

**AN EVALUATION OF THE COST
OF POINT SOURCE NITROGEN
LIMITS OF TREATMENT
IMPLEMENTATION IN THE
CHESAPEAKE BAY WATERSHED**

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The purpose of this project was to perform a cost evaluation of implementing nitrogen limits of treatment (LOT) technology at wastewater treatment plants (WWTPs) in the Chesapeake Bay Watershed. LOT technology was defined as technology that would produce a 12 month average effluent total nitrogen (TN) concentration of 3 mg/L from each of the WWTPs. Most of this effort was a follow up to the evaluation of 51 WWTPs performed under a previous project entitled, "Evaluation of Wastewater Treatment Plants for BNR Retrofits using Advances in Technology". This project was performed by Virginia Tech at the request of the Point Source Workgroup of the Nutrient Removal Subcommittee of the Implementation Committee of the Chesapeake Bay Program from 1996-1999, and it was funded by Bay Program Funds administered through the USEPA Region III Office. All 51 of those WWTPs were evaluated for this report, plus, a few additional WWTPs were included, notably the Blue Plains WWTP located at Washington, D.C., the largest WWTP in the Watershed. Altogether, 60 WWTPs were evaluated for this report.

An Excel spreadsheet model was developed and used for determination of the LOT upgrade costs for each of the 60 WWTPs. The summary page printouts for all 60 of the WWTPs are included in Appendix A of this report.

The WWTPs included in the 1999 report were evaluated for BNR upgrades that would reduce the effluent TN discharges to less than 8 mg/L on a yearly average. Recommendations were made for upgrades that would accomplish this, and a 20 year present worth cost evaluation was performed for each suggested upgrade option, including multiple options for individual WWTPs. When multiple options were provided, a preferred option was suggested for that specific WWTP. Lists of the estimated costs for each of the preferred options are included with this report in Appendix B. During the evaluations of this project and report, the LOT evaluations were performed as if the 51 WWTPs had implemented the preferred BNR upgrade recommended in the 1999 report. However, it was known that many of the plants had not implemented the upgrades. Therefore, the cost of the upgrade for 3 mg/L TN recommended in this report was combined with the cost of the upgrade recommended in the 1999 report to achieve 8 mg/L TN, unless the authors had specific information that the previously recommended upgrade, or an equivalent upgrade, was being or had been made to that specific WWTP. The capital costs and cost per pound additional N removal numbers for each of the plants included in the 1999 report are included in Appendix C of this report.

The separate and combined capital costs and the separate and combined cost per additional pound of nitrogen (N) removed are listed in Table 1 of this report. The

operation and maintenance costs, and the total 20-year present worth costs for each of the WWTPs are listed on the summary pages for each WWTP, included in Appendix A. Table 1 estimates that LOT could be implemented at these 60 WWTPs for an average additional cost beyond 8 mg/L BNR of \$2.58 per additional pound of N removed. Excluding the Blue Plains WWTP, the cost would be \$2.98 per pound.

It was known that upgrades were either underway or completed at several of the WWTPs. These can be identified in Table 1 because the cost and nitrogen removal information is omitted for them under the 8 mg/L heading. Also, cost and nitrogen removal information is not listed for the nine WWTPs included in this evaluation that were not part of the 8 mg/L evaluation and report. These nine plants are:

- Lewisburg, PA
- Lock Haven, PA
- Bowie, MD
- Easton, MD
- Havre de Grace, MD
- Princess Anne (Fairmount), MD
- Western Branch, MD
- Blue Plains, Washington, D.C.
- Tyson Foods, Temperanceville, VA

Table 1 also includes the cost of implementing 8 mg/L TN technology at the 51 plants, and combines it with the cost of implementing LOT technology at the 59 WWTPs of this report, not including the Blue Plains WWTP. Then, the cost per pound additional N removed becomes \$2.40 per pound. This number is not precisely accurate, however, because it includes flows for some of the 8 mg/L upgrades that are different from the flows used for the same WWTPs when determining the costs of the LOT upgrades. However, it is reasonably representative, and does represent the cost of upgrading WWTPs that currently are achieving average effluent TN concentrations greater than 8 mg/L. Note, however, that the cost per pound of N removed will be higher if the LOT upgrade is made after the WWTPs are already achieving annual average TN effluent concentration of <8 mg/L. This information is included in Table 2.

Note that the total capital cost for LOT implementation at the 60 WWTPs is estimated to be \$430 million. This includes the Blue Plains WWTP. The total 20 year present worth cost for LOT upgrading of all 60 WWTPs, assuming that the 51 WWTPs have already been upgraded to 8 mg/L, is estimated to be \$498.21 million (see Table 2).

The approach to the LOT cost estimations are summarized in the individual sheets for the WWTPs included in Appendix A. The design flow, rather than the current flow was used for all LOT estimates so that the full potential for nitrogen removal as well as the full cost would be included in the evaluation. The Blue Plains WWTP sheet is included as the next page for illustration purposes. If the current average effluent TN was known precisely, it was included with the flow so that an automatic calculation of the additional nitrogen reduction LOT would accomplish would be calculated on a daily basis, and then

summed for a year and for the 20 year amortization period. Note that when the Blue Plains costs were evaluated, it was known that the current WWTP as modified for BNR can average an effluent TN concentration of 5.0 mg/L. Therefore, LOT will reduce the effluent TN by only 2.0 mg/L. The known average effluent TN for the Bowie, MD WWTP is only 4 mg/L, and LOT will reduce it by only 1.0 mg/L. By contrast, the current Scranton, PA WWTP effluent TN averages 9.2 mg/L while the Rocco Farm Foods, Edinburg, VA WWTP will average 12 mg/L TN after the BNR modification currently being implemented is in place. It was assumed that LOT implementation would be sufficient to reduce all of these effluents to an annual average of 3.0 mg/L.

It was further assumed that LOT implementation would not be possible at any WWTP that was not nitrifying ammonia to less than 1 mg/L ammonia-nitrogen. Therefore, if the WWTP was not currently achieving an annual average effluent ammonia-nitrogen concentration of less than 1.0 mg/L, it was assumed that LOT implementation cost would include the cost of upgrading the WWTP to improve nitrification to that level. Fortunately, most of the plants are already capable of achieving this level of nitrification, so the number of plants that needed system or operational modifications was small. For most of those not achieving complete nitrification, it is possible to increase the MCRT (sludge age) and accomplish this change without additional capital costs. That is, for most of the WWTPs in this category, the secondary settling basins were adequate for the increased solids loadings that would result from increasing the MCRT.

Nearly all of the plants required some modification to reduce the nitrate nitrogen to the 1.0 mg/L effluent concentration required necessary to achieve an annual effluent TN concentration of <3 mg/L. The typical plant effluent contains 1-1.5 mg/L non-biodegradable soluble organic nitrogen. This cannot be removed biologically, chemically or by settling. Removal would require either activated carbon adsorption or reverse osmosis type membrane separation, and this would greatly increase the cost over the nutrient removal technologies assumed for this evaluation. Therefore, the nitrate nitrogen cannot significantly exceed 1.0 mg/L, and the ammonia-nitrogen must be less than 1.0 mg/L, and preferably less than 0.5 mg/L, if the LOT concentration of 3.0 mg/L is to be met.

The most common method recommended for upgrading the plants from 8 mg/L TN BNR to LOT was the addition of denitrification filters with methanol addition. Few other technologies are capable of LOT achievement, but it can be accomplished with Bardenpho or modified Bardenpho treatment trains. The latter is being implemented at the Fairmount WWTP, Princess Anne, MD, and the former is in place at the Parkway WWTP operated by the Washington Suburban Sanitary Commission. However, the operators have to want to operate to achieve the 3.0 mg/L TN goal, and the WWTPs possibly will have to have effluent sand filters to achieve the goal.

The modification cost for the Blue Plains WWTP is for modifying the existing deep bed effluent filters to denitrification filters and the installation of a methanol feed system for them. The total capital cost is estimated to be \$31.69 million, and the M&O cost increase is estimated to be \$1.676 million per year. This results in a 20 year present worth cost of

\$56.82 million for LOT implementation at Blue Plains. However, it would reduce the nitrogen discharge by 6,170 pounds per day, or more than 45 million pounds over a 20 year period, for a cost per pound of additional nitrogen removed of \$1.26 per pound.

Additional information that was used to estimate the LOT implementation costs are given in Table 2. This table lists the WWTPs by state, and provides summary data for each state. Please note that this table is only for the calculation of LOT costs, assuming that the 51 WWTPs of the previous report had upgraded to 8 mg/L TN or less using the technology recommended in the previous report. Exceptions to the 8 mg/L TN were the two industrial WWTPs plus Scranton and some of the newly included WWTPs that were not part of the 51 WWTP report.

The last page of Table 2 also includes a summary of the cost of LOT implementation for the WWTPs categorized by size, i.e., design influent flow. Again, the costs here are representative of upgrading WWTPs to LOT after they have already been upgraded to 8 mg/L effluent TN. The summary on the last page estimates that the cost would be \$2.58 per additional pound N removed for the 60 plants included in this report. If Blue Plains is not included, the cost is \$2.98 per pound. Note that the cost per additional pound N removed increases as the design flow of the WWTP decreases. The cost per pound N removed was estimated to be \$1.234 per pound for design flows greater than 50 MGD, \$2.786 per pound N for flows between 15 and 50 MGD, increasing up to \$4.108 per pound N for WWTPs with design flows less than 1.0 MGD.

DISCUSSION OF RESULTS AND THEIR IMPLEMENTATION

It is recommended that the WWTPs be classified according to their design flows rather than their current flows for LOT implementation purposes. It is unlikely that there will be a significant difference in the capital costs of the upgrades because all of the WWTP owners will insist that the plant capacities not be downgraded. This means that sufficient modifications will have to be made so that LOT can be achieved when the WWTPs reach design flow. Consequently, the actual amount of N removal LOT implementation will achieve will increase with time, but ultimately will approximate the removals calculated using design flows. Thus, this approach would appear to be a more representative approach over the coming 20 years than assuming current flows. If desired, a flow escalation factor could be applied to the current flows, assuming they will reach design flow in 20 years, to get a more accurate estimate of the amount of N that will be removed. In this regards, it should be noted that some of the WWTPs included in this report are already at design flow.

A logical approach would be to first try to classify all of the WWTPs in the Bay Watershed in accordance with whether or not they are capable of BNR to 8 mg/L or less at present. Following this classification, they should be classified in accordance with the likely LOT technology that would have to be applied to achieve an average effluent TN concentration of 3 mg/L. For most of the WWTPs capable of BNR to 8 mg/L or less this, the applicable LOT technology will be the implementation of effluent denitrification filters, or the modification of existing effluent filters to denitrification filters. For

example, of the WWTPs discharging to the James River and located in the Hampton Roads area. several of them are BNR facilities capable of effluent TN concentrations less than 8 mg/L. This includes the two Chesterfield County WWTPs, the Henrico County WWTP, the HRSD-VIP WWTP, the HRSD-Nansemond WWTP and the HRSD-York River WWTP. Others, such as the Richmond, the HRSD-Williamsburg and the HRSD-James River WWTPs could be easily upgraded for BNR. Some of the plants, such as Henrico County, already have effluent filters that could be converted to denite filters, but most of them would have to be retrofitted with effluent denite filters with methanol addition. Along the Potomac River, all of the WWTPs that have to meet an effluent total phosphorus (TP) concentration of 0.18 mg/L already have deep bed effluent filters. All of these filters need to be converted to denite filters, which is somewhat less expensive than the installation of denite filters where none currently exist. The point is that this information is readily available for most of the large plants and they could be quickly classified.

After the WWTPs have been classified in accordance with design flow and probable type of LOT upgrade, the results of this report could be used to determine the typical costs of upgrading for that classification. Then the cost of upgrading all of the WWTPs in that classification could be quickly determined. Using this approach, a reasonably accurate estimate of the costs of upgrading all of the WWTPs in the Bay Watershed could be made.

JAMES RIVER WWTPs

There are several large plants along the James River of Virginia that have not been included in any way in the preceding parts of this report. Seven of the largest James River WWTPs are listed in the following table. I was personally involved with the development of BNR designs for all of them except the Richmond WWTP, and I included it because it is the largest discharging to the River. Because I am aware that five of these WWTPs have already implemented BNR, and the sixth is under construction (Hopewell), I decided to perform an economic evaluation of what it would cost to upgrade all seven of the WWTPs for LOT. All of the BNR upgrades implemented or being implemented are capable of discharging yearly average TN concentrations of 6 mg/L. Therefore, the additional N removal calculations were based on the reduction from 6 to 3 mg/L. To the best of my knowledge, BNR treatment has not been implemented at the Richmond WWTP, but it is possible that plans for modification are underway.

WWTP	Des. Flow mgd	Increased Cap. Cost \$, mill.	Increased M&O Cost \$, thou/year	Incr. 20 -yr Pres't Worth \$, millions	Ad'l 20 yr. TN Rem. lbs, millions	Cost/lb ad'l TN rem. \$/lb
Richmond	50	46.2	1,948.4	75.42	39.566	1.91
Hopewell	50	42.57	796.7	54.52	9.125	5.97
Henrico	40	4.06	264	8.02	7.3	1.10
HRSD-VIP	40	30.39	739.3	41.48	7.3	5.68

HRSD-Nan	30	23.26	556.9	31.61	5.475	5.77
Proctor's Creek	20	16.16	377.6	21.82	3.65	5.98
Falling Ck.	10	9.05	195.2	11.98	1.825	6.56
TOTALS	240	171.69	5,049.7	244.85	74.241	3.30

The table shows that upgrading most of the WWTPs that already have BNR upgrades will be relatively expensive as determined by the cost per additional pound of nitrogen that will be removed. That is because all of these WWTPS are capable of producing an annual average effluent concentration of 6 mg/L or less as currently constructed or planned. The exception is the Henrico WWTP because it already has effluent filters, and the cost will be for modifying them rather than constructing them. The cost per additional pound of removal at the Richmond WWTP is low because it was assumed that this WWTP is currently discharging a TN concentration of 16 mg/L. The actual concentration was not known when this estimate was made.

The summary work sheets for the James River WWTPs are included in Appendix A of this report.

TABLE 1. THE COST OF IMPLEMENTING LIMITS OF TREATMENT NITROGEN REMOVAL IN THE CHESAPEAKE BAY WATERSHED

Pennsylvania WWTPs	Design Flow mgd	BNR Capital Costs, Million\$			\$ per lb N Removed		1000s lb N Removed		Tot. Nrem 1000 lbs	Total \$ per lb N Rem.
		8 mg/L	3 mg/L	Total	8 mg/L	3 mg/L	8 mg/L	3 mg/L		
Altoona East	9	1.23	8.33	9.56	0.51	4.15	3185	2740	5925	2.19
Altoona West	13.5	1.233	11.53	12.763	0.42	4.82	3880	3288	7168	2.44
Chambersburg	6.8	6.347	0	6.347	2.69	0.48	2841	414	3255	2.41
Greater Hazleton	8.9	7.84	16.25	24.09	3.24	8.19	3860	2701	6561	5.28
Hanover	4.5	0.06	5.13	5.19	0.08	8.19	3046	803	3849	1.77
Harrisburg	30	25.448	0	25.448	2	0.47	27635	1826	29461	1.9
Lancaster City	29.7	1.077	23.08	24.157	0.19	3.65	9230	9052	18282	1.9
Lebanon	8	4.039	7.62	11.659	1.19	4.35	4652	2435	7087	3.4
Lewisburg	2.4	-	3.63	3.63	-	1.31	-	490.4	490.4	1.31
Lock Haven	3.75	-	4.59	4.59	-	2.42	-	390	390	2.42
Scranton	16	2.815	13.32	16.135	0.76	3.2	4464	6059	10523	2.16
UAJA, St. College	6	0.78	0.52	1.3	0.33	0.78	3330	1825	5155	0.49
Susq-Lanc. Area	12	1.619	10.46	12.079	1.12	4.01	2288	3650	5938	2.9
Throop	7	3.32	6.92	10.24	1.68	4.46	1982	2117	4099	3.12
Wm'port Central	7.2	6.339	9.61	15.949	1.36	1.86	6600	6716	13316	1.61
Wm'port West	4.5	5.246	9.76	15.006	2.58	9.01	3200	1387	4587	4.52
Wyoming Valley	32	0.763	24.69	25.453	0.18	3.65	5575	9709	15284	2.38
York City	26	1.78	11.08	12.86	0.42	2.29	5806	7884	13690	1.5
TOTALS	227.25	69.94	166.52	236.46	0.97	3.41	91574	63486.4	155060.4	2.28

Maryland WWTPs	Design Flow mgd	BNR Capital Costs, Million\$			\$ per lb N Removed		1000s lb Ad'l N Rem.		Tot. Nrem 1000 lbs	Total \$ per lb N Rem.
		8 mg/L	3 mg/L	Total	8 mg/L	3 mg/L	8 mg/L	3 mg/L		
Bowie	2.2	-	0.52	0.52	-	8.08	-	73	73	8.08
Brunswick	0.7	0.39	2.65	3.04	0.5	14.2	530	219	749	4.51
Chestertown	0.9	1.35	0.1	1.45	5.92	0.38	247	292	539	2.92
Crisfield	1.2	1.949	2.78	4.729	4.95	9.26	379	365	744	7.06
Easton	2	-	5.7	5.7	-	9.81	-	730	730	9.81
Elkton	2.7	1.97	0	1.97	1.87	0.47	1452	803	2255	1.37
Federalsburg	0.75	0.75	2.65	3.4	3.34	5.16	507	657	1164	4.37
Georges Creek	0.63	0.6	2.65	3.25	3.55	10.82	457	292	749	6.38
Havre de Grace	1.9	-	3.3	3.3	-	7.16	-	584	584	7.16
Indian Head	0.5	0.49	0.52	1.01	2.9	3.11	219	219	438	3.01
Mattawoman	15	-	0	0	-	0	-	0	0	0.00
Princess Anne	1.26	-	2.81	2.81	-	2.68	-	383.25	383.25	2.68
Western Branch	16.63	-	0	0	-	0.48	-	5037	5037	0.48
Winebrenner	0.6	0.6	0	0.6	3.77	0.45	411	511	922	1.93
TOTALS	46.97	8.1	23.68	31.78	1.31	2.91	4202	10165.25	14367.25	1.92

NEW YORK WWTPs	Design Flow mgd	BNR Capital Costs, Million\$			\$ per lb N Removed		1000s lb Ad'l N Rem.		Tot. Nrem 1000 lbs	Total \$ per lb N Rem.
		8 mg/L	3 mg/L	Total	8 mg/L	3 mg/L	8 mg/L	3 mg/L		
Binghamton	25	-	19.72	19.72	-	3.7	-	7610	7610	3.7
Endicott Village	8	6.656	0	6.656	3.35	0.47	3292	2435	5727	2.13
TOTALS	33	6.656	19.72	26.38	3.35	2.92	3292	10045	13337	3.32

VIRGINIA WWTPs	Design Flow mgd	BNR Capital Costs, Million\$			\$ per lb N Removed		1000s lb Ad'l N Rem.		Tot. Nrem 1000 lbs	Total \$ per lb N Rem.
		8 mg/L	3 mg/L	Total	8 mg/L	3 mg/L	8 mg/L	3 mg/L		
Arlington	30	-	6.01	6.01	-	1.21	-	9125.0	9125.0	1.21
Colonial Beach	2	0.09	3.36	3.45	-0.065	8.22	431	511.0	942.0	4.06
Dahlgren	0.325	0.03	0.52	0.55	-0.12	8.08	218	73.0	291.0	1.94
Dale Services #1	3	-	1.06	1.06	-	2.45	-	584.0	584.0	2.45
Dale Services #8	3	-	1.06	1.06	-	2.45	-	584.0	584.0	2.45
Dupont W'boro	0.5	0	0.54	0.54	-0.11	0.91	3,184	1387.0	4571.0	0.20
Fishersville	2	-	3.36	3.36	-	8.22	260	511.0	771.0	8.22
Front Royal	4	0.05	4.79	4.84	0.02	5.12	1023	1241.0	2264.0	2.82
Harrisonburg	16	-	13.32	13.32	-	6.13	-	2920.0	2920.0	6.13
Merck, Elkton	1.2	0	0	0	0	0.47	-	2847.0	2847.0	0.47
H.L. Mooney	18	-	3.8	3.8	-	1.25	-	5475.0	5475.0	1.25
Leesburg	4.85	-	5.39	5.39	-	6.06	-	1168.0	1168.0	4.95
Lower Potomac	67	-	12.76	12.76	-	1.17	-	20367.0	20367.0	1.17
Luray	2	0	3.36	3.36	0	8.22	-	511.0	511.0	8.22
Middle River/Ver.	4.5	0.15	5.13	5.28	0.3	11.03	420	584.0	1004.0	6.54
Opequon	6.25	0.57	6.39	6.96	0.16	4.59	5328	1898.0	7226.0	1.32
Parkins Mill	2	0.097	3.36	3.457	-0.79	27.6	200	121.9	321.9	9.96
Purcellville	1	-	0.52	0.52	-	3.06	-	219.0	219.0	3.06
Rivanna River	15	-	12.59	12.59	-	4.75	-	3650.0	3650.0	4.75
Rocco, Edinburg	1.2	-	2.78	2.78	-	5.36	8140	657.0	8797.0	5.36
Strasburg	0.975	0.12	2.65	2.77	-0.14	21.58	4366	146.0	4512.0	0.56
Stuarts Draft	1.4	-	0.52	0.52	2.36	4.52	484	146.0	630.0	2.86
Tyson, Temper.	1	-	2.65	2.65	-	2.46	-	1533.0	1533.0	2.46
Waynesboro	4	3.5	0	3.5	1.27	0.48	3548	1241.0	4789.0	1.07
Wilderness	1	-	0.52	0.52	-	2.5	-	292.0	292.0	2.5
Woodstock	1	0.07	2.65	2.72	-0.22	11.03	292	292.0	584.0	5.41
TOTALS	193.2	4.68	99.09	103.77	0.48	2.49	27894	58084	85977.9	2.51

GRAND TOTALS

	Design Flow mgd	BNR Capital Costs, Million\$			\$ per lb N Removed		1000s lb Ad'l N Rem.		Tot. Nrem 1000 lbs	Total \$ per lb N Rem.
		8 mg/L	3 mg/L	Total	8 mg/L	3 mg/L	8 mg/L	3 mg/L		
	500.42	89.369	309.01	398.382	0.94	2.98	126962	141780.56	268742.56	2.4
Blue Plains, DC	370	-	31.69	31.69	-	1.26	-	45041	45041	1.26

TABLE 2. WORKSHEET FOR DETERMINATION OF COST OF LOT UPGRADES FOR CHESAPEAKE BAY WATERSHED WWTPs

PLANT	Design Flow MGD	BNR Config.	Recomend. Mod.	SRT Days	Design Temp C	Effluent NH ₃ -N mg/L	MLSS 75% VS mg/L	Nitrate Recycle	BNR Eff. NO ₃ -N	Add'l N Rem. lbs/d	Capital Cost \$ Mil	Ann. O&M \$ K	20 yr. Amort. \$ Mil	\$ per Add.lb N rem.
PENNSYLVANIA														
Altoona East	9.0	MLE	Denite Filters	15	12	0.8	2550	3Q (1.5Q)	6.5	375.3	8.33	212.4	11.52	4.15
Altoona West	13.5	MLE	Denite Filters	14	12	0.9	3524	3Q (1.5Q)	5.5	450.4	11.53	286.9	15.83	4.82
Chambersburg	6.8	TF-DeniteF	Add'l Meth.	-	10	<1.0	-	-	Remove 1 mg/L	56.7	0	14	0.21	0.48
Greater Hazleton	8.9	BAF-Denit F	Add BAF	-	10	<1.0	3500	-	6.5	370	16.25	390.4	22.11	8.19
Hanover	4.5	OD	Denite Filters	20	10	<1.0	5000	>50Q	4.5	110	5.13	96.5	6.58	8.19
Harrisburg	30	Unox	Add'l Meth.	-	10	<1.0	3600	3Q	Remove 1 mg/L	250.2	0	56.4	0.85	0.47
Lancaster City	29.7	MLE	Denite Filter	15	10	<1.0	N/a	2Q	6.5	1240	23.08	663.5	33.03	3.65
Lebanon	8.0	TF-AS	Denite Filters	15	10	<1.0	4000	2Q	6.5	333.6	7.62	190.3	10.47	4.35
Lewisburg	2.4	A2/O w ax-sw'g	Denite Filters	25	12	<1.0	4750	2Q	1.5	490.4	3.63	69.7	4.68	1.31
Lock Haven	3.75	A2/O	Denite Filters	25	12	<1.0	4500	3Q	13.5	390	4.59	153.6	6.89	2.42
Scranton	16	MLE	Denite Filters	15	10	1.2	2300	3Q	7.7	830	13.32	404	19.37	3.20
UAJA, St. College	6.0	MLE w Filters	>SRT, Meth.	15	12	3.2	3000	2.5Q	6.5	250	0.52	60.6	1.43	0.78
Sus'hann Lanc area	12.0	MLE	Denite Filters	15	10	<1.0	3600	1.5Q	6.5	500	10.46	279	14.64	4.01
Throop, Lack area	7.0	MLE	>SRT	15	12	2.4	2300	2Q	6.5	290	6.92	168.2	9.44	4.46
Wm'port Central	7.2	MLE-Conv.	N-DN BAF	12.5	10	16.7	4000	2.5Q	0*	920	9.61	193.5	12.51	1.86
Wm'port West.	4.5	MLE	N-DN BAF	15	10	2.6	4500	3Q	6.5	190	9.76	182.4	12.50	9.01
Wyoming Valley	32	Schreib-MLE	Denite Filters	12	8	<1.0	2750	1Q	6.5	1330	24.69	716.9	35.44	3.65
York City	26	MLE	Barden-pho	15	10	0.5	3600	1Q	6.5	1080	11.08	465.4	18.06	2.29
TOTALS	227.3									9461.6	166.52	4603.7	235.56	3.41

() current maximum recycle rate *Incomplete nitrification

PLANT	Design Flow MGD	BNR Config.	Recomend. Mod.	SRT Days	Design Temp C	Eff NH ₄ ⁺ -N mg/L	MLSS 75%VS mg/L	Nitrate Recycle	BNR Eff. NO ₃ -N	Add'l N Rem. Lbs/d	Capital Cost \$ Mil	Ann. O&M \$ K	20 yr. Amort. \$ Mil	\$ per Add.lb N rem.
MARYLAND														
Bowie	2.2	A2/O OD	Denite Filters	15	12	0.2	4000	>50Q	1.5	10	0.52	4.9	0.59	8.08
Brunswick	0.7	Cyclic aeration	Denite Filters	11.2	12	<1.0	3500	3Q	6.5	30	2.65	30.4	3.11	14.20
Chester-town	0.9	Biolac lagoons	improve lagoons	-	8	3.0	-	-	6.5	40	0.1	0.8	0.11	0.38
Crisfield	1.2	Step A2/O	Denite Filters	-	13	0.1	3000	2Q	6.5	50	2.78	39.7	3.38	9.26
Easton	2.0	Overland fl.	N-deN BAF	-	5	3.4	-	-	1.9 TN 9.1	100	5.7	97.1	7.16	9.81
Elkton	2.7	BAF-DeniteF	Add Meth.	-	10	<1.0	-	-	6.5	110	0	25.4	0.38	0.47
Federals-Burg	0.75	TF-Den. Filters	Add'l Meth.	-	12	0.2	-	-	3	90	2.65	49.2	3.39	5.16
Georges Creek	0.63	2 Step-MLEs	Denite Filters	15	9	<1.0	2700	3Q	8	40	2.65	34	3.16	10.82
Havre de Grace	1.9	MLE w RBCs	Denite Filters	15	10	<1.0	3000	2Q	6.5	80	3.30	58.9	4.18	7.16
Indian Head	0.5	A2/O	Denite Filters	7.2	14	0.5	3000	3Q(1.5)	8.5	30	0.52	10.6	0.68	3.11
Matta-Woman	15	Bardenpho OD	Add'l Meth.	20	12	<1.0	3000	>50 Q	1.0	0	0	0	0	0
Prin. An.-Somerset County	1.26	5-Stage Bardenpho M	Construction	-	12	<1.0	3000	1-3 Q	16 TN 18	160	2.81	21.6	3.13	2.68
Western Branch	16.63	MLE w DeniteF	Add'l Meth.	10	12	<1.0	3000	3Q	6.5	690	0	160.6	2.41	0.48
Wine-brenner	0.6	RBC-DeN F	Denite Filters	-	12	0.6	-	-	14.5	70	0	15.5	0.23	0.45
TOTALS	46.97									1500	23.68	548.7	31.91	2.91
NEW YORK														
Binghampton	25	MLE-BAF	DeniteF Meth.	-	10	<1.0	3000	1Q	6.5	1042.5	19.72	561.8	28.15	3.70
Endicott City	8.0	TF-SC	Denite Filters	-	10	<1.0	-	-	6.5	333.6	0	76.1	1.14	0.47
TOTALS	33.0									1376.1	19.72	637.9	29.29	2.92
VIRGINIA														
Arlington	30	Step MLE	Add'l Meth.	10	12	<1.0	4000	0	6.5	1250	6.01	336.2	11.05	1.21
Colonial Beach	2	Alt. Aer-Anoxic	Denite Filters	15	12	0.5	3000	none	5.5	70	3.36	55.9	4.2	8.22

