VVWRA SIDESTREAM AMMONIA TREATMENT

Revision	*Date*	*Description*
R1	*9 December 2025*	*Vendor Proposal Evaluation and Technical Recommendation*
R0	*20 October 2025*	*Updated Design Basis for Anammox System*

Contents

Victor Valley Wastewater Reclamation Authority (VVWRA) currently treats high-ammonium side stream filtrate generated from thickening of anaerobically digested solids. The document below summarizes the design criteria that will be used for the selection and sizing of Dewatering equipment and an Anammox system for the side-stream treatment of ammonia in the digestate produced by the 5 operating digesters at VVWRA.

1 Design Basis Scenarios

The project is divided into 3 phases, depending on Plant Inflow, the number of ADM trucks received, and the choice of dewatering technology.

Phase	Plant Flow	ADM Trucks	Dewatering System
I	11.4 MGD	90	GBT (existing)
II	11.4 MGD	110	Dewatering Press
III	18 MGD	110	Dewatering Press

Plant Flows (PS, WAS, and TPS and TWAS) and characteristics (TS/VS) were taken directly from B&V's modelled values (**Table 2, page 22**).

PLANT FLOWS		PHASE I	PHASE II	PHASE III
Flow	MGD	11.40	11.40	18.00
BOD	mg/L	320	320	350
TSS	mg/L	460	460	500
Flow	MGD	0.12	0.12	0.18
%TS	%	2.70	2.70	2.70
%VS	%	85.80	85.80	85.80
TS loading	Lbs/d	26,251	26,251	40,532
Flow	MGD	0.28	0.28	0.57
TSS	mg/L	7,300	7,300	7,300
TS loading	Lbs/d	17,008	17,008	34,703

2 Design Basis Summary

2.1 Initial design basis by B&V

The following was set by B&V and used by vendors for quoting the Anammox system.

PHASE	Daily Digestate Flow (MGD)	Filtrate Flow (MGD)	Filtrate Ammonia Concentration (mg/L)	Max Filtrate Ammonia Loading (lb/d)
PHASE I	0.15	0.13	1014	1100
PHASE II	0.17	0.21	1141	2000
PHASE III	0.25	0.31	1160	3000

The following were noted in Black & Veach's original design basis calculations

- Excluded Wash water usage in GBT/Press **(Page 14).**
- Excluded Polymer/dilution flow in their calculations **(Page 18)**.
- 5-day/wk operating basis for Dewatering and Anammox System **(Page 7).**

Anaergia has made the following additions to the design basis:

- Estimated ammonia generated in the digesters based on conversion of TKN in digesters for each of the individual feed streams (PS, TWAS, ADM) instead of using ~1000 mg/L as a base value for all scenarios.
- Provided average and max ammonia loadings using a design factor of 20%.
- Estimated flows out of GBT/ Filter press by considering both wash water, polymer flow, and cake production.
- Revised ADM flows to reflect 90 trucks instead of 70 for Phase I of the project.
- Anammox system to operate 7d/wk.

2.2 Design Basis updated by Anaergia

Digester will be processing feed 7 d/wk for all the three phases. Digestate will be stored in an open lagoon for approximately 10 days before thickening in a gravity belt thickener or dewatering press. Thickened digestate will be pumped to solar drying beds. The filtrate generated will flow into the equalization tank (~1 d HRT) before being fed to the Anammox tanks continuously.

- VVWRA has 3 secondary clarifiers (55ft Dia x 17 ft SWD) with holding volume ~302,000 gal that will be available to be converted to treatment tanks for the side stream ammonia treatment.
- 1 Tank will be used as an equalization tank for filtrate, and the remaining two tanks will be available to be converted to anammox treatment tanks.
- Dewatering equipment will be sized to handle the entire flow over 5 days/wk, while anammox will be sized to operate 7 days/wk.

Operating Days for Each System			
Process Unit	PHASE I	PHASE II	PHASE III
Digester	7d/wk	7d/wk	7d/wk
Dewatering	5d/wk	5d/wk	6d/wk
Anammox	7d/wk	7d/wk	7d/wk

2.2.1 Average Ammonia Loading

		PHASE I	PHASE II	PHASE III
Digestate Flow	ton/wk	4,662	5,062	7,164
	gal/wk	1,118,000	1,214,000	1,718,000
Ammonia in Digestate	lb/wk	8,479	9,248	13,455
	mg/L	909	913	939

Digestate Flow	ton/wk	4,662	5,062	7,164
	gal/wk	1,118,000	1,214,000	1,718,000
Polymer Dosing	lb/TTSS	20	20	20
Polymer+WashWater Flo	ton/wk	1,599	629	797
Flow to Dewatering	Gal/wk	1,501,440	1,364,880	1,909,200
Cake TS	%	6%	16%	16%
Cake Flow	ton/wk	1399	570	806
Filtrate Flow	ton/wk	4,862	5,122	7,155
	Gal/wk	1,166,040	1,228,305	1,715,925
Ammonia in Filtrate	lb/wk	6,088	8,374	12,183
	mg/L	626	817	851

Including a design factor of 20% for ammonia loading in digestate, the maximum loadings are summarized below.

