

# 4th Street Lift Station Condition Assessment



**City of Avondale**  
Avondale, Arizona

**Final Report**  
February 2019





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Abbreviations

A – Amperes

AAC – Arizona Administrative Code

ATS – Automatic Transfer Switch

CFS – Cubic Feet per Second

City – City of Avondale

CMU – Concrete Masonry Unit

FPS – Feet per Second

GPM – Gallons per Minute

GPD – Gallons per Day

H<sub>2</sub>S – Hydrogen Sulfide

HI Standard – Hydraulic Institute Standard

HP – Horsepower

I&C – Instrumentation and Control

LS – Lift Station

MCC – Motor Control Center

MGD – Million Gallons per Day

NEC – National Electric Code

PCP – Pump Control Panel

PPB – Parts per Billion

PVC – Polyvinyl Chloride

RTU – Remote Telemetry Unit

RVSS – Reduced Voltage Soft Starter

SES – Service Entrance Section

TDH – Total Dynamic Head

TVSS – Transient Voltage Surge Suppressor

VCP – Vitrified Clay Pipe

VFD – Variable Frequency Drive

## SECTION 1 INTRODUCTION

### 1.1. *Introduction*

The City of Avondale authorized Stanley Consultants to provide a Condition Assessment for Avondale's 4<sup>th</sup> Street Lift Station, located on the southeast corner of South 4<sup>th</sup> Street and East Lower Buckeye Road. The site was last updated in 2006 and consists of a submersible lift station and wet well, grinder building, above-grade discharge piping, biofilter system, and electrical building.

The grinder room contains a bypass bar screen and an in-line sewage Muffin Monster grinder. The Muffin Monster is the site's primary solids grinder for sewage entering the lift station. The bar screen was installed as a backup to strain the sewage in the event the Muffin Monster is inoperable or out of service for maintenance. The Muffin Monster is often in need of repair, and because the cost to repair is high, the City would prefer an alternative that does not require regular costly maintenance. The Muffin Monster and Bar Screen do not provide the operational reliability desired by the City. Figure 1.1 shows the above view of the Muffin Monster and the bar screen in the grinder building.

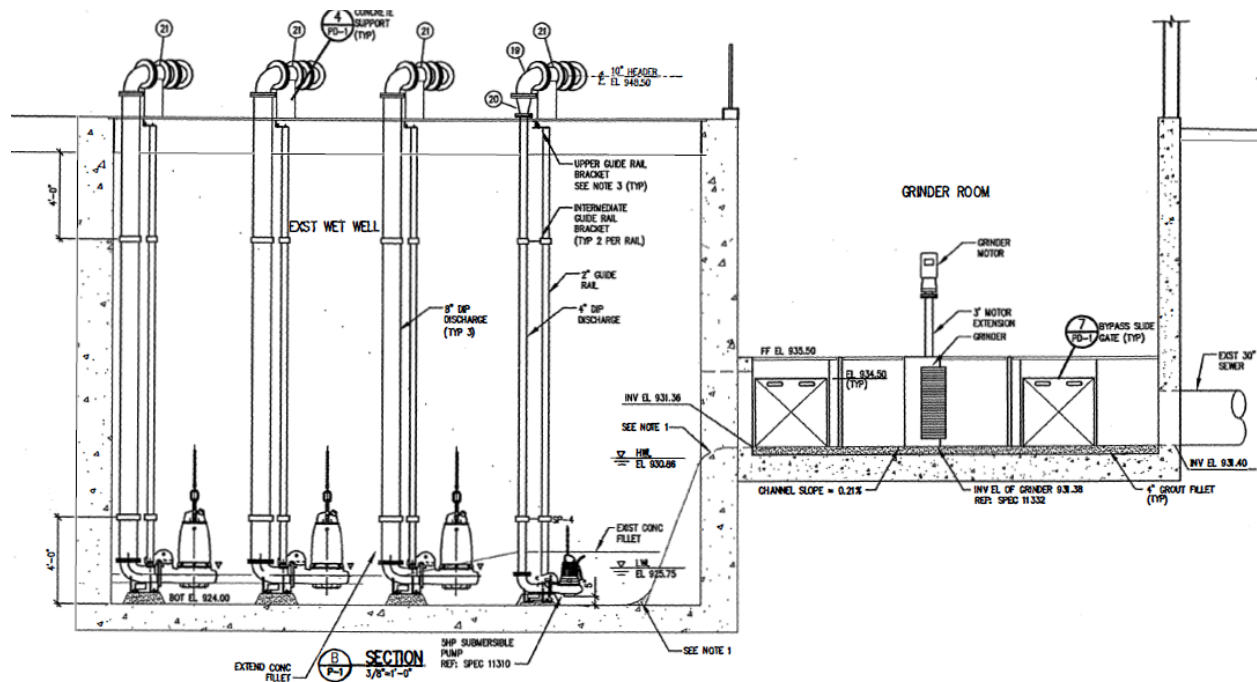
**Figure 1.1**  
**Muffin Monster & Bar Screen**



The sewer enters the grinder room from the north and the sewage flows through an open channel into the wet well. The channel is 3.5 feet wide and 4.5 feet deep. The top of the channel and the building grinder room lower level floor elevation is 935.50. The bottom of the channel and the inlet to the wet well is approximately 7 feet above the bottom of the wet well. The the wet well bottom elevation is 924.00. The discharge piping finished floor elevation is 946.50 and 11 feet above the building grinder

room lower level floor elevation. The building grinder room lower level floor elevation is the highest sewage level the operations staff allows to avoid flooding the grinder building. See Figure 1.2 for the grinder room and wet well section.

**Figure 1.2**  
**Wet Well & Channel Configuration**



Operations staff is having issues with grease buildup inside of the wet well. This can cause problems for the pumps as well as promote the accumulation of H<sub>2</sub>S inside of the wet well. The City is also looking at having the wet well re-coated to protect the structure.

The lift station currently uses three 20-HP submersible sewage pumps and has a fourth 5-HP pump. The City has a history of the pumps clogging and having to pull the pumps and remove the rags and other debris before the pump can be put back in operation. The fourth pump was installed to allow the wet well to be completely drained, but is not useful for its intended purpose. The fourth pump is located at the high end of the sloped wet well and is not capable of completely draining the wet well.

The discharge piping includes a magnetic flow meter, pig launcher, and an air relief valve that discharges to the wet well.

The lift station has a pump hoist that allows the operations staff to service the submersible pumps. However, the hoist track is not in-line with the centerline of the pumps. The hoist alignment makes it difficult for the operations staff to remove the pumps through the wet well access doors. Operations staff would like the hoist to be realigned directly above the pumps.

The City operates a biofilter system that consists of two media beds, a nutrient tank, a fan, and two blowers. With the current system there have been complaints regarding the odor in the lift station area. This is likely from the biofilter is not operating effectively or the biofilter needs additional capacity. The figures below show the current biofilter system.

**Figures 1.3 & 1.4  
Biofilter System Components**



Another issue the facility has been dealing with is the drainage on the east side of the site. Rain runoff has been draining across the east edge of the pavement, leading to heavy erosion ruts east of the pavement edge and into the drainage basin. See Figure 1.5.

**Figure 1.5  
Facility Drainage Overhead View**







## SECTION 2 IMPROVEMENT RECOMENDATIONS

### 2.1. Pumps

The 4<sup>th</sup> Street LS currently operates with three 20-HP Flygt Pumps. There is a fourth 5-HP pump that is not used. See Appendix A for the existing 20-HP pump curve and manufacturer information. The existing pumps were installed in 2006 during the Lift Station Improvements Project and are approximately 12 years old. The typical useful life of a submersible pump is 15 – 20 years old.

Stanley visited the 4<sup>th</sup> Street LS site on July 31, 2018 to perform a pump drawdown test. A complete test could not be performed due to the elevation of the sewer inlet and the operating levels. The sewer inlet is too low compared to the operating level in the wet well to provide a sufficient volume to perform a reasonable drawdown test. If the volume cannot not be isolated in the wet well, it becomes difficult and inaccurate to calculate the volume of sewage in the collection system and grinder room upstream of the wet well.

During pump operations, based on the magnetic flow meter readings, Stanley observed one pump producing about 1,040 GPM, two pumps producing about 1,500 GPM, and with all three pumps running about 1,700 GPM.

The City has requested Stanley replace the existing pumps with Vaughan Chopper Pumps. The City has several successful installations throughout City with Vaughan pumps. Because the lift station is so close to the wastewater treatment facility, the pumps encounter a lot of larger solids and to alleviate this problem we recommend the City install three new Vaughan Chopper Pumps, each at 25-HP. These pumps each have a capacity of 1,050 GPM at 45' TDH. The pump equipment will include pump and motor, base elbow, guiderail and brackets and controls. More information can be found in Appendix B.

It is recommended that the fourth 5-HP pump be removed. This pump is not used since it cannot drain the wet well completely. The pump's purpose was to allow the wet well to be completely drained, but cannot do so because it is not at the lowest point in the wet well.

With three new Vaughan Chopper Pumps the system will have the same capacity as currently in operation.

### 2.2. Grinder Room

With the addition of the Vaughan Chopper Pumps, the Muffin Monster and bar screen will no longer be needed. They could be left in place as backup, but because the equipment has been unreliable, it is recommended that the equipment be removed. To minimize the volume of air the biofilters need to treat, the channel should be sealed off with aluminum checker plate. The channel should also be re-coated when the wet well is re-coated to protect the structure.

### 2.3. Wet Well

Operations is currently experiencing issues with grease buildup on top of the sewage level in the wet well. The Reliant Wet Well Wizard can be used to reduce the amount of buildup of fats, oils, and grease (FOG) in the wet well by aerating and agitating the sewage. The Wet Well Wizard prevents grease from collecting, but also reduces odor generation. The aeration minimizes the formation of H<sub>2</sub>S and requires less frequent maintenance to clean out debris in the wet well.

Recommended for this lift station is one 3-HP Blower Wet Well Wizard with two diffusers. More information can be found in Appendix C.

Wet well re-coating is recommended to protect the concrete wet well. The existing wet well coating would be approximately 12 years old if the wet well has not been re-coated since the improvements in 2006. Because it is recommended all three Flygt pumps be replaced with Vaughan pumps, it would be a good opportunity to re-coat the wet well while the pumps are being replaced.

#### *2.4. Biofilter*

The existing biofilter needs to be either removed and replaced, or rehabilitated by replacing the media in the existing biofilter vessels. The existing biofilter system is approximately 12 years old and is not operating efficiently based on the odor complaints in the area. No field testing of the biofilter was completed. If the media is not the issue, low air volume could be part of the problem. To work effectively we want to create a low vacuum on the collection system and wet well so minimal odors are released into the atmosphere. The blowers could be under performing or not pulling enough air volume from the lift station and collection system to the biofilter. The air volume needs to be at least the volume coming from the collection system and 4 to 12 air changes in the wet well and grinder channel area. Sealing off the grinder channel area will help.

Below are two alternative systems that could replace the existing system.

One of the proposed biofilter options is the Bohn Biofilter. It consists of a foul air fan that pulls air from the wet well and collection system and forces odors through a bed of microorganism-covered media. The bed is generally constructed below grade, so there are no visual components except the blower equipment. The bed is filled with soil-like media, and topped with a rock cover. The air discharges directly into the atmosphere. This method requires low maintenance as the media does not need to be changed out regularly and the irrigation system is a simple sprinkler system. More information on this system can be found in Appendix D.

The second proposed biofilter option is the Eco Verde Biofilter. This biofilter is similar to the existing package biofilter system. The media is contained within an above-ground vessel that vents the treated air to the atmosphere. The vessel needed for this lift station would be about 10' in diameter and 14' tall (excluding the outlet stack). It would contain 610 cubic feet of primary-stage media, and 50.7 cubic feet of secondary-stage media (polishing step). The polishing step is very effective at reducing odors for nearby neighbors. More information can be found in Appendix E.

A cost estimate is provided based on a 2,300 CFM unit design. A rough cost for the media replacement has been included in the cost estimate based on the information provided on the existing biofilter system.

**Table 2.1  
Biofilter Option Comparison**

<b>Biofilter Benefits</b>		
<b>Bohn Biofilter</b>	<b>Eco Verde Biofilter</b>	<b>Media Replacement</b>
- Low maintenance - Does not require regular media replacement - Below-grade media bed - Air discharges over large surface area/not concentrated	- Package biofilter system - Smaller foot print - Similar to existing system - Carbon polishing available	- Utilizes existing equipment - Operations will remain the same
<b>Biofilter Disadvantages</b>		
<b>Bohn Biofilter</b>	<b>EcoVerde Biofilter</b>	<b>Media Replacement</b>
- More expensive - Requires watering	- Media vessel will extend above the existing CMU wall - Concentrated air discharge	- System will need to be evaluated for compatibility and efficiency

**2.5. Electrical System**

The existing Variable Frequency Drives (VFD’s) are the A1000 series by Yaskawa. Model Number CIMR-AU4A0038FAA – 480VAC rated at 25HP / 38A standard duty or 20HP / 31A heavy duty. With the current 20-HP Flygt Pumps installed, the installation is considered heavy duty. The new 25-HP recommended Vaughan Pumps would rate the VFD’s as standard duty. Yaskawa defines normal duty as an overload current rating of 120% of rated output current for 60 seconds and Heavy Duty as an overload current rating of 150% of rated output current for 60 seconds. The existing VFD’s should be able to handle the new Vaughan Pumps, but with potential increased loading due to increased solids handling, Stanley recommends replacing the VFD’s with new Yaskawa CIMR-AU4A0044FAA rated at 30HP / 44A standard duty or 25HP / 39A heavy duty.