PLANT	Design Flow MGD	BNR Config.	Recomend Mod.	SRT Days	Design Temp C	Eff. NH ₄ ⁺ -N mg/L	MLSS 75% vs mg/L	Nitrate Recycle	BNR Eff. NO ₂ -N	Add'l N Rem. Lbs/d	Capital Cost \$ Mil	Ann. O&M \$ K	20 yr. Amort. \$ Mil	\$ per Add.lb N rem.
Dahlgren	0.325	Orbal 3 rings	EQ & Meth	>30	12	0.9	9000	>50 Q	4.5	10	0.52	4.9	0.59	8.08
Dale Services #1	3	MLE pH Ad.	Denite Filters	15	12	<1.0	5300	4Q	4.5	80	1.06	24.8	1.43	2.45
Dale Services #8	3	MLE pH Ad.	Denite Filters	15	12	<1.0	5300	4Q	4.5	80	1.06	24.8	1.43	2.45
DuPont W'boro	0.5	Bardenpho w Meth.	Construction	15	20	<1.0	1400	5Q	4.7	190	0.54	49.2	1.26	0.91
Fishersville	2	A2/O-MLE	Denite Filters	15	12	<1.0	3000	3Q	5.5	70	3.36	55.9	4.2	8.22
Front Royal	4.0	Alt Ano -Aer	Denite Filters	15	12	0.3	3000	none	6.5	170	4.79	104.4	6.36	5.12
Harrisonburg	16	A2/O w Ferment.	Denite Filters	12	12	<1.0	3000	4Q	4.5	400	13.32	304.4	17.89	6.13
H.L. Mooney	18	Step MLE	Add'l Meth.	19	12	<1.0	2200	0	6.5	750	3.8	202.8	6.84	1.25
Leesburg	4.85	A2/O	Denite Filters	12	12	<1.0	3500	3Q	5.5	160	5.39	112.5	7.08	6.06
Lower Potomac	67	Step MLE	Denite Filters	8.3	12	<1.0	2700	0	6.5	2790	12.76	744.9	23.93	1.17
Luray	2.0	OD	Denite Filters	40	12	<1.0	4300	>50Q	5	70	3.36	55.9	4.2	8.22
Merek, Elkton	1.2	Bardenpho	Denite Filters	10	25	<1.0	4100	4Q	41.7	390	0	90.2	1.35	0.47
Middle River/Ver	4.5	OD	Add Meth	25	12	<1.0	5000	>50Q	3	80	5.13	87.3	6.44	11.03
Opequon Winchester	6.25	Step A2/O	Denite Filters	12	12	0.4	3000	3Q	6.5	260	6.39	155	8.71	4.59
Parkins Mill	2.0	Bio-Denitro, 1 ft Filters	Denite Filters	20	12	<1.0	3000	>50Q	2.5	16.7	3.36	44.6	4.03	27.6
Purcellville	1.0	Step MLE-F	Add Meth.	15	10	<1.0	3000	3Q	4.5	30	0.52	9.8	0.67	3.06
Rivanna, Char'ville	15	A2/O-MLE	Denite Filters	15	11	0.5	3000	2Q	5.0	500	12.59	315.9	17.33	4.75
Rocco Foods, Ed.	1.2	A2/O-Sch'ber	Denite Filters	53	10	<1.0	4000	10Q	10	90	2.78	49.6	3.52	5.36
Strasburg	0.975	OD	Denite Filters	25	12	<1.0	4000	>50 Q	4.5	20	2.65	33.6	3.15	21.58

PLANT	Design Flow MGD	BNR Config.	Recomend Mod.	SRT Days	Design Temp C	Eff. NH ₄ ⁺ -N mg/L	MLSS 75%vs mg/L	Nitrate Recycle	BNR Eff. NO ₃ -N	Add'l N Rem. Lbs/d	Capital Cost \$ Mil	Ann. O&M \$ K	20 yr. Amort. \$ Mil	\$ per Add.lb N rem.
Stuarts Draft	1.4	OD	Add Meth.	25	12	<1.0	5000	>50 Q	3.5	20	0.52	9.1	0.66	4.52
Tyson Foods	1.0	MLE	Denite Filters	50	14	0.3	4000	4Q	28	210	2.65	74.5	3.77	2.46
Waynesboro City	4.0	TF-RBC-Filters	Add Meth.	-	12	1.2	-	-	6.5	170	0	39.4	0.59	0.48
Wilderness	1.0	Orbal 4 Ring	Add Meth.			<1.0		>50Q		40	0.52	14.1	0.73	2.50
Woodstock	1.0	OD	Denite Filters			0.5	3200	>50Q		40	2.65	37.9	3.22	11.03
YA TOTALS	193.2									7956.7	99.09	3037.6	144.63	2.49
GRAND TOTALS	500.42									20294.4	309.01	8827.9	441.39	2.98
Blue Plains, DC	370	3 stage BNR w eff. Filt.	Conv't to deN filters	-	12	<1.0	-	None	3.5	6171.6	31.69	1675.7	56.82	1.26
Revised TOTALS	870.42									26466	340.7	10,504	498.21	2.58
TOTALS BY SIZE CATEGORY														
>50 mgd	437.0									8961.6	44.45	2420.6	80.75	1.234
15-50mgd	269.3									9362.7	127.61	4187.9	190.4	2.786
5-15 mgd	92.7									4139.6	77.6	2026.4	108.1	3.577
1-5 mgd	65.6									3477.1	78.7	1571.5	102.3	4.030
<1 mgd	5.9									522.8	12.3	228.2	15.68	4.108
Total Plants = 60														

APPENDIX A

SUMMARY SHEETS FOR COST ESTIMATIONS FOR THE 60 WWTPS PLUS 7 WWTPS IN THE JAMES RIVER BASIN OF VIRGINIA

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 24, 2001
FACILITY: Blue Plains WWTP
LOCATION: Washington DC
RATED FLOW: 370.0 mgd
CURRENT EFFLUENT TN: 5.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 8170 lbs/d
 2252 1000 lbs/yr
 45041 1000 lbs/20-years

PE COD N/a mg/L
 PE TKN N/a mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

<input type="checkbox"/>	MLE	Existing Aerated Volume (MG)	<u>N/a</u>
<input type="checkbox"/>	BEPR (A2/O, VIP, etc.)	Existing Anoxic Volume (MG)	<u>N/a</u>
<input type="checkbox"/>	Bardenpho	Current MLSS at Winter ADF	<u>N/a</u>
<input type="checkbox"/>	Oxidation Ditch		
<input type="checkbox"/>	Lagoon (Bioloac, etc.)		
<input type="checkbox"/>	Cyclical Aeration		
<input type="checkbox"/>	SBR		
<input type="checkbox"/>	High-Rate Biofilter		
<input type="checkbox"/>	Effluent Filtration		
<input checked="" type="checkbox"/>	Other: <u>3-Stage BNR System with Methanol Addition</u>		

CURRENT EFFLUENT AMMONIA-N: <1.0 mg/L

From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/>	No modifications required	New MLSS	<u>N/a</u>
<input type="checkbox"/>	Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/>	Construct additional aerated volume	Flow (mgd):	<u>0.0</u>
<input type="checkbox"/>	Construct additional clarifiers	Flow (mgd):	<u>0.0</u>
<input type="checkbox"/>	Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/>	Use aerated system for BOD removal only (construct separate nit/denit facility)		
<input type="checkbox"/>	Add influent flow equalization tank		
<input type="checkbox"/>	Other: _____		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input checked="" type="checkbox"/>	No modifications required
<input type="checkbox"/>	Add downstream Denit filter with methanol
<input type="checkbox"/>	Add downstream Nitrification Biofilter and DeNit filter with methanol
<input type="checkbox"/>	Add methanol to existing BNR process
<input type="checkbox"/>	Add downstream anoxic tank with methanol feed
<input type="checkbox"/>	Add effluent filtration
<input checked="" type="checkbox"/>	Other: <u>Convert effluent filters to denit filters and add more methanol there</u>

CAPITAL COST:

Equipment and Structures (from Page 2)		\$15,600,000
Electrical and Instrumentation	12%	\$1,872,000
Yard Piping and Site Work:	15%	\$2,340,000
Subtotal		\$19,810,000
Contractor OH&P:	15%	\$2,972,000
Engineering and Constr Mgmt:	15%	\$2,972,000
Subtotal		\$25,750,000
Contingency	30%	\$5,943,000
Total Capital Cost:		\$31,690,000
Capital Cost per lb 20-Yr. N removal		\$0.70

OPERATIONS COST:

Additional Horsepower (from Page 2)		0 HP
Electrical Power Cost	0.05 \$/KW	\$0 \$/year
Nitrate Reduction using Methanol		<u>2.0</u> mg/L
Methanol Required		2810 gals/d
Methanol Cost	0.75 \$/gal	\$769,200 \$/year
Separate Stage Ammonia Reduction:		<u>0.0</u> mg/L
Caustic Soda @ 25% conc.		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$267,500 \$/year
Denitrification Sludge Production w/Methanol		8990 lbs/d
Sludge Disposal Cost	400 \$/ton	\$649,000 \$/year
Total Annual O&M Cost		\$1,675,700 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs		\$25,130,000

TOTAL 20-YEAR PRESENT WORTH COST: **\$56,820,000**
 Total Cost per lb 20-Yr. N removal **\$1.28**

**SUMMARY COST SHEETS FOR THE
18 PENNSYLVANIA WWTPS**

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheter, LLC
DATE: March 19, 2001
FACILITY: Altoona East WWTP
LOCATION: Altoona, PA
RATED FLOW: 90 mgd
CURRENT EFFLUENT TN: 8.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 380 lbs/d
 139 1000 lbs/yr
 2774 1000 lbs/20-years

PE CBO05 77 mg/L
 PE COD 213 mg/L
 PE TKN 15 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE
 BEPR (A2/O, VIP, etc.)
 Bardenpho
 Oxidation Ditch
 Lagoon (Biocac, etc.)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other

Existing Aerated Volume (MG): 2.27
 Existing Anoxic Volume (MG): 0.78
 Current MLSS at Winter ADF: 2200

CURRENT EFFLUENT AMMONIA-N: 1.0 mg/L
 From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:
 No modifications required
 Raise MCRT/MLSS in existing tanks (check clarifier capacity) New MLSS 3000
 Construct additional aerated volume Flow (mgd) 0
 Construct additional clarifiers Flow (mgd) 0
 Use existing anoxic volume as aerobic (construct separate denit facility)
 Use aerated system for BOD removal only (construct separate n/denit facility)
 Add influent flow equalization tank
 Other

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:
 No modifications required
 Add downstream DeNit filter with methanol
 Add downstream Nitrification Biofilter and DeNit filter with methanol
 Add methanol to existing BNR process
 Add downstream anoxic tank with methanol feed
 Add effluent filtration
 Other

CAPITAL COST:

Equipment and Structures (from Page 2)		\$4,100,000
Electrical and Instrumentation	12%	\$482,000
Yard Piping and Site Work	15%	\$615,000
Subtotal		\$5,210,000
Contractor OH&P:	15%	\$782,000
Engineering and Constr. Mgmt	15%	\$782,000
Subtotal:		\$8,770,000
Contingency	30%	\$1,563,000
Total Capital Cost:		\$8,330,000
Capital Cost per lb. 20-Yr. N removal		\$3.80

OPERATIONS COST:

Additional Horsepower (from Page 2)		180 HP
Electrical Power Cost	0.05 \$/kW	\$56,800 \$/year
Nitrate Reduction using Methanol		5.0 mg/L
Methanol Required		170 gals/d
Methanol Cost:	0.75 \$/gal	\$46,500 \$/year
Separate Stage Ammonia Reduction		0.0 mg/L
Caustic Soda @ 25% conc.		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$67,700 \$/year
Denitrification Sludge Production w/Methanol		540 lbs/d
Sludge Disposal Cost	400 \$/ton	\$39,400 \$/year
Total Annual O&M Cost		\$212,400 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs		\$3,190,000

TOTAL 20-YEAR PRESENT WORTH COST: \$11,520,000
 Total Cost per lb. 20-Yr. N removal: \$4.15

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Altoona West WWTP
LOCATION: Altoona, PA
RATED FLOW: 13.5 mgd PE COD: N/a mg/L
CURRENT EFFLUENT TN: 7.0 mg/L PE TKN: N/a mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 450 lbs/d
 164 1000 lbs/yr
 3285 1000 lbs/20-years

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE Existing Aerated Volume (MG) N/a
 BEPR (A2/O VIP, etc.) Existing Anoxic Volume (MG) N/a
 Bardenpho Current MLSS at Winter ADF 3524
 Oxidation Ditch
 Lagoon (Biocac, etc.)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other:

CURRENT EFFLUENT AMMONIA-N: 0.9 mg/L From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	New MLSS
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)	<u>N/a</u>
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd) <u>0.0</u>
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd) <u>0</u>
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)	
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate nit/denit facility)	
<input type="checkbox"/> Add influent flow equalization tank	
<input type="checkbox"/> Other	

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required
<input checked="" type="checkbox"/> Add downstream DeNit filter with methanol
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol
<input type="checkbox"/> Add methanol to existing BNR process
<input type="checkbox"/> Add downstream anoxic tank with methanol feed
<input type="checkbox"/> Add effluent filtration
<input type="checkbox"/> Other

CAPITAL COST:

Equipment and Structures (from Page 2)		\$5,680,000
Electrical and Instrumentation	12%	\$682,000
Yard Piping and Site Work	15%	\$852,000
Subtotal		\$7,210,000
Contractor OH&P	15%	\$1,082,000
Engineering and Constr. Mgmt	15%	\$1,082,000
Subtotal		\$9,370,000
Contingency	30%	\$2,163,000
Total Capital Cost		\$11,530,000
Capital Cost per lb 20-Yr N removal		\$3.61

OPERATIONS COST:

Additional Horsepower (from Page 2)		270 HP
Electrical Power Cost	0.05 \$/KW	\$88,200 \$/year
Nitrate Reduction using Methanol		4.0 mg/L
Methanol Required:		210 gal/d
Methanol Cost	0.75 \$/gal	\$57,500 \$/year
Separate Stage Ammonia Reduction		0.0 mg/L
Cautic Soda @ 25% conc		0 gal/d
Cautic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$93,700 \$/year
Denitrification Sludge Production w/Methanol		850 lbs/d
Sludge Disposal Cost	400 \$/ton	\$47,500 \$/year
Total Annual O&M Cost		\$268,900 \$/year
Effective Annual Interest Rate after Inflation		2.81%
20-Year Present Worth of O&M Costs:		\$4,300,000

TOTAL 20-YEAR PRESENT WORTH COST: **\$15,830,000**
 Total Cost per lb 20-Yr N removal **\$4.82**

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Altoona West WWTP
LOCATION: Altoona, PA
RATED FLOW: 13.6 mgd
CURRENT EFFLUENT TN: 7.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 450 lbs/d
 184 1000 lbs/yr
 3285 1000 lbs/20-years

PE COD N/A mg/L
 PE TKN N/A mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE
 BEPR (A2/O VIP etc.)
 Bardenpho
 Oxidation Ditch
 Lagoon (Biolog, etc.)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other: _____

Existing Aerated Volume (MG) N/A
 Existing Anoxic Volume (MG) N/A
 Current MLSS at Winter ADF 3524

CURRENT EFFLUENT AMMONIA-N: 0.9 mg/L
 From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

No modifications required
 Raise MCRT/MLSS in existing tanks (check clarifier capacity) New MLSS N/A
 Construct additional aerated volume Flow (mgd): 0
 Construct additional clarifiers Flow (mgd): 0
 Use existing anoxic volume as aerobic (construct separate denit facility)
 Use aerated system for BOD removal only (construct separate nitrdenit facility)
 Add influent flow equalization tank
 Other: _____

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

No modifications required
 Add downstream DeNit filter with methanol
 Add downstream Nitrification Biofilter and DeNit filter with methanol
 Add methanol to existing BNR process
 Add downstream anoxic tank with methanol feed
 Add effluent filtration
 Other: _____

CAPITAL COST:

Equipment and Structures (from Page 2):		\$5,680,000
Electrical and Instrumentation:	12%	\$682,000
Yard Piping and Site Work:	15%	\$852,000
Subtotal:		\$7,210,000
Contractor OH&P:	15%	\$1,082,000
Engineering and Constr. Mgmt.	15%	\$1,082,000
Subtotal:		\$9,370,000
Contingency	30%	\$2,183,000
Total Capital Cost		\$11,830,000
Capital Cost per lb. 20-Yr. N removal		\$3.51

OPERATIONS COST:

Additional Horsepower (from Page 2):		270 HP
Electrical Power Cost	0.05 \$/KW	\$88,200 \$/year
Nitrate Reduction using Methanol:		<u>4.0</u> mg/L
Methanol Required:		210 gals/d
Methanol Cost:	.075 \$/gal	\$57,500 \$/year
Separate Stage Ammonia Reduction		<u>0.0</u> mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost	0.80 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$93,700 \$/year
Denitrification Sludge Production w/Methanol		650 lbs/d
Sludge Disposal Cost	400 \$/ton	\$47,500 \$/year
Total Annual O&M Cost:		\$286,900 \$/year
Effective Annual Interest Rate after Inflation:		2.91%
20-Year Present Worth of O&M Costs:		\$4,300,000

TOTAL 20-YEAR PRESENT WORTH COST: \$15,830,000
 Total Cost per lb. 20-Yr. N removal: \$4.82

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Chambersburg WWTP
LOCATION: Chambersburg, PA
RATED FLOW: 8.8 mgd
CURRENT EFFLUENT TN: 4.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 60 lbs/d
 22 1000 lbs/yr
 438 1000 lbs/20-years

PE COD: N/A mg/L
 PE TKN: N/A mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

<input type="checkbox"/> MLE	Existing Aerated Volume (MG)	N/A
<input type="checkbox"/> BEPR (A2/O, VIP, etc.)	Existing Anoxic Volume (MG)	N/A
<input type="checkbox"/> Bardenpho	Current MLSS at Winter ADF	N/A
<input type="checkbox"/> Oxidation Ditch		
<input type="checkbox"/> Lagoon (Biolac, etc.)		
<input type="checkbox"/> Cyclical Aeration		
<input type="checkbox"/> SBR		
<input type="checkbox"/> High-Rate Biofilter		
<input checked="" type="checkbox"/> Effluent Filtration		
<input type="checkbox"/> Other		

CURRENT EFFLUENT AMMONIA-N < 1.0 mg/L

<input checked="" type="checkbox"/> From Report
<input type="checkbox"/> From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	New MLSS
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)	N/A
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd): 0
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd): 0
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)	
<input type="checkbox"/> Use aerated system for COD removal only (construct separate nit/denit facility)	
<input type="checkbox"/> Add influent flow equalization tank	
<input type="checkbox"/> Other:	

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required
<input type="checkbox"/> Add downstream DeNitr filter with methanol
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNitr filter with methanol
<input type="checkbox"/> Add methanol to existing BNR process
<input type="checkbox"/> Add downstream anoxic tank with methanol feed
<input type="checkbox"/> Add effluent filtration
<input checked="" type="checkbox"/> Other: Increase Methanol Addition

CAPITAL COST:

Equipment and Structures (from Page 2)		\$0
Electrical and Instrumentation	12%	\$0
Yard Piping and Site Work	15%	\$0
Subtotal		\$0
Contractor OH&P	15%	\$0
Engineering and Constr Mgmt	18%	\$0
Subtotal		\$0
Contingency	30%	\$0
Total Capital Cost:		\$0
Capital Cost per lb 20-Yr N removal:		\$0.00

OPERATIONS COST:

Additional Horsepower (from Page 2)		0 HP
Electrical Power Cost: 0.05 \$/KW		\$0 \$/year
Nitrate Reduction using Methanol:		1.9 mg/L
Methanol Required:		30 gals/d
Methanol Cost: 0.75 \$/gal		\$8,200 \$/year
Separate Stage Ammonia Reduction:		0.0 mg/L
Caustic Soda @ 25% conc.		0 gals/d
Caustic Soda Cost: 0.50 \$/gal		\$0 \$/year
Equipment Maintenance Cost:		\$0 \$/year
Denitrification Sludge Production w/Methanol:		80 lbs/d
Sludge Disposal Cost: 400 \$/ton		\$5,800 \$/year
Total Annual O&M Cost:		\$14,000 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs:		\$210,000

TOTAL 20-YEAR PRESENT WORTH COST: \$210,000
Total Cost per lb 20-Yr N removal: \$0.48

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 10, 2001
FACILITY: Greater Hazleton WWTP
LOCATION: Hazleton PA
RATED FLOW: 8.9 mgd
CURRENT EFFLUENT TN: 8.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 370 lbs/d
 135 1000 lbs/yr
 2701 *000 lbs/20-years

PE COD 180 mg/L
 PE TKN 25 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE
 BEPR (A2/O, VIP, etc.)
 Bardenpho
 Oxidation Ditch
 Lagoon (Biolog. etc.)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other.

Existing Aerated Volume (MG) 0.5
 Existing Anoxic Volume (MG) 0.21
 Current MLSS at Winter ADF: 3500

CURRENT EFFLUENT AMMONIA-N: 3.2 mg/L
 From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input type="checkbox"/> No modifications required	New MLSS
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)	N/A
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd) <u>0</u>
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd) <u>0</u>
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)	
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate nit/denit facility)	
<input type="checkbox"/> Add influent flow equalization tank	
<input checked="" type="checkbox"/> Other. <u>Abandon activated sludge process and use biofilter for all flow</u>	

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required	
<input checked="" type="checkbox"/> Add downstream Denit filter with methanol	For all 8.9 mgd
<input type="checkbox"/> Add downstream Nitrification Biofilter and Denit filter with methanol	
<input type="checkbox"/> Add methanol to existing BNR process	
<input type="checkbox"/> Add downstream anoxic tank with methanol feed	
<input type="checkbox"/> Add effluent filtration	
<input checked="" type="checkbox"/> Other. <u>Add downstream Anoxic/Aerobic Biofilter for 3.41 mgd flow</u>	

CAPITAL COST:

Equipment and Structures (from Page 2).		\$7,990,000	Adjusted for Special Condition
Electrical and Instrumentation:	12%	\$958,000	
Yard Piping and Site Work	15%	\$1,199,000	
Subtotal:		\$10,150,000	
Contractor OH&P.	15%	\$1,523,000	
Engineering and Constr Mgmt.	15%	\$1,523,000	
Subtotal:		\$13,200,000	
Contingency	30%	\$3,045,000	
Total Capital Cost		\$16,250,000	
Capital Cost per lb. 20-Yr. N removal:		\$6.02	

OPERATIONS COST:

Additional Horsepower (from Page 2)		530 HP
Electrical Power Cost	0.05 \$/kW	\$173,200 \$/year
Nitrate Reduction using Methanol:		<u>5.0</u> mg/L
Methanol Required		170 gals/d
Methanol Cost	0.75 \$/gal	\$48,500 \$/year
Separate Sludge Ammonia Reduction		<u>0.0</u> mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$132,000 \$/year
Denitrification Sludge Production w/Methanol		530 lbs/d
Sludge Disposal Cost	400 \$/ton	\$36,700 \$/year
Total Annual O&M Cost.		\$390,400 \$/year
Effective Annual Interest Rate after inflation.		2.91%
20-Year Present Worth of O&M Costs:		\$5,860,000

TOTAL 20-YEAR PRESENT WORTH COST: **\$22,110,000**
 Total Cost per lb 20-Yr N removal. **\$8.19**

PROJECT: implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Hanover Area WWTP
LOCATION: Hanover, PA
RATED FLOW: 4.5 mgd
CURRENT EFFLUENT TN: 8.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 110 lbs/d
 40 1000 lbs/yr
 903 1000 lbs/20-years

PE BOD5 135 mg/L
 PE COD N/a mg/L
 PE TKN 30 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE
 BEPR (A2/O, VIP, etc.)
 Bardenpho
 Oxidation Ditch
 Lagoon (Biologic, etc.)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other: _____

Existing Aerated Volume (MG) 4.29
 Existing Anoxic Volume (MG) N/a
 Current MLSS at Winter ADF N/a

CURRENT EFFLUENT AMMONIA-N: 0.5 mg/L From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	New MLSS	3000
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)	Flow (mgd)	0
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd)	0
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd)	0
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for ECD removal only (construct separate nit/denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other: _____		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required
<input checked="" type="checkbox"/> Add downstream DeNit filter with methanol
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol
<input type="checkbox"/> Add methanol to existing BNR process
<input type="checkbox"/> Add downstream anoxic tank with methanol feed
<input type="checkbox"/> Add effluent filtration
<input type="checkbox"/> Other: _____

CAPITAL COST:

Equipment and Structures (from Page 2):		\$2,530,000
Electrical and Instrumentation:	12%	\$304,000
Yard Piping and Site Work:	15%	\$380,000
Subtotal:		\$3,214,000
Contractor O&M:	15%	\$482,000
Engineering and Constr. Mgmt:	15%	\$482,000
Subtotal:		\$4,178,000
Contingency:	30%	\$963,000
Total Capital Cost:		\$5,130,000
Capital Cost per lb. 20-Yr. N removal:		\$6.39

OPERATIONS COST:

Additional Horsepower (from Page 2):		90 HP
Electrical Power Cost:	0.05 \$/kWh	\$29,400 \$/year
Nitrate Reduction using Methanol:		3.0 mg/L
Methanol Required:		50 gal/d
Methanol Cost:	0.75 \$/gal	\$13,700 \$/year
Separate Stage Ammonia Reduction:		0.0 mg/L
Caustic Soda @ 25% conc:		0 gal/d
Caustic Soda Cost:	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost:		\$41,700 \$/year
Denitrification Sludge Production w/Methanol:		160 lbs/d
Sludge Disposal Cost:	400 \$/ton	\$11,700 \$/year
Total Annual O&M Cost:		\$96,500 \$/year
Effective Annual Interest Rate after inflation:		2.91%
20-Year Present Worth of O&M Costs:		\$1,460,000

TOTAL 20-YEAR PRESENT WORTH COST: \$6,590,000
 Total Cost per lb. 20-Yr. N removal: \$8.19

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 10, 2001
FACILITY: Greater Hazleton WWTP
LOCATION: Hazleton, PA
RATED FLOW: 88 mgd
CURRENT EFFLUENT TN: 80 mg/L
EFFLUENT TN GOAL: 30 mg/L
NITROGEN REDUCTION: 370 lbs/d
 135 1000 lbs/yr
 2701 1000 lbs/20-years

PE COD: 180 mg/L
PE TKN: 25 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE
 BEPR (A2/O, VIP, etc)
 Bardenpho
 Oxidation Ditch
 Lagoon (Biolac, etc.)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other

Existing Aerated Volume (MG): 0.5
 Existing Anoxic Volume (MG): 0.21
 Current MLSS at Winter ADF: 3500

CURRENT EFFLUENT AMMONIA-N: 3.2 mg/L
 From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input type="checkbox"/> No modifications required	New MLSS
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)	N/A
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd): 0
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd): 0
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)	
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate nitrification facility)	
<input type="checkbox"/> Add influent flow equalization tank	
<input checked="" type="checkbox"/> Other: Abandon activated sludge process and use biofilter for all flow	

