ATTACHMENT 7-VII

LEACHATE SYSTEM CALCULATIONS

Weaver Consultants Group	PROJECT	Ottawa County Farms Landfill Expansion			Project Number
	SUBJECT	Leachate Collection System			0120-685-11-03
	Designed By	Date	Checked By	Date	Sheet No.
	Katie Kinley	4/26/2016	TAP	4/27/2016	1 of 18
Objective:	Use the leachate generated per acre from the HELP Model and site information to find projected leachate generation, and size pumps, sumps, and tanks.				
References:	HELP Model data, site leachate generation data				

Step 1: Summarize Help Model results and site information to be used.

Leachate Generated

OPERATIONAL ANNUAL LEACHATE VOLUMES GENERATED

Phase	**Acres**	**Average GPY**	
Phase 1	14.66	887,284	
Phase 2	8.60	1,552,758	
Phase 3	17.61	1,320,028	
Phase 4	13.76	1,435,404	(with Cells C, D, & E)
Phase 5	11.06	4,982,270	
Phase 6	11.05	5,372,582	
Phase 7	11.05	2,641,811	
Phase 8	15.03	--	(not constructed)
Cell A/B	41.63	2,450,957	
Gas Wells	--	8,234,008	
TOTAL		**28,877,103**	

The current average leachate generation is ~28,877,103 GPY for the currently constructed 176 acres.

With the addition of the vertical expansion overliner, leachate generation is expected to simultaneously increase on the overliner and decrease under the overliner. Therefore, total future leachate generation was estimated based on a percent increase by finding the current average GPY per constructed acre, and multiplying by the future total acreage of 242.32 ac.

Current Waste Footprint	176.00	acres
Future Waste Footprint	242.84	acres
Increase in Leachate Based on Area	37.98	%
Estimated Future Leachate Generation	39,844,971	gallons per year
Current Tank Volume	300,000	gallons
Current Secondary containment volume	320,000	gallons including base of tank
Tank size needed based on area increase	109,164	gallons per day of capacity

Conclusion: Annual leachate volumes will increase with the expansion. An additional tank with additional secondary containment will be constructed when necessary. Other options for leachate management may include direct discharge to a sanitary sewer if made available in the future.

Weaver Consultants Group	PROJECT	Ottawa County Farms Landfill Expansion			Project Number
	SUBJECT	Leachate Collection System			0120-685-11-03
	Designed By	Date	Checked By	Date	Sheet No.
	Katie Kinley	4/26/2016	TAP	4/27/2016	2 of 18

Objective:	Use the leachate generated per acre from the HELP Model and site information to find projected leachate generation, and size pumps, sumps, and tanks.
References:	HELP Model data, site leachate generation data

Step 1 (continued): Summarize Help Model results and site information to be used.

PROJECTED ANNUAL LEACHATE GENERATION BASED ON HELP MODEL

Phase	Acres	Year 0-1	Years 2-6	Years 7-16	Years 17-46
Phase 8	15.03	6,959,346	5,685,995	4,255,875	15
Phase 9	11.09	5,136,715	4,196,851	3,141,275	11
Phase 10	7.13	3,302,505	2,698,246	2,019,593	7
Phase 11	11.73	5,433,153	4,439,050	3,322,557	12
Phase 12	10.25	4,747,640	3,878,965	2,903,342	10
Phase 13	11.07	5,127,451	4,189,282	3,135,610	11
Phase 14	6.66	2,961,176	2,519,838	1,884,866	7
Phase 15A	26.71	11,875,828	10,105,838	7,559,277	29
Phase 15B	9.33	4,148,314	3,530,044	2,640,511	10
Phase 16A	20.3	9,025,807	7,680,588	5,745,163	22
Phase 16B	9.22	4,099,406	3,488,425	2,609,380	10

Note: 1. Years 2-6 volumes and operational averages are used for sizing calcs.
2. Phases 14, 15A, and 16A drain to the north overliner sumps. Phases 15B and 16B drain south.

Step 2: Confirm pumps in sumps are adequately sized.

Sump Pump Sizing

A. Head Loss Computed using Hazen Formula

c= 140 for HDPE

Pump Number	Pipe Diam. inches	Pipe Length feet	Begin Elev feet	End Elev feet	Total Flow gpm	Dynamic Head ft	Static Head ft	Total Head ft	Design Velocity ft/sec	Pressure at Pump psi
Phase 8	2.095	185	680	626	50	7.93	54	61.93	4.65	26.83
Phase 9A	2.095	130	652	612	50	5.57	40	45.57	4.65	19.75
Phase 9B	2.095	180	670	612	50	7.71	58	65.71	4.65	28.47
Phase 10	2.095	130	652	610	50	5.57	42	47.57	4.65	20.61
Phase 11	2.095	200	662	596	50	8.57	66	74.57	4.65	32.31
Phase 12	2.095	210	662	596	50	9.00	66	75.00	4.65	32.50
Phase 13	2.095	210	660	594	50	9.00	66	75.00	4.65	32.50
Phase 14	2.095	65	730	710	50	2.78	20	22.78	4.65	9.87
Phase 15	2.095	85	730	706	75	7.72	24	31.72	6.98	13.74
Phase 16	2.095	65	730	712	75	5.90	18	23.90	6.98	10.36

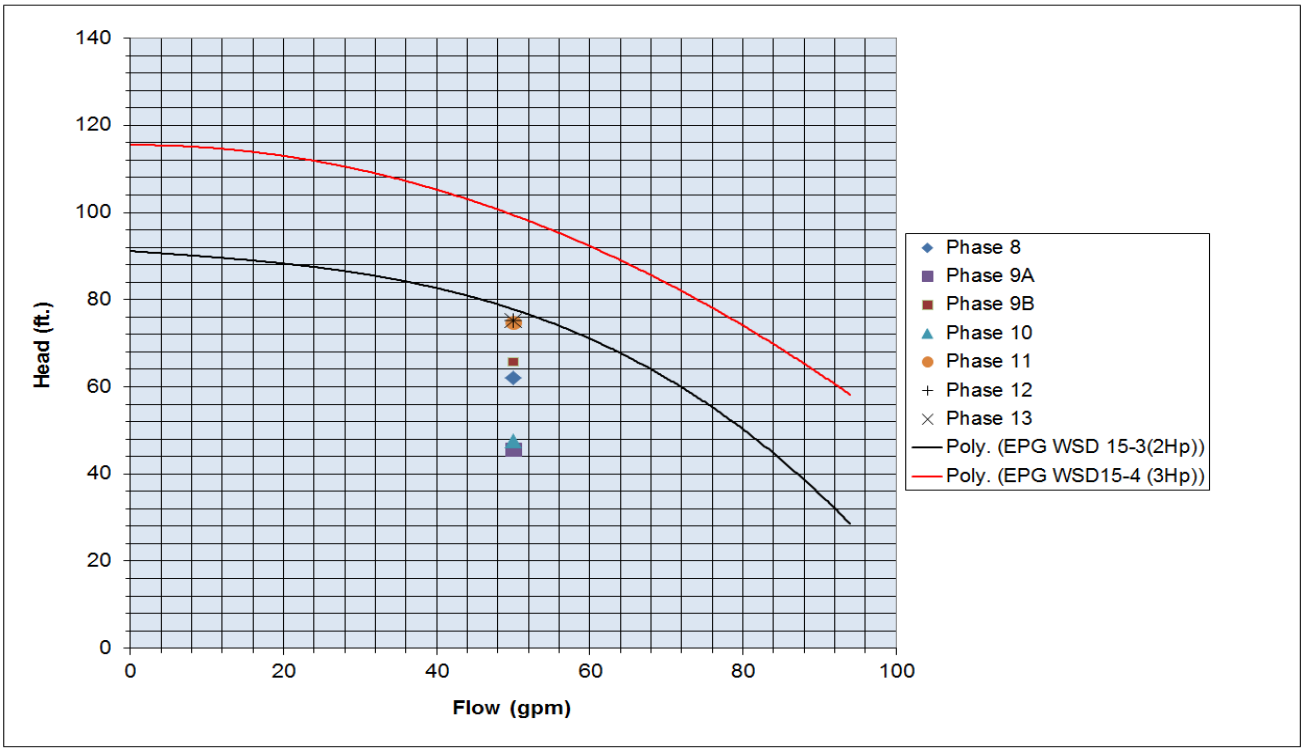
Notes: 1. Pump type is to be EPG 2HP or approved equivalent at sumps, except at Phases 14 & 15, where pumps capable of 75 gpm will be used.
2. Phase 9A is the Easterly sump in Phase 9 and will be the primary sump for Phase 9. Phase 9B is the Westerly sump in Phase 9 and will serve a portion of Phase 9, and the conveyed leachate from Phases 1 and 2.
3. Calculation results are shaded, input values are not.