The Service Entrance Section (SES) is a Pow-R-Line C Series Switchboard containing a Westinghouse IQ Data Plus II Power Quality Meter (PQM), a Main Breaker feeding the Automatic Transfer Switch (ATS), and a breaker feeding the MCC from the ATS. The Motor Control Center (MCC) is a 3-Phase 4-Wire 480VAC Westinghouse Series 2100 rated at 65KAIC withstand bus bracing rating, with surge protection provided by an Eaton SPD Series Transient Voltage Surge Suppressor (TVSS). As the equipment was installed in 2006, Stanley recommends at the very minimum breaker testing performed on all circuit breakers and a thorough vertical and horizontal bus inspection by a local Eaton service representative.

The ATS is a Cummins Onan, model OTCU-400G 3-Phase 4-Wire rated at 400A. This model is no longer offered or supported by Cummins Onan and Stanley recommends replacement with a unit sized equal to the SES and MCC.

Recommended electrical improvements include the following:

- New VFD motor starters for three pumps.
- New starter for wet well wizard
- Revise RTU/PLC showing connections of the new VFDs and wet well wizard
- New power and monitoring connection for new odor control system
- Replace automatic transfer switch

## 2.6. Drainage

To improve the drainage issues on the east side of the lift station site, the grade should be re-graded to control the storm drainage runoff. This would allow the runoff to be diverted to the large basin east of the lift station. This would include a curb and gutter along the edge of the pavement to act as a barrier and to guide the runoff to a designated drainage area. This would protect the edge of the pavement from eroding. A drain channel would be added from the curb and gutter to the basin below to eliminate the soil erosion and ruts that have been occurring.

## SECTION 3 COST ESTIMATE

*3.1. Summary*

The budget construction cost is summarized below (Table 3.1) for each recommended improvement. Each summary cost includes a 25% contingency, and 20% markup for engineering and construction administration services. The Bohn Biofilter is the recommended biofilter alternative and has been included in the estimate. See Appendix F for a more detailed cost breakdown.

**Table 3.1**  
**Cost Estimate Summary**

<b>Item</b>	<b>Cost</b>
Vaughan Chopper Pumps	\$351,000
Reliant Wet Well Wizard	\$78,000
Bohn Biofilter	\$546,000
Wet Well Coating	\$108,000
Painting	\$37,800
Drainage Repair	\$112,500
Electrical Upgrades	\$285,000
<b>Total Cost</b>	<b>\$1,234,000</b>



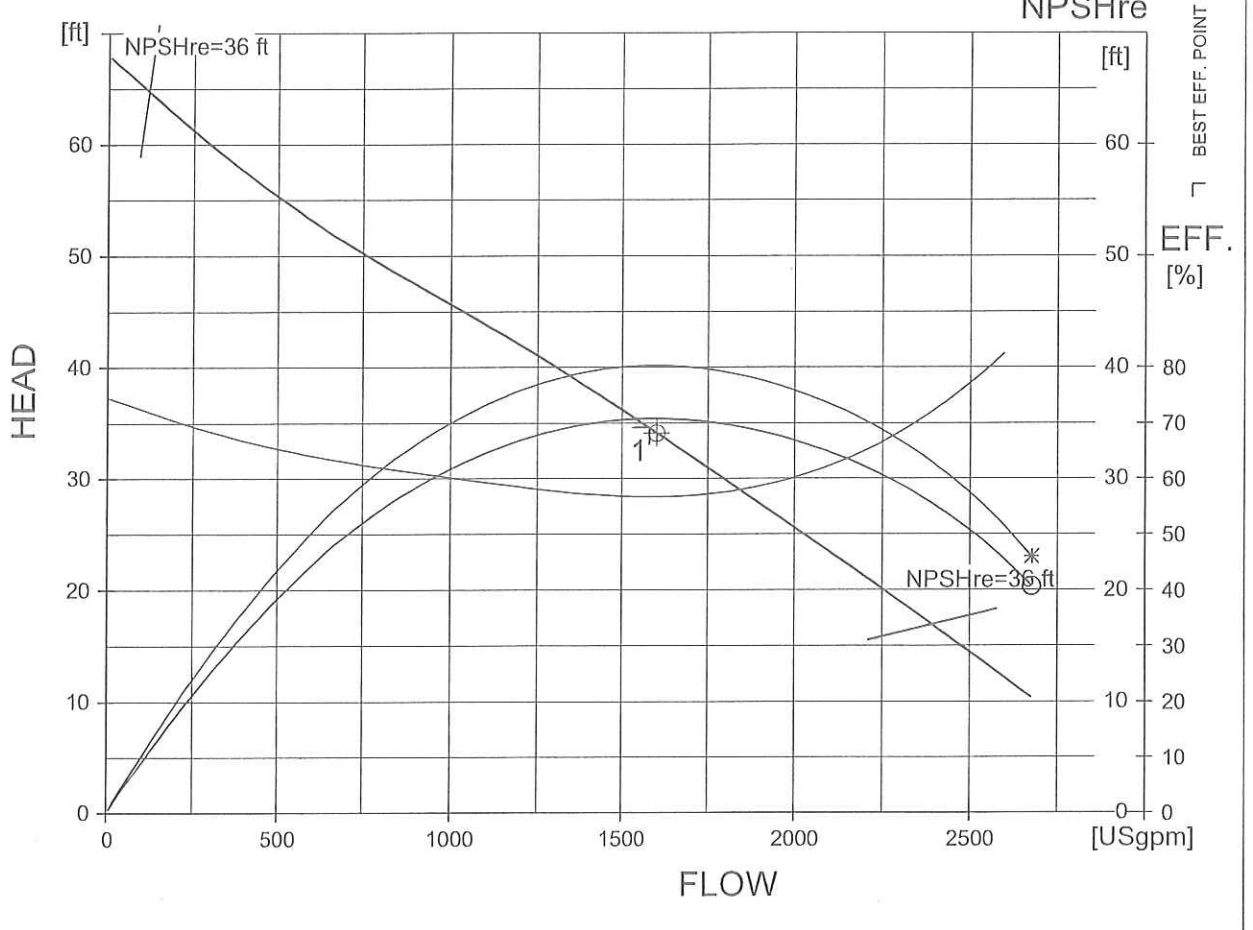
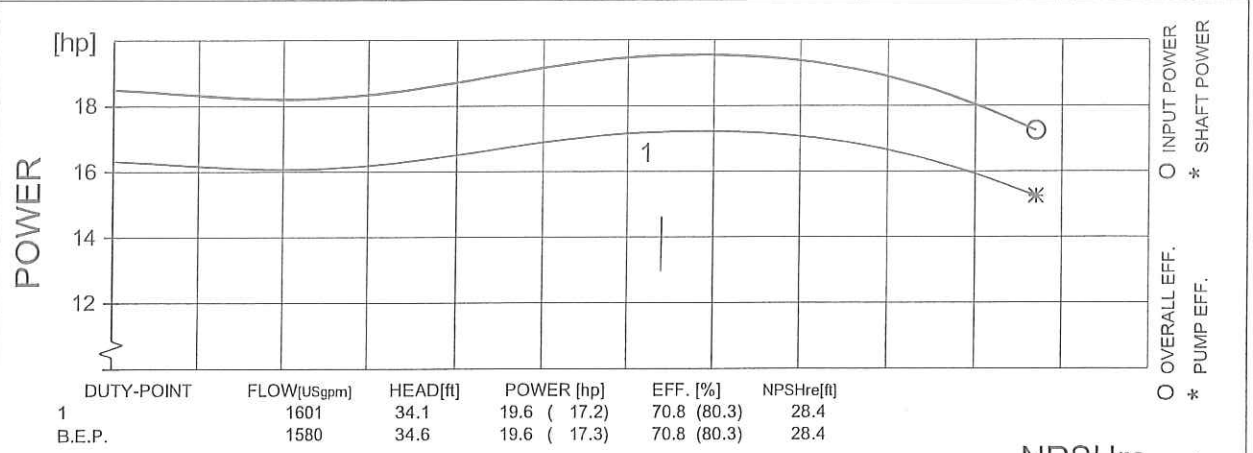
## Appendix A

### Existing Pump Curve and Manufacture Information





<b>FLYGT</b>		<b>PERFORMANCE CURVE</b>			PRODUCT <b>NP3153.091</b>	TYPE <b>LT</b>
DATE <b>2006-02-19</b>	PROJECT <b>AVONDALE L.S.</b>			CURVE NO <b>63-413-00-6010</b>	ISSUE <b>1</b>	
POWER FACTOR	1/1-LOAD <b>0.83</b>	3/4-LOAD <b>0.77</b>	1/2-LOAD <b>0.66</b>	RATED POWER ..... <b>20 hp</b>	IMPELLER DIAMETER <b>217 mm</b>	
EFFICIENCY	<b>87.5 %</b>	<b>89.0 %</b>	<b>89.0 %</b>	STARTING CURRENT ... <b>148 A</b>	MOTOR # <b>21-18-4AA</b>	STATOR REV <b>05YSER</b>
MOTOR DATA	---	---	---	RATED CURRENT ... <b>26 A</b>	REV <b>12</b>	
COMMENTS	INLET/OUTLET <b>-/ 8 inch</b>			RATED SPEED ..... <b>1755 rpm</b>	FREQ. <b>60 Hz</b>	PHASES <b>3</b>
	IMP. THROUGHLET <b>---</b>			TOT.MOM.OF INERTIA ... <b>0.084 kgm2</b>	VOLTAGE <b>460 V</b>	POLES <b>4</b>
				NO. OF BLADES <b>2</b>	GEARTYPE <b>---</b>	RATIO <b>---</b>



FLYPS3.1.4.0 (20050224)

NPSHre = NPSH3% + min. operational margin  
Performance with clear water and ambient temp 40 °C

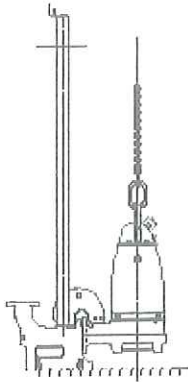


**HI B Curve**

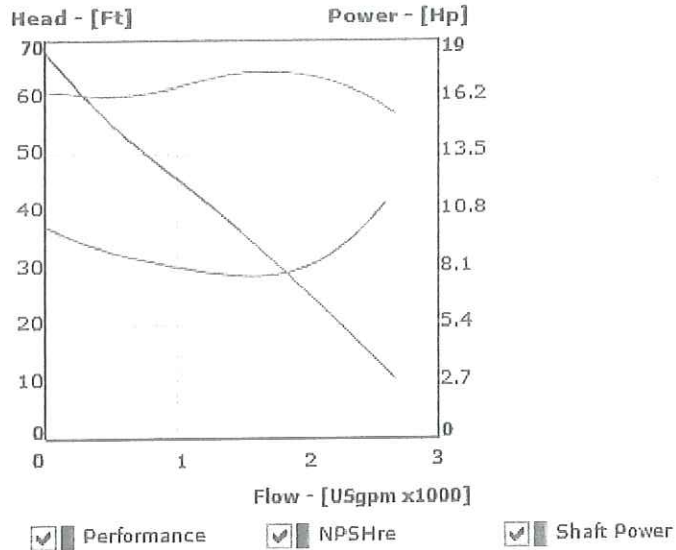
32 TDH 1600 gpm

# PRODUCT: NP 3153 LT

**Product picture**



**Curves  Enlarge**



**Pump Data**

Curve id: 63-413-00-6010      Impeller: 413      Poles: 4 - pole      Motor: 21-18-4AA      Frequency: 60 Hz

**Motor Data**

Rated output power Hp (kW)	∅	Nominal voltage (V)	Full load current (A)	Locked rotor current (A)	Locked rotor kVA	Locked rotor code letter kVA/HP	Poles/rpm
20 (14.9)	3	460	26	148	118	G	4/1755
20 (14.9)	3	230	52	296	118	G	4/1755

Pump motor Hp	Efficiency			Power factor		
	100% load	75% load	50% load	100% load	75% load	50% load
20	87.5	89	89	0.83	0.77	0.66

**Cable Data**

HP	Cables	Volts	Max. length (Ft)	Cable size/Nominal OD.	Conductors (In one cable)	Type	Part number
20	1	230 460	165 675	#6/3-2-1-GC 1.22"-(31.0mm)	(3) 6 AWG (PWR) (2) 10 AWG (CTRL) (1) 8 AWG (GND) (1) 10 AWG (GC)	STD	942109

**Available Discharge Connection Outlet Size**

Outlet Drilled Flange      8"

**Warm Liquid Data**

Rtd. Amb. Temp.	Rtd. Curr.(1)	Rtd. Curr.(2)	De-rated Shaft Power
70° C / 158° F	22 A	45 A	16.8 Hp