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required	
<input checked="" type="checkbox"/> Add downstream DeNit filter with methanol	For all 8.8 mgd
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol	
<input type="checkbox"/> Add methanol to existing BNR process	
<input type="checkbox"/> Add downstream anoxic tank with methanol feed	
<input type="checkbox"/> Add effluent filtration	
<input checked="" type="checkbox"/> Other: Add downstream Anoxic/Aerobic Biofilter for 3.41 mgd flow	

CAPITAL COST:

Equipment and Structures (from Page 2):	\$7,990,000	Adjusted for Special Condition
Electrical and Instrumentation:	12%	\$959,000
Yard Piping and Site Work:	15%	\$1,199,000
Subtotal:		\$10,160,000
Contractor OH&P:	15%	\$1,523,000
Engineering and Constr. Mgmt:	15%	\$1,523,000
Subtotal:		\$13,200,000
Contingency:	30%	\$3,045,000
Total Capital Cost:		\$16,250,000
Capital Cost per lb 20-Yr. N removal:		\$6.02

OPERATIONS COST:

Additional Horsepower (from Page 2):	530 HP
Electrical Power Cost 0.05 \$/kWh	\$173,200 \$/year
Nitrate Reduction using Methanol	5.0 mg/L
Methanol Required	170 gals/d
Methanol Cost 0.75 \$/gal	\$46,500 \$/year
Separate Stage Ammonia Reduction	0.0 mg/L
Caustic Soda @ 25% conc.	0 gals/d
Caustic Soda Cost 0.80 \$/gal	\$0 \$/year
Equipment Maintenance Cost:	\$132,000 \$/year
Denitrification Sludge Production w/Methanol	530 lbs/d
Sludge Disposal Cost 400 \$/ton	\$38,700 \$/year
Total Annual O&M Cost:	\$390,400 \$/year
Effective Annual Interest Rate after Inflation:	2.91%
20-Year Present Worth of O&M Costs:	\$5,860,000

TOTAL 20-YEAR PRESENT WORTH COST: \$22,110,000
 Total Cost per lb 20-Yr N removal: \$8.19

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 18, 2001
FACILITY: Harrisburg WWTP
LOCATION: Harrisburg, PA
RATED FLOW: 300 mgd
CURRENT EFFLUENT TN: 40 mg/L
EFFLUENT TN GOAL: 30 mg/L
NITROGEN REDUCTION: 250 lbs/d
 91 1000 lbs/yr
 1825 1000 lbs/20-years

PE COO N/a mg/L
 PE TKN 16 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

<input type="checkbox"/> MLE	Existing Aerated Volume (MG)	N/a
<input type="checkbox"/> BEPR (A2/O, VIP etc.)	Existing Anoxic Volume (MG)	N/a
<input type="checkbox"/> Bardenpho	Current MLSS at Winter ADF.	N/a
<input type="checkbox"/> Oxidation Ditch		
<input type="checkbox"/> Lagoon (Biolac, etc.)		
<input type="checkbox"/> Cyclical Aeration		
<input type="checkbox"/> SBR		
<input type="checkbox"/> High-Rate Biofilter		
<input checked="" type="checkbox"/> Effluent Filtration		
<input checked="" type="checkbox"/> Other: UNOX Process, Aerobic-Anoxic BAFs		

CURRENT EFFLUENT AMMONIA-N: <1.0 mg/L

From Report
 From Model (at ADF and load, 15 d MCRT 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required		New MLSS
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		N/a
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd) <u>0</u>	
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd) <u>0</u>	
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other:		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required		
<input type="checkbox"/> Add downstream DeNit filter with methanol		
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol		
<input type="checkbox"/> Add methanol to existing BNR process		
<input type="checkbox"/> Add downstream anoxic tank with methanol feed		
<input type="checkbox"/> Add effluent filtration		
<input checked="" type="checkbox"/> Other: Add Methanol		

CAPITAL COST:

Equipment and Structures (from Page 2)		\$0
Electrical and Instrumentation	12%	\$0
Yard Piping and Site Work	15%	\$0
Subtotal		\$0
Contractor OH&P	15%	\$0
Engineering and Constr. Mgmt	15%	\$0
Subtotal		\$0
Contingency	30%	\$0
Total Capital Cost		\$0
Capital Cost per lb 20-Yr N removal		\$8.00

OPERATIONS COST

Additional Horsepower (from Page 2)		0 HP
Electrical Power Cost	0.05 \$/KW	\$0 \$/year
Nitrate Reduction using Methanol		<u>1.0</u> mg/L
Methanol Required		110 gals/d
Methanol Cost	0.75 \$/gal	\$30.00 \$/year
Separate Sludge Ammonia Reduction		<u>0.0</u> mg/L
Caustic Soda @ 25% conc.		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$0 \$/year
Denitrification Sludge Production w/Methanol		360 lbs/d
Sludge Disposal Cost	400 \$/ton	\$26,300 \$/year
Total Annual O&M Cost:		\$56,400 \$/year
Effective Annual Interest Rate after Inflation:		2.91%
20-Year Present Worth of O&M Costs:		\$850,000

TOTAL 20-YEAR PRESENT WORTH COST: \$850,000
 Total Cost per lb, 20-Yr N removal \$8.47

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Lancaster WWTP
LOCATION: Lancaster, PA
RATED FLOW: 29.7 mgd PE COD N/a mg/L
CURRENT EFFLUENT TN: 8.0 mg/L PE TKN 22 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 1240 lbs/d
 453 1000 lbs/yr
 9052 1000 lbs/20-years

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE Existing Aerated Volume (MG) N/a
 BEPR (A2/O, VIP, etc.) Existing Anoxic Volume (MG) N/a
 Bardenpho Current MLSS at Winter ADF N/a
 Oxidation Ditch
 Lagoon (Bioc, etc.)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other

CURRENT EFFLUENT AMMONIA-N: 0.5 mg/L From Report
 From Model (at ADF and load, 15 d MCRT 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:
 No modifications required New MLSS N/a
 Raise MCRT/MLSS in existing tanks (check clarifier capacity) Flow (mgd) 0
 Construct additional aerated volume Flow (mgd) 0
 Construct additional clarifiers
 Use existing anoxic volume as aerobic (construct separate denit facility)
 Use aerated system for BOD removal only (construct separate denit facility)
 Add influent flow equalization tank
 Other

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:
 No modifications required
 Add downstream DeNit filter with methanol
 Add downstream Nitrification Biofilter and DeNit filter with methanol
 Add methanol to existing BNR process
 Add downstream anoxic tank with methanol feed
 Add effluent filtration
 Other

CAPITAL COST.

Equipment and Structures (from Page 2)		\$11,350,000
Electrical and Instrumentation:	12%	\$1,382,000
Yard Piping and Site Work:	15%	\$1,703,000
Subtotal:		\$14,420,000
Contractor OH&P:	15%	\$2,163,000
Engineering and Constr. Mgmt.	15%	\$2,163,000
Subtotal:		\$18,750,000
Contingency:	30%	\$4,326,000
Total Capital Cost		\$23,680,000
Capital Cost per lb. 20-Yr. N removal:		\$2.65

OPERATIONS COST:

Additional Horsepower (from Page 2):		590 HP
Electrical Power Cost: 0.05 \$/kWh		\$182,800 \$/year
Nitrate Reduction using Methanol:		<u>5.0</u> mg/L
Methanol Required		590 gals/d
Methanol Cost: 0.75 \$/gal		\$153,300 \$/year
Separate Stage Ammonia Reduction:		<u>0.0</u> mg/L
Caustic Soda @ 25% conc.		0 gals/d
Caustic Soda Cost: 0.60 \$/gal		\$0 \$/year
Equipment Maintenance Cost		\$187,500 \$/year
Denitrification Sludge Production w/Methanol		1780 lbs/d
Sludge Disposal Cost 400 \$/ton		\$129,000 \$/year
Total Annual O&M Cost		\$663,500 \$/year
Effective Annual Interest Rate after Inflation:		2.91%
20-Year Present Worth of O&M Costs:		\$9,950,000

TOTAL 20-YEAR PRESENT WORTH COST: \$33,030,000
 Total Cost per lb. 20-Yr. N removal \$3.66

PROJECT	Implementing a 3 mg/L Annual Average Total Nitrogen Limit	
PREPARED FOR	USEPA, Chesapeake Bay Office	
PREPARED BY	Virginia Tech with Stearns & Wheeler, LLC	
DATE	March 19, 2001	
FACILITY:	Chambersburg WWTP	
LOCATION:	Chambersburg, PA	
RATED FLOW	68 mgd	PE COD <u>N/A</u> mg/L
CURRENT EFFLUENT TN	40 mg/L	PE TKN <u>N/A</u> mg/L
EFFLUENT TN GOAL	3.0 mg/L	
NITROGEN REDUCTION	60 lbs/d	
	22 1000 lbs/yr	
	438 1000 lbs/20-years	

CURRENT PROCESS (CHECK ALL THAT APPLY):

<input type="checkbox"/> MLE	Existing Aerated Volume (MG)	<u>N/a</u>
<input type="checkbox"/> BEPR (A2/O, VIP etc)	Existing Anoxic Volume (MG)	<u>N/a</u>
<input type="checkbox"/> Bardenpho	Current MLSS at Winter ADF	<u>N/a</u>
<input type="checkbox"/> Oxidation Ditch		
<input type="checkbox"/> Lagoon (Biolac, etc)		
<input type="checkbox"/> Cyclical Aeraton		
<input type="checkbox"/> SBR		
<input type="checkbox"/> High-Rate Biofilter		
<input checked="" type="checkbox"/> Effluent Filtration		
<input type="checkbox"/> Other		

CURRENT EFFLUENT AMMONIA-N <1.0 mg/L

From Report

From Model (at ADF and load 15 d MCRT 12" C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	New MLSS	<u>N/a</u>
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd)	<u>0</u>
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd)	<u>0</u>
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate nit/denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required		
<input type="checkbox"/> Add downstream DeNit filter with methanol		
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol		
<input type="checkbox"/> Add methanol to existing BNR process		
<input type="checkbox"/> Add downstream anoxic tank with methanol feed		
<input type="checkbox"/> Add effluent filtration		
<input checked="" type="checkbox"/> Other	Increase Methanol Addition	

CAPITAL COST:

Equipment and Structures (from Page 2)		\$0
Electrical and Instrumentation	12%	\$0
Yard Piping and Site Work	15%	\$0
Subtotal		\$0
Contractor OH&P	15%	\$0
Engineering and Constr Mgmt	15%	\$0
Subtotal		\$0
Contingency	30%	\$0
Total Capital Cost		\$0
Capital Cost per lb 20-Yr N removal		\$0.00

OPERATIONS COST

Additional Horsepower (from Page 2)		0 HP
Electrical Power Cost	0.05 \$/kW	\$0 \$/year
Nitrate Reduction using Methanol		1.0 mg/L
Methanol Required		30 gals/d
Methanol Cost	0.75 \$/gal	\$8,200 \$/year
Separate Stage Ammonia Reduction:		0.0 mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$0 \$/year
Denitrification Sludge Production w/Methanol		80 lbs/d
Sludge Disposal Cost	400 \$/ton	\$5,800 \$/year
Total Annual O&M Cost		\$14,000 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs		\$210,000

TOTAL 20-YEAR PRESENT WORTH COST:

	\$210,000
Total Cost per lb 20-Yr N removal	\$0.48

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: UAJA WWTP
LOCATION: State College, PA
RATED FLOW: 60 mgd
CURRENT EFFLUENT TN: 80 mg/L
EFFLUENT TN GOAL: 30 mg/L
NITROGEN REDUCTION: 250 lbs/d
 91 1000 lbs/yr
 1825 1000 lbs/20-years

PE COD 334 mg/L
 PE TKN 36 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE
 BEPR (A2/O, VIP, etc.)
 Bardenpho
 Oxidation Ditch
 Lagoon (Biolog. etc.)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other:

Existing Aerated Volume (MG) 2.55
 Existing Anoxic Volume (MG) 0.46
 Current MLSS at Winter ADF: 2650

CURRENT EFFLUENT AMMONIA-N: 1.8 mg/L
 From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

No modifications required
 Raise MCRT/MLSS in existing tanks (check clarifier capacity) New MLSS 3650
 Construct additional aerated volume Flow (mgd): 0
 Construct additional clarifiers Flow (mgd): 0
 Use existing anoxic volume as aerobic (construct separate denit facility)
 Use aerated system for BOD removal only (construct separate nitr/denit facility)
 Add influent flow equalization tank
 Other:

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

No modifications required
 Add downstream Denit filter with methanol
 Add downstream Nitrification Biofilter and Denit filter with methanol
 Add methanol to existing BNR process
 Add downstream anoxic tank with methanol feed
 Add effluent filtration
 Other: Modify aeration tanks to create post anoxic zone

CAPITAL COST:

Equipment and Structures (from Page 2):		\$250,000
Electrical and Instrumentation:	12%	\$30,000
Yard Piping and Site Work:	15%	\$38,000
Subtotal:		\$320,000
Contractor OH&P:	15%	\$48,000
Engineering and Constr. Mgmt:	15%	\$48,000
Subtotal:		\$420,000
Contingency:	30%	\$96,000
Total Capital Cost:		\$520,000
Capital Cost per lb. 20-Yr N removal:		\$0.28

OPERATIONS COST:

Additional Horsepower (from Page 2)		0 HP
Electrical Power Cost	0.05 \$/kWh	\$0 \$/year
Nitrate Reduction using Methanol:		<u>5.0</u> mg/L
Methanol Required		110 gals/d
Methanol Cost	0.75 \$/gal	\$30,100 \$/year
Separate Stage Ammonia Reduction		<u>0.0</u> mg/L
Caustic Soda @ 25% conc.		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost:		\$4,200 \$/year
Denitrification Sludge Production w/Methanol:		360 lbs/d
Sludge Disposal Cost:	400 \$/ton	\$26,300 \$/year
Total Annual O&M Cost:		\$80,600 \$/year
Effective Annual Interest Rate after Inflation:		2.91%
20-Year Present Worth of O&M Costs:		\$910,000

TOTAL 20-YEAR PRESENT WORTH COST: **\$1,430,000**
 Total Cost per lb. 20-Yr N removal **\$0.78**

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Scranton WWTP
LOCATION: Scranton, PA
RATED FLOW: 16.0 mgd
CURRENT EFFLUENT TN: 9.2 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 830 lbs/d
 303 1000 lbs/yr
 6059 1000 lbs/20-years

PE COD. 220 mg/L
 PE TKN 20 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE
 BEPR (A2/O, VIP, etc.)
 Bardenpho
 Oxidation Ditch
 Lagoon (Biotac, etc.)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other

Existing Aerated Volume (MG)	4.58
Existing Anoxic Volume (MG)	1.97
Current MLSS at Winter ADF	2750

CURRENT EFFLUENT AMMONIA-N: 1.2 mg/L
 From Report
 From Model (at ADF and load, 16 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input type="checkbox"/> No modifications required	New MLSS
<input checked="" type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)	3000
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd) 0
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd) 0
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)	
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate nit/denit facility)	
<input type="checkbox"/> Add influent flow equalization tank	
<input type="checkbox"/> Other:	

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required
<input checked="" type="checkbox"/> Add downstream DeNit filter with methanol
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol
<input type="checkbox"/> Add methanol to existing BNR process
<input type="checkbox"/> Add downstream anoxic tank with methanol feed
<input type="checkbox"/> Add effluent filtration
<input type="checkbox"/> Other:

CAPITAL COST:

Equipment and Structures (from Page 2)		\$6,550,000
Electrical and Instrumentation	12%	\$788,000
Yard Piping and Site Work	15%	\$983,000
Subtotal:		\$8,320,000
Contractor O&M:	15%	\$1,248,000
Engineering and Constr. Mgmt	15%	\$1,248,000
Subtotal:		\$10,820,000
Contingency:	30%	\$2,496,000
Total Capital Cost:		\$13,320,000
Capital Cost per lb. 20-Yr N removal:		\$2.20

OPERATIONS COST

Additional Horsepower (from Page 2)		320 HP
Electrical Power Cost	0.05 \$/kWh	\$104,800 \$/year
Nitrate Reduction using Methanol		9.2 mg/L
Methanol Required:		380 gals/d
Methanol Cost	0.75 \$/gal	\$104,000 \$/year
Separate Stage Ammonia Reduction		0.0 mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$108,200 \$/year
Denitrification Sludge Production w/Methanol:		1190 lbs/d
Sludge Disposal Cost	400 \$/ton	\$86,900 \$/year
Total Annual O&M Cost		\$403,700 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs:		\$6,050,000

TOTAL 20-YEAR PRESENT WORTH COST: \$19,370,000
 Total Cost per lb. 20-Yr N removal \$3.20

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Lock Haven WWTP
LOCATION: Lock Haven PA
RATED FLOW: 38 mgd PE COD 300 mg/L
CURRENT EFFLUENT TN: 155 mg/L PE TKN 26 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 390 lbs/d
 142 1000 lbs/yr
 2847 1000 lbs/20-years

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE Existing Aerated Volume (MG): 1,344
 BEPR (A2/O, VIP, etc.) Existing Anoxic Volume (MG): 0
 Bardenpho Current MLSS at Winter ADF: 2500
 Oxidation Ditch
 Lagoon (Bioc, etc)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other: Conventional Activated Sludge

CURRENT EFFLUENT AMMONIA-N: 9.5 mg/L From Report
 From Model (at ADF and load, 15 d MCRT, 12°C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:
 No modifications required New MLSS 4500
 Raise MCRT/MLSS in existing tanks (check clarifier capacity) Flow (mgd) 0
 Construct additional aerated volume Flow (mgd) 0
 Construct additional clarifiers Flow (mgd) 0
 Use existing anoxic volume as aerobic (construct separate denit facility)
 Use aerated system for BOD removal only (construct separate nitr/denit facility)
 Add influent flow equalization tank
 Other: Add Baffles, Mixers and nitrate recycle

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:
 No modifications required
 Add downstream DeNit filter with methanol
 Add downstream Nitrification Biofilter and DeNit filter with methanol
 Add methanol to existing BNR process
 Add downstream anoxic tank with methanol feed
 Add effluent filtration
 Other:

CAPITAL COST:

Equipment and Structures (from Page 2)		\$2,280,000
Electrical and Instrumentation:	12%	\$271,000
Yard Piping and Site Work:	15%	\$339,000
Subtotal		\$2,870,000
Contractor OH&P:	15%	\$431,000
Engineering and Constr. Mgmt	15%	\$431,000
Subtotal		\$3,730,000
Contingency:	30%	\$861,000
Total Capital Cost		\$4,690,000
Capital Cost per lb 20-Yr N removal		\$1.61

OPERATIONS COST.

Additional Horsepower (from Page 2)		80 HP
Electrical Power Cost	0.05 \$/kWh	\$26,100 \$/year
Nitrate Reduction using Methanol		12.6 mg/L
Methanol Required		180 gals/d
Methanol Cost:	0.75 \$/gal	\$49,300 \$/year
Separate Stage Ammonia Reduction:		0.0 mg/L
Cautic Soda @ 25% conc		0 gals/d
Cautic Soda Cost:	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost:		\$37,300 \$/year
Denitrification Sludge Production w/Methanol:		560 lbs/d
Sludge Disposal Cost:	400 \$/ton	\$40,900 \$/year
Total Annual O&M Cost:		\$153,800 \$/year
Effective Annual Interest Rate after Inflation:		2.91%
20-Year Present Worth of O&M Costs:		\$2,300,000

TOTAL 20-YEAR PRESENT WORTH COST: \$6,890,000
 Total Cost per lb 20-Yr. N removal \$2.42

PROJECT:	Implementing a 3 mg/L Annual Average Total Nitrogen Limit		
PREPARED FOR:	USEPA, Chesapeake Bay Office		
PREPARED BY:	Virginia Tech with Stearns & Wheeler, LLC		
DATE:	March 10, 2001		
FACILITY:	LJSA WWTP		
LOCATION:	Lewisburg, PA		
RATED FLOW:	2.4 mgd	Current Eff. TN	PE COD. 460 mg/L
BNR EFFLUENT TN:	8.0 mg/L	27.5	PE TKN 35 mg/L
EFFLUENT TN GOAL:	3.0 mg/L		
NITROGEN REDUCTION by Denite Filters	100 lbs/d	Total N Rem 490.4 lbs/d	
	37 1000 lbs/yr	178 k/yr	
	730 1000 lbs/20-years	3,580 k/20-yrs	

CURRENT PROCESS (CHECK ALL THAT APPLY).	<input type="checkbox"/> MLE	Existing Aerated Volume (MG)	0.324/0.434
	<input checked="" type="checkbox"/> BEPR (A2/O VIP etc)	Existing Anoxic Volume (MG)	0.222/0.111
	<input type="checkbox"/> Bardenpho	Current MLSS at Winter ADF	4500
	<input type="checkbox"/> Oxidation Ditch		
	<input type="checkbox"/> Lagoon (Biolog. etc.)		
	<input type="checkbox"/> Cyclical Aeration		
	<input type="checkbox"/> SBR		
	<input type="checkbox"/> High-Rate Biofilter		
	<input type="checkbox"/> Effluent Filtration		
	<input type="checkbox"/> Other		

CURRENT EFFLUENT AMMONIA-N: 1.5 mg/L	<input type="checkbox"/> From Report
	<input checked="" type="checkbox"/> From Model (at ADF and load, 25 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:	<input type="checkbox"/> No modifications required	New MLSS	
	<input checked="" type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		4750
	<input type="checkbox"/> Construct additional aerated volume	Flow (mgd)	0
	<input type="checkbox"/> Construct additional clarifiers	Flow (mgd)	0
	<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
	<input type="checkbox"/> Use aerated system for denit removal only (construct separate denit facility)		
	<input type="checkbox"/> Add influent flow equalization tank		
	<input type="checkbox"/> Other:		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:	<input type="checkbox"/> No modifications required
	<input checked="" type="checkbox"/> Add downstream Denit filter with methanol
	<input type="checkbox"/> Add downstream Nitrification Biofilter and Denit filter with methanol
	<input type="checkbox"/> Add methanol to existing BNR process
	<input type="checkbox"/> Add downstream anoxic tank with methanol feed
	<input type="checkbox"/> Add effluent filtration
	<input type="checkbox"/> Other:

CAPITAL COST:	Equipment and Structures (from Page 2):	\$1,790,000
	Electrical and Instrumentation:	12% \$215,000
	Yard Piping and Site Work:	15% \$269,000
	Subtotal:	\$2,270,000
	Contractor O&M:	15% \$341,000
	Engineering and Constr. Mgmt:	15% \$341,000
	Subtotal:	\$2,950,000
	Contingency:	30% \$881,000
	Total Capital Cost:	\$3,630,000
	Capital Cost per lb. 20-Yr. N removal:	\$1.02

OPERATIONS COST:	Additional Horsepower (from Page 2)	50 HP
	Electrical Power Cost: 0.05 \$/kW	\$16,300 \$/year
	Nitrate Reduction using Methanol	5.0 mg/L
	Methanol Required:	50 gals/d
	Methanol Cost: 0.75 \$/gal	\$13,700 \$/year
	Separate Stage Ammonia Reduction	0.0 mg/L
	Cautic Soda @ 25% conc:	0 gals/d
	Cautic Soda Cost: 0.60 \$/gal	\$0 \$/year
	Equipment Maintenance Cost	\$29,500 \$/year
	Denitrification Sludge Production w/Methanol	140 lbs/d
	Sludge Disposal Cost: 400 \$/ton	\$10,200 \$/year
	Total Annual O&M Cost:	\$69,700 \$/year
	Effective Annual Interest Rate after Inflation	2.91%
	20-Year Present Worth of O&M Costs:	\$1,050,000

TOTAL 20-YEAR PRESENT WORTH COST:	\$4,680,000
Total Cost per lb. 20-Yr. N removal	\$1.31

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Lebanon WWTP
LOCATION: Lebanon, PA
RATED FLOW: 8.0 mgd
CURRENT EFFLUENT TN: 8.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 330 lbs/d
 120 1000 lbs/yr
 2409 1000 lbs/20-years

PE COD. 175 mg/L
 PE TKN. 27 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE
 BEPR (A2/O, VIP, etc.)
 Bardenpho
 Oxidation Ditch
 Lagoon (Biotac, etc.)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other

Existing Aerated Volume (MG) N/a
 Existing Anoxic Volume (MG) N/a
 Current MLSS at Winter ADF N/a

CURRENT EFFLUENT AMMONIA-N: 0.5 mg/L
 From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:
 No modifications required
 Raise MCRT/MLSS in existing tanks (check clarifier capacity) New MLSS N/a
 Construct additional aerated volume Flow (mgd) 0
 Construct additional clarifiers Flow (mgd) 0
 Use existing anoxic volume as aerobic (construct separate denit facility)
 Use aerated system for BOD removal only (construct separate n/denit facility)
 Add influent flow equalization tank
 Other

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:
 No modifications required
 Add downstream DeNit filter with methanol
 Add downstream Nitrification Biofilter and DeNit filter with methanol
 Add methanol to existing BNR process
 Add downstream anoxic tank with methanol feed
 Add effluent filtration
 Other

CAPITAL COST:

Equipment and Structures (from Page 2)		\$3,750,000
Electrical and Instrumentation	12%	\$450,000
Yard Piping and Site Work:	15%	\$563,000
Subtotal:		\$4,763,000
Contractor OH&P	15%	\$714,000
Engineering and Constr. Mgmt	15%	\$714,000
Subtotal:		\$8,191,000
Contingency:	30%	\$1,428,000
Total Capital Cost		\$7,820,000
Capital Cost per lb 20-Yr N removal:		\$3.16

OPERATIONS COST:

Additional Horsepower (from Page 2):		160 HP
Electrical Power Cost:	0.05 \$/kW	\$52,300 \$/year
Nitrate Reduction using Methanol:		5.0 mg/L
Methanol Required:		160 gals/d
Methanol Cost:	0.75 \$/gal	\$41,100 \$/year
Separate Stage Ammonia Reductor:		0.0 mg/L
Caustic Soda @ 25% conc.		0 gals/d
Caustic Soda Cost:	0.60 \$/gal	80 \$/year
Equipment Maintenance Cost:		\$61,900 \$/year
Denitrification Sludge Production w/Methanol:		480 lbs/d
Sludge Disposal Cost:	400 \$/ton	\$35,000 \$/year
Total Annual O&M Cost		\$190,300 \$/year
Effective Annual Interest Rate after Inflation:		2.91%
20-Year Present Worth of O&M Costs		\$2,850,000

TOTAL 20-YEAR PRESENT WORTH COST: \$10,470,000
 Total Cost per lb 20-Yr N removal: \$4.35

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: UAJA WWTP
LOCATION: State College, PA
RATED FLOW: 8.0 mgd
CURRENT EFFLUENT TN: 8.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 250 lbs/d
 PE COD 334 mg/L
 PE TKN 39 mg/L
 91 1000 lbs/yr
 1825 1000 lbs/20-years

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE
 BEPR (A2/O, VIP, etc.)
 Bardenpho
 Oxidation Ditch
 Lagoon (Biotec, etc.)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other: None

Existing Aerated Volume (MG) 2.55
 Existing Anoxic Volume (MG) 0.48
 Current MLSS at Winter ADF: 2850

CURRENT EFFLUENT AMMONIA-N: 1.8 mg/L
 From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:
 No modifications required
 Raise MCRT/MLSS in existing tanks (check clarifier capacity) New MLSS 3650
 Construct additional aerated volume Flow (mgd) 0
 Construct additional clarifiers Flow (mgd) 0
 Use existing anoxic volume as aerobic (construct separate denit facility)
 Use aerated system for BOD removal only (construct separate denit facility)
 Add influent flow equalization tank
 Other:

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:
 No modifications required
 Add downstream Denit filter with methanol
 Add downstream Nitrification Biofilter and Denit filter with methanol
 Add methanol to existing BNR process
 Add downstream anoxic tank with methanol feed
 Add effluent filtration
 Other: Modify aeration tanks to create post anoxic zone

CAPITAL COST:

