0.5m^3/ min	0.75	1	0	Grit Container with caster (0.5m^3/ unit × 4 units)
M02 -07	Oil skimmer	Dia.200 mm × 4200 mmL	0	1	0	Carbon steel with corrosion resistant paint.
M02 -08-01/02	Oil Discharge Pump	Submersible Sludge Pump Dia.65 mm × 0.2 m^3/min × 6 m	0.75	1	1	
M02 -09	Scum Screen	Automatic Drum type (Wedge Wire) 0.5m^3/ min, Openings : Less than 2 mm, with Container	0.4	1	0	
M02 -010	Screenings Conveyer	Screw conveyor, shaft less type Dia.200 mm × L5.5 m	2.2	1	0	Screenings Container with caster (0.5 m^3/ unit × 4 units)
M02 -11-01/02	Coarse Screen	Manually Bar Screen W 1,600 mm × H 1,900 mm, Bar openings 100 mm, with Container	0	2	0	Screenings Container with Caster (0.1m^3/ unit × 2 units)
M02 -12	Bypass Gate	Manual Operated Cast Iron Gate W 500 mm × H 500 mm	0	1	0	Design depth 2,450mm (Bottom to floor)
M02 -13	Grit Chamber Outlet Weir	Fi×ed Weir Plate (FRP) W 1.5 m	0	1	0	
M03	**Distribution Chamber Facility**					
M03 -01-01/04	Distribution Weir	Manual Operated Cast Iron Adjustable Weir W 800 mm × Stroke 400 mm	0	4	0	Design depth 1,300mm (Bottom to floor)

Item No.	Equipment Name	Specification	kW	Q'ty		Remarks
				duty	standby	
M04	**O×idation Ditch Facility**					
M04 -01-01/03	Air Diffuser	Super fine bubble, Membrane type air diffuser, whole aeration system Air : approx. 42 m^3/ min/ tank	0	3	0	Water depth 6.0 m
M04 -02-01/12	Reactor Tank Mixer	Submersible propeller type mixer Propeller dia.approx. 2.4 m	approx. 2.3	12	0	Water depth 6.0 m
M04 -03-01/03	Outlet Gate	Manual Operated Cast Iron Gate W 500 mm × H 500mm	0	3	0	Design depth 4,100mm (Bottom to floor)
M04 -04-01	Isolation Gate	Manual Operated Cast Iron Gate W 500 mm × H 500mm	0	1	0	Design depth 4,100mm (Bottom to floor)
M04 -05-01/06	Aeration Blower	Rotary piston (roots) type blower (Air cooling) Dia.200mm × 42 m^3/min × 70 kPa	75	3	2	
M04 -06-01/02	Hoist Block for Blower	Manual Operated Geared Trolly Chain Block 2.0 Ton, Lift= 5 m	0	2	0	
M04 -07-01/02	Air Supply Valve	Motorized butterfly valve with control panel Dia. 300mm	0.2	2	1	2 units are motorized and 1 unit is manual, 1 unit will be motorized in the future
M04 -08-01/06	Waste Sludge Pump	Submersible Sewage Pump (Non-clog type) Dia. 100mm × 1.1 m^3/min × 14 m	5.5	3	3	With one unit stock
M05	**Clarifier Facility**					
M05 -01-01/03	Clarifier	Center Driven Colum type Dia. 25 m × WH 3.5 m	0.75	3	0	
M05 -02-01/06	Return Sludge Pump	Centrifugal Pump (Screw type) Dia.150 mm × 3.2 m^3/min × 9 m	11	3	3	
M05 -03-01/02	Hoist Block for Sludge Pump	Manual Operated Geared Trolly Chain Block 1.0Ton, Lift=5 m	0	2	0	
M05 -04-01/04	Sump Drain Pump	Non-clog Submersible Sludge Pump Dia.80 mm × 0.3 m^3/ min × 6 m	1.5	2	2	
M05 -05-01/04	Scum Pump	Submersible Sludge Pump Dia.80 mm × 0.5 m^3/ min × 14 m	3.7	2	2	