# N-3153



## Impeller/Motor/Nominal Sizes

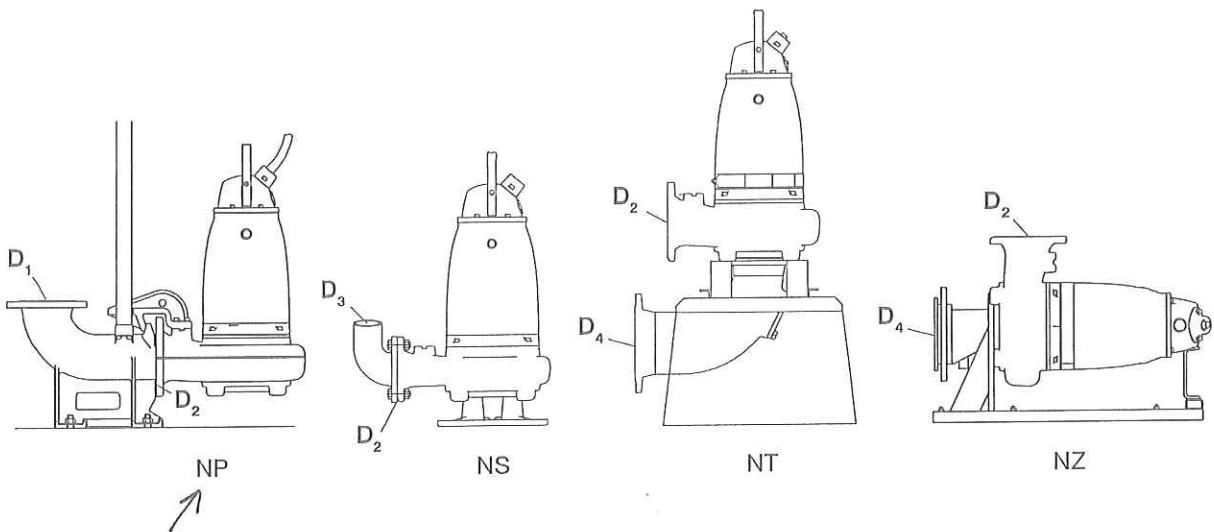
Issued: 7/05

Supersedes: 11/04

PUMP MODEL	IMPELLER CODE	HP RATING				VAC	D1	D2	D3	D4	
		NP	NS	NT	NZ						
 	413 LT	20	20	20	20	  	8"	8"	8"	*8" 10"	
	414 LT	15,20	15,20	15,20	15,20						
	415 LT	12,15,20	12,15,20	12,15,20	12,15,20						
	416 LT										
	433 MT	20	20	20	20		6"	6"	6"	8"	
	434 MT										
	435 MT	15, 20	15,20	15,20	15,20						
	436 MT	15, 20	12,15,20	12,15,20	12,15,20						
	437 MT	12,15,20	12,15,20	12,15,20	12,15,20						
	452 HT	15,20	15,20	15,20	15,20		4"	4"	4"	6"	
	453 HT										
	454 HT	12,15,20	12,15,20	12,15,20	12,15,20						
	455 HT										
	456 HT										
	457 HT										
	622 LT	15	15	15	15		10"	10"	8" or 10"	12"	
	623 LT										
	624 LT										
625 LT											
273 SH	23	23	23	23	3" 4"	3"	3"	6"			
274 SH											
275 SH											
276 SH											

LT = High Volume MT = Standard HT = High Head SH = Super High Head

\* for NZ only





## Appendix B

### Vaughan Chopper Pump Information



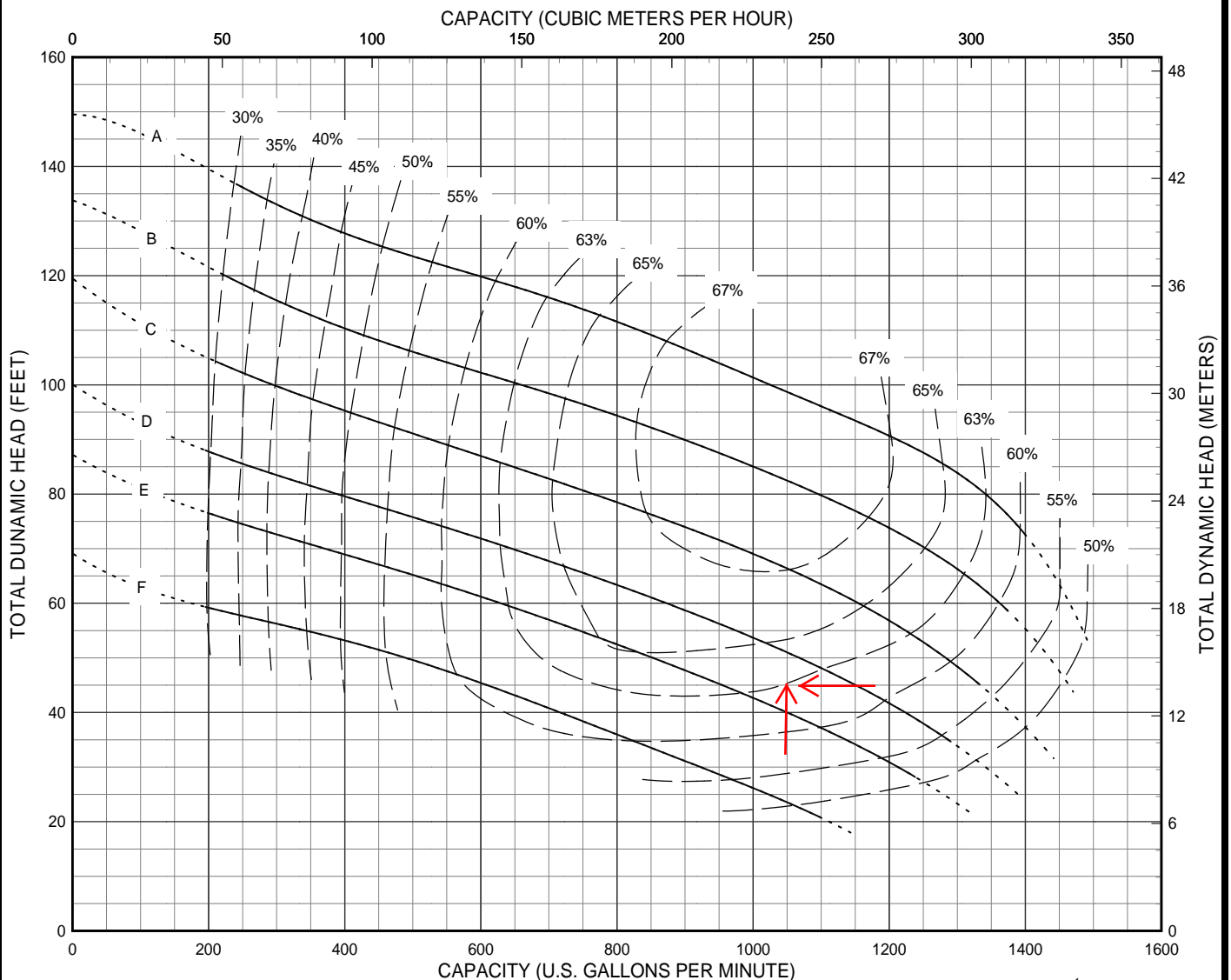
**PERFORMANCE CURVE**

**Models:  
S4S**

**3-Blade Impeller  
4" Discharge**

CURVE	POWER (HP/KW)	SPEED (RPM)	IMPELLER DIAMETER
A	50 / 37	1770	11.80" (300mm)
B	40 / 30	1740	11.30" (287mm)
C	30 / 22	1755	10.60" (269mm)
D →	25 / 18.5	1755	10.00" (254mm)
E	20 / 15	1750	9.50" (241mm)
F	15 / 11	1755	8.80" (224mm)

DO NOT OPERATE PUMP IN DOTTED PORTION OF CURVES. PUMPS MAY EXCEED HP SHOWN IF OPERATED IN DOTTED PORTION OF CURVE. CURVES ARE SUBJECT TO CHANGE WITHOUT NOTICE. EFFICIENCIES SHOWN ARE NOMINAL BOWL. GUARANTEED MINIMUM EFFICIENCIES PER H.I. LEVEL A.