Objective:	Use the leachate generated per acre from the HELP Model and site information to find projected leachate generation, and size pumps, sumps, and tanks.
References:	HELP Model data, site leachate generation data

Step 2 (continued): Confirm pumps in sumps are adequately sized.

Figure 1: Pump Curve for EPG 2HP

B. Head Loss Versus Flow



Conclusion: Each sump has a projected head loss underneath the EPG 2HP pump curve when operated at 50 gpm. Therefore, the EPG 2HP pump evaluated is projected to have adequate capacity to overcome head losses and will maintain velocities over 3 ft/s in order to prevent pipe clogging.

Weaver Consultants Group	PROJECT Ottawa County Farms Landfill Expansion				Project Number
	SUBJECT Leachate Collection System				0120-685-11-03
	Designed By Katie Kinley	Date 4/26/2016	Checked By TAP	Date 4/27/2016	Sheet No. 4 of 18

Objective:	Use the leachate generated per acre from the HELP Model and site information to find projected leachate generation, and size pumps, sumps, and tanks.
References:	HELP Model data, site leachate generation data

Step 3: Confirm pumps in lift stations are adequately sized.

Lift Station Pump Sizing

A. Head Loss Comptuted using Hazen Formula

c= 140 for HDPE

Pump Number	Pipe Diam. inches	Pipe Length[4] feet	Eq. Length Adjust	Eq. Pipe Length feet	Begin Elev feet	End Elev feet	Total Flow gpm	Dynamic Head ft	Static Head ft	Total Head ft	Design Velocity ft/sec	Pressure at Pump psi
South LS	6	7500	100	7600	680	656	325	62.34	24	86.34	3.69	37.42
North LS	6	3000	100	3100	680	654	325	25.43	26	51.43	3.69	22.29

Notes:

1. Pump type is to be Flygt NP 3153 HT 3-462 or approved equivalent.
2. South Lift Station is currently in place. North Lift Station to be constructed with Phase 9.
3. Calculation results are shaded, input values are not.
4. An equivalent pipe length of 100' is added to both calculations in order to add head loss for pipe fittings. As shown in Figure 1 below, this is equivalent to 4 Regular Elbows, 12 Line Flow Tees, and 4 Gate Valves.

Figure 1: Equivalent Pipe Lengths Chart

Equivalent Length of Straight Pipe for Valves and Fittings (feet)

Flanged Fittings		Pipe Size												
		1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	5	6	8	10
Elbows	Regular 90 deg	0.9	1.2	1.6	2.1	2.4	3.1	3.6	4.4	5.9	7.3	8.9	12	14
	Long radius 90 deg	1.1	1.3	1.6	2.0	2.3	2.7	2.9	3.4	4.2	5	5.7	7	8
	Regular 45 deg	0.5	0.6	0.8	1.1	1.3	1.7	2.0	2.6	3.5	4.5	5.6	7.7	9
Tees	Line flow	0.7	0.8	1.0	1.3	1.5	1.8	1.9	2.2	2.8	3.3	3.8	4.7	5.2
	Branch flow	2.0	2.6	3.3	4.4	5.2	6.6	7.5	9.4	12.0	15	18	24	30
Return Bends	Regular 180 deg	0.9	1.2	1.6	2.1	2.4	3.1	3.6	4.4	5.9	7.3	8.9	12	14
	Long radius 180 deg	1.1	1.3	1.6	2.0	2.3	2.7	2.9	3.4	4.2	5	5.7	7	8
Valves	Globe	38.0	40.0	45.0	54.0	59.0	70.0	77.0	94.0	120.0	150	190	260	310
	Gate						2.6	2.7	2.8	2.9	3.1	3.2	3.2	3.2
	Angle	15.0	15.0	17.0	18.0	18.0	21.0	22.0	28.0	38.0	50	63	90	120

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Conclusion: Both Lift Stations have a projected head loss underneath the pump curve shown in the attached spec sheet when operated at 325 gpm. Therefore, the pump evaluated is projected to have adequate capacity to overcome head losses and maintain velocities over 3 ft/s in order to prevent pipe clogging.

Weaver Consultants Group	PROJECT	Ottawa County Farms Landfill Expansion			Project Number 0120-685-11-03
	SUBJECT	Sump Sizing Calculations			Scale NA
	Designed By TAP	Date 5/5/2016	Checked By	Date	Sheet No: 5 of 18

OBJECTIVE	Size the pumps in the cell sumps. Size sumps to handle the average daily flow predicted from the HELP Model.

PHASE 8

From HELP Model. Average daily flow = 0.03818 in/acre/day * (15.03 acre) *(1 ft/12 in) * (43,560 ft2/acre) / (24 hr/day) / (60 min/hr)

= 1.4466 ft^3/min 10.8218 gal/min

The sumps are sized as follows:

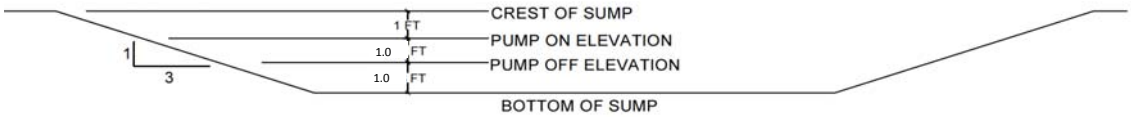
bottom dimensions:	12	width (ft)	12	length (ft)	
top dimensions:	30	width (ft)	27	length (ft)	
total sump depth:	3	ft			
pump off height:	1	ft	above bottom of sump (Figure 1)		
pump on height:	2	ft	above bottom of sump (Figure 1)		
porosity:	0.3	dimensionless			
net volume of sump:	429.3	ft^3	=	3212	gal
working volume of sump:	125.1	ft^3		936	gal
selected pumping rate:	50.0	gal/min			
Run time of pump (w/ ave inflow)	23.9	minutes	=	0.4	hr
Run time of pump (w/ no inflow)	18.7	minutes	=	0.3	hr
Time to fill sump at Average Daily Flow:	86.5	minutes	=	1.4	hr

Working volume of sump calculated as volume of leachate in sump at 2 ft. depth minus volume of leachate in sump at 1.0 ft. depth. (Volume between pump on level and pump off level)

In order to provide consistency, use same pump size for all cells. Use same model as currently in use, which is EPG WSD 15-3 (2HP).