2.2.2 Max Ammonia Loading

		PHASE I	PHASE II	PHASE III
Digestate Flow	ton/wk	4,662	5,062	7,164
	gal/wk	1,118,000	1,214,000	1,718,000
Ammonia in Digestate	lb/wk	10,175	11,097	16,146
	mg/L	1,091	1,096	1,127

Digestate Flow	ton/wk	4,662	5,062	7,164
	gal/wk	1,118,000	1,214,000	1,718,000
Polymer Dosing	lb/T TSS	20	20	20
Polymer+WashWater Flow	ton/wk	1,599	629	797
Flow to Dewatering	Gal/wk	1,501,440	1,364,880	1,909,200
Cake TS	%	6%	16%	16%
Cake Flow	ton/wk	1399	570	806
Filtrate Flow	ton/wk	4,862	5,122	7,155
	Gal/wk	1,166,040	1,228,305	1,715,925
Ammonia in Filtrate	lb/wk	7,306	10,049	14,620
	mg/L	751	981	1,022

2.2.3 Removal Efficiency

- B&V has modelled (**Figure 2, Page 8**) ammonia removal rates required in side stream treatment to meet effluent discharge limits (20 mg/L TN).
- 40% removal @ 12,840 lb/wk of ammonia is sufficient to meet discharge limits. 60% is considered for the design basis, suggesting that up to 5,200lb/wk (742 lb/d) of ammonia can be sent back to the headworks post side stream treatment.
- The required removal efficiencies for the three phases are summarized.

Phase	Avg Ammonia Loading	Max Ammonia Loading
Phase I	16%	30%
Phase II	39%	49%
Phase III	58%	65%

Additional WW characteristics common to all phases are summarized below

Parameter	unit	Range
TSS	mg/L	500-1,000
Total COD	mg/L	1,000-1,500
Soluble COD	mg/L	600-1,000
Alkalinity	mg/L	3,500-4,000
Temperature	C	20-35

3 Detailed Calculations

Calculations shown below are for average ammonia loadings.

3.1 Estimation of Digester Feed

FEED TO DIGESTER		PHASE I	PHASE II	PHASE III
Flow	MGD	0.05	0.05	0.08
%TS	%	6.40	6.40	6.40
%VS	%	88.20	88.20	88.20
TS loading	Lbs/d	29,247	29,247	45,159
Flow	MGD	0.04	0.04	0.09
%TS	%	4.4	4.4	4.4
%VS	%	83.6	83.6	83.6
TS loading	Lbs/d	16,336	16,336	33,332
Trucks per week	loads/wk	90	110	110
Capacity per truckload	gal/load	4800	4800	4800
Flow	MGD	0.06	0.08	0.08
TS%	%	10%	10%	10%
TS loading	lb/d	51,470	62,907	62,907

Please note that, for Phase III, the HRT of the Digester will fall below 15d, which may cause performance issues with the Digester.

3.2 Estimation of Ammonia Load in Digestate

Flow	MGD	0.05	0.05	0.08
TS Loading	Lbs/d	29,247	29,247	45,159
TKN in Sludge (%TS)	%	2.5%	2.5%	2.5%
VSR of Sludge in AD	%	50%	50%	50%
N Mineralization in AD	% VSR	80%	80%	80%
Ammonia Load PS	lb/d	292	292	452
Flow	MGD	0.04	0.04	0.09
TS Loading	Lbs/d	16,336	16,336	33,332
TKN in Sludge (%TS)	%	6.5%	6.5%	6.5%
VSR of Sludge in AD	%	50%	50%	50%
N Mineralization in AD	% VSR	80%	80%	80%
Ammonia Load TWAS	lb/d	425	425	867
Flow	MGD	0.06	0.08	0.08
TS Loading	Lbs/d	51,470	62,907	62,907
TKN in ADM(%TS)	%	1.50%	1.5%	1.5%
VSR of ADM in AD	%	80%	80%	80%
N Mineralization in AD	% VSR	80%	80%	80%
Ammonia Load ADM	lb/d	494	604	604
Daily Digestate Production	MGD	0.16	0.17	0.25
Total Ammonia Load in Digestate	lb/d	1,211	1,321	1,922
	lb/wk	8,479	9,248	13,455
Digestate Ammonia Conc.	mg/L	909	913	939