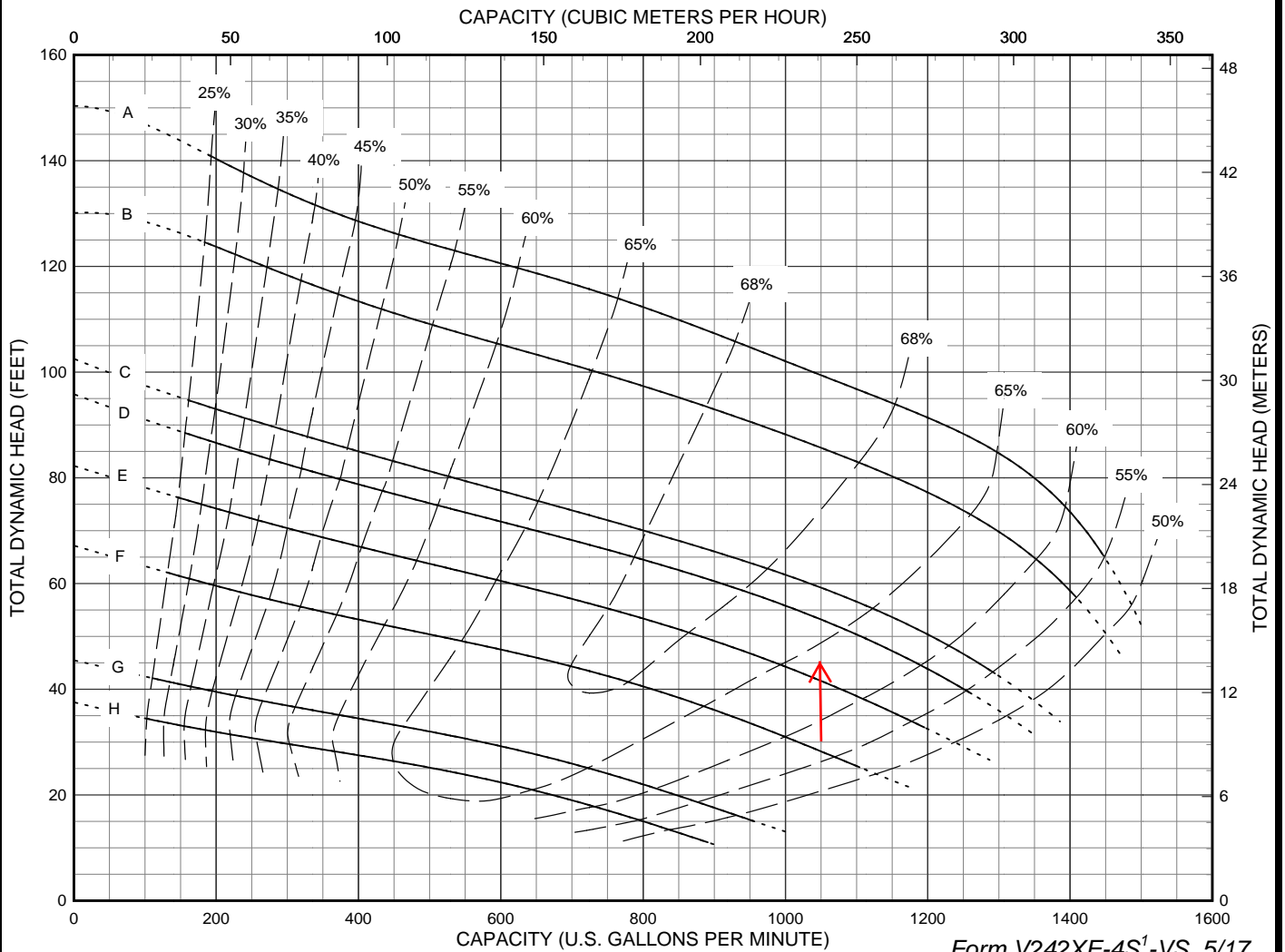


**Models:**  
**S4S**  
**V4S**  
**V4SR**

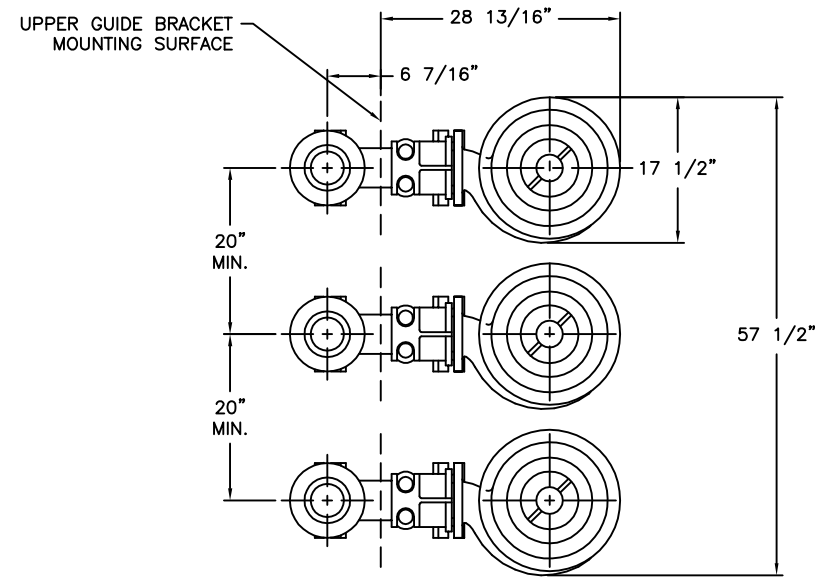
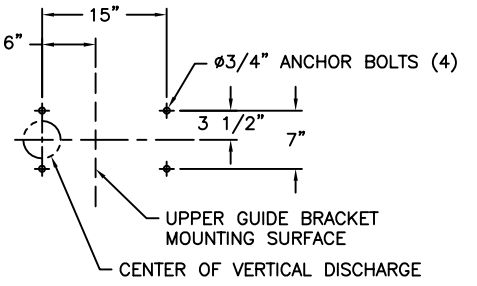
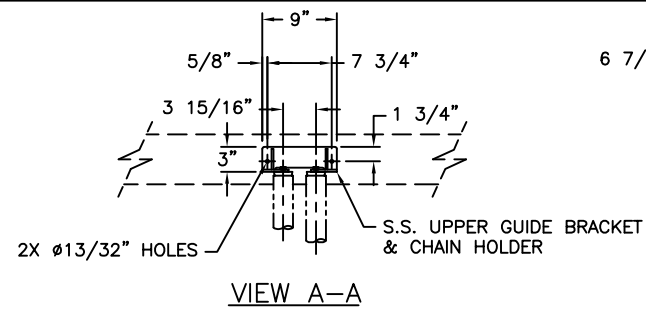
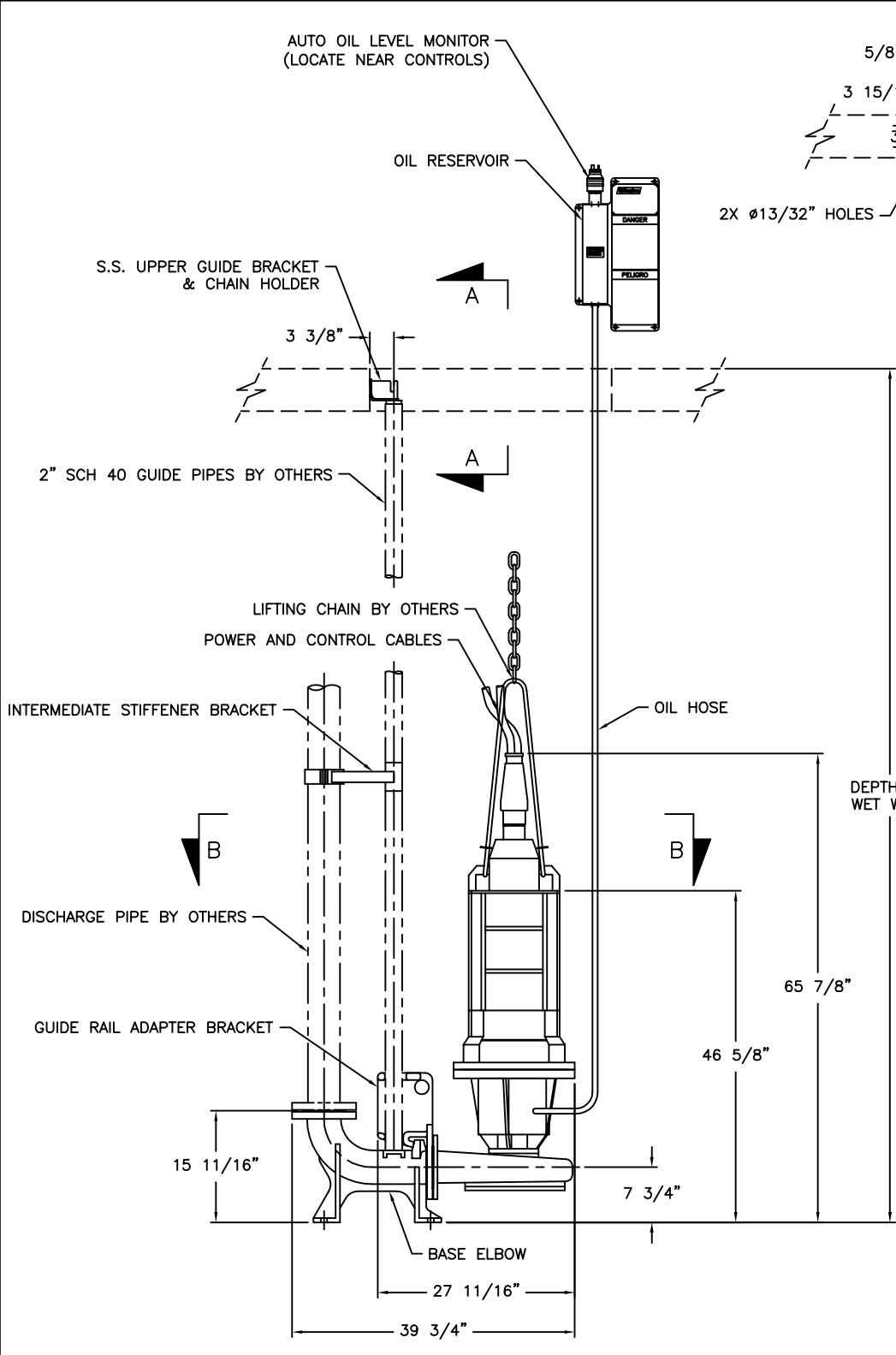
**3-Blade Impeller**  
**4" Discharge**  
**Variable Speed Curve**

CURVE	POWER (HP/KW)	SPEED (RPM)	IMPELLER DIAMETER
A	50 / 37	1775	11.80" (300mm)
B	40 / 30	1670	11.80" (300mm)
C	30 / 22	1460	11.80" (300mm)
D →	25 / 18.5	1410	11.80" (300mm)
E	20 / 15	1310	11.80" (300mm)
F	15 / 11	1180	11.80" (300mm)
G	10 / 7.5	970	11.80" (300mm)
H	7.5 / 5.5	880	11.80" (300mm)

DO NOT OPERATE PUMP IN DOTTED PORTION OF CURVES. PUMPS MAY EXCEED HP SHOWN IF OPERATED IN DOTTED PORTION OF CURVE. CURVES ARE SUBJECT TO CHANGE WITHOUT NOTICE. EFFICIENCIES SHOWN ARE NOMINAL BOWL. GUARANTEED MINIMUM EFFICIENCIES PER H.I. LEVEL A.







- NOTES:**
1. PUMP WEIGHT: 216 LBS
  2. MOTOR WEIGHT: 750 LBS
  3. TOTAL WEIGHT: 966 LBS
  4. PERFORMANCE REQUIRED: GPM @ TDH
  5. MOTOR: HP, RPM  
POWER: V, PH, HZ  
ENCLOSURE: SUBMERSIBLE  
MANUFACTURED BY: RELIANCE
  6. SURFACE PREPARATION:

	VAUGHAN CO., INC. 364 MONTE-ELMA ROAD MONTESANO, WA 98563 PHONE: (360) 249-4042 FAX: (360) 249-6155		TITLE: <b>OUTLINE DIMENSIONS          S4S3-          250TY MOTOR</b>		
	THIS DRAWING IS THE PROPERTY OF VAUGHAN COMPANY INC. IT IS FURNISHED FOR YOUR CONFIDENTIAL INFORMATION PURPOSES ONLY, AND IS NOT TO BE DISCLOSED TO ANYONE ELSE OR REPRODUCED OR USED FOR MANUFACTURING PURPOSES WITHOUT THE EXPRESS WRITTEN CONSENT OF VAUGHAN COMPANY INC.				
<small>UNLESS OTHERWISE NOTED, TOLERANCES ARE TO BE:          SURFACE FINISH: 128 MICROINCHES          DIMENSIONS: WELDS: 1/16"          DIMENSIONS: MACHINING: 1/32"          DIMENSIONS: MACHINING: 1/32" = 0.005"          DIMENSIONS: TOLERANCE: 0.010"          GEOMETRIC TOLERANCE: SURFACE ON CYLINDERS: 0.010"          GEOMETRIC TOLERANCE: PARALLELISM: 0.005"</small>	CHECKED:	ENGINEER:	DRAWN BY:	SCALE: <b>1:12</b>	PART NUMBER:
<small>BREAK ALL MACHINE EDGES 0.005" R UNLESS NOTED OTHERWISE</small>	JOB ORDER NUMBER:	DATE:	DRAWING NUMBER:	REVISION NUMBER: <b>0</b>	



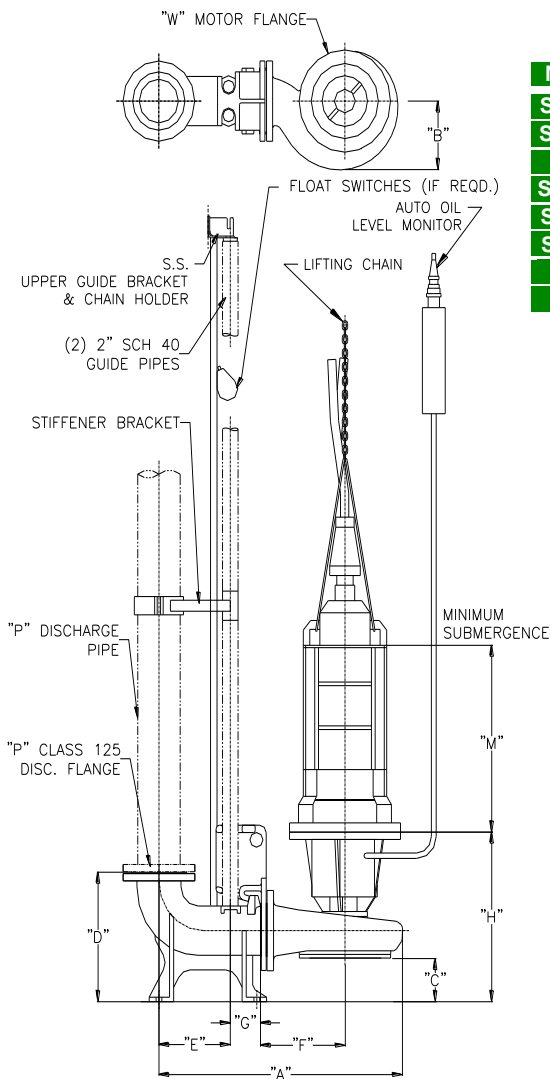


# 3"-6" S-SERIES SUBMERSIBLE CHOPPER PUMPS

## Materials of Construction:

- Impeller/Upper Cutter/Cutter Bar/Cutter Nut:** ..... Cast alloy steel, heat treated to minimum Rockwell C 60.
- Casing/Bearing Housing/Guide Bracket/Elbow:** ..... Ductile cast iron.
- Mechanical Seal:** ..... Cartridge type with silicon carbide (or tungsten carbide) seal faces and stainless steel sleeve.
- Thrust Bearings:** ..... Back-to-back angular contact ball type or face to face tapered roller type.
- Lubrication:** ..... ISO Grade 46 oil.
- Flange:** ..... ANSI Class 125.
- Paint:** ..... Ceramic Epoxy.

DRAWINGS AND DIMENSIONS SUBJECT TO CHANGE WITHOUT NOTICE. DO NOT USE FOR CONSTRUCTION PURPOSES. CONTACT VAUGHAN FOR CERTIFIED CONSTRUCTION PRINTS.



DIMENSIONS IN INCHES									
MODEL	A	B	C	D	E	F	G	H	P
S3F/S3G	27-5/8	5-7/8	4-7/8	15-3/4	9-7/16	8-1/2	4-9/16	21	3
S3L/S3M	29	6-1/2	5	15-3/4	9-7/16	9-1/2	4-9/16	20-1/2	3
S3P	33-3/4	7-11/16	5-11/16	15-3/4	9-7/16	11-7/8	4-9/16	20-7/8	3
S3V/S3W	28-5/8	6	5-5/8	15-3/4	9-7/16	9-1/2	4-9/16	21-1/8	3
S4K/S4L	31	7-1/2	4-5/8	15-3/4	9-13/16	10-3/8	4-9/16	21-1/4	4
S4S/S4T	34-5/8	9	4-5/8	15-3/4	9-13/16	12-3/8	4-9/16	21	4
S4V	42-7/16	10-11/16	4-3/8	15-3/4	9-13/16	17-7/8	4-9/16	21-7/16	4
S6U	36-3/4	9-5/8	6	17-7/8	11	13-1/8	4-9/16	23-1/4	6

## 15 MINUTE IN-AIR FRAME SIZES ONLY

HP	SPEED	FRAME	M	W	HP	SPEED	FRAME	M	W
5	1170	180TY	17-1/4	12 3/8	30	1170	320TY	25-1/2	18-3/4
	1750	180TY	17-1/4	12 3/8		1750	250TY	25	17
7.5	1170	210TY	21-7/8	15 1/4	40	1170	320TY	25-1/2	18-3/4
	1750	180TY	17-1/4	12 3/8		1750	250TY	25	17
10	1170	210TY	21-7/8	15 1/4	50	1170	320TY	25-1/2	18-3/4
	1750	210TY	21-7/8	15 1/4		1750	250TY	25	17
15	1170	250TY	25	17	60	1170	320TY	25-1/2	18-3/4
	1750	210TY	21-7/8	15 1/4		1750	320TY	25-1/2	18-3/4
20	3510	210TY	21-7/8	15 1/4	75	3510	320TY	25-1/2	18-3/4
	1170	250TY	25	17		1170	320TY	25-1/2	18-3/4
25	1750	210TY	21-7/8	15 1/4	100	1750	320TY	25-1/2	18-3/4
	3510	210TY	21-7/8	15 1/4		1750	250TY	25	17
75	1170	250TY	25	17	125	1170	320TY	25-1/2	18-3/4
	1750	250TY	25	17		1750	360TY	31-3/8	20-1/4
100	1170	250TY	25	17	125	1750	360TY	31-3/8	20-1/4
	3510	250TY	25	17					



**VAUGHAN CO., INC.**  
 364 Monte Elma Road, Montesano, WA 98563  
 Phone: 1-360-249-4042 / Fax: 1-360-249-6155  
 Toll Free Phone (US only): 1-888-249-CHOP (2467)  
 Web Site: [www.chopperpumps.com](http://www.chopperpumps.com)  
 Company E-mail: [info@chopperpumps.com](mailto:info@chopperpumps.com)

**MADE IN THE  
USA**

For all current patents, see <http://www.chopperpumps.com/patents.htm>

# SPECIFICATIONS: 3" – 6" S-SERIES SUBMERSIBLE CHOPPER PUMPS

The submersible chopper pump shall be specifically designed to pump waste solids at heavy consistencies without plugging or dewatering of the solids. Materials shall be chopped/macerated and conditioned by the pump as an integral part of the pumping action. The pump must have demonstrated the ability to chop through and pump high concentrations of solids such as plastics, heavy rags, grease and hair balls, wood, paper products and stringy materials without plugging, both in tests and field applications. Pump shall be manufactured by Vaughan Co., Inc.