Top of the pump is approximately 9 inches above the bottom of the sump. With a pump off level of 1.0 feet, the requirements of 6- to 12-inch minimum liquid depth above the top of the pump is met.

Figure 1. Sump schematic



Weaver Consultants Group	PROJECT	Ottawa County Farms Landfill Expansion			Project Number 0120-685-11-03
	SUBJECT	Sump Sizing Calculations			Scale NA
	Designed By TAP	Date 5/5/2016	Checked By	Date	Sheet No: 6 of 18

OBJECTIVE	Size the pumps in the cell sumps. Size sumps to handle the average daily flow predicted from the HELP Model.

PHASE 9A

From HELP Model. Average daily flow = 0.03818 in/acre/day * (5.96 acre) *(1 ft/12 in) * (43,560 ft2/acre) / (24 hr/day) / (60 min/hr)

= 0.5736 ft^3/min 4.2913 gal/min

The sumps are sized as follows:

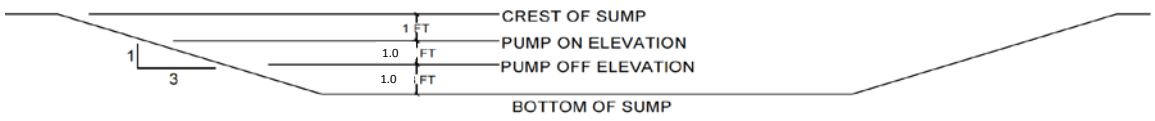
bottom dimensions:	12	width (ft)	12	length (ft)	
top dimensions:	30	width (ft)	27	length (ft)	
total sump depth:	3	ft			
pump off height:	1	ft	above bottom of sump (Figure 1)		
pump on height:	2	ft	above bottom of sump (Figure 1)		
porosity:	0.3	dimensionless			
net volume of sump:	429.3	ft^3	=	3212	gal
working volume of sump:	125.1	ft^3		936	gal
selected pumping rate:	50.0	gal/min			
Run time of pump (w/ ave inflow)	20.5	minutes	=	0.3	hr
Run time of pump (w/ no inflow)	18.7	minutes	=	0.3	hr
Time to fill sump at Average Daily Flow:	218.1	minutes	=	3.6	hr

Working volume of sump calculated as volume of leachate in sump at 2 ft. depth minus volume of leachate in sump at 1.0 ft. depth. (Volume between pump on level and pump off level)

In order to provide consistency, use same pump size for all cells. Use same model as currently in use, which is EPG WSD 15-3 (2HP).

Top of the pump is approximately 9 inches above the bottom of the sump. With a pump off level of 1.0 feet, the requirements of 6- to 12-inch minimum liquid depth above the top of the pump is met.

Figure 1. Sump schematic



Weaver Consultants Group	PROJECT	Ottawa County Farms Landfill Expansion			Project Number 0120-685-11-03
	SUBJECT	Sump Sizing Calculations			Scale NA
	Designed By TAP	Date 5/5/2016	Checked By	Date	Sheet No: 7 of 18

OBJECTIVE	Size the pumps in the cell sumps. Size sumps to handle the average daily flow predicted from the HELP Model.

PHASE 9B

From HELP Model. Average daily flow = 0.03818 in/acre/day *(5.13 acre)*(1 ft/12 in) * (43,560 ft2/acre) / (24 hr/day) / (60 min/hr)

= 0.4937 ft^3/min 8.3361 gal/min including Phase 1 and 2 inflows

The sumps are sized as follows:

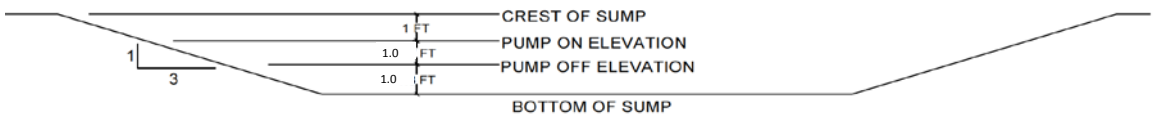
bottom dimensions:	12	width (ft)	12	length (ft)		
top dimensions:	30	width (ft)	27	length (ft)		
total sump depth:	3	ft				
pump off height:	1	ft	above bottom of sump (Figure 1)			
pump on height:	2	ft	above bottom of sump (Figure 1)			
porosity:	0.3	dimensionless				
net volume of sump:	429.3	ft^3	=	3212	gal	
working volume of sump:	125.1	ft^3		936	gal	
selected pumping rate:	50.0	gal/min				
Run time of pump (w/ ave inflow)	22.5	minutes	=	0.4	hr	
Run time of pump (w/ no inflow)	18.7	minutes	=	0.3	hr	
Time to fill sump at Average Daily Flow:	112.3	minutes	=	1.9	hr	

Working volume of sump calculated as volume of leachate in sump at 2 ft. depth minus volume of leachate in sump at 1.0 ft. depth. (Volume between pump on level and pump off level)

In order to provide consistency, use same pump size for all cells. Use same model as currently in use, which is EPG WSD 15-3 (2HP).

Top of the pump is approximately 9 inches above the bottom of the sump. With a pump off level of 1.0 feet, the requirements of 6- to 12-inch minimum liquid depth above the top of the pump is met.

Figure 1. Sump schematic



Weaver Consultants Group	PROJECT	Ottawa County Farms Landfill Expansion			Project Number 0120-685-11-03
	SUBJECT	Sump Sizing Calculations			Scale NA
	Designed By TAP	Date 5/5/2016	Checked By	Date	Sheet No: 8 of 18

OBJECTIVE	Size the pumps in the cell sumps. Size sumps to handle the average daily flow predicted from the HELP Model.

PHASE 10

From HELP Model. Average daily flow = 0.03818 in/acre/day * (7.13 acre) *(1 ft/12 in) * (43,560 ft2/acre) / (24 hr/day) / (60 min/hr)

= 0.6862 ft^3/min 5.1337 gal/min

The sumps are sized as follows:

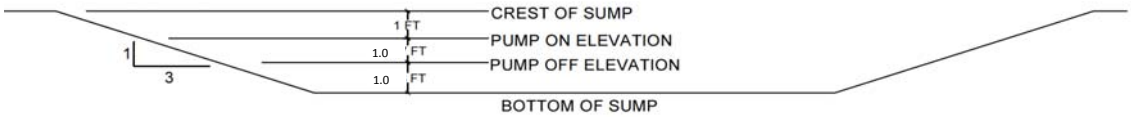
bottom dimensions:	12	width (ft)	12	length (ft)	
top dimensions:	30	width (ft)	27	length (ft)	
total sump depth:	3	ft			
pump off height:	1	ft	above bottom of sump (Figure 1)		
pump on height:	2	ft	above bottom of sump (Figure 1)		
porosity:	0.3	dimensionless			
net volume of sump:	429.3	ft^3	=	3212	gal
working volume of sump:	125.1	ft^3		936	gal
selected pumping rate:	50.0	gal/min			
Run time of pump (w/ ave inflow)	20.9	minutes	=	0.3	hr
Run time of pump (w/ no inflow)	18.7	minutes	=	0.3	hr
Time to fill sump at Average Daily Flow:	182.3	minutes	=	3.0	hr

Working volume of sump calculated as volume of leachate in sump at 2 ft. depth minus volume of leachate in sump at 1.0 ft. depth. (Volume between pump on level and pump off level)

In order to provide consistency, use same pump size for all cells. Use same model as currently in use, which is EPG WSD 15-3 (2HP).