Equipment and Structures (from Page 2):		\$260,000
Electrical and Instrumentation:	12%	\$30,000
Yard Piping and Site Work:	15%	\$38,000
Subtotal:		\$328,000
Contractor OH&P:	15%	\$48,000
Engineering and Constr. Mgmt:	15%	\$48,000
Subtotal:		\$420,000
Contingency	30%	\$96,000
Total Capital Cost		\$844,000
Capital Cost per lb 20-Yr N removal:		\$0.78

OPERATIONS COST:

Additional Horsepower (from Page 2)		0 HP
Electrical Power Cost	0.05 \$/kW	\$0 \$/year
Nitrate Reduction using Methanol:		<u>5.0</u> mg/L
Methanol Required		110 gals/d
Methanol Cost	0.75 \$/gal	\$30.00 \$/year
Separate Stage Ammonia Reduction		<u>0.0</u> mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$4,200 \$/year
Denitrification Sludge Production w/Methanol		360 lbs/d
Sludge Disposal Cost:	400 \$/ton	\$26,300 \$/year
Total Annual O&M Cost:		\$30,600 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs		\$910,000

TOTAL 20-YEAR PRESENT WORTH COST: \$1,430,000
 Total Cost per lb 20-Yr. N removal: \$0.78

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Lock Haven WWTP
LOCATION: Lock Haven, PA
RATED FLOW: 38 mgd
CURRENT EFFLUENT TN: 165 mg/L
EFFLUENT TN GOAL: 30 mg/L
NITROGEN REDUCTION: 390 lbs/d
 142 1000 lbs/yr
 2847 1000 lbs/20-years

PE COD 300 mg/L
 PE TKN 26 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE
 BEPR (A2/O, VIP, etc.)
 Bardenpho
 Oxidation Ditch
 Lagoon (Biolog. etc.)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other Conventional Activated Sludge

Existing Aerated Volume (MG): 1,344
 Existing Anoxic Volume (MG): 0
 Current MLSS at Winter ADF: 2500

CURRENT EFFLUENT AMMONIA-N. 95 mg/L
 From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input type="checkbox"/>	No modifications required	New MLSS	4500
<input checked="" type="checkbox"/>	Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/>	Construct additional aerated volume	Flow (mgd)	0
<input type="checkbox"/>	Construct additional clarifiers	Flow (mgd)	0
<input type="checkbox"/>	Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/>	Use aerated system for BOD removal only (construct separate n/denit facility)		
<input type="checkbox"/>	Add influent flow equalization tank		
<input checked="" type="checkbox"/>	Other: <u>Add Baffles, Mixers and nitrate recycle</u>		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/>	No modifications required
<input checked="" type="checkbox"/>	Add downstream DeNitr filter with methanol
<input checked="" type="checkbox"/>	Add downstream Nitrification Biofilter and DeNitr filter with methanol
<input checked="" type="checkbox"/>	Add methanol to existing BNR process
<input type="checkbox"/>	Add downstream anoxic tank with methanol feed
<input type="checkbox"/>	Add effluent filtration
<input type="checkbox"/>	Other:

CAPITAL COST:

Equipment and Structures (from Page 2)		\$2,260,000
Electrical and Instrumentation	12%	\$271,000
Yard Piping and Site Work:	15%	\$339,000
Subtotal		\$2,870,000
Contractor OH&P:	15%	\$431,000
Engineering and Constr. Mgmt.	15%	\$431,000
Subtotal:		\$3,730,000
Contingency	30%	\$861,000
Total Capital Cost		\$4,690,000
Capital Cost per lb 20-Yr N removal		\$1.61

OPERATIONS COST:

Additional Horsepower (from Page 2)		80 HP
Electrical Power Cost	0.05 \$/KW	\$26,100 \$/year
Nitrate Reduction using Methanol		12.5 mg/L
Methanol Required		180 gals/d
Methanol Cost:	0.75 \$/gal	\$49,300 \$/year
Separate Stage Ammonia Reduction:		0.0 mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost:	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost:		\$37,300 \$/year
Denitrification Sludge Production w/Methanol:		560 lbs/d
Sludge Disposal Cost:	400 \$/ton	\$40,900 \$/year
Total Annual O&M Cost		\$153,800 \$/year
Effective Annual Interest Rate after Inflation:		2.91%
20-Year Present Worth of O&M Costs:		\$2,300,000

TOTAL 20-YEAR PRESENT WORTH COST: \$6,890,000
 Total Cost per lb. 20-Yr N removal: \$2.42

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 10, 2001
FACILITY: LISA WWTP
LOCATION: Lewisburg, PA
RATED FLOW: 2.4 mgd Current Eff TN PE COD 450 mg/L
BNR EFFLUENT TN: 8.0 mg/L 27 % PE TKN 35 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 100 lbs/d Total N Rem 490.4 lbs/d
 by Denite Filters 37 1000 lbs/yr 179 k/yr
 730 1000 lbs/20-years 3 580 k/20-yr

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE Existing Aerated Volume (MG) 0 324/0 434
 BEPR (A2/O VIP etc.) Existing Anoxic Volume (MG) 0 222/0 111
 Bardenpho Current MLSS at Winter ADF 4500
 Oxidation Ditch
 Lagoon (Biolaq, etc.)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other.

CURRENT EFFLUENT AMMONIA-N: 1.5 mg/L From Report
 From Model (at ADF and load, 25 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:
 No modifications required New MLSS 4750
 Raise MCRT/MLSS in existing tanks (check clarifier capacity)
 Construct additional aerated volume Flow (mgd) 0
 Construct additional clarifiers Flow (mgd) 0
 Use existing anoxic volume as aerobic (construct separate denit facility)
 Use aerated system for BOD removal only (construct separate denit facility)
 Add influent flow equalization tank
 Other.

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:
 No modifications required
 Add downstream DeNit filter with methanol
 Add downstream Nitrification Biofilter and DeNit filter with methanol
 Add methanol to existing SNR process
 Add downstream anoxic tank with methanol feed
 Add effluent filtration
 Other.

CAPITAL COST:

Equipment and Structures (from Page 2)		\$1,790,000
Electrical and Instrumentation:	12%	\$215,000
Yard Piping and Site Work	15%	\$269,000
Subtotal:		\$2,270,000
Contractor OH&P:	15%	\$341,000
Engineering and Constr Mgmt	15%	\$341,000
Subtotal:		\$2,950,000
Contingency	30%	\$881,000
Total Capital Cost:		\$3,630,000
Capital Cost per lb 20-Yr. N removal:		\$1.02

OPERATIONS COST:

Additional Horsepower (from Page 2)		50 HP
Electrical Power Cost	0.05 \$/kW	\$16,300 \$/year
Nitrate Reduction using Methanol		5.0 mg/L
Methanol Required:		50 gals/d
Methanol Cost	0.75 \$/gal	\$13,700 \$/year
Separate Stage Ammonia Reduction		0.0 mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$29,500 \$/year
Denitrification Sludge Production w/Methanol		140 lbs/d
Sludge Disposal Cost	400 \$/ton	\$10,200 \$/year
Total Annual O&M Cost		\$68,700 \$/year
Effective Annual Interest Rate after inflation		2.91%
20-Year Present Worth of O&M Costs		\$1,080,000

TOTAL 20-YEAR PRESENT WORTH COST: \$4,680,000
 Total Cost per lb 20-Yr N removal \$1.31

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Lebanon WWTP
LOCATION: Lebanon, PA
RATED FLOW: 8.0 mgd
CURRENT EFFLUENT TN: 8.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 330 lbs/d
 120 1000 lbs/yr
 2409 1000 lbs/20-years

PE COD 175 mg/L
 PETKN. 27 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE
 BEPR (A2/O, VIP, etc.)
 Bardenpho
 Oxidation Ditch
 Lagoon (Biolac, etc.)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other

Existing Aerated Volume (MG) N/a
 Existing Anoxic Volume (MG) N/a
 Current MLSS at Winter ADF N/a

CURRENT EFFLUENT AMMONIA-N. 0.5 mg/L
 From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

No modifications required
 Raise MCRT/MLSS in existing tanks (check clarifier capacity) New MLSS N/a
 Construct additional aerated volume Flow (mgd) 0.0
 Construct additional clarifiers Flow (mgd) 0.0
 Use existing anoxic volume as aerobic (construct separate denit facility)
 Use aerated system for BOD removal only (construct separate n/denit facility)
 Add influent flow equalization tank
 Other

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

No modifications required
 Add downstream DeNit filter with methanol
 Add downstream Nitrification Biofilter and DeNit filter with methanol
 Add methanol to existing BNR process
 Add downstream anoxic tank with methanol feed
 Add effluent filtration
 Other

CAPITAL COST:

Equipment and Structures (from Page 2)		\$3,750,000
Electrical and Instrumentation	12%	\$450,000
Yard Piping and Site Work	15%	\$563,000
Subtotal		\$4,763,000
Contractor OH&P	15%	\$714,000
Engineering and Constr. Mgmt	15%	\$714,000
Subtotal		\$8,191,000
Contingency	30%	\$1,428,000
Total Capital Cost:		\$7,628,000
Capital Cost per lb 20-Yr. N removal:		\$3.18

OPERATIONS COST:

Additional Horsepower (from Page 2)		160 HP
Electrical Power Cost	0.05 \$/kW	\$52,300 \$/year
Nitrate Reduction using Methanol		<u>5.0</u> mg/L
Methanol Required:		150 gals/d
Methanol Cost:	0.75 \$/gal	\$41,100 \$/year
Separate Stage Ammonia Reduction		<u>0.0</u> mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost:	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$61,900 \$/year
Denitrification Sludge Production w/Methanol		480 lbs/d
Sludge Disposal Cost:	400 \$/ton	\$35,000 \$/year
Total Annual O&M Cost		\$190,300 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs		\$2,859,900

TOTAL 20-YEAR PRESENT WORTH COST: **\$10,478,000**
 Total Cost per lb 20-Yr N removal **\$4.35**

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Lancaster WWTP
LOCATION: Lancaster, PA
RATED FLOW: 29.7 mgd
CURRENT EFFLUENT TN: 8.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 1240 lbs/d
 453 1000 lbs/yr
 9052 1000 lbs/20-years

PE COD N/a mg/L
 PE TKN 22 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY)

<input checked="" type="checkbox"/>	MLE	Existing Aerated Volume (MG)	<u>N/a</u>
<input type="checkbox"/>	BEPR (A2/O, VIP, etc.)	Existing Anoxic Volume (MG)	<u>N/a</u>
<input type="checkbox"/>	Bardenpho	Current MLSS at Winter ADF	<u>N/a</u>
<input type="checkbox"/>	Oxidation Ditch		
<input type="checkbox"/>	Lagoon (Biocac etc.)		
<input type="checkbox"/>	Cyclical Aeration		
<input type="checkbox"/>	SBR		
<input type="checkbox"/>	High-Rate Biofilter		
<input type="checkbox"/>	Effluent Filtration		
<input type="checkbox"/>	Other		

CURRENT EFFLUENT AMMONIA-N: 0.5 mg/L

From Report
 From Model (at ADF and load 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/>	No modifications required	New MLSS	<u>N/a</u>
<input type="checkbox"/>	Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/>	Construct additional aerated volume	Flow (mgd)	<u>0</u>
<input type="checkbox"/>	Construct additional clarifiers	Flow (mgd)	<u>0</u>
<input type="checkbox"/>	Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/>	Use aerated system for BOD removal only (construct separate n/denit facility)		
<input type="checkbox"/>	Add influent flow equalization tank		
<input type="checkbox"/>	Other		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/>	No modifications required
<input checked="" type="checkbox"/>	Add downstream DeNit filter with methanol
<input type="checkbox"/>	Add downstream Nitrification Biofilter and DeNit filter with methanol
<input type="checkbox"/>	Add methanol to existing BNR process
<input type="checkbox"/>	Add downstream anoxic tank with methanol feed
<input type="checkbox"/>	Add effluent filtration
<input type="checkbox"/>	Other

CAPITAL COST:

Equipment and Structures (from Page 2)		\$11,350,000
Electrical and Instrumentation	12%	\$1,382,000
Yard Piping and Site Work	15%	\$1,703,000
Subtotal		\$14,420,000
Contractor OH&P	15%	\$2,163,000
Engineering and Constr Mgmt	15%	\$2,163,000
Subtotal		\$18,750,000
Contingency	30%	\$4,328,000
Total Capital Cost		\$23,080,000
Capital Cost per lb. 20-Yr N removal:		\$2.65

OPERATIONS COST:

Additional Horsepower (from Page 2):		500 HP
Electrical Power Cost	0.05 \$/kW	\$102,800 \$/year
Nitrate Reduction using Methanol		<u>5.0</u> mg/L
Methanol Required:		560 gals/d
Methanol Cost	0.75 \$/gal	\$153,300 \$/year
Separate Stage Ammonia Reduction		<u>0.0</u> mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost	0.80 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$187,500 \$/year
Denitrification Sludge Production w/Methanol		1780 lbs/d
Sludge Disposal Cost	400 \$/ton	\$129,900 \$/year
Total Annual O&M Cost		\$863,500 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs		\$9,950,000

TOTAL 20-YEAR PRESENT WORTH COST: \$33,030,000
Total Cost per lb 20-Yr N removal \$3.65

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Harrisburg WWTP
LOCATION: Harrisburg, PA
RATED FLOW: 30.0 mgd PE COD N/a mg/L
CURRENT EFFLUENT TN: 4.0 mg/L PE TKN 16 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 250 lbs/d
 91 1000 lbs/yr
 1825 1000 lbs/20-years

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE Existing Aerated Volume (MG) N/a
 BEPR (A2/O, VIP, etc.) Existing Anoxic Volume (MG) N/a
 Bardenpho Current MLSS at Winter ADF. N/a
 Oxidation Ditch
 Lagoon (Biotac, etc.)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other: UNOX Process, Aerobic-Anoxic BAFs

CURRENT EFFLUENT AMMONIA-N: <1.0 mg/L From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	New MLSS
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)	N/a
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd): <u>0</u>
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd): <u>0</u>
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)	
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate nit/denit facility)	
<input type="checkbox"/> Add influent flow equalization tank	
<input type="checkbox"/> Other: _____	

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required
<input type="checkbox"/> Add downstream DeNitr filter with methanol
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNitr filter with methanol
<input type="checkbox"/> Add methanol to existing BNR process
<input type="checkbox"/> Add downstream anoxic tank with methanol feed
<input type="checkbox"/> Add effluent filtration
<input checked="" type="checkbox"/> Other: <u>Add Methanol</u>

CAPITAL COST:

Equipment and Structures (from Page 2):	\$0
Electrical and Instrumentation	12% \$0
Yard Piping and Site Work:	15% \$0
Subtotal:	\$0
Contractor O&M:	15% \$0
Engineering and Constr Mgmt	15% \$0
Subtotal:	\$0
Contingency	30% \$0
Total Capital Cost:	\$0
Capital Cost per lb 20-Yr N removal	\$0.00

OPERATIONS COST:

Additional Horsepower (from Page 2)	0 HP
Electrical Power Cost: 0.05 \$/kW	\$0 \$/year
Nitrate Reduction using Methanol	<u>1.0</u> mg/L
Methanol Required:	110 gals/d
Methanol Cost: 0.75 \$/gal	\$30,100 \$/year
Separate Stage Ammonia Reduction	<u>0.0</u> mg/L
Caustic Soda @ 25% conc:	0 gals/d
Caustic Soda Cost: 0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost	\$0 \$/year
Denitrification Sludge Production w/Methanol:	360 lbs/d
Sludge Disposal Cost: 400 \$/ton	\$26,300 \$/year
Total Annual O&M Cost	\$56,400 \$/year
Effective Annual Interest Rate after Inflation:	2.61%
20-Year Present Worth of O&M Costs:	\$850,000

TOTAL 20-YEAR PRESENT WORTH COST: \$850,000
 Total Cost per lb 20-Yr N removal: \$0.47

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Whaler, LLC
DATE: March 19, 2001
FACILITY: Hanover Area WWTP
LOCATION: Hanover, PA
RATED FLOW: 45 mgd
CURRENT EFFLUENT TN: 80 mg/L
EFFLUENT TN GOAL: 30 mg/L
NITROGEN REDUCTION: 110 lbs/d
 40 1000 lbs/yr
 803 1000 lbs/20-years

PE BOD5 135 mg/L
 PE COD N/a mg/L
 PE TKN 30 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):
 IMLE Existing Aerated Volume (MG) 4.28
 BEPR (A2O, VIP, etc.) Existing Anoxic Volume (MG) N/a
 Bardenpho Current MLSS at Winter ADF N/a
 Oxidation Ditch
 Lagoon (Biolac, etc.)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other

CURRENT EFFLUENT AMMONIA-N: 0.5 mg/L From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:
 No modifications required New MLSS 3000
 Raise MCRT/MLSS in existing tanks (check clarifier capacity)
 Construct additional aerated volume Flow (mgd) 0
 Construct additional clarifiers Flow (mgd) 0
 Use existing anoxic volume as aerobic (construct separate denit facility)
 Use aerated system for BOD removal only (construct separate n/denit facility)
 Add influent flow equalization tank
 Other

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:
 No modifications required
 Add downstream DeNit filter with methanol
 Add downstream Nitrification Biofilter and DeNit filter with methanol
 Add methanol to existing BNR process
 Add downstream anoxic tank with methanol feed
 Add effluent filtration
 Other

CAPITAL COST:

Equipment and Structures (from Page 2)		\$2,530,000
Electrical and Instrumentation	12%	\$304,000
Yard Piping and Site Work	15%	\$380,000
Subtotal		\$3,210,000
Contractor OH&P	15%	\$482,000
Engineering and Constr Mgmt	18%	\$482,000
Subtotal		\$4,170,000
Contingency	30%	\$983,000
Total Capital Cost:		\$5,130,000
Capital Cost per lb 20-Yr N removal		\$8.39

OPERATIONS COST:

Additional Horsepower (from Page 2)		90 HP
Electrical Power Cost	0.05 \$/kW	\$29,400 \$/year
Nitrate Reduction using Methanol		3.0 mg/L
Methanol Required		50 gals/d
Methanol Cost	0.75 \$/gal	\$13,700 \$/year
Separate Stage Ammonia Reduction		0.0 mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$41,700 \$/year
Denitrification Sludge Production w/Methanol		180 lbs/d
Sludge Disposal Cost	400 \$/ton	\$11,700 \$/year
Total Annual O&M Cost:		\$96,500 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs		\$1,450,000

TOTAL 20-YEAR PRESENT WORTH COST: \$6,580,000
 Total Cost per lb 20-Yr N removal \$8.19

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 10, 2001
FACILITY: Greater Hazleton WWTP
LOCATION: Hazleton, PA
RATED FLOW: 8.9 mgd
CURRENT EFFLUENT TN: 8.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 370 lbs/d
 135 1000 lbs/yr
 2701 1000 lbs/20-years

PE COD: 180 mg/L
PE TKN: 25 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE
 BEPR (A2/O, VIP, etc.)
 Bardenpho
 Oxidation Ditch
 Lagoon (Biolac, etc.)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other

Existing Aerated Volume (MG): 0.5
Existing Anoxic Volume (MG): 0.21
Current MLSS at Winter ADF: 3500

CURRENT EFFLUENT AMMONIA-N: 3.2 mg/L
 From Report
 From Model (at ADF and load, 16 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input type="checkbox"/> No modifications required	New MLSS
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)	N/A
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd) 0
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd) 0
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)	
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate n/denit facility)	
<input type="checkbox"/> Add influent flow equalization tank	
<input checked="" type="checkbox"/> Other: Abandon activated sludge process and use biofilter for all flow	

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required	
<input checked="" type="checkbox"/> Add downstream DeNitr filter with methanol	For all 8.9 mgd
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol	
<input type="checkbox"/> Add methanol to existing BNR process	
<input type="checkbox"/> Add downstream anoxic tank with methanol feed	
<input type="checkbox"/> Add effluent filtration	
<input checked="" type="checkbox"/> Other: Add downstream Anoxic/Aerobic Biofilter for 3.41 mgd flow	

CAPITAL COST:

Equipment and Structures (from Page 2):	\$7,990,000	Adjusted for Special Condition
Electrical and Instrumentation	12% \$959,000	
Yard Piping and Site Work:	15% \$1,199,000	
Subtotal:	\$10,148,000	
Contractor O&M:	15% \$1,523,000	
Engineering and Constr Mgmt:	15% \$1,523,000	
Subtotal:	\$3,575,000	
Contingency:	30% \$3,045,000	
Total Capital Cost:	\$16,260,000	
Capital Cost per lb. 20-Yr N removal:	\$6.02	

OPERATIONS COST:

Additional Horsepower (from Page 2):	530 HP	
Electrical Power Cost	0.05 \$/kW	\$173,200 \$/year
Nitrate Reduction using Methanol	5.0 mg/L	
Methanol Required	170 gals/d	
Methanol Cost	0.75 \$/gal	\$46,500 \$/year
Separate Stage Ammonia Reduction	0.0 mg/L	
Caustic Soda @ 25% conc	0 gals/d	
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost	\$132,000	\$/year
Denitrification Sludge Production w/Methanol:	530 lbs/d	
Sludge Disposal Cost	400 \$/ton	\$38,700 \$/year
Total Annual O&M Cost	\$390,400	\$/year
Effective Annual Interest Rate after Inflation:	2.91%	
20-Year Present Worth of O&M Costs:	\$6,860,000	

TOTAL 20-YEAR PRESENT WORTH COST:

	\$22,110,000	
Total Cost per lb. 20-Yr N removal:	\$8.19	

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Susquehanna WWTP
LOCATION: Lancaster Area, PA
RATED FLOW: 12.0 mgd PE COD 220 mg/L
CURRENT EFFLUENT TN: 8.0 mg/L PE TKN 24 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 500 lbs/d
 183 1000 lbs/yr
 3850 1000 lbs/20-years

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE Existing Aerated Volume (MG) 1.9
 BEPR (A2/O, VIP, etc.) Existing Anoxic Volume (MG) 0.844
 Bardenpho Current MLSS at Winter ADF 3600
 Oxidation Ditch
 Lagoon (Biolaq, etc.)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other

CURRENT EFFLUENT AMMONIA-N: <1.0 mg/L From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:
 No modifications required New MLSS N/A
 Raise MCRT/MLSS in existing tanks (check clarifier capacity)
 Construct additional aerated volume Flow (mgd) 0
 Construct additional clarifiers Flow (mgd) 0
 Use existing anoxic volume as aerobic (construct separate denit facility)
 Use aerated system for BOD removal only (construct separate nit/denit facility)
 Add influent flow equalization tank
 Other:

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:
 No modifications required
 Add downstream DeNit filter with methanol
 Add downstream Nitrification Biofilter and DeNit filter with methanol
 Add methanol to existing BNR process
 Add downstream anoxic tank with methanol feed
 Add effluent filtration
 Other:

CAPITAL COST:

Equipment and Structures (from Page 2)		\$5,150,000
Electrical and Instrumentation	12%	\$618,000
Yard Piping and Site Work	15%	\$773,000
Subtotal		\$6,540,000
Contractor OH&P	15%	\$981,000
Engineering and Constr Mgmt	15%	\$981,000
Subtotal		\$8,500,000
Contingency	30%	\$1,982,000
Total Capital Cost		\$10,460,000
Capital Cost per lb. 20-Yr N removal		\$2.87

OPERATIONS COST:

Additional Horsepower (from Page 2)		240 HP
Electrical Power Cost	0.05 \$/kW	\$78,400 \$/year
Nitrate Reduction using Methanol		5.0 mg/L
Methanol Required:		230 gals/d
Methanol Cost	0.75 \$/gal	\$83,000 \$/year
Separate Stage Ammonia Reduction		0.0 mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$85,000 \$/year
Denitrification Sludge Production w/Methanol		720 lbs/d
Sludge Disposal Cost	400 \$/ton	\$52,800 \$/year
Total Annual O&M Cost:		\$279,000 \$/year
Effective Annual Interest Rate after Inflation:		2.91%
20-Year Present Worth of O&M Costs:		\$4,180,000

TOTAL 20-YEAR PRESENT WORTH COST: \$14,640,000
 Total Cost per lb. 20 Yr N removal \$4.01

PROJECT:	Implementing a 3 mg/L Annual Average Total Nitrogen Limit		
PREPARED FOR:	USEPA, Chesapeake Bay Office		
PREPARED BY:	Virginia Tech with Stearns & Wheeler, LLC		
DATE:	March 19, 2001		
FACILITY:	Throop WWTP		
LOCATION:	Lackawanna RBSA, PA		
RATED FLOW:	7.0 mgd	PE COD:	180 mg/L
CURRENT EFFLUENT TN:	8.0 mg/L	PE TKN:	20 mg/L
EFFLUENT TN GOAL:	3.0 mg/L		
NITROGEN REDUCTION:	290 lbs/d		
	106 1000 lbs/yr		
	2117 1000 lbs/20-years		

CURRENT PROCESS (CHECK ALL THAT APPLY):	<input checked="" type="checkbox"/> MLE	Existing Aerated Volume (MG)	2.025
	<input type="checkbox"/> BEPR (A2/O VIP, etc)	Existing Anoxic Volume (MG)	0.875
	<input type="checkbox"/> Bardenpho	Current MLSS at Winter ADF	2300
	<input type="checkbox"/> Oxidation Ditch		
	<input type="checkbox"/> Lagoon (Biocac, etc)		
	<input type="checkbox"/> Cyclical Aeration		
	<input type="checkbox"/> SBR		
	<input type="checkbox"/> High-Rate Biofilter		
	<input type="checkbox"/> Effluent Filtration		
	<input type="checkbox"/> Other:		

CURRENT EFFLUENT AMMONIA-N:	2.4 mg/L	<input type="checkbox"/> From Report
		<input checked="" type="checkbox"/> From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:		New MLSS
<input type="checkbox"/> No modifications required		3900
<input checked="" type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd)	3.0
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd)	0
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate nit/denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other:		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:	
<input type="checkbox"/> No modifications required	
<input checked="" type="checkbox"/> Add downstream DeNit filter with methanol	
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol	
<input type="checkbox"/> Add methanol to existing BNR process	
<input type="checkbox"/> Add downstream anoxic tank with methanol feed	
<input type="checkbox"/> Add effluent filtration	
<input type="checkbox"/> Other:	

CAPITAL COST:	Equipment and Structures (from Page 2):	\$3,400,000
	Electrical and Instrumentation:	12% \$408,000
	Yard Piping and Site Work:	15% \$610,000
	Subtotal:	\$4,320,000
	Contractor OH&P:	15% \$648,000
	Engineering and Constr' Mgmt:	15% \$648,000
	Subtotal:	\$5,620,000
	Contingency:	30% \$1,296,000
	Total Capital Cost:	\$6,920,000
	Capital Cost per lb. 20-Yr. N removal:	\$3.27

OPERATIONS COST:	Additional Horsepower (from Page 2):	140 HP
	Electrical Power Cost:	0.05 \$/kW \$45,700 \$/year
	Nitrate Reduction using Methanol:	6.0 mg/L
	Methanol Required:	130 gals/d
	Methanol Cost:	0.75 \$/gal \$35,600 \$/year
	Separate Stage Ammonia Reduction:	0.0 mg/L
	Caustic Soda @ 25% conc:	0 gals/d
	Caustic Soda Cost:	0.60 \$/gal \$0 \$/year
	Equipment Maintenance Cost:	\$56,200 \$/year
	Denitrification Sludge Production w/Methanol:	420 lbs/d
	Sludge Disposal Cost:	400 \$/ton \$30,700 \$/year
	Total Annual O&M Cost:	\$168,200 \$/year
	Effective Annual Interest Rate after Inflation:	2.81%
	20-Year Present Worth of O&M Costs:	\$2,520,000

TOTAL 20-YEAR PRESENT WORTH COST:	\$3,440,000
Total Cost per lb. 20-Yr. N removal:	\$4.46

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Susquehanna WWTP
LOCATION: Lancaster Area, PA
RATED FLOW: 12.0 mgd
CURRENT EFFLUENT TN: 8.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 500 lbs/d
 183 1000 lbs/yr
 3650 1000 lbs/20-years

PE COD: 220 mg/L
PETKN: 24 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE
 BEPR (A2/O, VIP, etc.)
 Bardenpho
 Oxidation Ditch
 Lagoon (Biolog, etc.)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other

Existing Aerated Volume (MG) 1.9
 Existing Anoxic Volume (MG) 0.844
 Current MLSS at Winter ADF 3600

CURRENT EFFLUENT AMMONIA-N < 1.0 mg/L
 From Report
 From Model (at ADF and load 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:
 No modifications required
 Raise MCRT/MLSS in existing tanks (check clarifier capacity) New MLSS N/A
 Construct additional aerated volume Flow (mgd) 0
 Construct additional clarifiers Flow (mgd) 0
 Use existing anoxic volume as aerobic (construct separate denit facility)
 Use aerated system for BOD removal only (construct separate nit/denit facility)
 Add influent flow equalization tank
 Other

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:
 No modifications required
 Add downstream DeNit filter with methanol
 Add downstream Nitrification Biofilter and DeNit filter with methanol
 Add methanol to existing BNR process
 Add downstream anoxic tank with methanol feed
 Add effluent filtration
 Other

CAPITAL COST.