## DETAILS OF CONSTRUCTION

- A. Casing:** Shall be of volute design, spiraling outward to the Class 125 flanged centerline discharge. Casing shall be ductile cast iron with all water passages to be smooth, and free of blowholes and imperfections for good flow characteristics. Casing shall include a replaceable Rockwell C 60 alloy steel cutter to cut against the rotating impeller pump-out vanes for removing fiber and debris.
- B. Impeller:** Shall be semi-open type with pump out vanes to reduce seal area pressure. Chopping/maceration of materials shall be accomplished by the action of the cupped and sharpened leading edges of the impeller blades moving across the cutter bar at the intake openings, with a set clearance between the impeller and cutter bar of 0.015-0.025" cold. Impeller shall be cast alloy steel heat treated to minimum Rockwell C 60 and dynamically balanced. The impeller shall be keyed to the shaft and shall have no axial adjustments and no set screws.
- C. Cutter Bar Plate:** Shall be recessed into the pump casing and shall contain at least 2 shear bars extending diametrically across the intake opening to within 0.010-0.030" of the rotating cutter nut tooth, for the purpose of preventing intake opening blockage and wrapping of debris at the shaft area. Chopper pumps utilizing individually mounted shear bars shall not be acceptable. Cutter bar shall be alloy steel heat-treated to minimum Rockwell C 60.
- D. Cutter Nut:** The impeller shall be secured to the shaft using a cutter nut, designed to cut stringy materials and prevent binding using a raised, rotating cutter tooth. The cutter nut shall be cast alloy steel heat treated to minimum Rockwell C 60.
- E. Upper Cutter:** Shall be threaded into the casing or back pull-out adapter plate behind the impeller, designed to cut against the pump-out vanes and the impeller hub, reducing and removing stringy materials from the mechanical seal area. Upper cutter shall be cast alloy steel heat treated to minimum Rockwell C 60. The upper cutter teeth are positioned as closely as possible to the center of shaft rotation to minimize cutting torque and nuisance motor tripping. The ratio of upper cutter cutting diameter to shaft diameter in the upper cutter area of the pump shall be 3.0 or less.
- F. Pump Shafting:** Shafting shall be heat treated alloy steel, with a minimum diameter of 1.5 inches in order to minimize deflection during solids chopping.
- G. Bearing Housing:** Shall be ductile cast iron, and machined with piloted bearing fits for concentricity of all components. Piloted motor mount shall securely align motor on top of bearing housing.
- H. Thrust Bearings:** Shaft thrust in both directions shall be taken up by two back-to-back mounted single-row angular contact ball bearings, or a matched set of face to face tapered roller bearings, with a minimum L-10 rated life of 100,000 hours. Overhang from the centerline of the lower thrust bearing to the seal faces shall be a maximum of 1.7". A third mechanical seal (two in motor) shall also be provided to isolate the bearings from the pumped media. The third seal, as well as the thrust bearings shall be oil bath lubricated in the bearing housing by ISO Grade 46 oil. Shaft overhang exceeding 1.7 inches from the center of the lowest thrust bearing to the seal faces shall be considered unacceptable.
- I. Pump Mechanical Seal:** The mechanical seal shall be located immediately behind the impeller hub to maximize the flushing available from the impeller pump-out vanes. The seal shall be a cartridge-type mechanical seal with Viton O-rings and silicon carbide (or tungsten carbide) faces. This cartridge seal shall be pre-assembled and pre-tested so that no seal settings or adjustments are required from the installer. Any springs used to push the seal faces together must be shielded from the fluid to be pumped. The cartridge shall also include a 17-4PH, heat-treated seal sleeve and a ductile cast iron seal gland.
- J. Automatic Oil Level Monitor:** An oil level switch shall be mounted at the top of the wet well, with a hose feeding down to the side of the bearing housing to monitor oil level and shut off the motor in event of low oil level. A relay shall be included for mounting in the motor control panel.
- K. Shaft Coupling:** The submersible motor shall be close coupled directly to the pump shaft using a solid sleeve coupling, which is keyed to both the pump and motor shafts. Slip clutches and shear pins between the shaft and the motor are considered unacceptable.
- L. Stainless Steel Nameplate:** Shall be attached to the pump giving the manufacturer's model and serial number, rated capacity, head, speed and all pertinent data.
- M. Submersible Motor:** The submersible motor shall be U/L or FM listed and suitable for Class I, Group C & D, Division I hazardous locations, rated at \_\_\_ HP, \_\_\_ RPM, \_\_\_ Volts, 60 Hertz and 3 phase, 1.15 service factor (1.0 for Continuous In-Air) with Class F insulation. Motor shall have tandem mechanical seals in oil bath and dual moisture sensing probes. Moisture probes must be connected to indicate water intrusion. The lower motor seal shall be exposed only to the lubricant in the pump bearing housing, with no exposure to the pumped media. Motor shall include two normally closed automatic resetting thermostats connected in series and embedded in adjoining phases. The thermostats must be connected per local, state, and/or the National Electric Code to maintain hazardous location rating and to disable motor starter if overheating occurs. Motor frame shall be cast iron, and all external hardware and shaft shall be stainless steel. Motor shall be sized for non-overloading conditions.
- N. Guide Rail System:** Provide a guide rail system consisting of two galvanized or stainless steel guide rails (by others), cast ductile iron pump guide bracket, cast ductile discharge elbow with mounting feet and Class 125 flanges, 316 stainless steel upper guide rail mounting bracket, and 316 stainless steel intermediate guide rail stiffener bracket every 10 feet.
- O. Optional Spark Proof Guide Rail System:** Provide a non-sparking guide rail system consisting of two galvanized or stainless steel guide rails (by others), cast bronze pump guide bracket, cast ductile iron discharge elbow with mounting feet and Class 125 flanges, 316 stainless steel upper guide rail mounting bracket, and 316 stainless steel intermediate guide rail stiffener bracket every 10 feet. System design shall prevent spark ignition of explosive gases during pump installation and removal.
- P. Surface Preparation:** Solvent wash and a single coat of Tnemec 431 epoxy applied at 5 MDFT minimum (except motor).
- Q. OPTIONAL Surface Preparation:** SSPC-SP6 commercial sandblast (except motor), a prime coat of Tnemec 431 epoxy and a finish coat of Tnemec 431 epoxy for total finish of 30 MDFT minimum (except motor).

## Appendix C

### Wet Well Wizard Information



# **Wet Well Wizard Specifications**

## **GENERAL SPECIFICATIONS**

The system shall be a Reliant Water Technologies **Wet Well Wizard**. It shall consist of at least three major parts, with specific fitting hardware, for the purpose of aerating and vigorously agitating sewer or lift station wet wells, or similar applications, on a continuous basis.

## **THE AIR SOURCE**

The air source must be a side channel, two stage, low volume, high pressure regenerative blower with an air release valve, plumbing for one or more wet well aeration ejectors, and a weather-proof pressure gauge for the purpose of aerating and agitating the liquid in a sewer or lift station wet well. The blower motor and flywheel specifications must be sized to accommodate the necessary pressure and air volume to properly aerate and agitate the water in a specific wet well, taking into consideration the well surface area, altitude, and water depths, including low water and high water depths. The wet well water agitation must be aggressive enough to continuously cause wave surges across the entire wet well surface. A single blower must be capable of supplying enough air volume and pressure for enough aeration ejectors to completely affect the entire surface of the wet well. It is important that no air from the air source can reach the intakes of underwater pumps in the wet well.

The air source will have a stainless steel manifold with the necessary number of air outlet ports to supply air to the required number of aeration ejectors identified in this specification. Each port will utilize stainless steel cam lock hose connectors to accommodate the required number of air feed hoses. There will be an Inches of Water gauge located on the primary manifold feed pipe.

## **THE AIR FEED HOSE**

A 1" OD, 3/4" ID, reinforced, double walled, PVC and polyurethane hose of variable lengths for the connection of the regenerative blower to each ejector tube in the wet well. Each end of the air feed hose must terminate with a mating stainless steel cam lock fitting for the air source manifold and the aeration tube or tubes.

## **THE AIR FEED HOSE CONNECTING HARDWARE**

All nipples and cam lock fittings for the hose between the regenerative blower and the aeration ejector in the wet well are to be made of either stainless steel or brass.

## **THE AERATION EJECTOR**

An 18" HDPE tube fitted to a stainless steel support 6" atop a 5" diameter stainless steel base weighing no less than 10 lbs. The interior of the ejector tube will be fitted with no less than 4 circular bubble cleaving disks made of HDPE with 1 flat edge each, situated in an antipodal manner as to cleave and spin large bubbles as they rise through the tube. The reinforced, double walled hose, (noted above) must enter the ejector from the dorsal end and pass through each cleaving disk, ending below

the bottom disk in such a way as to terminate with a brass outlet nipple held in place with a stainless steel clamp. All hardware holding the antipodal cleaving disks in place must be stainless steel and welded to the cleaving disks. The ejector tube must be positioned in a vertical orientation in the wet well and there will be no holes in the tube other than at the dorsal and bottom ends of the tube. No air entering the tube can escape the bottom end of the tube near the intakes of pumps situated in the bottom of the wet well. No air escaping the ejector will be in a fine bubble configuration. The ejector is strictly a coarse bubble ejector. The ejector must remain in a minimum of 3' of water.

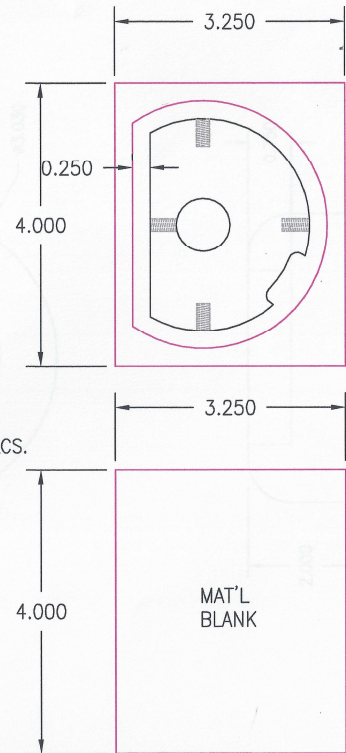
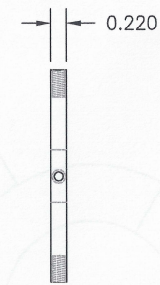
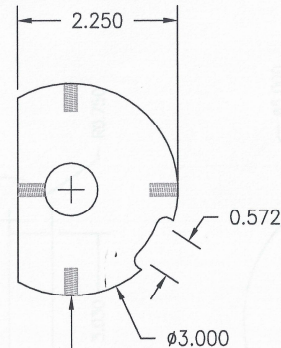
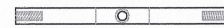
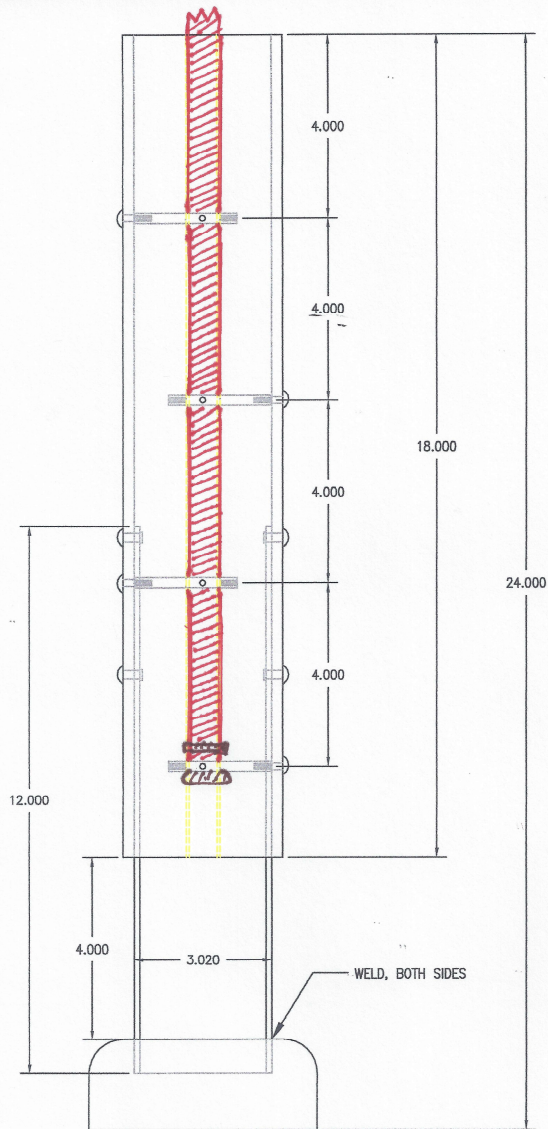
#### WARRANTIES

The equipment manufacturer must provide against defective or deficient equipment, workmanship and materials under normal use, operation and service. This warranty shall end one (1) year from accepted start-up or eighteen months from delivery, whichever is longest. The warranty shall be in printed form and shall apply to all units.