Top of the pump is approximately 9 inches above the bottom of the sump. With a pump off level of 1.0 feet, the requirements of 6- to 12-inch minimum liquid depth above the top of the pump is met.

Figure 1. Sump schematic



Weaver Consultants Group	PROJECT	Ottawa County Farms Landfill Expansion			Project Number 0120-685-11-03
	SUBJECT	Sump Sizing Calculations			Scale NA
	Designed By TAP	Date 5/5/2016	Checked By	Date	Sheet No: 9 of 18

OBJECTIVE	Size the pumps in the cell sumps. Size sumps to handle the average daily flow predicted from the HELP Model.

PHASE 11

From HELP Model. Average daily flow = 0.03818 in/acre/day * (11.73 acre) *(1 ft/12 in) * (43,560 ft2/acre) / (24 hr/day) / (60 min/hr)

= 1.1290 ft^3/min 8.4457 gal/min

The sumps are sized as follows:

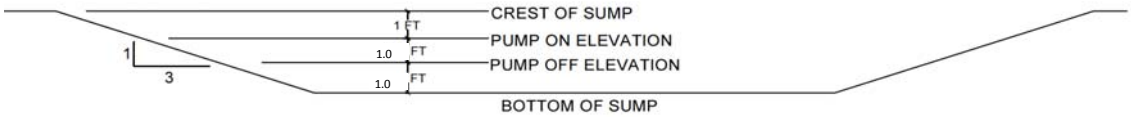
bottom dimensions:	12	width (ft)	12	length (ft)	
top dimensions:	30	width (ft)	27	length (ft)	
total sump depth:	3	ft			
pump off height:	1	ft	above bottom of sump (Figure 1)		
pump on height:	2	ft	above bottom of sump (Figure 1)		
porosity:	0.3	dimensionless			
net volume of sump:	429.3	ft^3	=	3212	gal
working volume of sump:	125.1	ft^3		936	gal
selected pumping rate:	50.0	gal/min			
Run time of pump (w/ ave inflow)	22.5	minutes	=	0.4	hr
Run time of pump (w/ no inflow)	18.7	minutes	=	0.3	hr
Time to fill sump at Average Daily Flow:	110.8	minutes	=	1.8	hr

Working volume of sump calculated as volume of leachate in sump at 2 ft. depth minus volume of leachate in sump at 1.0 ft. depth. (Volume between pump on level and pump off level)

In order to provide consistency, use same pump size for all cells. Use same model as currently in use, which is EPG WSD 15-3 (2HP).

Top of the pump is approximately 9 inches above the bottom of the sump. With a pump off level of 1.0 feet, the requirements of 6- to 12-inch minimum liquid depth above the top of the pump is met.

Figure 1. Sump schematic



Weaver Consultants Group	PROJECT	Ottawa County Farms Landfill Expansion			Project Number 0120-685-11-03
	SUBJECT	Sump Sizing Calculations			Scale NA
	Designed By TAP	Date 5/5/2016	Checked By	Date	Sheet No: 10 of 18

OBJECTIVE	Size the pumps in the cell sumps. Size sumps to handle the average daily flow predicted from the HELP Model.

PHASE 12

From HELP Model. Average daily flow = 0.03818 in/acre/day * (10.25 acre) *(1 ft/12 in) * (43,560 ft2/acre) / (24 hr/day) / (60 min/hr)

= 0.9865 ft^3/min 7.3801 gal/min

The sumps are sized as follows:

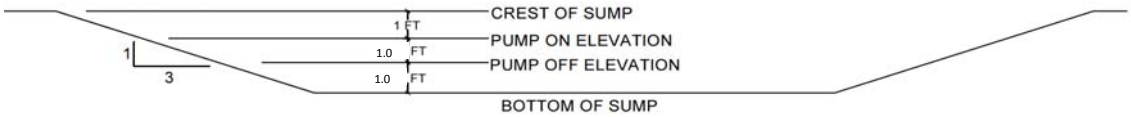
bottom dimensions:	12	width (ft)	12	length (ft)	
top dimensions:	30	width (ft)	27	length (ft)	
total sump depth:	3	ft			
pump off height:	1	ft	above bottom of sump (Figure 1)		
pump on height:	2	ft	above bottom of sump (Figure 1)		
porosity:	0.3	dimensionless			
net volume of sump:	429.3	ft^3	=	3212	gal
working volume of sump:	125.1	ft^3		936	gal
selected pumping rate:	50.0	gal/min			
Run time of pump (w/ ave inflow)	22.0	minutes	=	0.4	hr
Run time of pump (w/ no inflow)	18.7	minutes	=	0.3	hr
Time to fill sump at Average Daily Flow:	126.8	minutes	=	2.1	hr

Working volume of sump calculated as volume of leachate in sump at 2 ft. depth minus volume of leachate in sump at 1.0 ft. depth. (Volume between pump on level and pump off level)

In order to provide consistency, use same pump size for all cells. Use same model as currently in use, which is EPG WSD 15-3 (2HP).

Top of the pump is approximately 9 inches above the bottom of the sump. With a pump off level of 1.0 feet, the requirements of 6- to 12-inch minimum liquid depth above the top of the pump is met.

Figure 1. Sump schematic



Weaver Consultants Group	PROJECT	Ottawa County Farms Landfill Expansion			Project Number 0120-685-11-03
	SUBJECT	Sump Sizing Calculations			Scale NA
	Designed By TAP	Date 5/5/2016	Checked By	Date	Sheet No: 11 of 18

OBJECTIVE	Size the pumps in the cell sumps. Size sumps to handle the average daily flow predicted from the HELP Model.

PHASE 13

From HELP Model. Average daily flow = 0.03818 in/acre/day * (11.06 acre) *(1 ft/12 in) * (43,560 ft2/acre) / (24 hr/day) / (60 min/hr)

= 1.0645 ft^3/min 7.9633 gal/min

The sumps are sized as follows:

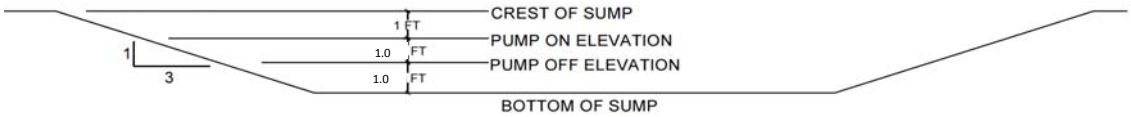
bottom dimensions:	12	width (ft)	12	length (ft)	
top dimensions:	30	width (ft)	27	length (ft)	
total sump depth:	3	ft			
pump off height:	1	ft	above bottom of sump (Figure 1)		
pump on height:	2	ft	above bottom of sump (Figure 1)		
porosity:	0.3	dimensionless			
net volume of sump:	429.3	ft^3	=	3212	gal
working volume of sump:	125.1	ft^3		936	gal
selected pumping rate:	50.0	gal/min			
Run time of pump (w/ ave inflow)	22.3	minutes	=	0.4	hr
Run time of pump (w/ no inflow)	18.7	minutes	=	0.3	hr
Time to fill sump at Average Daily Flow:	117.5	minutes	=	2.0	hr

Working volume of sump calculated as volume of leachate in sump at 2 ft. depth minus volume of leachate in sump at 1.0 ft. depth. (Volume between pump on level and pump off level)

In order to provide consistency, use same pump size for all cells. Use same model as currently in use, which is EPG WSD 15-3 (2HP).