Equipment and Structures (from Page 2)		\$5 150,000
Electrical and Instrumentation	12%	\$618,000
Yard Piping and Site Work.	15%	\$773,000
Subtotal		\$6,540,000
Contractor OH&P	15%	\$981,000
Engineering and Constr Mgmt	15%	\$981,000
Subtotal		\$8,500,000
Contingency	30%	\$1,962,000
Total Capital Cost		\$10,460,000
Capital Cost per lb 20-Yr N removal:		\$2.87

OPERATIONS COST:

Additional Horsepower (from Page 2)		240 HP
Electrical Power Cost	0.05 \$/kW	\$78,400 \$/year
Nitrate Reduction using Methanol		5.0 mg/L
Methanol Required		230 gals/d
Methanol Cost	0.75 \$/gal	\$63,000 \$/year
Separate Stage Ammonia Reduction.		0.0 mg/L
Cautic Soda @ 25% conc		0 gals/d
Cautic Soda Cost.	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost.		\$85,000 \$/year
Denitrification Sludge Production w/Methanol.		720 lbs/d
Sludge Disposal Cost	400 \$/ton	\$52,800 \$/year
Total Annual O&M Cost		\$279,000 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs		\$4,180,000

TOTAL 20-YEAR PRESENT WORTH COST: \$14,640,000
 Total Cost per lb 20-Yr N removal \$4.91

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 18, 2001
FACILITY: Williamsport Central WWTP
LOCATION: Williamsport, PA
RATED FLOW: 7.2 mgd PE COD: 268 mg/L
CURRENT EFFLUENT TN: 18.4 mg/L PE TKN: 32 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 920 lbs/d
 338 1000 lbs/yr
 6716 1000 lbs/20-years

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE Existing Aerated Volume (MG): 1.081
 BEPR (A2/O, VIP, etc.) Existing Anoxic Volume (MG): 0.5225
 Bardenpho Current MLSS at Winter ADF: 1318
 Oxidation Ditch
 Lagoon (Biolac, etc.)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other:

CURRENT EFFLUENT AMMONIA-N: 16.7 mg/L From Report
 From Model (at ADF and load, 15 d MCRT 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:
 No modifications required New MLSS 4000
 Raise MCRT/MLSS in existing tanks (check clarifier capacity)
 Construct additional aerated volume Flow (mgd) 0
 Construct additional clarifiers Flow (mgd) 2.88
 Use existing anoxic volume as aerobic (construct separate denit facility)
 Use aerated system for BOD removal only (construct separate nit/denit facility)
 Add influent flow equalization tank
 Other:

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:
 No modifications required
 Add downstream DeNitr filter with methanol
 Add downstream Nitrification Biofilter and DeNitr filter with methanol
 Add methanol to existing BNR process
 Add downstream anoxic tank with methanol feed
 Add effluent filtration
 Other:

CAPITAL COST:

Equipment and Structures (from Page 2)		\$4,730,000
Electrical and Instrumentation:	12%	\$568,000
Yard Piping and Site Work	15%	\$710,000
Subtotal		\$6,010,000
Contractor OH&P:	15%	\$902,000
Engineering and Constr Mgmt	15%	\$902,000
Subtotal		\$7,810,000
Contingency:	30%	\$1,803,000
Total Capital Cost		\$9,510,000
Capital Cost per lb 20-Yr N removal		\$1.43

OPERATIONS COST:

Additional Horsepower (from Page 2)		140 HP
Electrical Power Cost	0.05 \$/kW	\$45,700 \$/year
Nitrate Reduction using Methanol:		5.0 mg/L
Methanol Required		140 gals/d
Methanol Cost	0.75 \$/gal	\$38,300 \$/year
Separate Stage Ammonia Reduction:		0.0 mg/L
Caustic Soda @ 25% conc.		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$78,100 \$/year
Denitrification Sludge Production w/Methanol:		430 lbs/d
Sludge Disposal Cost	400 \$/ton	\$31,400 \$/year
Total Annual O&M Cost		\$183,500 \$/year
Effective Annual Interest Rate after Inflation:		2.91%
20-Year Present Worth of O&M Costs:		\$2,900,000

TOTAL 20-YEAR PRESENT WORTH COST: \$12,810,000
 Total Cost per lb 20-Yr N removal \$1.88

PROJECT: implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Williamsport West WWTP
LOCATION: Williamsport, PA
RATED FLOW: 4.8 mgd
CURRENT EFFLUENT TN: 8.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 180 lbs/d
 69 1000 lbs/yr
 1387 1000 lbs/20-years

PE COD 300 mg/L
 PE TKN 37 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

<input checked="" type="checkbox"/> MLE	Existing Aerated Volume (MG)	<u>0.89</u>
<input type="checkbox"/> BEPR (A2/O, VIP, etc.)	Existing Anoxic Volume (MG)	<u>0.33</u>
<input type="checkbox"/> Bardenpho	Current MLSS at Winter ADF:	<u>4500</u>
<input type="checkbox"/> Oxidation Ditch		
<input type="checkbox"/> Lagoon (Bioloac etc.)		
<input type="checkbox"/> Cyclical Aeration		
<input type="checkbox"/> SBR		
<input type="checkbox"/> High-Rate Biofilter		
<input type="checkbox"/> Effluent Filtration		
<input type="checkbox"/> Other		

CURRENT EFFLUENT AMMONIA-N: 2.6 mg/L

From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	New MLSS	<u>N/A</u>
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd)	<u>0</u>
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd)	<u>0</u>
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input checked="" type="checkbox"/> Use aerated system for BOD removal only (construct separate nit/denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other:		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required	
<input type="checkbox"/> Add downstream Denit filter with methanol	
<input checked="" type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol	
<input type="checkbox"/> Add methanol to existing BNR process	
<input type="checkbox"/> Add downstream anoxic tank with methanol feed	
<input type="checkbox"/> Add effluent filtration	
<input type="checkbox"/> Other:	

CAPITAL COST.

Equipment and Structures (from Page 2)		\$4,800,000
Electrical and Instrumentation	12%	\$576,000
Yard Piping and Site Work	15%	\$720,000
Subtotal:		\$6,100,000
Contractor O&M&P	15%	\$915,000
Engineering and Constr. Mgmt	15%	\$915,000
Subtotal:		\$7,930,000
Contingency:	30%	\$1,830,000
Total Capital Cost		\$9,760,000
Capital Cost per lb. 20-Yr. N removal		\$7.04

OPERATIONS COST:

Additional Horsepower (from Page 2):		180 HP
Electrical Power Cost	0.05 \$/kWh	\$58,800 \$/year
Nitrate Reduction using Methanol:		<u>5.0</u> mg/L
Methanol Required:		90 gals/d
Methanol Cost:	0.75 \$/gal	\$24,800 \$/year
Separate Stage Ammonia Reduction:		0.0 mg/L
Caustic Soda @ 25% conc.		0 gals/d
Caustic Soda Cost:	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost:		\$79,300 \$/year
Denitrification Sludge Production w/Methanol		270 lbs/d
Sludge Disposal Cost:	400 \$/ton	\$19,700 \$/year
Total Annual O&M Cost		\$182,400 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20 Year Present Worth of O&M Costs:		\$2,740,000

TOTAL 20-YEAR PRESENT WORTH COST: \$12,500,000
 Total Cost per lb. 20-Yr N removal \$9.81

PROJECT:	Implementing a 3 mg/L Annual Average Total Nitrogen Limit		
PREPARED FOR:	USEPA, Chesapeake Bay Office		
PREPARED BY:	Virginia Tech with Starns & Wheeler, LLC		
DATE:	March 19, 2001		
FACILITY:	Wyoming Valley WWTP		
LOCATION:	Luzerne Cty, PA	PE BOD5:	200 mg/L
RATED FLOW:	32.0 mgd	PE COD:	N/A mg/L
CURRENT EFFLUENT TN:	8.0 mg/L	PE TKN:	27 mg/L
EFFLUENT TN GOAL:	3.0 mg/L		
NITROGEN REDUCTION:	1330 lbs/d		
	485 1000 lbs/yr		
	9709 1000 lbs/20-years		

CURRENT PROCESS (CHECK ALL THAT APPLY):	<input checked="" type="checkbox"/> MLE	Existing Aerated Volume (MG)	1.34
	<input type="checkbox"/> BEPR (A2/O, VIP, etc.)	Existing Anoxic Volume (MG)	0.334
	<input type="checkbox"/> Bardenpho	Current MLSS at Winter ADF	3000
	<input type="checkbox"/> Oxidation Ditch		
	<input type="checkbox"/> Lagoon (Biologic etc.)		
	<input checked="" type="checkbox"/> Cyclical Aeration		
	<input type="checkbox"/> SBR		
	<input type="checkbox"/> High-Rate Biofilter		
	<input type="checkbox"/> Effluent Filtration		
	<input checked="" type="checkbox"/> Other: Schrelber Process		

CURRENT EFFLUENT AMMONIA-N: <1.0 mg/L

From Report

From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	New MLSS	N/A
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd)	0
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd)	0
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate nit/denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required
<input checked="" type="checkbox"/> Add downstream DeNitr filter with methanol
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol
<input type="checkbox"/> Add methanol to existing BNR process
<input type="checkbox"/> Add downstream anoxic tank with methanol feed
<input type="checkbox"/> Add effluent filtration
<input type="checkbox"/> Other

CAPITAL COST:

Equipment and Structures (from Page 2)		\$12,150,000
Electrical and Instrumentation	12%	\$1,458,000
Yard Piping and Site Work	15%	\$1,823,000
Subtotal		\$15,430,000
Contractor OH&P	15%	\$2,315,000
Engineering and Constr. Mgmt	15%	\$2,315,000
Subtotal		\$20,080,000
Contingency	30%	\$4,828,000
Total Capital Cost:		\$24,896,000
Capital Cost per lb. 20-Yr. N removal		\$3.64

OPERATIONS COST:

Additional Horsepower (from Page 2)		640 HP
Electrical Power Cost	0.05 \$/kW	\$208,100 \$/year
Nitrate Reduction using Methanol:		6.0 mg/L
Methanol Required		610 gals/d
Methanol Cost:	0.75 \$/gal	\$167,000 \$/year
Separate Stage Ammonia Reduction:		0.0 mg/L
Caustic Soda @ 25% conc.		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$200,600 \$/year
Denitrification Sludge Production w/Methanol		1920 lbs/d
Sludge Disposal Cost	400 \$/ton	\$140,200 \$/year
Total Annual O&M Cost:		\$716,900 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs		\$10,760,000

TOTAL 20-YEAR PRESENT WORTH COST: \$35,446,000

Total Cost per lb 20-Yr N removal: \$3.65

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: York WWTP
LOCATION: York, PA
RATED FLOW: 26.0 mgd. PE COD 200 mg/L
CURRENT EFFLUENT TN: 8.0 mg/L PE TKN 16 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 1080 lbs/d
 384 1000 lbs/yr
 7884 1000 lbs/20-years

CURRENT PROCESS (CHECK ALL THAT APPLY):

<input checked="" type="checkbox"/> MLE	Existing Aerated Volume (MG)	0.01
<input type="checkbox"/> BEPR (A2/O, VIP, etc)	Existing Anoxic Volume (MG)	2.05
<input type="checkbox"/> Bardenpho	Current MLSS at Winter ADF	3800
<input type="checkbox"/> Oxidation Ditch		
<input type="checkbox"/> Lagoon (Biolac, etc)		
<input type="checkbox"/> Cyclical Aeration		
<input type="checkbox"/> SBR		
<input type="checkbox"/> High-Rate Biofilter		
<input type="checkbox"/> Effluent Filtration		
<input type="checkbox"/> Other:		

CURRENT EFFLUENT AMMONIA-N: 0.5 mg/L

From Report
 From Model (at ADF and load 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	New MLSS	N/a
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd)	0
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd)	0
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate nit/denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other:		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required
<input type="checkbox"/> Add downstream DeNit filter with methanol
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol
<input type="checkbox"/> Add methanol to existing BNR process
<input checked="" type="checkbox"/> Add downstream anoxic tank with methanol feed
<input type="checkbox"/> Add effluent filtration
<input type="checkbox"/> Other:

CAPITAL COST:

Equipment and Structures (from Page 2)		\$5,450,000
Electrical and Instrumentation	12%	\$654,000
Yard Piping and Site Work:	15%	\$818,000
Subtotal:		\$6,922,000
Contractor OH&P:	15%	\$1,038,000
Engineering and Constr. Mgmt.	15%	\$1,038,000
Subtotal:		\$9,000,000
Contingency:	30%	\$2,076,000
Total Capital Cost		\$11,080,000
Capital Cost per lb. 20-Yr N removal		\$1.41

OPERATIONS COST

Additional Horsepower (from Page 2)		380 HP
Electrical Power Cost	0.05 \$/kW	\$127,400 \$/year
Nitrate Reduction using Methanol:		5.0 mg/L
Methanol Required:		490 gals/d
Methanol Cost	0.75 \$/gal	\$134,100 \$/year
Separate Sludge Ammonia Reduction:		0.0 mg/L
Caustic Soda @ 25% conc.		0 gals/d
Caustic Soda Cost:	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost:		\$90,000 \$/year
Denitrification Sludge Production w/Methanol		1680 lbs/d
Sludge Disposal Cost:	400 \$/ton	\$113,900 \$/year
Total Annual O&M Cost		\$465,400 \$/year
Effective Annual Interest Rate after Inflation:		2.91%
20-Year Present Worth of O&M Costs:		\$6,980,000

TOTAL 20-YEAR PRESENT WORTH COST: \$18,060,000
Total Cost per lb. 20-Yr N removal: \$2.29

**SUMMARY COST SHEETS FOR THE
14 MARYLAND WWTPS**

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Bowie WWTP
LOCATION: Bowie, MD

RATED FLOW: 2.2 mgd
CURRENT EFFLUENT TN: 3.5 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 10 lbs/d
 4 1000 lbs/yr
 73 1000 lbs/20-years

PE COD N/a mg/L
 PE TKN N/a mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

<input type="checkbox"/>	MLE	Existing Aerated Volume (MG)	<u>N/a</u>
<input checked="" type="checkbox"/>	BEPR (A2/O, VIP etc)	Existing Anoxic Volume (MG)	<u>N/a</u>
<input type="checkbox"/>	Bardenpho	Current MLSS at Winter ADF	<u>4000</u>
<input checked="" type="checkbox"/>	Oxidation Ditch		
<input type="checkbox"/>	Lagoon (Biolac, etc)		
<input type="checkbox"/>	Cyclical Aeration		
<input type="checkbox"/>	SBR		
<input type="checkbox"/>	High-Rate Biofilter		
<input type="checkbox"/>	Effluent Filtration		
<input checked="" type="checkbox"/>	Other <u>Anaerobic Basin followed by 2-stage Brush Aerator Oxidation Ditches</u>		

CURRENT EFFLUENT AMMONIA-N 0.2 mg/L

From Report
 From Model (at ADF and load, 15 d MCRT 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/>	No modifications required	New MLSS	<u>N/a</u>
<input type="checkbox"/>	Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/>	Construct additional aerated volume	Flow (mgd)	<u>0</u>
<input type="checkbox"/>	Construct additional clarifiers	Flow (mgd)	<u>0</u>
<input type="checkbox"/>	Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/>	Use aerated system for BOD removal only (construct separate nitr/denit facility)		
<input type="checkbox"/>	Add influent flow equalization tank		
<input type="checkbox"/>	Other		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

No modifications required
 Add downstream DeNit filter with methanol
 Add downstream Nitrification Biofilter and DeNit filter with methanol
 Add methanol to existing BNR process
 Add downstream anoxic tank with methanol feed
 Add effluent filtration
 Other

CAPITAL COST:

Equipment and Structures (from Page 2)		\$250,000
Electrical and Instrumentation	12%	\$30,000
Yard Piping and Site Work	15%	\$38,000
Subtotal		\$320,000
Contractor OH&P	15%	\$48,000
Engineering and Constr Mgmt	15%	\$48,000
Subtotal		\$420,000
Contingency	30%	\$96,000
Total Capital Cost		\$520,000
Capital Cost per lb. 20-Yr. N removal		\$7.12

OPERATIONS COST:

Additional Horsepower (from Page 2)		0 HP
Electrical Power Cost	0.05 \$/kW	\$0 \$/year
Nitrate Reduction using Methanol		<u>0.5</u> mg/L
Methanol Required		0 gals/d
Methanol Cost	0.75 \$/gal	\$0 \$/year
Separate Stage Ammonia Reduction		<u>0.0</u> mg/L
Caustic Soda @ 26% conc		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$4,200 \$/year
Denitrification Sludge Production w/Methanol		10 lbs/d
Sludge Disposal Cost	400 \$/ton	\$700 \$/year
Total Annual O&M Cost		\$4,900 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20 Year Present Worth of O&M Costs		\$70,000

TOTAL 20-YEAR PRESENT WORTH COST:

	\$590,000
Total Cost per lb. 20-Yr. N removal	\$8.08

PROJECT:	Implementing a 3 mg/L Annual Average Total Nitrogen Limit	
PREPARED FOR:	USEPA, Chesapeake Bay Office	
PREPARED BY:	Virginia Tech with Stearns & Wheeler, LLC	
DATE:	March 11, 2001	
FACILITY:	Brunswick WWTP	
LOCATION:	Brunswick, MD	
RATED FLOW:	07 mgd	PE COD <u>280</u> mg/L
CURRENT EFFLUENT TN	80 mg/L	PE TKN <u>34</u> mg/L
EFFLUENT TN GOAL:	3.0 mg/L	
NITROGEN REDUCTION:	30 lbs/d	
	11 1000 lbs/yr	
	219 1000 lbs/20-years	

CURRENT PROCESS (CHECK ALL THAT APPLY)	<input type="checkbox"/> MLE	Existing Aerated Volume (MG)	<u>0.234</u>
	<input type="checkbox"/> BEPR (A2/O, VIP, etc)	Existing Anoxic Volume (MG)	<u>-</u>
	<input type="checkbox"/> Bardenpho	Current MLSS at Winter ADF	<u>3500</u>
	<input type="checkbox"/> Oxidation Ditch	Cyclically Aerated	
	<input type="checkbox"/> Lagoon (Biolac, etc)		
	<input checked="" type="checkbox"/> Cyclical Aeration		
<input type="checkbox"/> SBR			
<input type="checkbox"/> High-Rate Biofilter			
<input type="checkbox"/> Effluent Filtration			
<input type="checkbox"/> Other			

CURRENT EFFLUENT AMMONIA-N. < 1.0 mg/L

From Report

From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	New MLSS	<u>N/A</u>
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd):	<u>10 r</u>
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd):	<u>0.3</u>
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate nit/denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required
<input checked="" type="checkbox"/> Add downstream DeNit filter with methanol
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol
<input type="checkbox"/> Add methanol to existing BNR process
<input type="checkbox"/> Add downstream anoxic tank with methanol feed
<input type="checkbox"/> Add effluent filtration
<input type="checkbox"/> Other

CAPITAL COST:	Equipment and Structures (from Page 2)	\$1,300,000
	Electrical and Instrumentation	12% \$158,000
	Yard Piping and Site Work	15% \$195,000
	Subtotal	\$1,650,000
	Contractor OH&P	15% \$248,000
	Engineering and Constr Mgmt	15% \$248,000
	Subtotal	\$2,150,000
	Contingency	30% \$645,000
	Total Capital Cost	\$2,830,000
	Capital Cost per lb 20-Yr N removal	\$12.10

OPERATIONS COST:	Additional Horsepower (from Page 2)	10 HP
	Electrical Power Cost	0.05 \$/kWh \$3,300 \$/year
	Nitrate Reduction using Methanol	<u>5.0</u> mg/L
	Methanol Required	10 gals/d
	Methanol Cost	0.75 \$/gal \$2,700 \$/year
	Separate Stage Ammonia Reduction	<u>0.0</u> mg/L
	Caustic Soda @ 25% conc.	0 gals/d
	Caustic Soda Cost	0.60 \$/gal \$0 \$/year
	Equipment Maintenance Cost	\$21,500 \$/year
	Denitrification Sludge Production w/Methanol	40 lbs/d
	Sludge Disposal Cost	400 \$/ton \$2,900 \$/year
	Total Annual O&M Cost	\$30,400 \$/year
	Effective Annual Interest Rate after Inflation	2.91%
	20-Year Present Worth of O&M Costs	\$460,000

TOTAL 20-YEAR PRESENT WORTH COST:	\$3,110,000
Total Cost per lb 20-Yr N removal:	\$14.20

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 10, 2001
FACILITY: Chestertown WWTP
LOCATION: Kent County, MD
RATED FLOW: 0.9 mgd
CURRENT EFFLUENT TN: 3.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 40 lbs/d
 15 1000 lbs/yr
 292 1000 lbs/20-years

PE COD: N/a mg/L
 PE TKN: N/a mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE
 BEPR (A2/O, VIP, etc.)
 Bardenpho
 Oxidation Ditch
 Lagoon (Biotac, etc.)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other

Existing Aerated Volume (MG): N/a
 Existing Anoxic Volume (MG): N/a
 Current MLSS at Winter ADF: N/a

CURRENT EFFLUENT AMMONIA-N: 3.0 mg/L
 From Report
 From Model (at ADF and load, 15 d MCRT 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input type="checkbox"/> No modifications required	New MLSS
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)	<u>N/a</u>
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd) <u>0</u>
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd) <u>0</u>
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)	
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate ni/denit facility)	
<input type="checkbox"/> Add influent flow equalization tank	
<input checked="" type="checkbox"/> Other: <u>improve lagoon operation w/flow pattern and diffuser changes</u>	

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required
<input type="checkbox"/> Add downstream DeNit filter with methanol
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol
<input type="checkbox"/> Add methanol to existing BNR process
<input type="checkbox"/> Add downstream anoxic tank with methanol feed
<input type="checkbox"/> Add effluent filtration
<input checked="" type="checkbox"/> Other: <u>Minor operational changes in lagoon</u>

CAPITAL COST.

Equipment and Structures (from Page 2)		\$50,000
Electrical and Instrumentation	12%	\$6,000
Yard Piping and Site Work.	15%	\$8,000
Subtotal:		\$60,000
Contractor O&M:P:	15%	\$9,000
Engineering and Constr Mgmt:	15%	\$9,000
Subtotal		\$80,000
Contingency	30%	\$18,000
Total Capital Cost		\$100,000
Capital Cost per lb. 20-Yr N removal		\$0.34

OPERATIONS COST:

Additional Horsepower (from Page 2).		0 HP
Electrical Power Cost	0.05 \$/KW	\$0 \$/year
Nitrate Reduction using Methanol.		<u>0.0</u> mg/L
Methanol Required		0 gals/d
Methanol Cost	0.75 \$/gal	\$0 \$/year
Separate Stage Ammonia Reduction		<u>0.0</u> mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost.		\$600 \$/year
Denitrification Sludge Production w/Methanol.		0 lbs/d
Sludge Disposal Cost	400 \$/ton	\$0 \$/year
Total Annual O&M Cost.		\$600 \$/year
Effective Annual Interest Rate after Inflation.		2.91%
20-Year Present Worth of O&M Costs		\$10,000

TOTAL 20-YEAR PRESENT WORTH COST: **\$110,000**
 Total Cost per lb. 20-Yr N removal **\$0.38**

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Crisfield WWTP
LOCATION: Crisfield, VA
RATED FLOW: 12 mgd
CURRENT EFFLUENT TN: 80 mg/L
EFFLUENT TN GOAL: 30 mg/L
NITROGEN REDUCTION: 50 lbs/d
 18 1000 lbs/yr
 365 1000 lbs/20-years

PE COD: 345 mg/L
PE TKN: 25 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

<input type="checkbox"/> MLE	Existing Aerated Volume (MG)	0.348
<input checked="" type="checkbox"/> BEPR (A2/O, VIP, etc.)	Existing Anoxic Volume (MG)	0.167
<input type="checkbox"/> Bardenpho	Current MLSS at Winter ADF	3700
<input type="checkbox"/> Oxidation Ditch		
<input type="checkbox"/> Lagoon (Biocac, etc.)		
<input type="checkbox"/> Cyclical Aeration		
<input type="checkbox"/> SBR		
<input type="checkbox"/> High-Rate Biofilter		
<input type="checkbox"/> Effluent Filtration		
<input type="checkbox"/> Other		

CURRENT EFFLUENT AMMONIA-N: 0.5 mg/L

From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	New MLSS	N/A
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd)	0
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd)	0
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate nitr/denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required	
<input checked="" type="checkbox"/> Add downstream DeNit filter with methanol	
<input checked="" type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol	
<input checked="" type="checkbox"/> Add methanol to existing BNR process	
<input type="checkbox"/> Add downstream anoxic tank with methanol feed	
<input type="checkbox"/> Add effluent filtration	
<input type="checkbox"/> Other	

CAPITAL COST:

Equipment and Structures (from Page 2):		\$1,370,000
Electrical and Instrumentation	12%	\$164,000
Yard Piping and Site Work:	15%	\$206,000
Subtotal:		\$1,740,000
Contractor OH&P	15%	\$261,000
Engineering and Constr. Mgmt.	15%	\$261,000
Subtotal:		\$2,260,000
Contingency	30%	\$322,000
Total Capital Cost		\$2,780,000
Capital Cost per lb 20-Yr N removal:		\$7.82

OPERATIONS COST:

Additional Horsepower (from Page 2)		20 HP
Electrical Power Cost	0.05 \$/kW	\$0.50 \$/year
Nitrate Reduction using Methanol		5.0 mg/L
Methanol Required:		20 gals/d
Methanol Cost	0.75 \$/gal	\$5,500 \$/year
Separate Stage Ammonia Reduction		0.0 mg/L
Caustic Soda @ 25% conc.		0 gals/d
Caustic Soda Cost	0.90 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$22,600 \$/year
Denitrification Sludge Production w/Methanol		70 lbs/d
Sludge Disposal Cost	400 \$/ton	\$5,100 \$/year
Total Annual O&M Cost:		\$39,700 \$/year
Effective Annual Interest Rate after Inflation:		2.91%
20-Year Present Worth of O&M Costs:		\$600,000

TOTAL 20-YEAR PRESENT WORTH COST: \$3,380,000
 Total Cost per lb. 20-Yr N removal: \$9.26

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Easton WWTP
LOCATION: Easton, MD
RATED FLOW: 2.0 mgd
CURRENT EFFLUENT TN: 9.1 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 100 lbs/d
 37 1000 lbs/yr
 730 1000 lbs/20-years

PE COD 220 mg/L
PE TKN 30 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE
 BEPR (A2/O, VIP, etc.)
 Bardenpho
 Oxidation Ditch
 Lagoon (Biotac, etc.)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other: Overland Flow of Lagoon Effluent

Existing Aerated Volume (MG) N/A
 Existing Anoxic Volume (MG) N/A
 Current MLSS at Winter ADF N/A

CURRENT EFFLUENT AMMONIA-N: 3.4 mg/L
 From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:
 No modifications required
 Raise MCRT/MLSS in existing tanks (check clarifier capacity) New MLSS N/A
 Construct additional aerated volume Flow (mgd) 2.0
 Construct additional clarifiers Flow (mgd) 1.0
 Use existing anoxic volume as aerobic (construct separate denit facility)
 Use aerated system for BOD removal only (construct separate nit/denit facility)
 Add influent flow equalization tank
 Other: Nitrification BAF