# UNIQUE!

Patent  
Pending



1/4" THICK HDPE PLASTIC  
4 REQ'D PER ASSEMBLY

**RELIANT**



## Appendix D

### Bohn Biofilter Information



**Bohn Biofilter Specifications:**

Biofilter Medium	Bohn soil biofilter media
Media Depth	5 ft (Standard range 4-6 ft)
Media Weight	105-120 lbs per cubic foot
Air Flow Rate	2300 CFM
Biofilter Size	552 ft <sup>2</sup> (Standard range 3-6 CFM per ft <sup>2</sup> ) Example 20 x 28 ft
Shutdown Required	None, other than semi-annual fan maintenance
Maintenance Required	1 hour per month to inspect fan and irrigation
Operating Requirements	
Fan	480V, 60 Hz, 3-phase, estimate 7.5 hp
Irrigation	Non-potable OK. Minimum 30 psi. On an irrigation day, 1 gpd per 10 CFM. Normal use is 4 days per week.
Design Conditions	Foul air from raw or treated sewage. Moist soil biofilter media. Foul air temperature from 40-130 F, 5- 55 deg C.
Design Performance	99% DRE of H <sub>2</sub> S for concentrations of 10-200 ppm. For concentrations below 10 ppm, a maximum discharge concentration of 0.1 ppm.

## **Bohn Biofilter Scope of Supply:**

### **I. Included are the following components:**

- A. Bohn soil media, the filter medium, a blend of sands, soils and top-soils.
- B. A foul air fan, FRP, with motor, flex-couplers and discharge transition.
- C. PE containment liner.
- D. HDPE biofilter air pipe and fittings.
- E. Gravel, air distribution and pipe-bedding material.
- F. Automated irrigation system, sprinkler or drip type.
- G. On-site construction oversight and start-up assistance.
- H. Operator training and Operation & Maintenance manuals.
- I. A 10 year life-span guarantee of the soil media.

### **II. Excluded components:**

- A. Installation of any components.
- B. Foul air duct to the fan and from the fan to the biofilter.
- C. Fan control components.
- D. Concrete works for fan, or other.
- E. Any duct supports, anchors or fasteners.

### **III. Included components in brief detail:**

- A. Soil media. Provide the biofilter soil media, an inorganic substrate, selected and amended per laboratory analysis for the degradation of pollutant gases. It is a blend of sands, soils and topsoils. This Bohn soil blend will be delivered to the job site in bulk, moist, blended and ready-to-place.
- B. Foul air fan. Provide a centrifugal type FRP foul air fan suitable for foul air and corrosive gases; includes fan motor, two smooth-wall flexible connectors and discharge transition; a Verantis CLUB, or equal
- C. PE containment liner. Provide a single-sheet PE containment liner with tape-on boots and fittings for pipe penetrations; a BTL-30 liner as manufactured by Bend Tarp&Liner, or equal.

### III. Included components in brief detail, continued:

- D. HDPE air pipe and fittings. Provide an HDPE header manifold with fabricated lateral connection stubs; a multi-tee. Provide all 6-inch slotted air distribution pipe and fittings. All connections and perforations are prefabricated, by Advanced Drainage Systems, or equal.
- E. Gravel, pipe-bedding. Provide gravel for air distribution, media support and bedding of pipe; a clean, washed rock tested for suitability with corrosive gases, approximately 1 inch.
- F. Automated irrigation system. Provide a sprinkler system by Rain Bird for surface irrigation of the biofilter; independently controlled by an automated timer, all ancillary components are provided up to the valve box.
- G. On-site construction overview. Provide authorized personnel for two (2) person-days for construction consultation, i.e. method of media placement, component installation/function. Provide certificate of proper installation. Provide consultation by telephone for start-up assistance.
- H. Operator training and manuals. Provide authorized personnel for one(1) person-day for hands-on training to the operations staff in the correct operation of the biofilter; includes troubleshooting and standard maintenance requirements. Provide Operation & Maintenance manuals produced specifically for the project.
- I. A 10 year life-span guarantee of the soil media. Provide a written guarantee that the soil media will not need removal or replacement for at least 10 years.

# Little microbes, Big impact.



## Improving communities by improving facilities...

Since 1986, we've been making biofilters that solve odor problems. Problems like a wastewater pump station located in a public park. Known for our 'soil media', BOHN systems are longterm solutions built to work all day, every day.

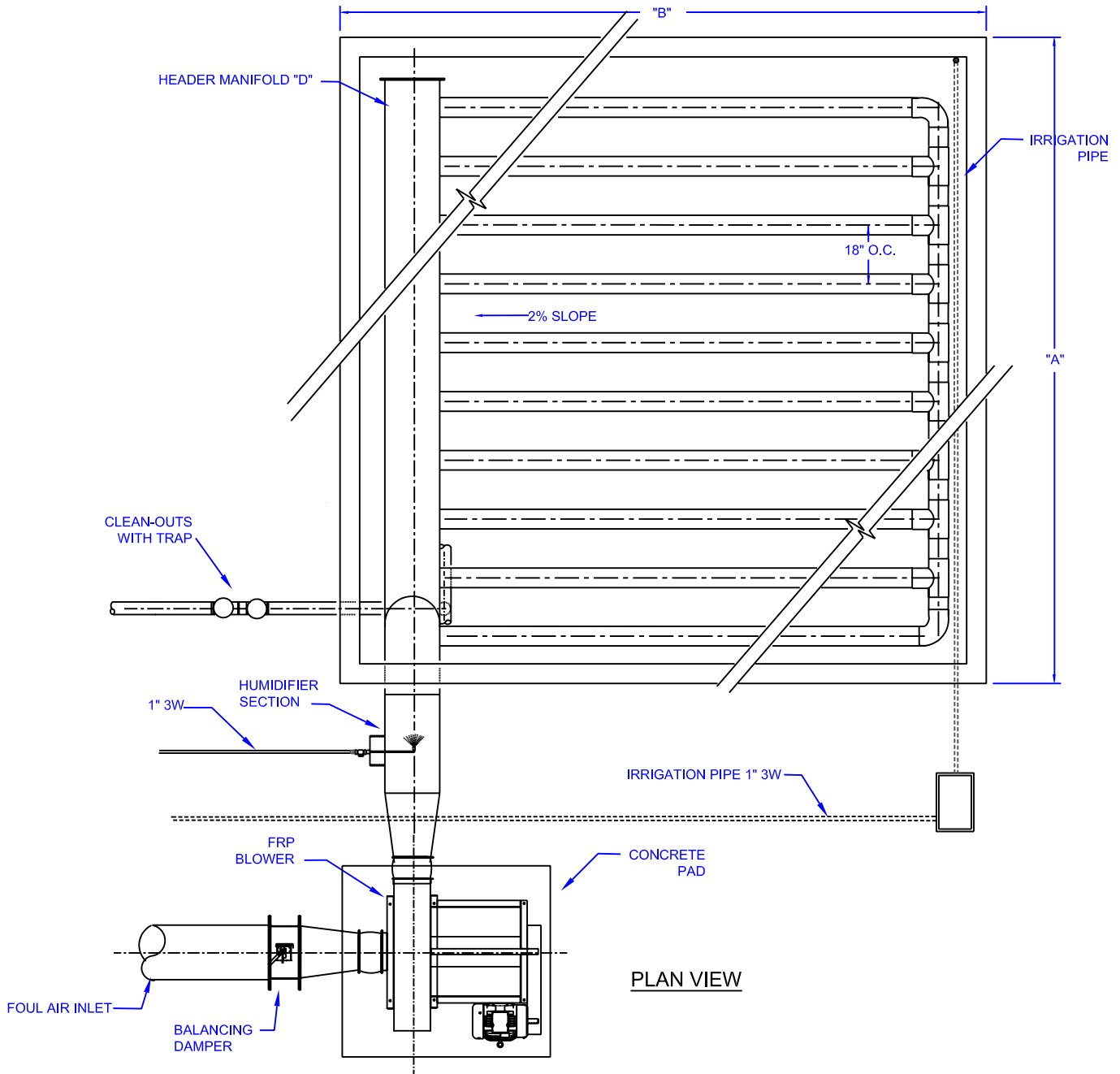
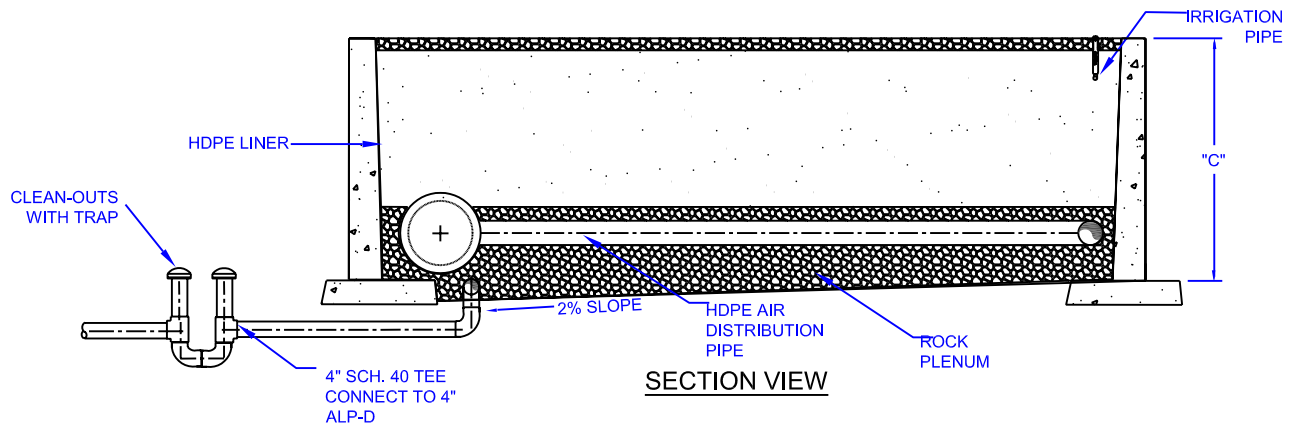
## **BOHN BIOFILTER**

**Odor and Air Emissions Control**

Tel: + 1 520.624.4644 • [www.bohnbiofilter.com](http://www.bohnbiofilter.com)







DRAWING IS FOR CUSTOMER APPROVAL.

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**BOHN BIOFILTER** CORP  
**Odor and Air Emissions Control**

Project:

Title:

Date:

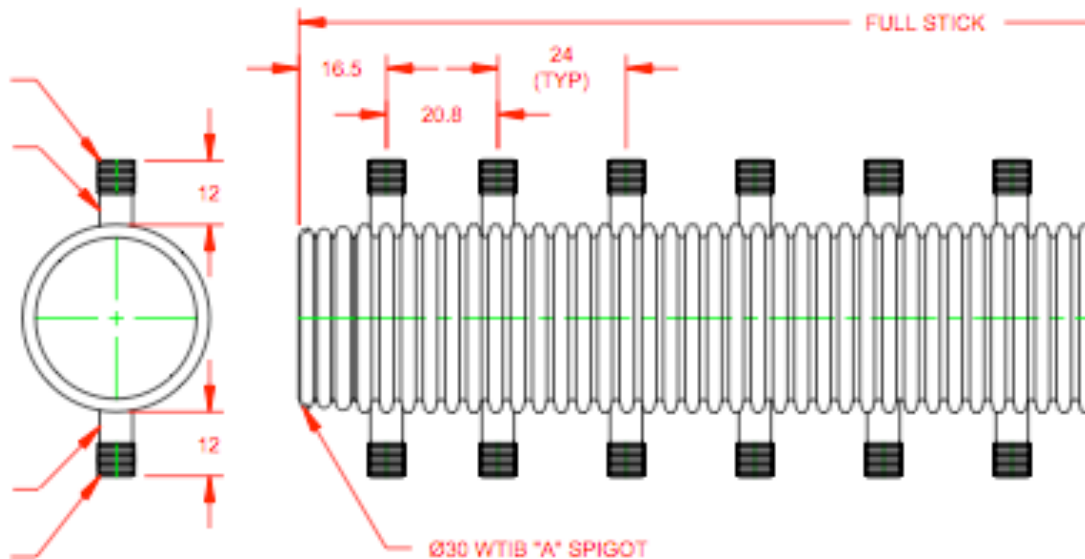
## FOUL AIR PIPE



### N-12® WT (watertight) Pipe

N-12 WT IB's polymer composite joint combined with HDPE's excellent abrasion and corrosion resistance, produces a joint with excellent strength. The wide proprietary polymer composite is fused to the outside wall of the built-in bell, improving the joint's integrity and tolerance control.

With its integral built-in bell and factory-installed gasket, the pipe requires no extra couplers, grout or other sealants to install. Includes a pressure-tested coupler that provides watertight connections meeting a full 10.8 psi in accordance with ASTM D3212 and ASTM C969 watertight field test.