Top of the pump is approximately 9 inches above the bottom of the sump. With a pump off level of 1.0 feet, the requirements of 6- to 12-inch minimum liquid depth above the top of the pump is met.

Figure 1. Sump schematic



Weaver Consultants Group	PROJECT	Ottawa County Farms Landfill Expansion			Project Number 0120-685-11-03
	SUBJECT	Sump Sizing Calculations			Scale NA
	Designed By TAP	Date 5/5/2016	Checked By	Date	Sheet No: 12 of 18

OBJECTIVE	Size the pumps in the cell sumps. Size sumps to handle the average daily flow predicted from the HELP Model.

PHASE 14

From HELP Model. Average daily flow = 0.03818 in/acre/day * (6.66 acre) *(1 ft/12 in) * (43,560 ft2/acre) / (24 hr/day) / (60 min/hr)

= 0.6410 ft^3/min 4.7953 gal/min

The sumps are sized as follows:

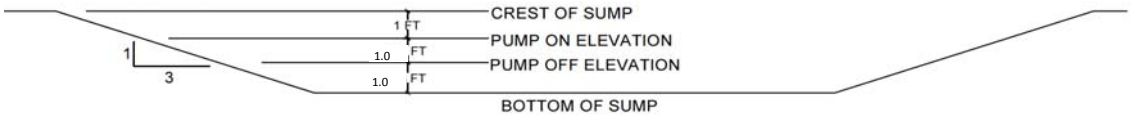
bottom dimensions:	12	width (ft)	12	length (ft)	
top dimensions:	30	width (ft)	27	length (ft)	
total sump depth:	3	ft			
pump off height:	1	ft	above bottom of sump (Figure 1)		
pump on height:	2	ft	above bottom of sump (Figure 1)		
porosity:	0.3	dimensionless			
net volume of sump:	429.3	ft^3	=	3212	gal
working volume of sump:	125.1	ft^3		936	gal
selected pumping rate:	50.0	gal/min			
Run time of pump (w/ ave inflow)	20.7	minutes	=	0.3	hr
Run time of pump (w/ no inflow)	18.7	minutes	=	0.3	hr
Time to fill sump at Average Daily Flow:	195.2	minutes	=	3.3	hr

Working volume of sump calculated as volume of leachate in sump at 2 ft. depth minus volume of leachate in sump at 1.0 ft. depth. (Volume between pump on level and pump off level)

In order to provide consistency, use same pump size for all cells. Use same model as currently in use, which is EPG WSD 15-3 (2HP).

Top of the pump is approximately 9 inches above the bottom of the sump. With a pump off level of 1.0 feet, the requirements of 6- to 12-inch minimum liquid depth above the top of the pump is met.

Figure 1. Sump schematic



Weaver Consultants Group	PROJECT	Ottawa County Farms Landfill Expansion			Project Number 0120-685-11-03
	SUBJECT	Sump Sizing Calculations			Scale NA
	Designed By TAP	Date 5/5/2016	Checked By	Date	Sheet No: 13 of 18

OBJECTIVE	Size the pumps in the cell sumps. Size sumps to handle the average daily flow predicted from the HELP Model.

Phase 15

From HELP Model. Average daily flow = 0.03817 in/acre/day * (26.71 acre) *(1 ft/12 in) * (43,560 ft2/acre) / (24 hr/day) / (60 min/hr)

= 2.5700 ft^3/min 19.2265 gal/min

The sumps are sized as follows:

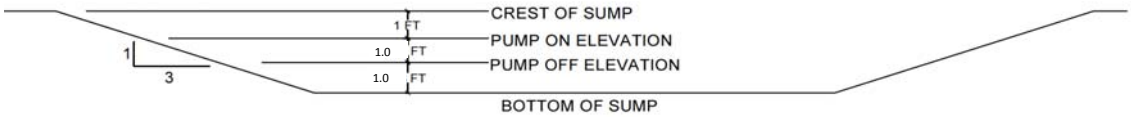
bottom dimensions:	12	width (ft)	12	length (ft)	
top dimensions:	30	width (ft)	27	length (ft)	
total sump depth:	3	ft			
pump off height:	1	ft	above bottom of sump (Figure 1)		
pump on height:	2	ft	above bottom of sump (Figure 1)		
porosity:	0.3	dimensionless			
net volume of sump:	429.3	ft^3	=	3212	gal
working volume of sump:	125.1	ft^3		936	gal
selected pumping rate:	50.0	gal/min			
Run time of pump (w/ ave inflow)	30.4	minutes	=	0.5	hr
Run time of pump (w/ no inflow)	18.7	minutes	=	0.3	hr
Time to fill sump at Average Daily Flow:	48.7	minutes	=	0.8	hr

Working volume of sump calculated as volume of leachate in sump at 2 ft. depth minus volume of leachate in sump at 1.0 ft. depth. (Volume between pump on level and pump off level)

In order to provide consistency, use same pump size for all cells. Use same model as currently in use, which is EPG WSD 15-3 (2HP).

Top of the pump is approximately 9 inches above the bottom of the sump. With a pump off level of 1.0 feet, the requirements of 6- to 12-inch minimum liquid depth above the top of the pump is met.

Figure 1. Sump schematic



Weaver Consultants Group	PROJECT	Ottawa County Farms Landfill Expansion			Project Number 0120-685-11-03
	SUBJECT	Sump Sizing Calculations			Scale NA
	Designed By TAP	Date 5/5/2016	Checked By	Date	Sheet No: 14 of 18

OBJECTIVE	Size the pumps in the cell sumps. Size sumps to handle the average daily flow predicted from the HELP Model.

PHASE 16

From HELP Model. Average daily flow = 0.03818 in/acre/day * (20.3 acre) *(1 ft/12 in) * (43,560 ft2/acre) / (24 hr/day) / (60 min/hr)

= 1.9538 ft^3/min 14.6162 gal/min

The sumps are sized as follows:

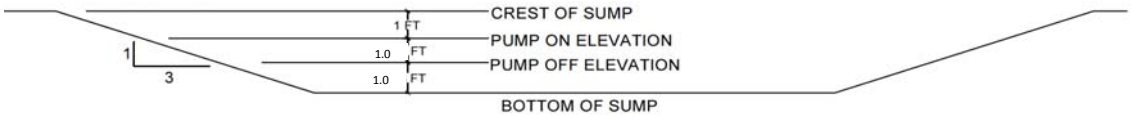
bottom dimensions:	12	width (ft)	12	length (ft)	
top dimensions:	30	width (ft)	27	length (ft)	
total sump depth:	3	ft			
pump off height:	1	ft	above bottom of sump (Figure 1)		
pump on height:	2	ft	above bottom of sump (Figure 1)		
porosity:	0.3	dimensionless			
net volume of sump:	429.3	ft^3	=	3212	gal
working volume of sump:	125.1	ft^3		936	gal
selected pumping rate:	50.0	gal/min			
Run time of pump (w/ ave inflow)	26.4	minutes	=	0.4	hr
Run time of pump (w/ no inflow)	18.7	minutes	=	0.3	hr
Time to fill sump at Average Daily Flow:	64.0	minutes	=	1.1	hr

Working volume of sump calculated as volume of leachate in sump at 2 ft. depth minus volume of leachate in sump at 1.0 ft. depth. (Volume between pump on level and pump off level)

In order to provide consistency, use same pump size for all cells. Use same model as currently in use, which is EPG WSD 15-3 (2HP).