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:
 No modifications required
 Add downstream DeNit filter with methanol
 Add downstream Nitrification Biofilter and DeNit filter with methanol
 Add methanol to existing BNR process
 Add downstream anoxic tank with methanol feed
 Add effluent filtration
 Other

CAPITAL COST	Equipment and Structures (from Page 2)	\$2,800,000
	Electrical and Instrumentation 12%	\$336,000
	Yard Piping and Site Work 15%	\$420,000
	Subtotal	\$3,560,000
	Contractor OH&P 15%	\$534,000
	Engineering and Constr. Mgmt 15%	\$534,000
	Subtotal	\$4,630,000
	Contingency 30%	\$1,068,000
	Total Capital Cost	\$6,700,000
	Capital Cost per lb. 20-Yr N removal	\$9.81

OPERATIONS COST	Additional Horsepower (from Page 2):	80 HP
	Electrical Power Cost: 0.05 \$/kWh	\$26,100 \$/year
	Nitrate Reduction using Methanol:	6.1 mg/L
	Methanol Required	60 gals/d
	Methanol Cost: 0.75 \$/gal	\$13,700 \$/year
	Separate Stage Ammonia Reduction	0.0 mg/L
	Caustic Soda @ 25% conc	0 gals/d
	Caustic Soda Cost: 0.80 \$/gal	\$0 \$/year
	Equipment Maintenance Cost	\$46,300 \$/year
	Denitrification Sludge Production w/Methanol	150 lbs/d
	Sludge Disposal Cost 400 \$/ton	\$11,000 \$/year
	Total Annual O&M Cost	\$97,100 \$/year
	Effective Annual Interest Rate after Inflation	2.91%
	20 Year Present Worth of O&M Costs	\$1,460,000

TOTAL 20-YEAR PRESENT WORTH COST: \$7,160,000
 Total Cost per lb. 20-Yr N removal \$9.81

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 10, 2001
FACILITY: Elkton WWTP
LOCATION: Cecil County, MD
RATED FLOW: 2.7 mgd
CURRENT EFFLUENT TN: 8.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 110 lbs/d
 40 1000 lbs/yr
 803 1000 lbs/20-years

PE COD: 344 mg/L
 PETKN: 28 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

<input type="checkbox"/> MLE	Existing Aerated Volume (MG)	N/a
<input type="checkbox"/> BEPR (A2/O, VIP, etc)	Existing Anoxic Volume (MG)	N/a
<input type="checkbox"/> Bardenpho	Current MLSS at Winter ADF.	N/a
<input type="checkbox"/> Oxidation Ditch		
<input type="checkbox"/> Lagoon (Biolac etc.)		
<input type="checkbox"/> Cyclical Aeration		
<input type="checkbox"/> SBR		
<input checked="" type="checkbox"/> High-Rate Biofilter		
<input type="checkbox"/> Effluent Filtration		
<input type="checkbox"/> Other		

CURRENT EFFLUENT AMMONIA-N: <1.0 mg/L
 From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	New MLSS	N/a
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd):	0.0
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd):	0.0
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate n/denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other:		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required		
<input type="checkbox"/> Add downstream DeNt filter with methanol		
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNt filter with methanol		
<input type="checkbox"/> Add methanol to existing BNR process		
<input type="checkbox"/> Add downstream anoxic tank with methanol feed		
<input type="checkbox"/> Add effluent filtration		
<input checked="" type="checkbox"/> Other: Add more methanol to existing Denite Filters		

CAPITAL COST:

Equipment and Structures (from Page 2)		\$0
Electrical and Instrumentation	12%	\$0
Yard Piping and Site Work	15%	\$0
Subtotal		\$0
Contractor OH&P	15%	\$0
Engineering and Constr Mgmt	15%	\$0
Subtotal		\$0
Contingency	30%	\$0
Total Capital Cost		\$0
Capital Cost per lb 20-Yr. N removal		\$0.06

OPERATIONS COST:

Additional Horsepower (from Page 2):		0 HP
Electrical Power Cost	0.05 \$/kW	\$0 \$/year
Nitrate Reduction using Methanol		<u>5.0</u> mg/L
Methanol Required		50 gals/d
Methanol Cost	0.75 \$/gal	\$13,700 \$/year
Separate Stage Ammonia Reduction		<u>0.0</u> mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$0 \$/year
Denitrification Sludge Production w/Methanol		160 lbs/d
Sludge Disposal Cost	400 \$/ton	\$11,700 \$/year
Total Annual O&M Cost		\$25,400 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs		\$380,000

TOTAL 20-YEAR PRESENT WORTH COST: **\$380,000**
 Total Cost per lb 20-Yr N removal: **\$0.47**

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 8, 2001
FACILITY: Federalsburg WWTP
LOCATION: Caroline County, MD
RATED FLOW: 0.75 mgd
CURRENT EFFLUENT TN: 180 mg/L
EFFLUENT TN GOAL: 30 mg/L
NITROGEN REDUCTION: 90 lbs/d
 33 1000 lbs/yr
 657 1000 lbs/20-years

PE COD: 332 mg/L
PE TKN: 20 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE
 BEPR (A2/O, VIP, etc.)
 Bardenpho
 Oxidation Ditch
 Lagoon (Biotac, etc.)
 Cyclical Aerobion
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other: Trickling Filter with effluent filtration

Existing Aerated Volume (MG) N/a
 Existing Anoxic Volume (MG) N/a
 Current MLSS at Winter ADF N/a

CURRENT EFFLUENT AMMONIA-N: 0.5 mg/L From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	New MLSS	<u>N/a</u>
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		<u>N/a</u>
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd)	<u>0</u>
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd)	<u>0</u>
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other:		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required
<input checked="" type="checkbox"/> Add downstream DeNit filter with methanol
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol
<input type="checkbox"/> Add methanol to existing BNR process
<input type="checkbox"/> Add downstream anoxic tank with methanol feed
<input type="checkbox"/> Add effluent filtration
<input type="checkbox"/> Other:

CAPITAL COST:

Equipment and Structures (from Page 2)		\$1,300,000
Electrical and Instrumentation:	12%	\$156,000
Yard Piping and Site Work	15%	\$195,000
Subtotal		\$1,650,000
Contractor OH&P:	15%	\$248,000
Engineering and Constr Mgmt	15%	\$248,000
Subtotal		\$2,150,000
Contingency:	30%	\$495,000
Total Capital Cost		\$2,650,000
Capital Cost per lb. 20-Yr. N removal		\$4.03

OPERATIONS COST:

Additional Horsepower (from Page 2):		20 HP
Electrical Power Cost:	0.05 \$/kW	\$6,500 \$/year
Nitrate Reduction using Methanol:		15.0 mg/L
Methanol Required:		40 gals/d
Methanol Cost:	0.75 \$/gal	\$11,000 \$/year
Separate Stage Ammonia Reduction:		0.0 mg/L
Caustic Soda @ 25% conc.		0 gals/d
Caustic Soda Cost:	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost:		\$21,500 \$/year
Denitrification Sludge Production w/Methanol:		140 lbs/d
Sludge Disposal Cost:	400 \$/ton	\$10,200 \$/year
Total Annual O&M Cost		\$49,200 \$/year
Effective Annual Interest Rate after Inflation:		2.81%
20-Year Present Worth of O&M Costs		\$740,000

TOTAL 20-YEAR PRESENT WORTH COST: **\$3,390,000**
 Total Cost per lb. 20-Yr. N removal: **\$5.16**

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Georges Creek WWTP
LOCATION: Allegheny County, MD
RATED FLOW: 0.5 mgd
CURRENT EFFLUENT TN: 10.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 40 lbs/d
15 1000 lbs/yr
292 1000 lbs/20-years

PE COD: 385 mg/L
PE TKN: 22 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE Existing Aerated Volume (MG) 0.4958
 BEPR (A2/O, VIP etc) Existing Anoxic Volume (MG) 0.2124
 Bardenpho Current MLSS at Winter ADF. 2700
 Oxidation Ditch
 Lagoon (Biolac. etc)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other Oxidation Ditch modified to two step-feed MLE Units

CURRENT EFFLUENT AMMONIA-N: 0.5 mg/L From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	New MLSS
<input checked="" type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)	<u>N/A</u>
<input checked="" type="checkbox"/> Construct additional aerated volume	Flow (mgd) <u>0.0</u>
<input checked="" type="checkbox"/> Construct additional clarifiers	Flow (mgd) <u>0.0</u>
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)	
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate nitr/denit facility)	
<input type="checkbox"/> Add influent flow equalization tank	
<input type="checkbox"/> Other:	

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required
<input checked="" type="checkbox"/> Add downstream DeNit filter with methanol
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol
<input type="checkbox"/> Add methanol to existing BNR process
<input type="checkbox"/> Add downstream anoxic tank with methanol feed
<input type="checkbox"/> Add effluent filtration
<input type="checkbox"/> Other:

CAPITAL COST:

Equipment and Structures (from Page 2)		\$1,300,000
Electrical and Instrumentation	12%	\$158,000
Yard Piping and Site Work	15%	\$195,000
Subtotal		\$1,653,000
Contractor OH&P	15%	\$248,000
Engineering and Constr. Mgmt	15%	\$248,000
Subtotal		\$2,150,000
Contingency	30%	\$495,000
Total Capital Cost		\$2,650,000
Capital Cost per lb 20-Yr. N removal:		\$9.98

OPERATIONS COST:

Additional Horsepower (from Page 2)		10 HP
Electrical Power Cost	0.05 \$/kW	\$3,300 \$/year
Nitrate Reduction using Methanol		<u>7.0</u> mg/L
Methanol Required:		<u>20</u> gals/d
Methanol Cost:	0.75 \$/gal	\$5,500 \$/year
Separate Stage Ammonia Reduction		<u>0.0</u> mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$21,500 \$/year
Denitrification Sludge Production w/Methanol		50 lbs/d
Sludge Disposal Cost	400 \$/ton	\$3,700 \$/year
Total Annual O&M Cost		\$34,000 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs		\$510,000

TOTAL 20-YEAR PRESENT WORTH COST: \$3,160,000
 Total Cost per lb 20-Yr. N removal \$10.82

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: DuPont
LOCATION: Waynesboro, VA
RATED FLOW: 0.5 mgd
CURRENT EFFLUENT TN: 49.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 190 lbs/d
 69 1000 lbs/yr
 1387 1000 lbs/20-years

PE COD: 487 mg/L
PE TKN: 63 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

<input type="checkbox"/> MLE	Existing Aerated Volume (MG)	0.76
<input type="checkbox"/> BEPR (A2O, VIP, etc)	Existing Anoxic Volume (MG)	N/A
<input checked="" type="checkbox"/> Bardenpho	Current MLSS at Winter ADF	7140
<input type="checkbox"/> Oxidation Ditch		
<input type="checkbox"/> Lagoon (Biotac, etc)		
<input checked="" type="checkbox"/> Cyclical Aeration		
<input type="checkbox"/> SBR		
<input type="checkbox"/> High-Rate Biofilter		
<input type="checkbox"/> Effluent Filtration		
<input type="checkbox"/> Other		

CURRENT EFFLUENT AMMONIA-N: <1.0 mg/L

From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	New MLSS	- N/A
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd)	0.0
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd)	0.0
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate nit/denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required	
<input type="checkbox"/> Add downstream DeNit filter with methanol	
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol	
<input checked="" type="checkbox"/> Add methanol to existing BNR process	
<input type="checkbox"/> Add downstream anoxic tank with methanol feed	
<input type="checkbox"/> Add effluent filtration	
<input type="checkbox"/> Other	

CAPITAL COST:

Equipment and Structures (from Page 2)		\$250,000
Electrical and Instrumentation	12%	\$30,000
Yard Piping and Site Work	15%	\$38,000
Subtotal:		\$320,000
Contractor OH&P	15%	\$48,000
Engineering and Constr Mgmt	15%	\$48,000
Subtotal:		\$420,000
Contingency	30%	\$98,000
Total Capital Cost:		\$520,000
Capital Cost per lb. 20-Yr N removal		\$0.37

OPERATIONS COST:

Additional Horsepower (from Page 2)		0 HP
Electrical Power Cost	0.05 \$/kW	\$0 \$/year
Nitrate Reduction using Methanol		48.0 mg/L
Methanol Required		90 gals/d
Methanol Cost	0.75 \$/gal	\$24,600 \$/year
Separate Sludge Ammonia Reduction		0.0 mg/L
Caustic Soda @ 25% conc.		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$4,200 \$/year
Denitrification Sludge Production w/Methanol		280 lbs/d
Sludge Disposal Cost	400 \$/ton	\$20,400 \$/year
Total Annual O&M Cost		\$49,200 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs		\$740,000

TOTAL 20-YEAR PRESENT WORTH COST: \$1,260,000
 Total Cost per lb. 20-Yr N removal: \$0.91

PROJECT:	Implementing a 3 mg/L Annual Average Total Nitrogen Limit	
PREPARED FOR:	USEPA, Chesapeake Bay Office	
PREPARED BY:	Virginia Tech with Stearns & Wheeler, LLC	
DATE:	March 16, 2001	
FACILITY:	Dale Services #8 WWTP	
LOCATION:	Dale City, VA	
RATED FLOW:	3.0 mgd	PE COD <u>N/a</u> mg/L
CURRENT EFFLUENT TN:	6.0 mg/L	PE TKN <u>N/a</u> mg/L
EFFLUENT TN GOAL:	3.0 mg/L	
NITROGEN REDUCTION:	80 lbs/d	
	29 1000 lbs/yr	
	584 1000 lbs/20-years	

CURRENT PROCESS (CHECK ALL THAT APPLY):

<input checked="" type="checkbox"/> MLE	Existing Aerated Volume (MG):	N/a
<input type="checkbox"/> BEPR (A2/O, VIP, etc.)	Existing Anoxic Volume (MG):	N/a
<input type="checkbox"/> Bardenpho	Current MLSS at Winter ADF:	5300
<input type="checkbox"/> Oxidation Ditch		
<input type="checkbox"/> Lagoon (Biotac, etc.)		
<input type="checkbox"/> Cyclical Aeration		
<input type="checkbox"/> SBR		
<input type="checkbox"/> High-Rate Biofilter		
<input type="checkbox"/> Effluent Filtration		
<input checked="" type="checkbox"/> Other: <u>pH adjustment to increase nitrification rate</u>		

CURRENT EFFLUENT AMMONIA-N: <1.0 mg/L

From Report

From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	New MLSS	N/a
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd)	<u>0</u>
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd)	<u>0</u>
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate nit/denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	
<input checked="" type="checkbox"/> Add downstream DeNitr filter with methanol	
<input checked="" type="checkbox"/> Add downstream Nitrification Biofilter and DeNitr filter with methanol	
<input checked="" type="checkbox"/> Add methanol to existing BNR process	
<input checked="" type="checkbox"/> Add downstream anoxic tank with methanol feed	
<input checked="" type="checkbox"/> Add effluent filtration	
<input checked="" type="checkbox"/> Other: <u>Modify Sand Bed filters to Denitr filters</u>	

CAPITAL COST:

Equipment and Structures (from Page 2):		\$520,000
Electrical and Instrumentation:	12%	\$62,000
Yard Piping and Site Work	15%	\$78,000
Subtotal		\$660,000
Contractor O&M/P.	15%	\$99,000
Engineering and Constr. Mgmt	15%	\$99,000
Subtotal		\$660,000
Contingency	30%	\$198,000
Total Capital Cost.		\$1,660,000
Capital Cost per lb 20-Yr N removal.		\$1.82

OPERATIONS COST:

Additional Horsepower (from Page 2)		0 HP
Electrical Power Cost	0.05 \$/kW	30 \$/year
Nitrate Reduction using Methanol		3.0 mg/L
Methanol Required		30 gals/d
Methanol Cost	0.75 \$/gal	\$8,200 \$/year
Separate Sludge Ammonia Reduction.		0.0 mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost.	0.60 \$/gal	30 \$/year
Equipment Maintenance Cost		\$8,600 \$/year
Denitrification Sludge Production w/Methanol		110 lbs/d
Sludge Disposal Cost.	400 \$/ton	\$8,000 \$/year
Total Annual O&M Cost		\$24,800 \$/year
Effective Annual Interest Rate after Inflation.		2.91%
20-Year Present Worth of O&M Costs:		\$376,000

TOTAL 20-YEAR PRESENT WORTH COST:

	\$1,430,000
Total Cost per lb. 20-Yr N removal	\$2.45

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 16, 2001
FACILITY: Dale Services #1 WWTP
LOCATION: Dale City, VA
RATED FLOW: 3.0 mgd
CURRENT EFFLUENT TN: 6.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 80 lbs/d
 29 1000 lbs/yr
 584 1000 lbs/20-years

PE COD: N/A mg/L
PE TKN: N/A mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE
 BEPR (A2/O, VIP, etc.)
 Bardenpho
 Oxidation Ditch
 Lagoon (Biolac, etc.)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other: pH adjust to increase nit rate

Existing Aerated Volume (MG): N/A
 Existing Anoxic Volume (MG): N/A
 Current MLSS at Winter ADF: 5300

CURRENT EFFLUENT AMMONIA-N. <1.0 mg/L
 From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	New MLSS
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)	<u>N/A</u>
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd): <u>0.0</u>
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd): <u>0.0</u>
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)	
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate nitr/denit facility)	
<input type="checkbox"/> Add influent flow equalization tank	
<input type="checkbox"/> Other:	

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required
<input type="checkbox"/> Add downstream DeNR filter with methanol
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNR filter with methanol
<input checked="" type="checkbox"/> Add methanol to existing BNR process
<input type="checkbox"/> Add downstream anoxic tank with methanol feed
<input type="checkbox"/> Add effluent filtration
<input checked="" type="checkbox"/> Other: Modify deep bed filters to denite filters

CAPITAL COST.

Equipment and Structures (from Page 2)		\$520,000
Electrical and Instrumentation	12%	\$62,000
Yard Piping and Site Work:	15%	\$78,000
Subtotal:		\$660,000
Contractor OH&P.	15%	\$99,000
Engineering and Constr Mgmt	15%	\$99,000
Subtotal:		\$880,000
Contingency:	30%	\$198,000
Total Capital Cost:		\$1,060,000
Capital Cost per lb. 20-Yr. N removal		\$1.62

OPERATIONS COST:

Additional Horsepower (from Page 2):		0 HP
Electrical Power Cost:	0.05 \$/kW	\$0 \$/year
Nitrate Reduction using Methanol:		3.0 mg/L
Methanol Required:		30 gals/d
Methanol Cost:	0.75 \$/gal	\$8,200 \$/year
Separate Stage Ammonia Reduction:		0.0 mg/L
Caustic Soda @ 25% conc:		0 gals/d
Caustic Soda Cost:	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost:		\$8,600 \$/year
Denitrification Sludge Production w/Methanol:		110 lbs/d
Sludge Disposal Cost:	400 \$/ton	\$8,000 \$/year
Total Annual O&M Cost:		\$24,800 \$/year
Effective Annual Interest Rate after Inflation:		2.81%
20-Year Present Worth of O&M Costs:		\$370,000

TOTAL 20-YEAR PRESENT WORTH COST: \$1,430,000
 Total Cost per lb. 20-Yr N removal: \$2.45

PROJECT:	Implementing a 3 mg/L Annual Average Total Nitrogen Limit		
PREPARED FOR:	USEPA, Chesapeake Bay Office		
PREPARED BY:	Virginia Tech with Stearns & Wheeler, LLC		
DATE:	March 19, 2001		
FACILITY:	Dahlgren WWTP		
LOCATION:	Dahlgren, VA		
RATED FLOW:	0.3 mgd	PE COD	N/a mg/L
CURRENT EFFLUENT TN:	6.0 mg/L	PE TKN	N/a mg/L
EFFLUENT TN GOAL:	3.0 mg/L		
NITROGEN REDUCTION:	10 lbs/d		
	4 1000 lbs/yr		
	73 1000 lbs/20-years		

CURRENT PROCESS (CHECK ALL THAT APPLY):	<input type="checkbox"/> MLE <input type="checkbox"/> BEPR (A2/O, VIP, etc.) <input type="checkbox"/> Bardenpho <input checked="" type="checkbox"/> Oxidation Ditch <input type="checkbox"/> Lagoon (Biolac, etc.) <input type="checkbox"/> Cyclical Aeration <input type="checkbox"/> SBR <input type="checkbox"/> High-Rate Biofilter <input type="checkbox"/> Effluent Filtration <input checked="" type="checkbox"/> Other: <u>Orbal, 3 concentric rings</u>	Existing Aerated Volume (MG) <u>N/a</u> Existing Anoxic Volume (MG) <u>N/a</u> Current MLSS at Winter ADF <u>2700</u>
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CURRENT EFFLUENT AMMONIA-N: <u><1.0</u> mg/L	<input checked="" type="checkbox"/> From Report <input type="checkbox"/> From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)
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PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:	<input checked="" type="checkbox"/> No modifications required <input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity) New MLSS <u>N/a</u> <input type="checkbox"/> Construct additional aerated volume Flow (mgd) <u>0</u> <input type="checkbox"/> Construct additional clarifiers Flow (mgd) <u>0</u> <input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility) <input type="checkbox"/> Use aerated system for BOD removal only (construct separate nitr/denit facility) <input type="checkbox"/> Add influent flow equalization tank <input type="checkbox"/> Other: _____
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PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:	<input type="checkbox"/> No modifications required <input type="checkbox"/> Add downstream DeNit filter with methanol <input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol <input checked="" type="checkbox"/> Add methanol to existing BNR process <input type="checkbox"/> Add downstream anoxic tank with methanol feed <input type="checkbox"/> Add effluent filtration <input type="checkbox"/> Other: _____
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CAPITAL COST:	Equipment and Structures (from Page 2): \$250,000 Electrical and Instrumentation: 12% \$30,000 Yard Piping and Site Work: 15% \$38,000 Subtotal: \$320,000 Contractor O&M: 15% \$48,000 Engineering and Constr. Mgmt: 15% \$48,000 Subtotal: \$420,000 Contingency: 30% \$98,000 Total Capital Cost: \$820,000 Capital Cost per lb 20-Yr N removal: \$7.12	
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OPERATIONS COST:	Additional Horsepower (from Page 2) 0 HP Electrical Power Cost: 0.05 \$/kW \$0 \$/year Nitrate Reduction using Methanol: <u>3.0</u> mg/L Methanol Required: 0 gals/d Methanol Cost: 0.75 \$/gal \$0 \$/year Separate Stage Ammonia Reduction: <u>0.0</u> mg/L Caustic Soda @ 25% conc: 0 gals/d Caustic Soda Cost: 0.60 \$/gal \$0 \$/year Equipment Maintenance Cost: \$4,200 \$/year Denitrification Sludge Production w/Methanol: 10 lbs/d Sludge Disposal Cost: 400 \$/ton \$700 \$/year Total Annual O&M Cost: \$4,900 \$/year Effective Annual Interest Rate after Inflation: 2.91% 20-Year Present Worth of O&M Costs: \$70,000	
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TOTAL 20-YEAR PRESENT WORTH COST:	\$590,000
Total Cost per lb 20-Yr N removal	\$8.08

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Colonial Beach WWTP
LOCATION: Colonial Beach, VA
RATED FLOW: 2.0 mgd
CURRENT EFFLUENT TN: 7.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 70 lbs/d
 28 1000 lbs/yr
 511 1000 lbs/20-years

PE COD N/A mg/L
PE TKN N/A mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

<input type="checkbox"/> MLE	Existing Aerated Volume (MG)	<u>N/A</u>
<input type="checkbox"/> BEPR (A2/O, VIP, etc.)	Existing Anoxic Volume (MG)	<u>N/A</u>
<input type="checkbox"/> Bardenpho	Current MLSS at Winter ADF	<u>N/A</u>
<input type="checkbox"/> Oxidation Ditch		
<input type="checkbox"/> Lagoon (Biolac, etc.)		
<input checked="" type="checkbox"/> Cyclical Aeration		
<input type="checkbox"/> SBR		
<input type="checkbox"/> High-Rate Biofilter		
<input type="checkbox"/> Effluent Filtration		
<input type="checkbox"/> Other:		

CURRENT EFFLUENT AMMONIA-N: 0.5 mg/L

From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	New MLSS	<u>N/A</u>
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd)	<u>0</u>
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd)	<u>0</u>
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate n/denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other:		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	
<input checked="" type="checkbox"/> Add downstream DeNitr filter with methanol	
<input checked="" type="checkbox"/> Add downstream Nitrification Biofilter and DeNitr filter with methanol	
<input checked="" type="checkbox"/> Add methanol to existing BNR process	
<input checked="" type="checkbox"/> Add downstream anoxic tank with methanol feed	
<input checked="" type="checkbox"/> Add effluent filtration	
<input type="checkbox"/> Other:	

CAPITAL COST:

Equipment and Structures (from Page 2)		\$1,650,000
Electrical and Instrumentation	12%	\$198,000
Yard Piping and Site Work	15%	\$248,000
Subtotal		\$2,100,000
Contractor OH&P	15%	\$315,000
Engineering and Constr Mgmt	15%	\$315,000
Subtotal		\$2,738,000
Contingency	30%	\$830,000
Total Capital Cost		\$3,360,000
Capital Cost per lb 20-Yr N removal		\$8.58

OPERATIONS COST

Additional Horsepower (from Page 2)		40 HP
Electrical Power Cost	0.05 \$/kW	\$13,100 \$/year
Nitrate Reduction using Methanol		<u>4.0</u> mg/L
Methanol Required		30 gals/d
Methanol Cost	0.75 \$/gal	\$8,200 \$/year
Separate Stage Ammonia Reduction		<u>0.0</u> mg/L
Caustic Soda @ 25% conc.		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$27,300 \$/year
Denitrification Sludge Production w/Methanol		100 lbs/d
Sludge Disposal Cost	400 \$/ton	\$7,300 \$/year
Total Annual O&M Cost		\$55,900 \$/year
Effective Annual Interest Rate after Inflation		2.81%
20-Year Present Worth of O&M Costs		\$840,000

TOTAL 20-YEAR PRESENT WORTH COST: \$4,200,000
 Total Cost per lb 20-Yr N removal: \$8.22

PROJECT:	Implementing a 3 mg/L Annual Average Total Nitrogen Limit	
PREPARED FOR:	USEPA, Chesapeake Bay Office	
PREPARED BY:	Virginia Tech with Stearns & Wheeler, LLC	
DATE:	March 16, 2001	
FACILITY:	Arlington WWTP	
LOCATION:	Arlington, VA	
RATED FLOW:	30.0 mgd	PE COD <u>300</u> mg/L
CURRENT EFFLUENT TN:	8.0 mg/L	PE TKN <u>27</u> mg/L
EFFLUENT TN GOAL:	3.0 mg/L	
NITROGEN REDUCTION:	1250 lbs/d	
	456 1000 lbs/yr	
	9125 1000 lbs/20-years	

CURRENT PROCESS (CHECK ALL THAT APPLY):	<input checked="" type="checkbox"/> MLE <input type="checkbox"/> BEPR (A2/O, VIP, etc.) <input type="checkbox"/> Bardenpho <input type="checkbox"/> Oxidation Ditch <input type="checkbox"/> Lagoon (Biolac, etc.) <input type="checkbox"/> Cyclical Aeration <input type="checkbox"/> SBR <input type="checkbox"/> High-Rate Biofilter <input type="checkbox"/> Effluent Filtration <input checked="" type="checkbox"/> Other: <u>Step-Feed MLE, no nitrate recycle, Deep Bed Filters</u>	Existing Aerated Volume (MG): <u>1.82</u> Existing Anoxic Volume (MG): <u>0.78</u> Current MLSS at Winter ADF: <u>3000</u>
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CURRENT EFFLUENT AMMONIA-N:	<u><1.0</u> mg/L	<input checked="" type="checkbox"/> From Report <input type="checkbox"/> From Model (at ADF and load, 15 d MCRT 12° C winter conditions)
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PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:	<input checked="" type="checkbox"/> No modifications required <input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity) <input type="checkbox"/> Construct additional aerated volume Flow (mgd) <u>0</u> <input type="checkbox"/> Construct additional clarifiers Flow (mgd) <u>0</u> <input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility) <input type="checkbox"/> Use aerated system for BOD removal only (construct separate denit facility) <input type="checkbox"/> Add influent flow equalization tank <input type="checkbox"/> Other:	Now MLSS <u>N/A</u>
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PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:	<input type="checkbox"/> No modifications required <input type="checkbox"/> Add downstream DeNit filter with methanol <input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol <input checked="" type="checkbox"/> Add methanol to existing BNR process <input type="checkbox"/> Add downstream anoxic tank with methanol feed <input type="checkbox"/> Add effluent filtration <input checked="" type="checkbox"/> Other: <u>Convert existing deep bed effluent filters to denit filters</u>
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CAPITAL COST:	Equipment and Structures (from Page 2):	\$2,950,000
	Electrical and Instrumentation: 12%	\$394,000
	Yard Piping and Site Work: 15%	\$443,000
	Subtotal:	\$3,787,000
	Contractor OH&P: 15%	\$568,000
	Engineering and Constr. Mgmt: 15%	\$568,000
	Subtotal:	\$4,880,000
	Contingency: 30%	\$1,125,000
	Total Capital Cost:	\$8,010,000
	Capital Cost per lb 20-Yr N removal:	\$0.68