3.3 Estimation of Filtrate Flows and Ammonia Loadings

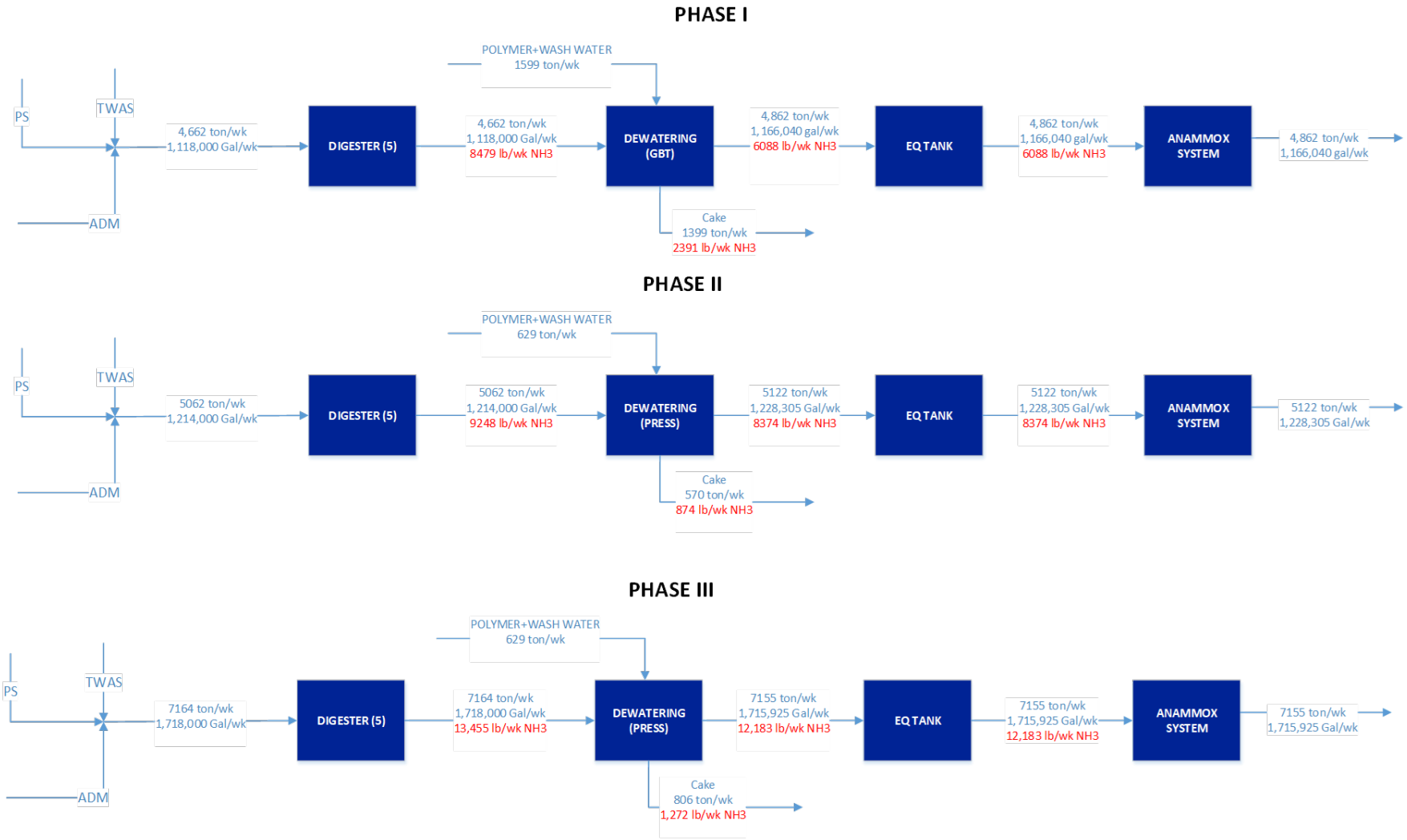
3.3.1 PHASE I

Polymer Dose	lb/TTSS	20
Polymer Concentration	%	0.25%
Polymer Flow	Gal/wk	89,440
Wash Water	Gal/wk	294,000
Polymer+Wash Water	ton/wk	1,599
Total Flow to GBT	Gal/wk	1,501,440
TSS Capture Rate	%	90%
Cake TS	%	6%
Cake Flow	ton/wk	1399
Filtrate Flow	gal/wk	1,166,040
	ton/wk	4,862
Ammonia Fraction in Cake	%	28%
Filtrate Ammonia Load	lb/wk	6,088
	lb/d	870
Filtrate Ammonia Concentration	mg/L	626