## IRRIGATION

**RAIN BIRD**

- 5505-SS: 3/4" NPT female threaded inlet (5" stainless steel covered riser stem)



### ESP Modular Series Controller

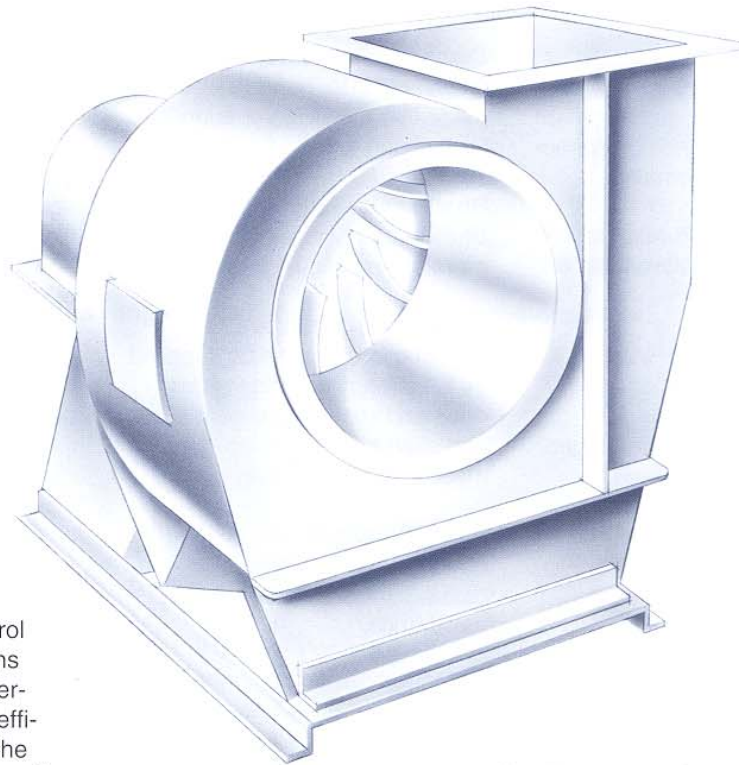
#### More Flexible

- Multiple programs give you the flexibility to accommodate the diverse watering needs of different plants and those areas of your lawn and garden that get more sun or shade, saving you water and money.
- Each program can have multiple start times, allowing you the flexibility to run programs several times a day for shorter lengths of time, helping you maintain a healthier lawn and garden.
- The modular design makes it easy to expand the controller's capabilities to 13 stations should the watering needs of your landscape change in the future.
- The water budget feature allows you to easily increase or decrease watering schedules without reprogramming, so you don't have to waste time at the controller.
- Four irrigation cycle modes for maximum flexibility and compliance to all major watering restrictions (Custom 7-day calendar, cyclic 1-31 day interval, and odd/even day calendar).

#### More Reliable

- Built in 5-year lithium battery keeps time, date and watering schedules intact during power outages, so relax and enjoy your landscape, worry-free.
- Superior surge protection — withstands nearly 3 times higher electrical surges than competitive controllers.
- Rain Bird quality construction and components.

# High Efficiency FRP Centrifugal Fans



Ceilcote Air Pollution Control CLUB Series fiberglass fans offer the widest range of performance and the highest efficiency of any FRP fan on the market. Since 1968 Ceilcote Air Pollution Control fans have provided trouble-free service in corrosive environments ranging from mild to severe.

## **Constructed to highest standards.**

Housings are made of premium corrosion-resistant, fire retardant polyester resin systems. Impellers are manufactured of premium vinylester to assure structural integrity under the intense dynamic forces of rotation. All fiberglass components are fabricated in accordance with ASTM C582 and ASTM 4167 specifications for fiberglass laminates and fiberglass blowers.

All metal parts exposed to the process gasses are fully encapsulated in FRP to assure maximum protection against chemical attack. Fan and motor bases are heavy-gauge steel coated with high build vinyl. Other protective coatings are available for severe service conditions.

## **Wide choice of sizes and performance characteristics.**

The CLUB Series is available in sizes 1500 through 6000 providing exhaust volumes up to 76,885 CFM and static pressures up to 10" WG.

## **Every unit pretested.**

Impellers are balanced statically and dynamically prior to assembly. Each fan is test run before shipment. Fan performance data has been obtained from tests conducted in accordance with standards published by AMCA and is licensed to bear the AMCA seal.

## **Using this bulletin.**

The following pages include all the information you need to select a CLUB Series fan for most applications. If you require technical assistance, call your Ceilcote Air Pollution Control representative or sales office. Phone numbers are on the back of this bulletin.

## CONTAINMENT LINER

# BTL™-30

## Single Scrim RPE (polyethylene)

LOW TEMPERATURE - HYDROCARBON STABLE

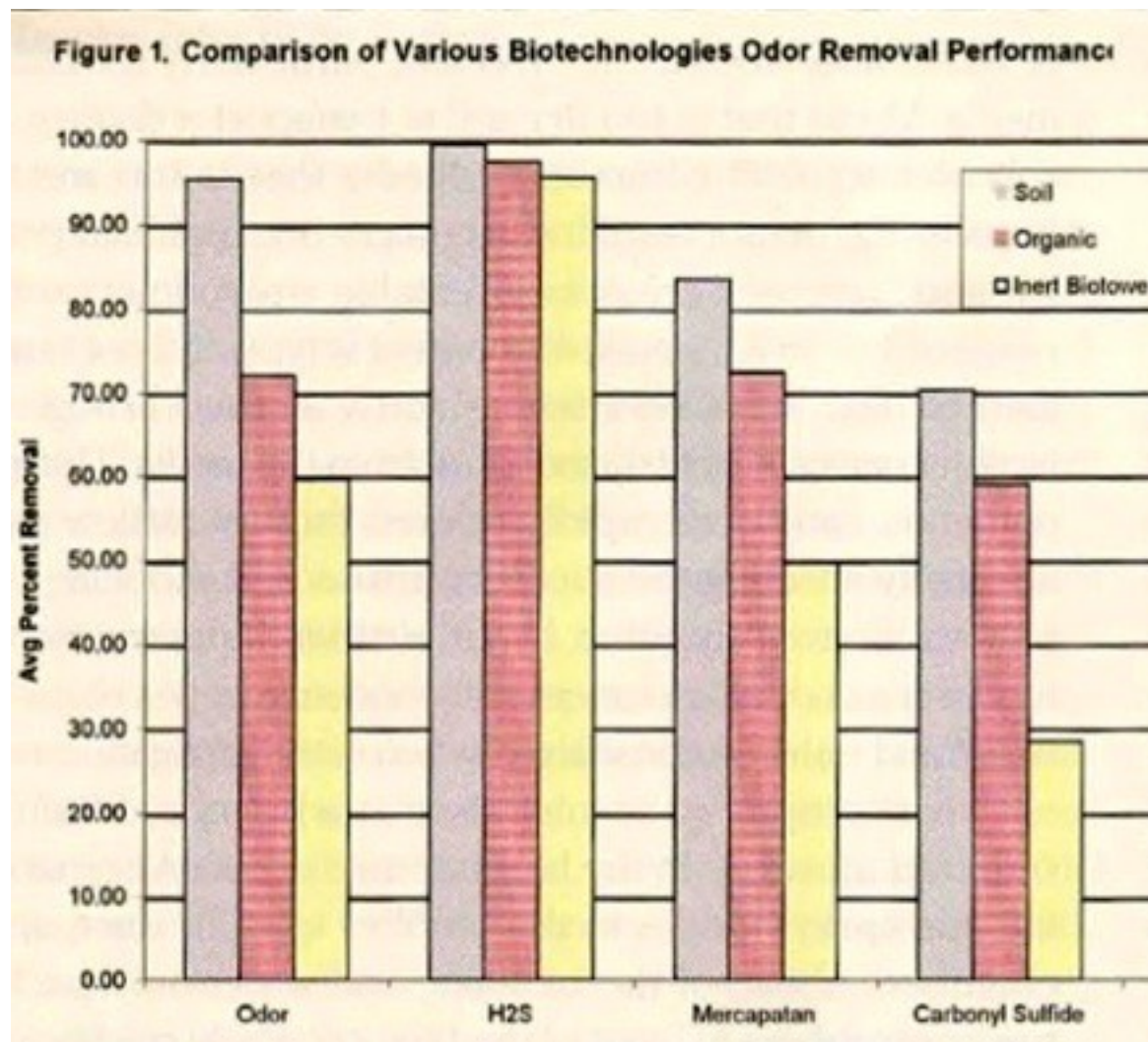
<b>DESCRIPTION</b>	BLACK 12 X 12 COUNT PER INCH	
<b>FABRICATION &amp; WAREHOUSE</b>	PRINEVILLE, OREGON	
<b>WEIGHT</b>	13.5 OZ./SQ.YD. (+/-5%)	ASTM D 751
<b>THICKNESS</b>	30 MILS (+/-5%)	ASTM D 5199
<b>COATING THICKNESS</b>	4.0 MILS EACH (+/-5%)	
<b>TONGUE TEAR</b>	WARP 421 LBS. WEFT 377 LBS.	ASTM D 5884-01
<b>ELONGATION TO BREAK</b>	WARP 29%	
<b>TRAPEZOIDAL TEAR</b>	WARP 340 LBS/INCH WEFT 530 LBS/INCH	ASTM D 4533-04
<b>BURSTING STRENGTH (MULLEN BURST)</b>	690 PSI	ASTM D 3786
<b>HYDROSTATIC RESISTANCE</b>	418 PSI	ASTM D 751
<b>LOW TEMPERATURE COLD CRACK</b>	-85F	ASTM D 2136
<b>PERMEABILITY</b>	0.0143 CM/SEC	ASTM D 4491
<b>CARBON BLACK CONTENT CARBON BLACK DISPERSION</b>	4.77% A-1	ASTM D 4218
<b>UV RESISTANCE</b>	90% STRENGTH RETAINED AFTER 2000 HRS.	ASTM G-151

**Bohn Biofilter Client Reference List:**

City of Corona WWTP (California)  
 Fairfield/Suisun Sewer District (California)  
 El Toro Water District (California)  
 Dublin/San Ramon Services District (California)  
 Truckee/Tahoe Sewer District (California)  
 City of Camas WWTP (Washington)  
 City of Puyallup WWTP (Washington)  
 City of Scottsdale (Arizona)  
 City of Phoenix (Arizona)

Frank Garza 951.279.3665  
 Marcie Bodeux 707.429.8930  
 Mark Pade 949.837.1050 x103  
 Dan Gallagher 925.846.4565  
 Jay Parker 530.587.3804  
 Bob Busch 360.834.3263  
 Jim Lee 253.435.3658  
 Bill Wilson 602.316.4584  
 Vernon Vasquez 602.262.1864

We also proudly share performance data.  
 Below is a graph published in an article for WE&T magazine... our product is the blue bars.  
 Chris Easter, et al. "Biotechnologies: Worth a Second Look." May 2005



## Appendix E

### Eco Verde Biofilter Information







| Design |


| Build |

| Deliver |

**A PROUD MEMBER OF THE NATIONAL MINORITY SUPPLIER DEVELOPMENT COUNCIL.**

*All of the information set forth in this document is confidential and/or proprietary. It has been prepared for the recipient's use in considering the purchase of the equipment as described herein. Transmission of any part of this information to others is expressly prohibited without EcoVerde's prior written consent.*

## 1. Performance Table:

		<b>Project: Avondale Lift Station</b> <b>Site: 4<sup>th</sup> Street Lift Station</b> <b>Size: EcoVerde EG-10.2T</b>		
<b>Performance Design*</b>				
Drain Water	pH	1.7-2.5		Lower H <sub>2</sub> S ppm yields higher pH drain water
Design Parameters	Units	Range		Comments
		Lower Limit	Upper Limit	
Airflow (24/7)	CFM	2150	2550	Design for 2300
<b>Assumed</b> H <sub>2</sub> S concentration inlet	ppm	5	100	Average 30
Process Air Temperature	°F	45	100	Heated air might be necessary if the process air temperature falls below the stated parameters.
Relative Humidity	%	60	100	
<i>The air should be free from dust, grease and oil particles, etc. It is assumed that the air supply is continuous, 24 hours a day, 7 days a week and that the design criteria above referenced is met.</i>				
<b>Utilities</b>				
Water Quality	Potable or <b>Non- Chlorinated</b> Effluent - depending on site			
Required Flow Rate	gpm	18		<i>intermittent</i>
Water Pressure- dynamic	psi	20		
System Pressure Drop	"W.C.	< 2"		**

### Notes:

\* The Owner must ensure that System is operated and maintained as verified through written records in accordance to Supplier's operation and maintenance manuals and within specified design criteria and performance table above.

\*\* Not including any pressure drop created by ductwork upstream of the blower.

## Irrigation water - quality required for an EG System:

Water	Effluent*
pH	6-8
Temp. Avg.	65 – 77° F (20-25° C)
Temp. Min/Max	59 – 99° F (15-37° C)

Property	Limits
COD	< 100 mg O <sub>2</sub> /L
BOD	< 30 mg O <sub>2</sub> /L
N <sub>tot</sub>	= 2-20 mg N/L
P <sub>tot</sub>	= 1-5 mg P/L
Chlorine	< 1 ppm (total Chlorine; e.g. Cl <sub>2</sub> , OCl)
TSS	< 10 mg/L
Salts	< 2000 ppm (e.g. NaCl, KCl)
Hardness	< 400 mg CaCO <sub>3</sub> (operated at pH = 2)

\*If using potable water, the need to add EG-Assist nutrients to the system will be required to meet the performance specifications provided.