OPERATIONS COST:	Additional Horsepower (from Page 2):	0 HP
	Electrical Power Cost 0.05 \$/kW	\$0 \$/year
	Nitrate Reduction using Methanol:	<u>5.0</u> mg/L
	Methanol Required:	570 gals/d
	Methanol Cost: 0.75 \$/gal	\$156,000 \$/year
	Separate Stage Ammonia Reduction:	<u>0.0</u> mg/L
	Caustic Soda @ 25% conc:	0 gals/d
	Caustic Soda Cost 0.60 \$/gal	\$0 \$/year
	Equipment Maintenance Cost:	\$48,800 \$/year
	Denitrification Sludge Production w/Methanol:	1800 lbs/d
	Sludge Disposal Cost 400 \$/ton	\$131,400 \$/year
	Total Annual O&M Cost:	\$336,200 \$/year
	Effective Annual Interest Rate after Inflation:	2.91%
	20-Year Present Worth of O&M Costs:	\$5,040,000

TOTAL 20-YEAR PRESENT WORTH COST:	\$11,050,000
Total Cost per lb 20-Yr N removal:	\$1.21

**SUMMARY COST SHEETS FOR THE
26 VIRGINIA WWTPS**

PROJECT:	Implementing a 3 mg/L Annual Average Total Nitrogen Limit	
PREPARED FOR:	USEPA, Chesapeake Bay Office	
PREPARED BY:	Virginia Tech with Stearns & Wheeler, LLC	
DATE:	March 11, 2001	
FACILITY:	Endicott WWTP	
LOCATION:	Endicott, NY	
RATED FLOW:	80 mgd	PE COD <u>100</u> mg/L
CURRENT EFFLUENT TN:	80 mg/L	PE TKN <u>28</u> mg/L
EFFLUENT TN GOAL:	30 mg/L	
NITROGEN REDUCTION	330 lbs/d	
	120 1000 lbs/yr	
	2409 1000 lbs/20-years	

CURRENT PROCESS (CHECK ALL THAT APPLY):	<input type="checkbox"/> MLE <input type="checkbox"/> BEPR (A2/O, VIP, etc.) <input type="checkbox"/> Bardenpho <input type="checkbox"/> Oxidation Ditch <input type="checkbox"/> Lagoon (Biocac, etc.) <input type="checkbox"/> Cyclical Aeration <input type="checkbox"/> SBR <input checked="" type="checkbox"/> High-Rate Biofilter with Solids Contact Activated Sludge <input type="checkbox"/> Effluent Filtration <input checked="" type="checkbox"/> Other <u>Denite Filters</u>	Existing Aerated Volume (MG) <u>1.82</u> Existing Anoxic Volume (MG) <u>0.78</u> Current MLSS at Winter ADF <u>2700</u>
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CURRENT EFFLUENT AMMONIA-N:	<u><1.0</u> mg/L	<input type="checkbox"/> From Report <input type="checkbox"/> From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)
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PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:	<input checked="" type="checkbox"/> No modifications required <input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity) <input type="checkbox"/> Construct additional aerated volume Flow (mgd) <u>0.2</u> <input type="checkbox"/> Construct additional clarifiers Flow (mgd) <u>0.5</u> <input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility) <input type="checkbox"/> Use aerated system for BOD removal only (construct separate nitr/denit facility) <input type="checkbox"/> Add influent flow equalization tank <input type="checkbox"/> Other:	New MLSS <u>N/A</u>
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PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:	<input type="checkbox"/> No modifications required <input type="checkbox"/> Add downstream DeNit filter with methanol <input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol <input type="checkbox"/> Add methanol to existing BNR process <input type="checkbox"/> Add downstream anoxic tank with methanol feed <input type="checkbox"/> Add effluent filtration <input checked="" type="checkbox"/> Other: <u>Add Additional Methanol to Denite Filters</u>
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CAPITAL COST:	Equipment and Structures (from Page 2) \$0 Electrical and Instrumentation 12% \$0 Yard Piping and Site Work: 15% \$0 Subtotal: \$0 Contractor OH&P: 15% \$0 Engineering and Constr. Mgmt. 15% \$0 Subtotal: \$0 Contingency 30% \$0 Total Capital Cost: \$0 Capital Cost per lb 20-Yr N removal: \$0.00
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OPERATIONS COST:	Additional Horsepower (from Page 2) 0 HP Electrical Power Cost 0.05 \$/kW \$0 \$/year Nitrate Reduction using Methanol <u>5.0</u> mg/L Methanol Required 150 gals/d Methanol Cost: 0.75 \$/gal \$41,100 \$/year Separate Stage Ammonia Reduction <u>0.0</u> mg/L Caustic Soda @ 25% conc 0 gals/d Caustic Soda Cost 0.80 \$/gal \$0 \$/year Equipment Maintenance Cost \$0 \$/year Denitrification Sludge Production w/Methanol 480 lbs/d Sludge Disposal Cost 400 \$/ton \$35,000 \$/year Total Annual O&M Cost \$76,100 \$/year Effective Annual Interest Rate after Inflation 2.91% 20-Year Present Worth of O&M Costs \$1,140,000
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TOTAL 20-YEAR PRESENT WORTH COST:	\$1,140,000
Total Cost per lb 20-Yr N removal	\$0.47

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 11, 2001
FACILITY: Binghamton-Johnson City WWTP
LOCATION: Binghamton, NY
RATED FLOW: 25.0 mgd PE COD 240 mg/L
CURRENT EFFLUENT TN: 8.0 mg/L PE TKN 18 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 1040 lbs/d
 380 1000 lbs/yr
 7592 1000 lbs/20 years

CURRENT PROCESS (CHECK ALL THAT APPLY):

<input checked="" type="checkbox"/> MLE	Existing Aerated Volume (MG)	1 82
<input type="checkbox"/> BEPR (A2/O, VIP etc)	Existing Anoxic Volume (MG)	0 78
<input type="checkbox"/> Bardenpho	Current MLSS at Winter ADF	2700
<input type="checkbox"/> Oxidation Ditch		
<input type="checkbox"/> Lagoon (Biolac, etc)		
<input type="checkbox"/> Cyclical Aeration		
<input type="checkbox"/> SBR		
<input type="checkbox"/> High-Rate Biofilter		
<input type="checkbox"/> Effluent Filtration		
<input checked="" type="checkbox"/> Other: Nit-Denit BAFs for 12.5 mgd		

CURRENT EFFLUENT AMMONIA-N. 0.5 mg/L

<input checked="" type="checkbox"/> From Report
<input type="checkbox"/> From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	New MLSS	N/a
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd):	10 000
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd):	5 05
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate nit/denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other:		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required
<input checked="" type="checkbox"/> Add downstream Denit filter with methanol
<input type="checkbox"/> Add downstream Nitrification Biofilter and Denit filter with methanol
<input type="checkbox"/> Add methanol to existing BNR process
<input type="checkbox"/> Add downstream anoxic tank with methanol feed
<input type="checkbox"/> Add effluent filtration
<input type="checkbox"/> Other:

CAPITAL COST:

Equipment and Structures (from Page 2)		\$8,700,000
Electrical and Instrumentation	12%	\$1,164,000
Yard Piping and Site Work:	15%	\$1,455,000
Subtotal		\$12,320,000
Contractor OH&P	15%	\$1,848,000
Engineering and Constr Mgmt	15%	\$1,848,000
Subtotal		\$18,020,000
Contingency	30%	\$3,696,000
Total Capital Cost		\$19,720,000
Capital Cost per lb 20-Yr N removal:		\$2.60

OPERATIONS COST:

Additional Horsepower (from Page 2)		500 HP
Electrical Power Cost:	0.05 \$/kW	\$183,400 \$/year
Nitrate Reduction using Methanol:		50 mg/L
Methanol Required:		470 gals/d
Methanol Cost:	0.75 \$/gal	\$128,700 \$/year
Separate Stage Ammonia Reduction		0.0 mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$160,200 \$/year
Denitrification Sludge Production w/Methanol		1500 lbs/d
Sludge Disposal Cost	400 \$/ton	\$109,500 \$/year
Total Annual O&M Cost		\$561,800 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs:		\$8,430,000

TOTAL 20-YEAR PRESENT WORTH COST: \$28,150,000
 Total Cost per lb 20-Yr N removal: \$3.71

**SUMMARY COST SHEETS FOR THE
2 NEW YORK WWTPS**

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Winebrenner WWTP
LOCATION: Washington County, MD
RATED FLOW: 0.8 mgd
CURRENT EFFLUENT TN: 16.5 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 70 lbs/d
 26 1000 lbs/yr
 511 1000 lbs/20-years

PE COD: 365 mg/L
PE TKN: 22 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

<input type="checkbox"/> MLE	Existing Aerated Volume (MG)	N/a
<input type="checkbox"/> BEPR (A2/O, VIP, etc.)	Existing Anoxic Volume (MG)	N/a
<input type="checkbox"/> Bardenpho	Current MLSS at Winter ADF	N/a
<input type="checkbox"/> Oxidation Ditch		
<input type="checkbox"/> Lagoon (Biolac, etc.)		
<input type="checkbox"/> Cyclical Aeration		
<input checked="" type="checkbox"/> SBR		
<input type="checkbox"/> High-Rate Biofilter		
<input type="checkbox"/> Effluent Filtration		
<input checked="" type="checkbox"/> Other	RBCs followed by Denite Filters	

CURRENT EFFLUENT AMMONIA-N: 0.8 mg/L

From Report
 From Model (at ADF and load, 15 d MCRT 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	New MLSS	N/a
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd)	0
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd)	0
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate nit/denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required	
<input type="checkbox"/> Add downstream DeNit filter with methanol	
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol	
<input type="checkbox"/> Add methanol to existing BNR process	
<input checked="" type="checkbox"/> Add downstream anoxic tank with methanol feed	
<input checked="" type="checkbox"/> Add effluent filtration	
<input checked="" type="checkbox"/> Other	Add additional methanol to existing Denite Filter

CAPITAL COST:

Equipment and Structures (from Page 2):		\$0
Electrical and Instrumentation:	12%	\$0
Yard Piping and Site Work	15%	\$0
Subtotal:		\$0
Contractor OH&P	15%	\$0
Engineering and Constr Mgmt	15%	\$0
Subtotal:		\$0
Contingency	30%	\$0
Total Capital Cost:		\$0
Capital Cost per lb. 20-Yr. N removal		\$0.00

OPERATIONS COST

Additional Horsepower (from Page 2)		0 HP
Electrical Power Cost	0.05 \$/kW	\$0 \$/year
Nitrate Reduction using Methanol		13.5 mg/L
Methanol Required		30 gals/d
Methanol Cost	0.75 \$/gal	\$8,200 \$/year
Separate Stage Ammonia Reduction		0.0 mg/L
Caustic Soda @ 25% conc.		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost:		\$0 \$/year
Denitrification Sludge Production w/Methanol		100 lbs/d
Sludge Disposal Cost	400 \$/ton	\$7,300 \$/year
Total Annual O&M Cost:		\$15,500 \$/year
Effective Annual Interest Rate after Inflation:		2.91%
20-Year Present Worth of O&M Costs		\$230,000

TOTAL 20-YEAR PRESENT WORTH COST: \$230,000
 Total Cost per lb. 20-Yr. N removal: \$0.45

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 18, 2001
FACILITY: Western Branch WWTP
LOCATION: Washington Suburban Sanitary Commission MD
RATED FLOW: 18.6 mgd
CURRENT EFFLUENT TN: 80 mg/L
EFFLUENT TN GOAL: 30 mg/L
NITROGEN REDUCTION: 690 lbs/d
 252 1000 lbs/yr
 5037 1000 lbs/20-years

PE COD: N/a mg/L
PE TKN: N/a mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE
 BEPR (A2/O, VIP, etc.)
 Bardenpho
 Oxidation Ditch
 Lagoon (Bioc, etc.)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other Denite Filters

Existing Aerated Volume (MG): N/a
Existing Anoxic Volume (MG): N/a
Current MLSS at Winter ADF: 3000

CURRENT EFFLUENT AMMONIA-N: <1.0 mg/L
 From Report
 From Model (at ADF and load, 15 d MCRT 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:
 No modifications required
 Raise MCRT/MLSS in existing tanks (check clarifier capacity)
 Construct additional aerated volume
 Construct additional clarifiers
 Use existing anoxic volume as aerobic (construct separate denit facility)
 Use aerated system for BOD removal only (construct separate n/denit facility)
 Add influent flow equalization tank
 Other

New MLSS: N/a
Flow (mgd): 0
Flow (mgd): 0

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:
 No modifications required
 Add downstream DeNit filter with methanol
 Add downstream Nitrification Biofilter and DeNit filter with methanol
 Add methanol to existing BNR process
 Add downstream anoxic tank with methanol feed
 Add effluent filtration
 Other Add additional methanol to existing denite filter

CAPITAL COST:

Equipment and Structures (from Page 2)		\$0
Electrical and Instrumentation:	12%	\$0
Yard Piping and Site Work	15%	\$0
Subtotal:		\$0
Contractor OH&P:	15%	\$0
Engineering and Constr Mgmt	15%	\$0
Subtotal:		\$0
Contingency	30%	\$0
Total Capital Cost:		\$0
Capital Cost per lb 20-Yr N removal		\$0.00

OPERATIONS COST:

Additional Horsepower (from Page 2)		0 HP
Electrical Power Cost	0.05 \$/kW	\$0 \$/year
Nitrate Reduction using Methanol		5.0 mg/L
Methanol Required:		320 gals/d
Methanol Cost	0.75 \$/gal	\$87,600 \$/year
Separate Stage Ammonia Reduction:		0.0 mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$0 \$/year
Denitrification Sludge Production w/Methanol		1000 lbs/d
Sludge Disposal Cost	400 \$/ton	\$73,000 \$/year
Total Annual O&M Cost		\$160,600 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs		\$2,410,000

TOTAL 20-YEAR PRESENT WORTH COST: \$2,410,000
 Total Cost per lb 20-Yr N removal: \$0.48

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 11, 2001
FACILITY: Princess Anne WWTP
LOCATION: Somerset County, MD
RATED FLOW: 1.3 mgd PE COD: 260 mg/L
CURRENT EFFLUENT TN: 18.0 mg/L PE TKN: 26 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 160 lbs/d
 58 1000 lbs/yr
 1188 1000 lbs/20-years

CURRENT PROCESS (CHECK ALL THAT APPLY)

<input type="checkbox"/> MLE	Existing Aerated Volume (MG):	N/A
<input type="checkbox"/> BEPR (A2/O, VIP, etc.)	Existing Anoxic Volume (MG):	N/A
<input type="checkbox"/> Bardenpho	Current MLSS at Winter ADF:	3000
<input type="checkbox"/> Oxidation Ditch		
<input type="checkbox"/> Lagoon (Biolac, etc.)		
<input type="checkbox"/> Cyclical Aeration		
<input type="checkbox"/> SBR		
<input type="checkbox"/> High-Rate Biofilter		
<input type="checkbox"/> Effluent Filtration		
<input checked="" type="checkbox"/> Other: <u>Currently Conventional Activated Sludge</u>		

CURRENT EFFLUENT AMMONIA-N: <1.0 mg/L
 From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L

<input checked="" type="checkbox"/> No modifications required	New MLSS	N/A
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd):	0
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd):	0
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate nit/denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required	
<input type="checkbox"/> Add downstream DeNit filter with methanol	
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol	
<input type="checkbox"/> Add methanol to existing BNR process	
<input type="checkbox"/> Add downstream anoxic tank with methanol feed	
<input type="checkbox"/> Add effluent filtration	
<input checked="" type="checkbox"/> Other: <u>2-Stage Bardenpho has been bid; will be constructed</u>	

CAPITAL COST:

Equipment and Structures (from Page 2):		\$1,309,230
Electrical and Instrumentation:	12%	\$157,000
Yard Piping and Site Work:	15%	\$198,000
Subtotal		\$1,662,722
Contractor OH&P:	15%	\$249,000
Engineering and Constr Mgmt:	15%	\$249,000
Subtotal		\$2,161,538
Contingency:	30%	\$843,000
Total Capital Cost		\$2,810,000
Capital Cost per lb 20-Yr N removal:		\$2.41

OPERATIONS COST

Additional Horsepower (from Page 2)		0 HP
Electrical Power Cost	0.05 \$/kW	\$0 \$/year
Nitrate Reduction using Methanol		0.0 mg/L
Methanol Required		0 gals/d
Methanol Cost	0.75 \$/gal	\$0 \$/year
Separate Stage Ammonia Reduction		0.0 mg/L
Caustic Soda @ 25% conc.		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$21,600 \$/year
Denitrification Sludge Production w/Methanol		0 lbs/d
Sludge Disposal Cost	400 \$/ton	\$0 \$/year
Total Annual O&M Cost		\$21,600 \$/year
Effective Annual Interest Rate after Inflation:		2.91%
20-Year Present Worth of O&M Costs		\$320,000

TOTAL 20-YEAR PRESENT WORTH COST: \$3,130,000
 Total Cost per lb 20-Yr N removal: \$2.68

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 9, 2001
FACILITY: Mattawoman WTPP
LOCATION: Charles County, MD
RATED FLOW: 150 mgd
CURRENT EFFLUENT TN: 3.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 0 lbs/d
 0 1000 lbs/yr
 0 1000 lbs/20-years

PE COD: 104 mg/L
PE TKN: 28 mg/L
 * The plant is currently being upgraded to a Bardenpho with the ability to add methanol so 3 TN will be achievable

CURRENT PROCESS (CHECK ALL THAT APPLY):

<input type="checkbox"/> MLE	Existing Aerated Volume (MG):	N/a
<input type="checkbox"/> BEPR (A2/O, VIP, etc.)	Existing Anoxic Volume (MG):	N/a
<input checked="" type="checkbox"/> Bardenpho	Current MLSS at Winter ADF:	N/a
<input type="checkbox"/> Oxidation Ditch		
<input type="checkbox"/> Lagoon (Biotac, etc.)		
<input type="checkbox"/> Cyclical Aeration		
<input type="checkbox"/> SBR		
<input type="checkbox"/> High-Rate Biofilter		
<input type="checkbox"/> Effluent Filtration		
<input type="checkbox"/> Other:		

(Under Design - March 2001)

CURRENT EFFLUENT AMMONIA-N: 0.5 mg/L

<input checked="" type="checkbox"/> From Report
<input type="checkbox"/> From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	New MLSS	N/a
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd):	0
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd):	0
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate nitrdenit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other:		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	
<input type="checkbox"/> Add downstream Denit filter with methanol	
<input type="checkbox"/> Add downstream Nitrification Biofilter and Denit filter with methanol	
<input type="checkbox"/> Add methanol to existing BNR process	
<input type="checkbox"/> Add downstream anoxic tank with methanol feed	
<input type="checkbox"/> Add effluent filtration	
<input type="checkbox"/> Other:	

CAPITAL COST:

Equipment and Structures (from Page 2):		\$0
Electrical and Instrumentation:	12%	\$0
Yard Piping and Site Work:	15%	\$0
Subtotal:		\$0
Contractor O&M:	15%	\$0
Engineering and Constr. Mgmt:	15%	\$0
Subtotal:		\$0
Contingency:	30%	\$0
Total Capital Cost		\$0
Capital Cost per lb. 20-Yr. N removal:	#DIV/0!	

OPERATIONS COST:

Additional Horsepower (from Page 2):		0 HP
Electrical Power Cost: 0.05 \$/kW		\$0 \$/year
Nitrate Reduction using Methanol:		0.0 mg/L
Methanol Required:		0 gals/d
Methanol Cost: 0.75 \$/gal		\$0 \$/year
Separate Stage Ammonia Reduction:		0.0 mg/L
Caustic Soda @ 25% conc.		0 gals/d
Caustic Soda Cost: 0.80 \$/gal		\$0 \$/year
Equipment Maintenance Cost:		\$0 \$/year
Denitrification Sludge Production w/Methanol:		0 lbs/d
Sludge Disposal Cost: 400 \$/ton		\$0 \$/year
Total Annual O&M Cost:		\$0 \$/year
Effective Annual Interest Rate after Inflation:		2.81%
20-Year Present Worth of O&M Costs:		\$0

TOTAL 20-YEAR PRESENT WORTH COST: \$0
 Total Cost per lb. 20-Yr N removal #DIV/0!

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Indian Head WWTP
LOCATION: Indian Head, MD
RATED FLOW: 0.5 mgd
CURRENT EFFLUENT TN: 10.5 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 30 lbs/d
 11 1000 lbs/yr
 219 1000 lbs/20-years

PE COD: 430 mg/L
PE TKN: 29 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE
 BEPR (A2/O, VIP, etc.)
 Bardenpho
 Oxidation Ditch
 Lagoon (Biolac, etc.)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other:

Existing Aerated Volume (MG) 0.037
 Existing Anoxic Volume (MG) 0.258
 Current MLSS at Winter ADF 2800

CURRENT EFFLUENT AMMONIA-N: 0.5 mg/L
 From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:
 No modifications required
 Raise MCRT/MLSS in existing tanks (check clarifier capacity)
 Construct additional aerated volume Flow (mgd) 0
 Construct additional clarifiers Flow (mgd) 0
 Use existing anoxic volume as aerobic (construct separate denit facility)
 Use aerated system for BOD removal only (construct separate nitr/denit facility)
 Add influent flow equalization tank
 Other:

New MLSS N/g

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:
 No modifications required
 Add downstream DeNit filter with methanol
 Add downstream Nitrification Biofilter and DeNit filter with methanol
 Add methanol to existing BNR process
 Add downstream anoxic tank with methanol feed
 Add effluent filtration
 Other:

CAPITAL COST:

Equipment and Structures (from Page 2)		\$250,000
Electrical and Instrumentation	12%	\$30,000
Yard Piping and Site Work	15%	\$38,000
Subtotal:		\$320,000
Contractor OH&P	15%	\$48,000
Engineering and Constr Mgmt.	16%	\$48,000
Subtotal:		\$420,000
Contingency:	30%	\$96,000
Total Capital Cost:		\$520,000
Capital Cost per lb 20-Yr N removal:		\$2.37

OPERATIONS COST:

Additional Horsepower (from Page 2):		0 HP
Electrical Power Cost	0.05 \$/kW	\$0 \$/year
Nitrate Reduction using Methanol:		7.5 mg/L
Methanol Required:		10 gals/d
Methanol Cost:	0.75 \$/gal	\$2,700 \$/year
Separate Stage Ammonia-Reduction		0.0 mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$4,200 \$/year
Nitrification Sludge Production w/Methanol		50 lbs/d
Sludge Disposal Cost	400 \$/ton	\$3,700 \$/year
Total Annual O&M Cost:		\$10,000 \$/year
Effective Annual Interest Rate after Inflation:		2.91%
20-Year Present Worth of O&M Costs:		\$160,000

TOTAL 20-YEAR PRESENT WORTH COST: \$680,000
 Total Cost per lb 20-Yr. N removal \$3.11

PROJECT:	Implementing a 3 mg/L Annual Average Total Nitrogen Limit		
PREPARED FOR:	USEPA, Chesapeake Bay Office		
PREPARED BY:	Virginia Tech with Stearns & Wheeler, LLC		
DATE:	March 19, 2001		
FACILITY:	Havre de Grace WWTP		
LOCATION:	Havre de Grace, MD		
RATED FLOW:	19 mgd	PE COD	N/a mg/L
CURRENT EFFLUENT TN:	80 mg/L	PE TKN	N/a mg/L
EFFLUENT TN GOAL:	30 mg/L		
NITROGEN REDUCTION	80 lbs/d		
	29 1000 lbs/yr		
	584 1000 lbs/20-years		

CURRENT PROCESS (CHECK ALL THAT APPLY):	<input checked="" type="checkbox"/> MLE	Existing Aerated Volume (MG):	N/a
	<input type="checkbox"/> BEPR (A2/O, VIP, etc.)	Existing Anoxic Volume (MG):	N/a
	<input type="checkbox"/> Bardenpho	Current MLSS at Winter ADF	N/a
	<input type="checkbox"/> Oxidation Ditch		
	<input type="checkbox"/> Lagoon (Biolac, etc.)		
	<input type="checkbox"/> Cyclical Aeration		
	<input type="checkbox"/> SBR		
	<input type="checkbox"/> High-Rate Biofilter		
	<input type="checkbox"/> Effluent Filtration		
	<input checked="" type="checkbox"/> Other: MLE with Recycle from RBCs in Series before Clarifier		

CURRENT EFFLUENT AMMONIA-N:	< 1.0 mg/L	<input checked="" type="checkbox"/> From Report
		<input type="checkbox"/> From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:		New MLSS
<input checked="" type="checkbox"/> No modifications required		N/a
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd): 0	
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd): 0	
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate n/denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other:		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:	
<input checked="" type="checkbox"/> No modifications required	
<input checked="" type="checkbox"/> Add downstream Denit filter with methanol	
<input checked="" type="checkbox"/> Add downstream Nitrification Biofilter and Denit filter with methanol	
<input checked="" type="checkbox"/> Add methanol to existing BNR process	
<input checked="" type="checkbox"/> Add downstream anoxic tank with methanol feed	
<input checked="" type="checkbox"/> Add effluent filtration	
<input type="checkbox"/> Other:	

CAPITAL COST:	Equipment and Structures (from Page 2)	\$1,620,000
	Electrical and Instrumentation: 12%	\$184,000
	Yard Piping and Site Work: 15%	\$243,000
	Subtotal:	\$2,060,000
	Contractor OH&P: 15%	\$309,000
	Engineering and Constr Mgmt: 15%	\$309,000
	Subtotal:	\$2,680,000
	Contingency: 30%	\$818,000
	Total Capital Cost	\$3,300,000
	Capital Cost per lb 20-Yr N removal	\$5.65

OPERATIONS COST:	Additional Horsepower (from Page 2)	40 HP
	Electrical Power Cost: 0.05 \$/kW	\$13,100 \$/year
	Nitrate Reduction using Methanol:	5.0 mg/L
	Methanol Required:	40 gals/d
	Methanol Cost: 0.75 \$/gal	\$11,000 \$/year
	Separate Stage Ammonia Reduction:	0.0 mg/L
	Caustic Soda @ 25% conc:	0 gals/d
	Caustic Soda Cost: 0.60 \$/gal	\$0 \$/year
	Equipment Maintenance Cost:	\$28,800 \$/year
	Denitrification Sludge Production w/Methanol:	110 lbs/d
	Sludge Disposal Cost: 400 \$/ton	\$8,000 \$/year
	Total Annual O&M Cost	\$58,900 \$/year
	Effective Annual Interest Rate after Inflation:	2.91%
	20-Year Present Worth of O&M Costs:	\$880,000

TOTAL 20-YEAR PRESENT WORTH COST:	\$4,180,000
Total Cost per lb 20-Yr N removal	\$7.16

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Rocco Farm Foods WWTP
LOCATION: Edinburg, VA
RATED FLOW: 1.2 mgd
CURRENT EFFLUENT TN: 12.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 90 lbs/d
 33 1000 lbs/yr
 657 1000 lbs/20-years

PE COD: N/A mg/L
PE TKN: N/A mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