Item No.	Equipment Name	Specification	kW	Q'ty		Remarks
				duty	standby	
M06	**Utility & Disinfection Facility**					
M06 -01	Chlorine Solution Tank	Cylindrical Tank $7m^3$ (effective more than 4.6 m^3)	1.5	1	0	with Agitator
M06 -02-01	Chlorine Solution Storage Tank	Cylindrical tank, polyethylene 0.1 m^3	0	1	0	
M06 -03-01/02	Chlorine Solution Dosing Charger	Manual flow control and gravity flow type Measuring range : 0 - 0.26 m^3/ hr, PVC	0	1	1	Manually Control
M06 -04	Utility TE Water Supply Unit	Submersible two pumps with pressure tank Dia. 50 mm × 0.6m^3/ min × 42 m	7.4	1	0	With Control Panel
M06 -05-01/04	Auto Strainer	Automatic Washing System 0.6 m^3/ min × mesh.0.4 mm	0.1	2	2	With Control Panel
M06 -06-01/02	Defoaming Pump	Submersible Turbine Pump 0.6 m^3/ min × 29 m	3.7	1	1	
M06 -07-01/02	Ultra Violet Disinfection Unit	Low Pressure High Intensity Type Daily Average Flow 9,200 m^3/day/unit, Hourly Ma×imum 18,400 m^3/day/unit	15	2	0	With Control Panel
M06 -08-01/03	Disinfection Inlet Gate	Manual Operated Cast Iron Gate W 400 mm × H 600 mm	0	2	1	Design depth 1,800mm (Bottom to floor)
M06 -09	Hoist Block for UV Unit	Manual Operated Geared Trolly Chain Block 0.5 Ton, Lift= 5 m	0	1	0	
M06 -10	Hoist Block for Utility Pump	Manual Operated Geared Trolly Chain Block 0.5 Ton, Lift= 5 m	0	1	0	
M06 -11	Disinfection Outlet Weir	Fi×ed Weir Plate (FRP) W 1.5 m	0	1	0	

Item No.	Equipment Name	Specification	kW	Q'ty		Remarks
				duty	standby	
M07	**Sludge Treatment Facility**					
M07 -01-01/02	Sludge Dewatering Unit	Multi-Diskplate Screw Press 180 kg-ds/ hr	approx. 6	1	1	With Control Panel
M07 -02	Sludge Cake Conveyor	Shaftless Screw Conveyor Dia. 400 mm × L 10 m	5.5	1	0	
M07 -03	Sludge Cake Hopper	Motor Driven Cutgate Type 15 m^3	4.4	1	0	
M07 -04-01/02	Polymer Dissolving Tank	Cylindrical Steel Tank 17 m^3	11	1	1	With Agitator
M07 -05-01/02	Polymer Feeder	Constant Chemical Feeder 2.3 kg/ min	0.4	1	1	
M07 -06-01/02	Polymer Feed Pump for Dewatering	Progress Cavity Pump 0.7-2.0 m3/hr × 20m	1.5	1	1	
M07 -07-01/02	Air Compressor	Pressure-switch Type 400 NL/ min × 0.83 Mpa	3.7	1	1	With Control Panel
M07 -08-01/02	Air Dryer	Refrigerating type 400 NL/ min	0.2	1	1	
M07 -09	Hoist Block for Dewatering Unit	Manual Operated Geared Trolly Chain Block 2.0 Ton, Lift=5 m	0	2	0	
M07 -10	Hoist Block for Sludge Treatme Building	Manual Operated Geared Trolly Chain Block 2.0 Ton, Lift=5 m	2.8 0.4	2	0	one unit manual and one unit motorized
M07 -11-01/02	Sump Drain Pump	Non-clog Submersible Sludge Pump Dia.80 mm × 0.3 m^3/min × 6 m	1.5	1	1	
M07 -12-01/02	Waste Water Mixer	Submersible Mixer	1.5	1	0	With one unit stock
M07 -13-01/02	Waste Water Pump	Submersible Sludge Pump Dia.100 mm × 2.0 m^3/min × 14 m	11	1	1	
M07 -14	Biological Odor Control	40 m^3/ min	0	1	0	With Control Panel
M07 -15-01/02	Deodorization Fan	Turbo fan 40 m^3/ min	5.5	1	1	
M07 -16	Utility Potable Water Supply Unit	Submersible two pumps with pressure tank Dia. 50 mm × 0.45 m^3/ min × 25 m	4.4	1	0	With Control Panel
M07 -17	Hoist Block for Utility Pump	Manual Operated Geared Trolly Chain Block 0.5 Ton, Lift=5 m	0	1	0	