## 2. Estimated Operational Expenditures:

Parameter	Value	Notes
Operations and Maintenance Labor	Approx. 30 mins/week	
Electrical Consumption	± 80 kW/h per day	Blower + recirculation pump + Controls
BTF Media (1st stage)	15 yr warranty	<b>No maintenance or replacement needed.</b>
Required Water Supply	18 GPM at 20 PSI Dynamic	Water use is intermittent.
Total Daily Water Use	± 2160 GPD	Daily water use is proportional to the H <sub>2</sub> S concentration and is based on 15 ppm on average. Estimate is based on using recirculation water for 25% of the time.
Nutrient Consumption*	± 40 lbs./55-Gal tank	*If potable water is used. The nutrient cost is \$12/lbs.

### **3. EcoVerde's Scope of Supply:**

#### **One (1) EcoVerde EG-10.2T Biological Odor Control System:**

The system (10' diameter x 14' height approx. without the outlet stack) is constructed with corrosion resistant fiberglass resin with UV inhibitors and constructed per ASTM-D-4097. Tank includes all 316 S.S. hardware and EPDM gaskets, an FRP air distribution system, FRP grating to support the media, and FRP outlet elbow stack. There is approximately 610 ft<sup>3</sup> of structured synthetic media in the primary stage and 50.7 ft<sup>3</sup> of polishing media in the secondary stage providing a total contact time of approximately 17.2 seconds. A handrail, ladder and cage will also be provided as per OSHA requirements. (Polishing media to be installed on-site after acclimation period, by others).

#### **One (1) Electrical Control Panel:**

One standard electrical control system including an HMI/PLC to monitor the system and all necessary components for proper functioning of the system. The panel comes prewired/preassembled and integral to the system for a standard. All electronic components are housed in a NEMA 4X enclosure and rated for class 1 division 2 environments.

#### **One (1) Water Cabinet:**

One standard water control unit including one Class 1 Division 2 solenoid valve, a flow meter, ball valves, diaphragm valve, a water pressure gauge, a chemical metering pump (for nutrients), nutrient tank, and a recirculation pump.

#### **One (1) Damper Valve:**

One 16" FRP Damper Valve at inlet to control the airflow.

#### **One (1) Blower:**

One FRP Blower capable of 2300cfm at 2" w.c.

#### **Ductwork:**

One lot of ductwork to connect from the blower to the odor control system including flexibles and transition pieces. (Installation and support by others.)

#### **Start-up of Equipment and Training:**

A factory trained Field Service Engineer will be available 8 days for training, inspection and start-up of the system. Equipment training will coincide with start-up.

#### **Freight**

FOB – Jobsite

#### **Lead Time**

4-5 weeks for submittals

14-16 weeks after approved submittals

### **Items required that MUST be provided by others:**

- **One (1) level pad:**  
Used for placement of system.
- **One (1) level pad:**  
Used for placement of the blower.
- **Electrical:**  
Power must be available and brought to the EG system and blower.
- **Fresh Raw Activated Sludge (RAS):**  
Client will provide and apply fresh RAS to the system for the first three (3) days of start-up or as instructed by EcoVerde.
- **Supply Water:**  
Potable/Non-chlorinated water available always at 40-75 psi static per the flows depicted above.
- **System shipment/ offloading/ installation:**  
Client will provide means to unload, place, and anchor the EG system.

### **4. Warranties:**

#### **System Warranty**

EcoVerde warrants the integrity of the FRP vessel for a period of one (1) year after the date of substantial completion. All other equipment within the system is warranted against defects in material and workmanship for a period of twelve (12) months after start-up. In the event it is determined that a defect exists in such equipment, EcoVerde's sole obligation shall be to repair or replace the defective equipment.

#### **Media Warranty**

The Owner must ensure that System is operated and maintained in accordance with specified design criteria through written records and in accordance with the instructions provided in the Supplier's operation and maintenance manuals. EcoVerde warrants the synthetic media against defects in material and workmanship for a period of fifteen (15) years from equipment delivery. In the event it is determined that a defect exists in the media, EcoVerde's sole obligation shall be to repair or replace the defective media. *There is no warranty on the Carbon media.*

#### **Performance Warranty**

The Owner must ensure that System is operated and maintained as verified through written records in accordance with specified design criteria and in accordance with the instructions provided in the Supplier's operation and maintenance manuals. The warranty is subject to validation of operation of the equipment in accordance with EcoVerde's Operation and Maintenance Manual, and Equipment Startup and Operator training being performed by an EcoVerde service engineer.

## ECOVERDE, LLC. STANDARD TERMS AND CONDITIONS OF SALE

Applicable Terms. These terms govern the purchase and sale of the equipment and related services. If any (collectively, "Equipment"), referred to in Seller's purchase order, quotations, proposal or acknowledgement, as the case may be ("Seller's Documentation"). Whether those terms are included in an offer or an acceptance by Seller, such offer or acceptance is conditions on Buyer's assent to these terms. Seller rejects all additional or different terms in any of Buyer's forms or documents.

Payment. Buyer shall pay Seller the full purchase price as set forth in Seller's Documentation. Unless Seller's Documentation provides otherwise, freight, storage, insurance and all taxes, duties or other governmental charges relating to the Equipment shall be paid by Buyer. If Seller is required to pay any such charges, Buyer shall immediately reimburse Seller. All payments are due within 14 days after receipt of invoice. Buyer shall be charged the lower of 1.5% interest per month or the maximum legal rate on all amounts not received from the date of the invoice until the date on which such invoice is paid and shall pay all of Seller's reasonable costs (including attorney's fees) of collecting amounts due but unpaid. All orders are subject to credit approval.

Delivery. The Delivery date set forth in the Proposal is the Seller's best estimate when the Equipment will be available for the carrier and shall not be deemed to represent a fixed or guaranteed delivery date. Unless Seller's Documentation provides otherwise, deliver terms are F.O.B. Seller's facility. Delivery shall be deemed to have been made when Seller place the Equipment in the possession of a carrier selected by Buyer (or Seller with Buyer's approval) at which time Buyer shall bear the risk of loss for the Equipment. If conditions do not permit immediate installation, storage of FRP materials as well as all other products delivered by Seller must be in accordance with instructions included in Seller's O&M. Seller assumes no liability and expressly disclaims responsibility for any loss or damage, direct, indirect or consequential, due to improper storage.

Ownership of Materials. All devices, designs (including drawings, plans, specifications, and manuals), estimates, prices, notes, electronic data and other documents or information prepared or disclosed by Seller, and all related intellectual property rights, shall remain Seller's property. Seller grants Buyer a non-exclusive, non-transferable license to use any such material solely for Buyer's use of the Equipment. Buyer shall not disclose any such material to third parties without Seller's prior written consent.

Changes. Seller shall not implement any changes in the scope of work described in Seller's Documentation unless Buyer and Seller agree in writing to the details of the change and any resulting price, schedule or other contractual modifications. This includes any changes necessitated by a change in applicable law occurring after the effective date of any contract including these terms.

Seller's Liability for Shortages, Delivery of Improper Material or Deliver of Damages or Defective Material. The buyer agrees to carefully check material upon unloading at destination. No claims for shortages or delivery of improper material shall be recognized by seller unless written notice with accompanying photos of the material specifying in detail the nature and extent of the shortage, effect, or damage is mailed or emailed to Seller within ten (10) days from receipt. In no case shall Seller pay or be liable for any claims resulting from the use of the Buyer or improper material or use by the Buyer of having material apparent defects or damages when installed by the buyer.

Cancellation. In the event that any order is canceled, either in whole or in part, the Buyer shall pay to the Seller all of the cost incurred by the Seller incident to such cancellation, including, but not limited to engineering costs, costs of special tools, equipment and raw material plus 30% thereof for restocking or cancellation fees. In addition, thereto, the Buyer shall pay the unit price for all items of special manufacture completed before the seller receives notice of cancellation.

LIMITATION OF LIABILITY. NOTWITHSTANDING ANYTHING ELSE TO THE CONTRARY, SELLER SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL, SPECIAL, PUNITIVE OR OTHER INDIRECT DAMAGES, AND SELLER'S TOTAL LIABILITY ARISING AT ANY TIME FROM THE SALE OR USE FO THE EQUIPMENT SHALL NOT EXCEED THE PURCHASE PRICE PAID FOR THE EQUIPMENT. THESE LIMITATIONS APPLY WHETHER THE LIABILITY IS BASED ON CONTRACT, TORT, STRICT LIABILITY OR ANY OTHER THEORY.

Miscellaneous. If these terms are issued in connection with a government contract, they shall be deemed to include those federal acquisition regulations that are required by law to be included. The parties specifically exclude the provisions of the United Nations Convention on Contracts For the International Sale of Goods. These terms, together with any quotations, purchase order or acknowledgement issues or signed by the Seller, comprise the complete and exclusive statement of the agreement between the parties ("The Agreement") and supersede any terms contained in Buyer's documents, unless separately signed by Seller. No part of the Agreement may be changed or cancelled except by a written document signed by Seller and Buyer. No course of dealing or performance, usage of trade or failure to enforce any term shall be used to modify the Agreement. If any of these terms is unenforceable, such term shall be limited only to the extent necessary to make it enforceable, and all other terms shall remain in full force and effect. Buyer may not assign or permit any other transfer of the Agreement without Seller's prior written consent.

Governing Law. This Agreement and the rights of the parties hereunder shall be interpreted in accordance with the laws of the State of Arizona, and all rights and remedies shall be governed by such laws without regard to any provision that would result in the application of the laws of any other state or jurisdiction.





## Appendix F

### Cost Estimate





**City of Avondale  
4th Street Lift Station**

**Project No. 28489  
Budgetary Cost Estimate**

**February 2018**

**Summary of Total Cost**

<b>Vaughan Chopper Pumps</b>	<b>\$</b>	<b>351,000.00</b>
<b>Reliant Wet Well Wizard</b>	<b>\$</b>	<b>78,000.00</b>
<b>Bohn Biofilter (recommended)</b>	<b>\$</b>	<b>546,000.00</b>
<b>Eco Verde Biofilter</b>	<b>\$</b>	<b>448,110.00</b>
<b>Replacing Existing Biofilter Media</b>	<b>\$</b>	<b>103,500.00</b>
<b>Wet Well Coating</b>	<b>\$</b>	<b>108,000.00</b>
<b>Painting</b>	<b>\$</b>	<b>37,800.00</b>
<b>Drainage Repair</b>	<b>\$</b>	<b>112,500.00</b>
<b>Upgrading Electrical Equipment</b>	<b>\$</b>	<b>285,000.00</b>

City of Avondale				
4th Street Lift Station				
Item	Quantity	Unit	Unit Price	Total Price
Contingency (25%)				\$ 91,000.00
<b>Subtotal</b>				<b>\$ 455,000.00</b>
Engineering & Construction Administration (20%)				\$ 91,000.00
<b>Total</b>				<b>\$ 546,000.00</b>
<b>Eco Verde Biofilter</b>				
Eco Verde Biofilter	1	EA	\$ 298,740.00	\$ 298,740.00
Contingency (25%)				\$ 74,685.00
<b>Subtotal</b>				<b>\$ 373,425.00</b>
Engineering & Construction Administration (20%)				\$ 74,685.00
<b>Total</b>				<b>\$ 448,110.00</b>
<b>Replacing Existing Media</b>				
Media Replacement	1	EA	\$ 69,000.00	\$ 69,000.00
Contingency (25%)				\$ 17,250.00
<b>Subtotal</b>				<b>\$ 86,250.00</b>
Engineering & Construction Administration (20%)				\$ 17,250.00
<b>Total</b>				<b>\$ 103,500.00</b>
<b>Wet Well Coating</b>				
Wet Well Coating	1800	SF	\$ 40.00	\$ 72,000.00
Contingency (25%)				\$ 18,000.00
<b>Subtotal</b>				<b>\$ 90,000.00</b>
Engineering & Construction Administration (20%)				\$ 18,000.00
<b>Total</b>				<b>\$ 108,000.00</b>
<b>Painting</b>				
Exterior Painting	5400	SF	\$ 2.50	\$ 13,500.00
Pump Hoist Rails	1	EA	\$ 500.00	\$ 500.00
Contingency (25%)				\$ 3,500.00
<b>Subtotal</b>				<b>\$ 31,500.00</b>
Engineering & Construction Administration (20%)				\$ 6,300.00
<b>Total</b>				<b>\$ 37,800.00</b>
<b>Drainage Repair</b>				
Curb, grading, drains	1	EA	\$ 75,000.00	\$ 75,000.00
Contingency (25%)				\$ 18,750.00
<b>Subtotal</b>				<b>\$ 93,750.00</b>
Engineering & Construction Administration (20%)				\$ 18,750.00
<b>Total</b>				<b>\$ 112,500.00</b>
<b>Electrical Upgrades</b>				
Electrical	1	EA	\$ 190,000.00	\$ 190,000.00
Contingency (25%)				\$ 47,500.00
<b>Subtotal</b>				<b>\$ 237,500.00</b>
Engineering & Construction Administration (20%)				\$ 47,500.00
<b>Total</b>				<b>\$ 285,000.00</b>