3.3.2 PHASE II and III

Polymer Dose	lb/T TSS	20	20
Polymer Concentration	%	0.25%	0.25%
Polymer Flow	Gal/wk	97,120	137,440
Wash Water	Gal/wk	53,760	53,760
Polymer+Wash Water	ton/wk	629	797
Total Flow to SSD	Gal/wk	1,364,880	1,909,200
TSS Capture Rate	%	90%	90%
Cake TS	%	16%	16%
Cake Flow	ton/wk	570	806
Filtrate Flow	Gal/wk	1,228,305	1,715,925
	ton/wk	5,122	7,155
Ammonia Fraction in Cake	%	9%	9%
Filtrate Ammonia Load	lb/wk	8,374	12,183
	lb/d	1,196	1,740
Filtrate Ammonia Concentration	mg/L	817	851

3.4 Block Flow Diagram (Average Loading)



4 Vendor Proposal Evaluation

- Pre-Screened vendors (Word Water Works and Veolia) by Black and Veatch were requested to submit revised proposals with the updated design basis.
- World Water Works, which has previously submitted a proposal for the Suspended Growth System, was requested to revise the proposal and submit an MBBR proposal, as VVWRA had shown inclination to have an MBBR system.
- Vendors were also requested to include Chemical Dosing Skid (Caustic) in their scope, along with Influent/Effluent Ammonia Analyzers.
- Design Basis for RFP is provided below.

Parameter	Units	Phase 1	Phase 2	Phase 3
Flow	MGD	0.166	0.175	0.245
Ammonia Loading (Average)	lb/d	870	1196	1740
Ammonia Loading (Max)	lb/d	1044	1436	2089
Temp	C	20-35		
Alkalinity	mg/L	3000-4000		
Soluble COD	mg/L	600-800		
TSS	mg/L	500-1500		
Removal Efficiency Required (TIN)	%	70%		

- Detailed breakdown of system and process parameters comparing the proposals are provided in the next sections.

4.1 Proposal Summary

Category	WWW – DEANA®	Veolia – ANITA™ Mox
Technology	DEANA® fixed-film anammox (MBBR) (Revised from original proposal of suspended growth system)	ANITA™ Mox MBBR
Phasing approach	1 Treatment Tank for all three phases (Optional) 2 Treatment Tank for Phase 3	1 Treatment Tank for Phase 1/2. 2 Treatment Tanks for Phase 3
Media	WWW-02 VHT media (25 mm dia × 4 mm tall; density 0.97–0.99);	AnoxK™5 media
Media Fill %	Not Mentioned	43% **(P1)** 46% **(P2)** 32% **(P3)**
Media retention screens	Perforated plate screen (SS 304L) (1 per reactor)	Cylindrical screen assemblies (2 per reactor), 304L SS
Aeration system	Medium bubble (but also mentions coarse at other places)	Medium bubble aeration grids
Mixing	Side-mounted mixers (Landia) with VFDs; 2 × ~9 HP mixers per tank	1 mixer per reactor with VFD (~10 HP)
Air Demand	1,320–2,600 SCFM per tank depending on phase Blowers, 100 HP (2 duty + 1 standby) **(P1-P3)**	1,300–2,600 SCFM per tank depending on phase Blowers 175 HP, 1+1 (Duty+Standby) **(P1-P2)** 2+1 (Duty+Standby) **(P3)**
Controls	Allen Bradley PLC; 15” touchscreen HMI; DO & pH probes (and conductivity) on float; Ethernet remote access	ControlLogix PLC + PanelView HMI; DO, pH, influent/effluent ammonia analyzers, nitrate probe, airflow meter; Hubgrade remote connectivity
Chemical Dosing (Caustic)	Did not quote chemical skid in scope	Chemical dosing skid included
Field services / support	**P1-P3** Startup & training: 9 trips / 36 days; 6 months remote monitoring (base). **P3** -Add-tank scope: 4 trips / 16 days + 6 months remote	Inspection, startup assistance, training, control testing; Hubgrade start-up kit with remote expert review
Lead Time	Does not mention in proposal	Shop drawings 6–8 weeks after contract; delivery 18–28 weeks after shop drawing approval; O&M manuals within 90 days after approval
Pricing presented	$1,850,000 (**P1–P3** – 1 tank scope) + $850,000 (**P3** – second tank scope)	$1,998,000 **(P1)**; $2,085,000 **(P2)**; $2,916,000 **(P3)**
Additional Notes	References not shared for MBBR	Feed pumps/valves not in scope
	pH/DO based control	Influent/effluent NH3+DO based control
	Design Temp 25C	Design Temp. 28C
	Ammonia Analyzers or chemical dosing skid not included in scope of supply (both were requested)	
	Does not expand media volume/fill requirements	
	Underestimating TSS variation	
Final Recommendation	Disqualified, WWW is primarily interested in supplying suspended growth systems and does not have a robust proposal for a MBBR system	Qualified, is most suited for MBBR system with technical and field expertise.