Top of the pump is approximately 9 inches above the bottom of the sump. With a pump off level of 1.0 feet, the requirements of 6- to 12-inch minimum liquid depth above the top of the pump is met.

Figure 1. Sump schematic



Weaver Consultants Group	PROJECT	Ottawa County Farms Landfill Expansion			Project Number
	SUBJECT	Leachate Collection System			0120-685-11-03
	Designed By	Date	Checked By	Date	Sheet No.
	Katie Kinley	4/26/2016	TAP	4/27/2016	15 of 18

Objective:	Use the leachate generated per acre from the HELP Model and site information to find projected leachate generation, and size pumps, sumps, and tanks.
References:	HELP Model data, site leachate generation data

Step 5: Check capacity of lift stations

South Lift Station

158.6 Acres of area drained (Cells C, D, E, Phases 3, 4, 5, 6, 7, 8, 11, 12, 13)

39,337,941 gal/yr projected flow
74.84 gal/minute
6 foot diameter sump
3.92 feet between floats
829.16 gal maximum capacity
11.08 minutes to fill sump
2.55 minutes to evacuate sump at 325 gpm setting

North Lift Station

83.3 Acres of area drained (Cells A, B, A and B Extensions, Phases 1, 2, 9, 10)

14,828,504 max flow
28.21 gal/minute
6 foot diameter sump
3.92 feet between floats
829.16 gal maximum capacity
29.39 minutes to fill sump
2.55 minutes to evacuate sump at 325 gpm setting

Conclusion: Pump and lift stations have adequate capacity to remove maximum anticipated leachate flows.

Weaver Consultants Group	PROJECT	Ottawa County Farms Landfill Expansion			Project Number
	SUBJECT	Leachate Collection System			0120-685-11-03
	Designed By	Date	Checked By	Date	Sheet No.
	Katie Kinley	4/26/2016	TAP	4/27/2016	16 of 18
Objective:	Use the leachate generated per acre from the HELP Model and site information to find projected leachate generation, and size pumps, sumps, and tanks.				
References:	HELP Model data, site leachate generation data				

Step 6: Confirm leachate collection pipes are adequately sized.

6" HDPE Perforated Leachate Collection Pipe Capacity

Maximum flow capacity at a 1% slope:

$$Q = \left(\frac{1.486}{n}\right) * \left(\frac{A}{p}\right)^{0.6667} * (S)^{0.5}$$

n= Manning's Coefficient	0.012	for HDPE pipe
A=Area	0.196	sq ft
p=wetted perimter	1.57	ft
S= pipe slope	0.01	ft/ft
Q= pipe flow capacity	3.096	cfs
Q=	**1389.50**	**gpm**

Peak Pipe Flow

Peak Daily Leachate Production	1,036	gal/acre/day		
Max Drainage Area to Pipe	12	acres (for pipes at sump end of cells)		
Peak Pipe Flow	**12,432**	**gal/day=**	**8.63**	**gpm**

8.63 gpm < 1389.50 gpm
GOOD

Conclusion: Leachate collection pipes will have adequate capacity for anticipated peak flows.

Weaver Consultants Group	PROJECT	Ottawa County Farms Landfill Expansion			Project Number
	SUBJECT	Leachate Collection System			0120-685-11-03
	Designed By	Date	Checked By	Date	Sheet No.
	Katie Kinley	4/26/2016	TAP	4/27/2016	17 of 18

Objective:	Use the leachate generated per acre from the HELP Model and site information to find projected leachate generation, and size pumps, sumps, and tanks.
References:	HELP Model data, site leachate generation data, geosynthetic manufacturer's data

Step 7: Confirm geocomposite meets capacity and permeability of sand layer, and both have adequate conveyance capacity.

Sand Capacity

Permeability Required:	0.01	cm/s
Thickness Required:	1.00	foot

Capacity:	0.000328	ft2/s	0.14726	gpm/ft
Peak HELP Leachate Estimate:	0.000000165	ft2/s	0.00007	gpm/ft
			0.09	gpm/1200 ft max flow length

Capacity > Projected Flow **GOOD**

Conclusion: The 1 foot, permeability of 0.01 cm/s, sand layer has a capacity of 0.14726 gpm/ft. This is adequate for projected flows. Therefore, sand or a geocomposite with at least a permeability of 0.01 cm/s and capacity of 0.14726 gpm/ft may be used.

Geocomposite Capacity

Permeability Required:	1	cm/s

Transmissivity of Geocomposite:	0.0001	m2/s			
Thickness of typical Geonet:	200	mil			
Permeability of Geocomposite:	0.020	m/s	1.97	cm/s	**Satisfies Regulation**
Capacity:	0.001	ft2/s	0.48	gpm/ft	

Capacity > Projected Flow **GOOD**

Note: AgruNet DS 200 evaluated. This or approved equivalent may be used.

Conclusion: The evaluated geocomposite is projected to have adequate capacity for peak flows, and greater capacity and permeability than the required sand layer. Therefore, either option may be used.

Weaver Consultants Group	PROJECT	Ottawa County Farms Landfill Expansion			Project Number
	SUBJECT	Leachate Collection System			0120-685-11-03
	Designed By	Date	Checked By	Date	Sheet No.
	Katie Kinley	4/26/2016	TAP	4/27/2016	18 of 18

Objective:	Determine if final cover drainage layer has adequate capacity, based on HELP Model results.
References:	HELP Model data, geosynthetic manufacturer's data GRI-GC-8; Designing with Geosynthetics, Koerner, Robert M.

Impingement

HELP Model Peak Final Cover Flow Estimate	1,530	cf/acre/day
	0.00018	gpm/ft
Geocomposite Capacity	0.48000	gpm/ft

Factors from GRI-GC8 and Koerner

Reduction Factor for Creep	1.6
Reduction Factor for Biological Clogging	1.5
Reduction Factor for Chemical Clogging	1.2
Total Factor	2.88

FS for 150' **6.09** >5 --GOOD

Note: AgruNet DS 200 evaluated. This or approved equivalent may be used.

Conclusion: The evaluated geocomposite is projected to have adequate capacity for peak flows, and will daylight at each storm water terrace.