4.2 Technical Summary

Metric	**WWW (DEANA) Average/Max**	**Veolia (ANITA Mox)**
Design flow (MGD)	0.166 / 0.166	0.166
TSS (mg/L)	< 700 / < 700	1,500
TKN (mg/L)	628 / 754	
Soluble COD (mg/L)	< 600 / < 700	800
Alkalinity (mg/L as CaCO3)	3,500 / 3,500	3,500–4,000
Temperature (°C)	20–30 / 20–30	20/35 (min/max)
NH4-N (avg) mg/L		630
NH4-N (avg) lb/d		870
NH4-N (max @ design flow) mg/L		754
NH4-N (max @ design flow) lb/d		1,044
Design nitrogen load (lb/d)	870 / 1,044	
Air flow requirement	1,320 / 1,565 SCFM per tank	1,810 SCFM total
Blower discharge pressure (psig)	6.85	7.5
Blower motor (HP)	100	175
Blower quantity	2 duty + 1 spare	1 duty + 1 standby
	WWW (DEANA) Average/Max	**Veolia (ANITA Mox)**
Design flow (MGD)	0.175 / 0.175	0.175
TSS (mg/L)	< 700 / < 700	1,500
TKN (mg/L)	819 / 983	
Soluble COD (mg/L)	< 600 / < 700	800
Alkalinity (mg/L as CaCO3)	3,500 / 3,500	3,500–4,000
Temperature (°C)	20–30 / 20–30	20/35 (min/max)
NH4-N (avg) mg/L		820
NH4-N (avg) lb/d		1,196
NH4-N (max @ design flow) mg/L		984
NH4-N (max @ design flow) lb/d		1,436
Design nitrogen load (lb/d)	1,196 / 1,436	
Air flow requirement	1,640 / 1,950 SCFM per tank	1,940 SCFM total
Blower discharge pressure (psig)	6.85	7.5
Blower motor (HP)	100	175
Blower quantity	2 duty + 1 spare	1 duty + 1 standby
	WWW (DEANA) Average/Max	**Veolia (ANITA Mox)**
Design flow (MGD)	0.245 / 0.245	0.245
TSS (mg/L)	< 700 / < 1,000	1,500
TKN (mg/L)	851 / 1,022	
Soluble COD (mg/L)	< 600 / < 700	800
Alkalinity (mg/L as CaCO3)	3,500 / 3,500	3,500–4,000
Temperature (°C)	20–30 / 20–30	20/35 (min/max)
NH4-N (avg) mg/L		852
NH4-N (avg) lb/d		1,740
NH4-N (max @ design flow) mg/L		1,022
NH4-N (max @ design flow) lb/d		2,089
Design nitrogen load (lb/d)	1,740 / 2,089	
Air flow requirement	2600 SCFM Total	2,740 SCFM total
Blower discharge pressure (psig)	6.85	7.5
Blower motor (HP)	100	175
Blower quantity	2 duty + 1 spare	2 duty + 1 standby

4.3 Technical Notes

- Both Proposals have suggested using 1 treatment tank for Phase 1-2 and a Second treatment tank for Phase 3. WWW, however, does give optionality the 1 treatment tank could be sufficient for all three phases, but it falls within the limits of max design loading rates and may not be able to meet performance requirements.
- Anammox Performance is temperature depended on and while it will work for a range of temp. a minimum of 25-28C (77F-83F) is recommended to continually meet performance requirements, which would require heating the influent/maintaining a heated equalization tank.
- World Water Works had previously submitted a suspended growth system (DEMON) as it is their primary technology of choice for the Anammox System. Their revised proposal on the MBBR system (DEANA) appeared to lack critical details of the functionality of the system (media fill volume, references, operating philosophy), which are otherwise present in Veolia's system.
- Veolia is the market leader in MBBR Anammox System, and for a first install, Veolia's expertise and experience is an asset that will be needed for a successful long-term operation.