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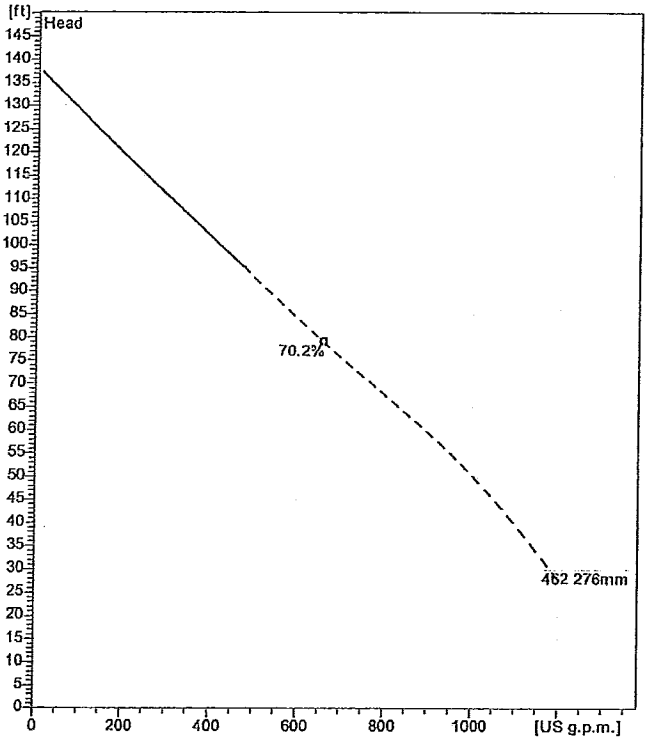
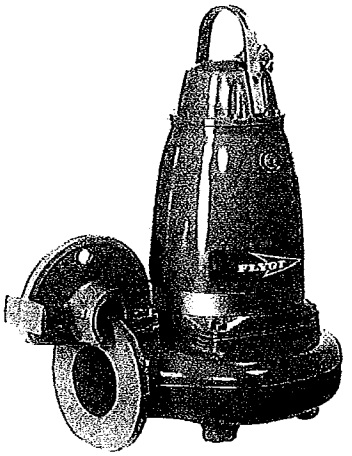
NP 3153 HT 3~ 462

Technical specification

FLYGT

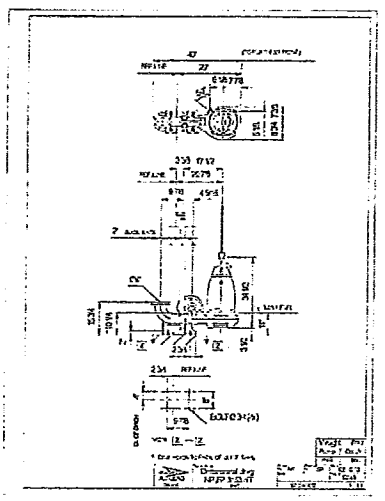


Curve according to: ISO 9906 grade 2 annex 1 or 2



Note: Picture might not correspond to the current configuration.

Installation: P - Semi permanent, Wet



General

Patented self cleaning semi-open channel impeller, ideal for pumping in waste water applications. Possible to be upgraded with Guide-pin® for even better clogging resistance. Modular based design with high adaptation grade.

Impeller

Impeller material	Hard-Iron ™
Outlet width	3 15/16 inch
Inlet diameter	150 mm
Impeller diameter	276 mm
Number of blades	2
	0 inch

Motor

Motor #	N3153.830 21-18-4XS-W IE3 17hp
Stator variant	5
Frequency	60 Hz
Rated voltage	460 V
Number of poles	4
Phases	3~
Rated power	17 hp
Rated current	18 A
Starting current	148 A
Rated speed	1800 rpm
Power factor	
1/1 Load	0.96
3/4 Load	0.96
1/2 Load	0.93
Efficiency	
1/1 Load	92.6 %
3/4 Load	92.6 %
1/2 Load	91.5 %

Configuration

Project	Project ID	Created by	Created on	Last update
			2013-07-20	

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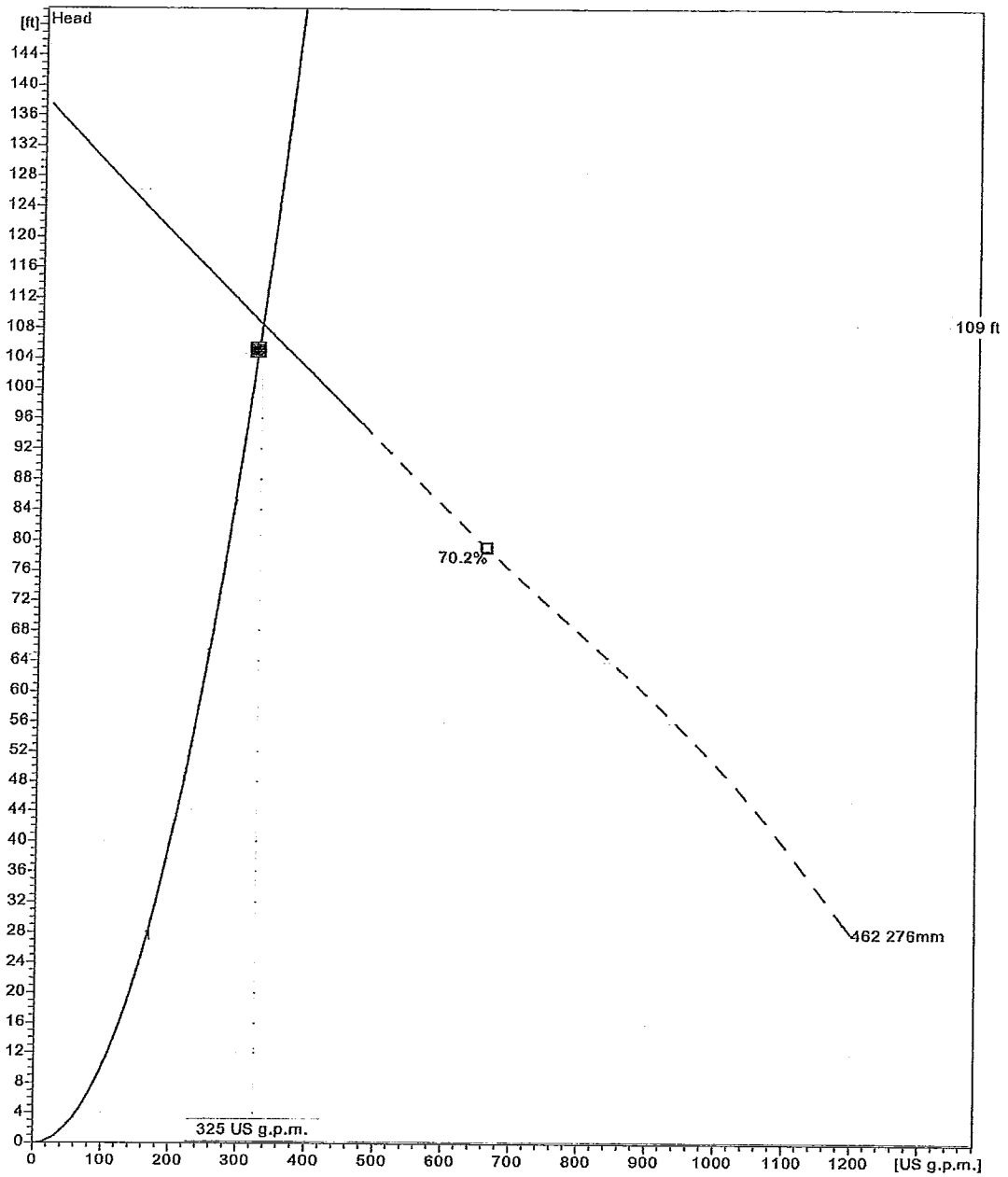
NP 3153 HT 3~ 462

Duty Analysis



Curve according to: ISO 9906 grade 2 annex 1 or 2

Pumps running /System	Individual pump Flow	Head	Shaft power	Total Flow	Head	Shaft power	Hyd eff.	Specific energy	NPSHre
1	325 US g.p.m.	109 ft	15.6 hp	325 US g.p.m.	109 ft	15.6 hp	57.3 %	644 kWh/US MG	13.6 ft

Project	Project ID	Created by	Created on	Last update
			2013-07-20	

FLYGT
a xylem brand

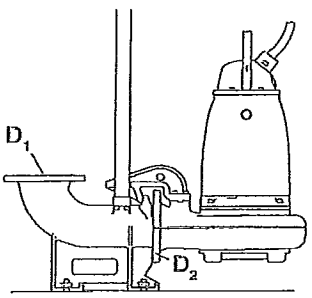
Issued: 8/12 Supersedes:

N-3153.800/810/820/830

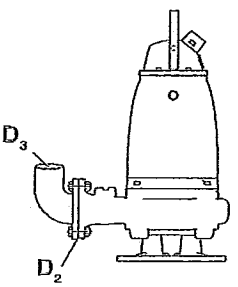
PUMP MODEL	IMPELLER CODE	HP RATING NP	NS	NT	NZ	VAC	D1	D2	D3	D4
N-3153 3Ø	414 LT	15, 20	15, 20	15, 20	15, 20	200 230/460 575	8"	8"	8"	*8" 10"
	415 LT 416 LT	12,15,20	12,15,20	12,15,20	12,15,20					
	434 MT	20	20	20	20		6"	6"	6"	8"
	435 MT	15, 20	15, 20	15, 20	15, 20					
	436 MT 437 MT	12,15, 20	12,15,20	12,15,20	12,15,20					
	462 HT	20	20	20	20		4"	4"	4"	6"
	463 HT	15, 20	15, 20	15, 20	15, 20					
	464 HT 465 HT 466 HT	12,15,20	12,15,20	12,15,20	12,15,20					
	**273 SH **274 SH	23	23	23	23		3" 4"	3" ^4"	3"	6"
	**275 SH **276 SH	17, 23	17, 23	17, 23	17, 23					

LT = High Volume MT = Standard HT = High Head SH = Super High Head ^for NP only * for NZ only

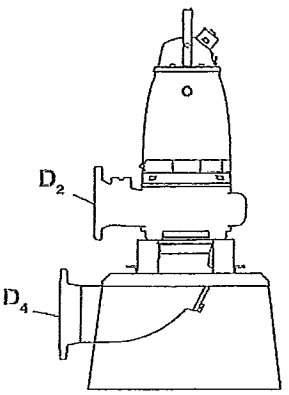
**IMPORTANT
Pump must be specifically ordered to match discharge connection.



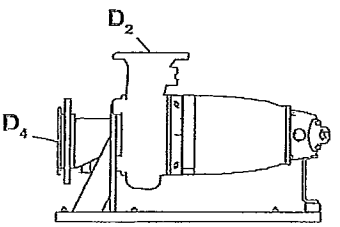
NP



NS



NT



NZ

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FLYGT

Performance curve

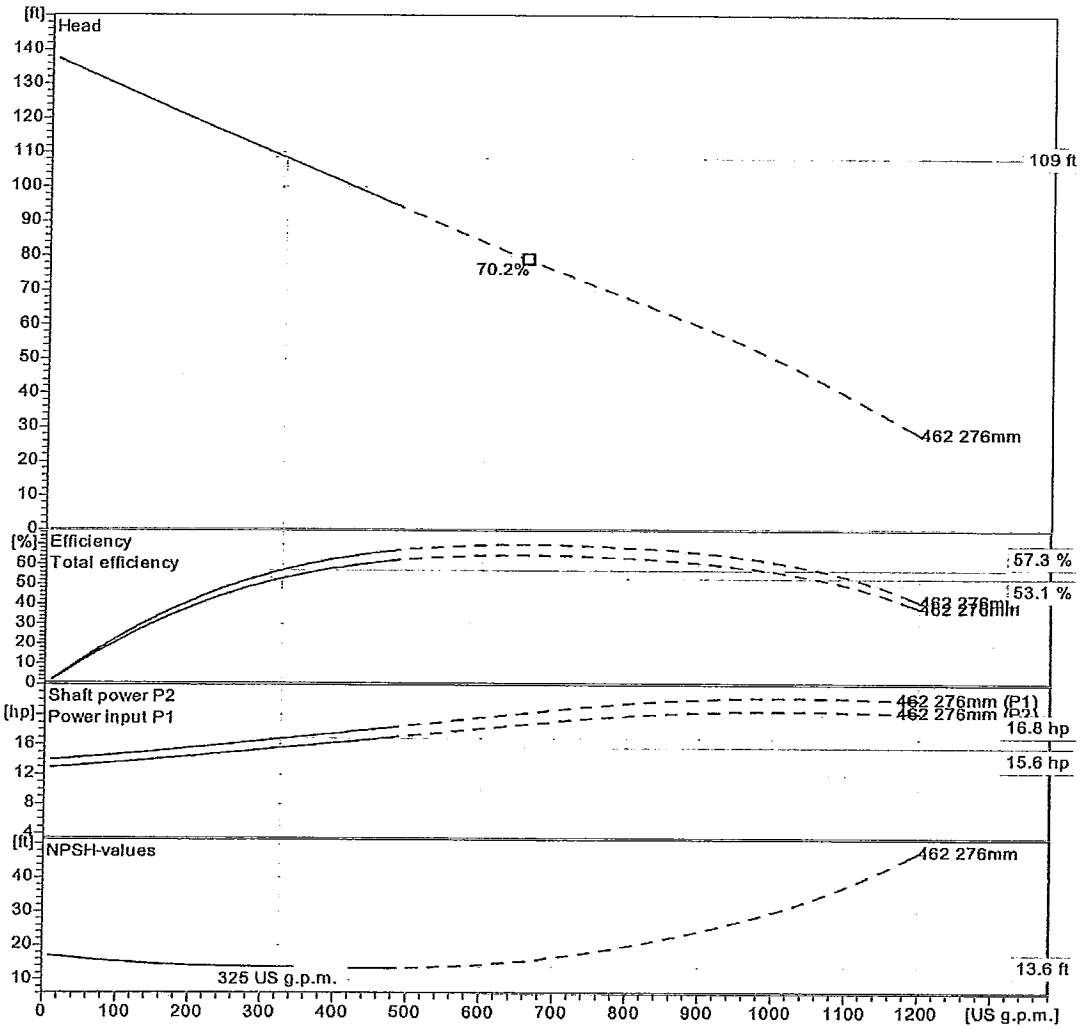
Pump

Outlet width	3 15/16 inch
Inlet diameter	150 mm
Impeller diameter	10⁷/₈"
Number of blades	2
	0 inch

Motor

Motor #	N3153.830 21-18-4XS-W IE3 17hp
Stator variant	5
Frequency	60 Hz
Rated voltage	460 V
Number of poles	4
Phases	3~
Rated power	17 hp
Rated current	18 A
Starting current	148 A
Rated speed	1800 rpm

Power factor	
1/1 Load	0.96
3/4 Load	0.96
1/2 Load	0.93
Efficiency	
1/1 Load	92.6 %
3/4 Load	92.6 %
1/2 Load	91.5 %



Curve according to: ISO 9906 grade 2 annex 1 or 2

Duty point					Guarantee
Flow	Head	Shaft power	NPSHre	Hyd eff.	ISO_9906_Grade_2
320 US g.p.m.	105 ft			%	No

Project	Project ID	Created by	Created on	Last update
			2013-07-20	