<input type="checkbox"/> MLE	Existing Aerated Volume (MG)	N/A
<input checked="" type="checkbox"/> BEPR (A2/O, VIP, etc.)	Existing Anoxic Volume (MG)	N/A
<input type="checkbox"/> Barotrophe	Current MLSS at Winter ADF	4000
<input type="checkbox"/> Oxidation Ditch		
<input type="checkbox"/> Lagoon (Biolec, etc.)		
<input type="checkbox"/> Cyclical Aeration		
<input type="checkbox"/> SBR		
<input type="checkbox"/> High-Rate Biofilter		
<input type="checkbox"/> Effluent Filtration		
<input checked="" type="checkbox"/> Other A2/O with integral Schreiber Process		

CURRENT EFFLUENT AMMONIA-N < 1.0 mg/L

<input checked="" type="checkbox"/> From Report
<input type="checkbox"/> From Model (at ADF and load 15 d MCRT 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	New MLSS	N/A
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd)	0.0
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd)	0.0
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required
<input checked="" type="checkbox"/> Add downstream DeNit filter with methanol
<input checked="" type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol
<input type="checkbox"/> Add methanol to existing BNR process
<input type="checkbox"/> Add downstream anoxic tank with methanol feed
<input type="checkbox"/> Add effluent filtration
<input type="checkbox"/> Other

CAPITAL COST:

Equipment and Structures (from Page 2)		\$1,370,000
Electrical and Instrumentation	12%	\$164,000
Yard Piping and Site Work	15%	\$206,000
Subtotal		\$1,740,000
Contractor OH&P	15%	\$261,000
Engineering and Constr Mgmt	15%	\$261,000
Subtotal		\$2,260,000
Contingency	30%	\$522,000
Total Capital Cost		\$2,780,000
Capital Cost per lb 20-Yr N removal:		\$4.23

OPERATIONS COST:

Additional Horsepower (from Page 2):		20 HP
Electrical Power Cost	0.05 \$/kW	\$6,600 \$/year
Nitrate Reduction using Methanol		0.0 mg/L
Methanol Required		40 gals/d
Methanol Cost	0.75 \$/gal	\$11,000 \$/year
Separate Stage Ammonia Reduction:		0.0 mg/L
Caustic Soda @ 25% conc.		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$22,800 \$/year
Denitrification Sludge Production w/Methanol		130 lbs/d
Sludge Disposal Cost	400 \$/ton	\$9,500 \$/year
Total Annual O&M Cost		\$49,600 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs		\$740,000

TOTAL 20-YEAR PRESENT WORTH COST: \$3,520,000
 Total Cost per lb. 20-Yr N removal \$5.36

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Moores Creek WWTP
LOCATION: Rivanna Authority, Charlottesville, VA
RATED FLOW: 15.0 mgd
CURRENT EFFLUENT TN: 7.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 500 lbs/d
 183 1000 lbs/yr
 3650 1000 lbs/20-years

PE COD N/A mg/L
 PE TKN N/A mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

<input checked="" type="checkbox"/>	MLE	Existing Aerated Volume (MG):	<u>N/A</u>
<input checked="" type="checkbox"/>	BEPR (A2/O, VIP, etc)	Existing Anoxic Volume (MG):	<u>N/A</u>
<input type="checkbox"/>	Bardenpho	Current MLSS at Winter ADF	<u>3000</u>
<input type="checkbox"/>	Oxidation Ditch		
<input type="checkbox"/>	Lagoon (Biolac, etc)		
<input type="checkbox"/>	Cyclical Aeration		
<input type="checkbox"/>	SBR		
<input type="checkbox"/>	High-Rate Biofilter		
<input type="checkbox"/>	Effluent Filtration		
<input checked="" type="checkbox"/>	Other: <u>A2/O that also can be operated as an MLE</u>		

CURRENT EFFLUENT AMMONIA-N: 0.5 mg/L

<input checked="" type="checkbox"/>	From Report
<input type="checkbox"/>	From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/>	No modifications required	New MLSS	<u>N/A</u>
<input type="checkbox"/>	Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/>	Construct additional aerated volume	Flow (mgd)	<u>0</u>
<input type="checkbox"/>	Construct additional clarifiers	Flow (mgd)	<u>0</u>
<input type="checkbox"/>	Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/>	Use aerated system for BOD removal only (construct separate denit facility)		
<input type="checkbox"/>	Add influent flow equalization tank		
<input type="checkbox"/>	Other:		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/>	No modifications required
<input checked="" type="checkbox"/>	Add downstream DeNit filter with methanol
<input type="checkbox"/>	Add downstream Nitrification Biofilter and DeNit filter with methanol
<input type="checkbox"/>	Add methanol to existing BNR process
<input type="checkbox"/>	Add downstream anoxic tank with methanol feed
<input type="checkbox"/>	Add effluent filtration
<input type="checkbox"/>	Other:

CAPITAL COST.

Equipment and Structures (from Page 2)		\$8,200,000
Electrical and Instrumentation	12%	\$744,000
Yard Piping and Site Work:	15%	\$930,000
Subtotal		\$7,670,000
Contractor OH&P:	15%	\$1,181,000
Engineering and Constr. Mgmt:	15%	\$1,181,000
Subtotal		\$10,230,000
Contingency	30%	\$2,381,000
Total Capital Cost		\$12,890,000
Capital Cost per lb. 20-Yr N removal		\$3.45

OPERATIONS COST.

Additional Horsepower (from Page 2)		300 HP
Electrical Power Cost	0.05 \$/kW	\$98,000 \$/year
Nitrate Reduction using Methanol		4.0 mg/L
Methanol Required		230 gals/d
Methanol Cost	0.75 \$/gal	\$83,000 \$/year
Separate Stage Ammonia Reduction		0.0 mg/L
Cautic Soda @ 25% conc.		0 gals/d
Cautic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$102,300 \$/year
Denitrification Sludge Production w/Methanol		720 lbs/d
Sludge Disposal Cost	400 \$/ton	\$52,800 \$/year
Total Annual O&M Cost		\$315,900 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs		\$4,740,000

TOTAL 20-YEAR PRESENT WORTH COST. \$17,330,000
 Total Cost per lb 20-Yr N removal \$4.75

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Whaler, LLC
DATE: March 19, 2001
FACILITY: Purcellville WWTP
LOCATION: Purcellville, VA
RATED FLOW: 1.0 mgd PE COD: N/A mg/L
CURRENT EFFLUENT TN: 8.0 mg/L PE TKN: N/A mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 30 lbs/d
 11 1000 lbs/yr
 219 1000 lbs/20-years

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE Existing Aerated Volume (MG) N/A
 BEPR (A2/O VIP, etc) Existing Anoxic Volume (MG) N/A
 Bardenpho Current MLSS at Winter ADF 3000
 Oxidation Ditch
 Lagoon (Biolac, etc)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other Step Feed MLE with Effluent Filters

CURRENT EFFLUENT AMMONIA-N: <1.0 mg/L From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:
 No modifications required New MLSS N/A
 Raise MCRT/MLSS in existing tanks (check clarifier capacity)
 Construct additional aerated volume Flow (mgd) 0.0
 Construct additional clarifiers Flow (mgd) 0
 Use existing anoxic volume as aerobic (construct separate denit facility)
 Use aerated system for BOD removal only (construct separate n/denit facility)
 Add influent flow equalization tank
 Other:

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:
 No modifications required
 Add downstream DeNit filter with methanol
 Add downstream Nitrification Biofilter and DeNit filter with methanol
 Add methanol to existing BNR process
 Add downstream anoxic tank with methanol feed
 Add effluent filtration
 Other:

CAPITAL COST:

Equipment and Structures (from Page 2)		\$250,000
Electrical and Instrumentation	12%	\$30,000
Yard Piping and Site Work	15%	\$38,000
Subtotal:		\$320,000
Contractor OH&P:	15%	\$48,000
Engineering and Constr. Mgmt.	15%	\$48,000
Subtotal:		\$420,000
Contingency	30%	\$98,000
Total Capital Cost:		\$620,000
Capital Cost per lb. 20-Yr. N removal:		\$2.37

OPERATIONS COST:

Additional Horsepower (from Page 2)		0 HP
Electrical Power Cost	0.05 \$/kW	\$0 \$/year
Nitrate Reduction using Methanol:		3.0 mg/L
Methanol Required		10 gals/d
Methanol Cost	0.75 \$/gal	\$2,700 \$/year
Separate Stage Ammonia Reduction:		0.0 mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$4,200 \$/year
Denitrification Sludge Production w/Methanol		40 lbs/d
Sludge Disposal Cost	400 \$/ton	\$2,900 \$/year
Total Annual O&M Cost:		\$9,800 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs		\$150,000

TOTAL 20-YEAR PRESENT WORTH COST: \$670,000
 Total Cost per lb. 20-Yr. N removal: \$3.06

PROJECT:	Implementing a 3 mg/L Annual Average Total Nitrogen Limit		
PREPARED FOR:	USEPA, Chesapeake Bay Office		
PREPARED BY:	Virginia Tech with Stearns & Wheeler, LLC		
DATE:	March 19, 2001		
FACILITY:	Parkins Mill WWTP		
LOCATION:	Frederick County, VA		
RATED FLOW:	2.0 mgd	PE COD	N/a mg/L
CURRENT EFFLUENT TN:	4.0 mg/L	PE TKN	N/a mg/L
EFFLUENT TN GOAL:	3.0 mg/L		
NITROGEN REDUCTION:	20 lbs/d		
	7 1000 lbs/yr		
	146 1000 lbs/20-years		

CURRENT PROCESS (CHECK ALL THAT APPLY):	<input type="checkbox"/> MLE	Existing Aerated Volume (MG)	N/a
	<input type="checkbox"/> BEPR (A2/O, VIP, etc.)	Existing Anoxic Volume (MG)	N/a
	<input type="checkbox"/> Bardenpho	Current MLSS at Winter ADF	3000
	<input checked="" type="checkbox"/> Oxidation Ditch		
	<input checked="" type="checkbox"/> Lagoon (Biolog, etc.)		
	<input type="checkbox"/> Cyclical Aeration		
	<input type="checkbox"/> SBR		
	<input type="checkbox"/> High-Rate Biofilter		
	<input type="checkbox"/> Effluent Filtration		
	<input checked="" type="checkbox"/> Other	Biodenitro Oxidation Ditch configuration	

CURRENT EFFLUENT AMMONIA-N: < 1.0 mg/L	<input checked="" type="checkbox"/> From Report <input type="checkbox"/> From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)
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PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:		New MLSS
<input checked="" type="checkbox"/> No modifications required		N/a
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd) 0	
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd) 0	
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate nit/denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:	<input type="checkbox"/> No modifications required <input checked="" type="checkbox"/> Add downstream DeNit filter with methanol <input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol <input type="checkbox"/> Add methanol to existing BNR process <input type="checkbox"/> Add downstream anoxic tank with methanol feed <input type="checkbox"/> Add effluent filtration <input type="checkbox"/> Other
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CAPITAL COST:		
	Equipment and Structures (from Page 2)	\$1,850,000
	Electrical and Instrumentation. 12%	\$198,000
	Yard Piping and Site Work. 15%	\$248,000
	Subtotal	\$2,100,000
	Contractor OH&P 15%	\$315,000
	Engineering and Constr Mgmt. 15%	\$315,000
	Subtotal	\$2,730,000
	Contingency 30%	\$830,000
	Total Capital Cost	\$3,360,000
	Capital Cost per lb 20-Yr N removal	\$23.01

OPERATIONS COST.		
	Additional Horsepower (from Page 2)	40 HP
	Electrical Power Cost 0.05 \$/kW	\$13,100 \$/year
	Nitrate Reduction using Methanol.	1.0 mg/L
	Methanol Required	10 gals/d
	Methanol Cost 0.75 \$/gal	\$2,700 \$/year
	Separate Sludge Ammonia Reduction:	0.0 mg/L
	Caustic Soda @ 25% conc.	0 gals/d
	Caustic Soda Cost 0.60 \$/gal	\$0 \$/year
	Equipment Maintenance Cost	\$27,300 \$/year
	Denitrification Sludge Production w/Methanol	20 lbs/d
	Sludge Disposal Cost 400 \$/ton	\$1,800 \$/year
	Total Annual O&M Cost	\$44,800 \$/year
	Effective Annual Interest Rate after Inflation	2.91%
	20-Year Present Worth of O&M Costs	\$678,000

TOTAL 20-YEAR PRESENT WORTH COST.	\$4,030,000
Total Cost per lb 20-Yr N removal	\$27.60

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Opequon WWTP
LOCATION: Frederick County, VA
RATED FLOW: 4.3 mgd
CURRENT EFFLUENT TN: 3.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 260 lbs/d
 95 1000 lbs/yr
 1898 1000 lbs/20-years

PE COD: N/A mg/L
PE TKN: N/A mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

<input type="checkbox"/>	MLE	Existing Aerated Volume (MG)	N/A
<input checked="" type="checkbox"/>	BEPR (A2/O, VIP, etc.)	Existing Anoxic Volume (MG)	N/A
<input type="checkbox"/>	Bardenpho	Current MLSS at Winter ADF	3000
<input type="checkbox"/>	Oxidation Ditch		
<input type="checkbox"/>	Lagoon (Bioloac etc.)		
<input type="checkbox"/>	Cyclical Aeration		
<input type="checkbox"/>	SBR		
<input type="checkbox"/>	High-Rate Biofilter		
<input type="checkbox"/>	Effluent Filtration		
<input checked="" type="checkbox"/>	Other Step-feed A2/O system		

CURRENT EFFLUENT AMMONIA-N: 0.4 mg/L

<input checked="" type="checkbox"/>	From Report
<input type="checkbox"/>	From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/>	No modifications required	New MLSS	N/A
<input type="checkbox"/>	Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input checked="" type="checkbox"/>	Construct additional aerated volume	Flow (mgd)	1.00
<input checked="" type="checkbox"/>	Construct additional clarifiers	Flow (mgd)	1.00
<input type="checkbox"/>	Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/>	Use aerated system for BOD removal only (construct separate denit facility)		
<input type="checkbox"/>	Add influent flow equalization tank		
<input type="checkbox"/>	Other		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input checked="" type="checkbox"/>	No modifications required
<input checked="" type="checkbox"/>	Add downstream DeNit filter with methanol
<input type="checkbox"/>	Add downstream Nitrification Biofilter and DeNit filter with methanol
<input type="checkbox"/>	Add methanol to existing BNR process
<input type="checkbox"/>	Add downstream anoxic tank with methanol feed
<input type="checkbox"/>	Add effluent filtration
<input type="checkbox"/>	Other

CAPITAL COST:

Equipment and Structures (from Page 2)		\$3,140,000
Electrical and Instrumentation	12%	\$377,000
Yard Piping and Site Work	15%	\$471,000
Subtotal		\$3,990,000
Contractor OH&P	15%	\$598,000
Engineering and Constr Mgmt	15%	\$598,000
Subtotal		\$6,190,000
Contingency	30%	\$1,197,000
Total Capital Cost		\$6,390,000
Capital Cost per lb. 20-Yr N removal		\$3.37

OPERATIONS COST:

Additional Horsepower (from Page 2)		130 HP
Electrical Power Cost	0.05 \$/KW	\$42,500 \$/year
Nitrate Reduction using Methanol		5.0 mg/L
Methanol Required		120 gals/d
Methanol Cost	0.75 \$/gal	\$32,900 \$/year
Separate Stage Ammonia Reduction:		0.0 mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$51,900 \$/year
Denitrification Sludge Production w/Methanol		380 lbs/d
Sludge Disposal Cost	400 \$/ton	\$27,700 \$/year
Total Annual O&M Cost		\$155,000 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs		\$2,320,000

TOTAL 20-YEAR PRESENT WORTH COST: \$8,710,000
 Total Cost per lb. 20-Yr N removal: \$4.59

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler LLC
DATE: March 19, 2001
FACILITY: Middle River-Verona WWTP
LOCATION: Augusta County, VA
RATED FLOW: 4.5 mgd
CURRENT EFFLUENT TN: 50 mg/L
EFFLUENT TN GOAL: 30 mg/L
NITROGEN REDUCTION: 80 lbs/d
 29 1000 lbs/yr
 584 1000 lbs/20-years

PE COD: N/a mg/L
PE TKN: N/a mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE
 BEPR (A2/O, VIP, etc)
 Bardenpho
 Oxidation Ditch
 Lagoon (Biolac, etc)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other Brush Aerator Oxidation Ditch

Existing Aerated Volume (MG): N/a
Existing Anoxic Volume (MG): N/a
Current MLSS at Winter ADF: 5000

CURRENT EFFLUENT AMMONIA-N: <1.0 mg/L
 From Report
 From Model (at ADF and load, 15 d MCRT 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:
 No modifications required
 Raise MCRT/MLSS in existing tanks (check clarifier capacity) **New MLSS** N/a
 Construct additional aerated volume **Flow (mgd):** 0
 Construct additional clarifiers **Flow (mgd):** 0
 Use existing anoxic volume as aerobic (construct separate denit facility)
 Use aerated system for BOD removal only (construct separate n/denit facility)
 Add influent flow equalization tank
 Other

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:
 No modifications required
 Add downstream DeNit filter with methanol
 Add downstream Nitrification Biofilter and DeNit filter with methanol
 Add methanol to existing BNR process
 Add downstream anoxic tank with methanol feed
 Add effluent filtration
 Other

CAPITAL COST:

Equipment and Structures (from Page 2)		\$2,830,000
Electrical and Instrumentation	12%	\$304,000
Yard Piping and Site Work	18%	\$380,000
Subtotal		\$3,210,000
Contractor OH&P:	15%	\$482,000
Engineering and Constr. Mgmt	15%	\$482,000
Subtotal		\$4,170,000
Contingency	30%	\$963,000
Total Capital Cost		\$5,130,000
Capital Cost per lb 20-Yr N removal		\$8.78

OPERATIONS COST:

Additional Horsepower (from Page 2)		90 HP
Electrical Power Cost	0.05 \$/kW	\$29,400 \$/year
Nitrate Reduction using Methanol		2.0 mg/L
Methanol Required:		30 gals/d
Methanol Cost:	0.75 \$/gal	\$8,200 \$/year
Separate Stage Ammonia Reduction:		0.0 mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost:	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$41,700 \$/year
Denitrification Sludge Production w/Methanol:		110 lbs/d
Sludge Disposal Cost	400 \$/ton	\$8,000 \$/year
Total Annual O&M Cost:		\$87,300 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs:		\$1,310,000

TOTAL 20-YEAR PRESENT WORTH COST: \$6,440,000
 Total Cost per lb 20-Yr N removal: \$11.03

PROJECT: implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Merck, Inc. VA
LOCATION: Elkton, VA
RATED FLOW: 1.2 mgd
CURRENT EFFLUENT TN: 41.7 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 380 lbs/d
 142 1000 lbs/yr
 2847 1000 lbs/20-years

PE COD 5077 mg/L
 PE TKN 99 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE
 BEPR (A2/O, VIP etc.)
 Bardenpho
 Oxidation Ditch
 Lagoon (Biolac etc.)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other:

Existing Aerated Volume (MG): 4.0715
 Existing Anoxic Volume (MG): 0.7755
 Current MLSS at Winter ADF: N/a

CURRENT EFFLUENT AMMONIA-N: <1.0 mg/L
 From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/>	No modifications required	New MLSS
<input type="checkbox"/>	Raise MCRT/MLSS in existing tanks (check clarifier capacity)	N/a
<input type="checkbox"/>	Construct additional aerated volume	Flow (mgd): <u>4.0</u>
<input type="checkbox"/>	Construct additional clarifiers	Flow (mgd): <u>4.0</u>
<input type="checkbox"/>	Use existing anoxic volume as aerobic (construct separate denit facility)	
<input type="checkbox"/>	Use aerated system for BOD removal only (construct separate denit facility)	
<input type="checkbox"/>	Add influent flow equalization tank	
<input type="checkbox"/>	Other:	

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/>	No modifications required
<input type="checkbox"/>	Add downstream DeNit filter with methanol
<input type="checkbox"/>	Add downstream Nitrification Biofilter and DeNit filter with methanol
<input type="checkbox"/>	Add methanol to existing BNR process
<input type="checkbox"/>	Add downstream anoxic tank with methanol feed
<input type="checkbox"/>	Add effluent filtration
<input checked="" type="checkbox"/>	Other: <u>Add more methanol</u>

CAPITAL COST:

Equipment and Structures (from Page 2):		\$0
Electrical and instrumentation:	12%	\$0
Yard Piping and Site Work:	15%	\$0
Subtotal:		\$0
Contractor OH&P:	15%	\$0
Engineering and Constr. Mgmt:	15%	\$0
Subtotal:		\$0
Contingency:	30%	\$0
Total Capital Cost:		\$0
Capital Cost per lb 20-Yr N removal:		\$0.00

OPERATIONS COST:

Additional Horsepower (from Page 2):		0 HP
Electrical Power Cost	0.05 \$/kW	\$0 \$/year
Nitrate Reduction using Methanol		38.7 mg/L
Methanol Required:		180 gals/d
Methanol Cost:	0.75 \$/gal	\$49,300 \$/year
Separate Stage Ammonia Reduction:		0.0 mg/L
Caustic Soda @ 25% conc.		0 gals/d
Caustic Soda Cost:	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$0 \$/year
Denitrification Sludge Production w/Methanol		560 lbs/d
Sludge Disposal Cost:	400 \$/ton	\$49,900 \$/year
Total Annual O&M Cost		\$90,200 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs:		\$1,350,000

TOTAL 20-YEAR PRESENT WORTH COST: \$1,350,000
 Total Cost per lb 20-Yr N removal: \$0.47

PROJECT:	Implementing a 3 mg/L Annual Average Total Nitrogen Limit		
PREPARED FOR:	USEPA, Chesapeake Bay Office		
PREPARED BY:	Virginia Tech with Stearns & Wheeler, LLC		
DATE:	March 19, 2001		
FACILITY:	Luray WWTP		
LOCATION:	Luray, PA		
RATED FLOW:	2.0 mgd	PE COD:	N/a mg/L
CURRENT EFFLUENT TN:	7.0 mg/L	PE TKN:	N/a mg/L
EFFLUENT TN GOAL:	3.0 mg/L		
NITROGEN REDUCTION:	70 lbs/d		
	26 1000 lbs/yr		
	511 1000 lbs/20-years		

CURRENT PROCESS (CHECK ALL THAT APPLY):	<input type="checkbox"/> MLE	Existing Aerated Volume (MG)	1.96
	<input type="checkbox"/> BEPR (A2/O, VIP, etc)	Existing Anoxic Volume (MG)	N/a
	<input type="checkbox"/> Bardenpho	Current MLSS at Winter ADF	5,500
	<input checked="" type="checkbox"/> Oxidation Ditch		
	<input type="checkbox"/> Lagoon (Bioclar, etc)		
	<input checked="" type="checkbox"/> Cyclical Aeration		
	<input type="checkbox"/> SBR		
	<input type="checkbox"/> High-Rate Biofilter		
	<input type="checkbox"/> Effluent Filtration		
	<input type="checkbox"/> Other		

CURRENT EFFLUENT AMMONIA-N:	<1.0 mg/L	<input checked="" type="checkbox"/> From Report
		<input type="checkbox"/> From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:		New MLSS
<input checked="" type="checkbox"/> No modifications required		N/a
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd): 0	
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd): 0	
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate nitrdenit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:	
<input type="checkbox"/> No modifications required	
<input checked="" type="checkbox"/> Add downstream DeNit filter with methanol	
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol	
<input type="checkbox"/> Add methanol to existing BNR process	
<input type="checkbox"/> Add downstream anoxic tank with methanol feed	
<input type="checkbox"/> Add effluent filtration	
<input type="checkbox"/> Other	

CAPITAL COST:	Equipment and Structures (from Page 2)	\$1,650,000
	Electrical and Instrumentation 12%	\$198,000
	Yard Piping and Site Work: 15%	\$248,000
	Subtotal:	\$2,100,000
	Contractor OH&P: 15%	\$315,000
	Engineering and Constr. Mgmt 18%	\$316,000
	Subtotal:	\$2,730,000
	Contingency: 30%	\$830,000
	Total Capital Cost:	\$3,360,000
	Capital Cost per lb 20-Yr. N removal	\$6.68

OPERATIONS COST:	Additional Horsepower (from Page 2)	40 HP
	Electrical Power Cost 0.05 \$/kW	\$13,100 \$/year
	Nitrate Reduction using Methanol:	4.0 mg/L
	Methanol Required:	30 gals/d
	Methanol Cost 0.75 \$/gal	\$8,200 \$/year
	Separate Stage Ammonia Reduction:	0.0 mg/L
	Caustic Soda @ 25% conc	0 gals/d
	Caustic Soda Cost 0.80 \$/gal	\$0 \$/year
	Equipment Maintenance Cost	\$27,300 \$/year
	Denitrification Sludge Production w/Methanol	100 lbs/d
	Sludge Disposal Cost 400 \$/ton	\$7,300 \$/year
	Total Annual O&M Cost:	\$55,900 \$/year
	Effective Annual Interest Rate after Inflation	2.91%
	20-Year Present Worth of O&M Costs	\$840,000

TOTAL 20-YR PRESENT WORTH COST	\$4,200,000
Total Cost per lb 20-Yr N removal	\$8.22

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 18, 2001
FACILITY: Noman M. Cole WWTP (formerly Lower Potomac)
LOCATION: Fairfax County, VA
RATED FLOW: 87.0 mgd PE COD: 300 mg/L
CURRENT EFFLUENT TN: 8.0 mg/L PE TKN: 23 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 2790 lbs/d
1018 1000 lbs/yr
20367 1000 lbs/20-years

CURRENT PROCESS (CHECK ALL THAT APPLY):

<input checked="" type="checkbox"/> MLE	Existing Aerated Volume (MG)	18.65
<input type="checkbox"/> BEPR (A2/O, VIP, etc.)	Existing Anoxic Volume (MG)	7.3
<input type="checkbox"/> Bardenpho	Current MLSS at Winter ADF	2700
<input type="checkbox"/> Oxidation Ditch		
<input type="checkbox"/> Lagoon (Biolac, etc.)		
<input type="checkbox"/> Cyclical Aeration		
<input type="checkbox"/> SBR		
<input type="checkbox"/> High-Rate Biofilter		
<input type="checkbox"/> Effluent Filtration		
<input checked="" type="checkbox"/> Other <u>Step Feed MLE, no nitrate recycle</u>		

CURRENT EFFLUENT AMMONIA-N: <1.0 mg/L

<input checked="" type="checkbox"/> From Report
<input type="checkbox"/> From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required		New MLSS
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		N/A
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd)	<u>0</u>
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd)	<u>0</u>
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOO removal only (construct separate nit/denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required	
<input type="checkbox"/> Add downstream DeNit filter with methanol	
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol	
<input checked="" type="checkbox"/> Add methanol to existing BNR process	
<input type="checkbox"/> Add downstream anoxic tank with methanol feed	
<input type="checkbox"/> Add effluent filtration	
<input checked="" type="checkbox"/> Other <u>Convert existing deep bed effluent filters to denite filters</u>	

CAPITAL COST:

Equipment and Structures (from Page 2)		\$6,280,000
Electrical and Instrumentation:	12%	\$754,000
Yard Piping and Site Work:	15%	\$942,000
Subtotal:		\$7,980,000
Contractor OH&P:	15%	\$1,197,000
Engineering and Constr. Mgmt	15%	\$1,197,000
Subtotal:		\$10,370,000
Contingency:	30%	\$2,394,000
Total Capital Cost:		\$12,760,000
Capital Cost per lb. 20-Yr N removal		\$0.63

OPERATIONS COST:

Additional Horsepower (from Page 2):		0 HP
Electrical Power Cost	0.05 \$/kW	\$0 \$/year
Nitrate Reduction using Methanol		5.0 mg/L
Methanol Required		1270 gals/d
Methanol Cost	0.75 \$/gal	\$347,700 \$/year
Separate Stage Ammonia Reduction		0.0 mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$103,700 \$/year
Denitrification Sludge Production w/Methanol		4020 lbs/d
Sludge Disposal Cost	400 \$/ton	\$263,500 \$/year
Total Annual O&M Cost		\$744,900 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs		\$11,170,000

TOTAL 20-YEAR PRESENT WORTH COST:

	\$23,930,000
Total Cost per lb. 20-Yr. N removal.	\$1.17

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Leesburg WWTP
LOCATION: Leesburg, VA
RATED FLOW: 4.9 mgd
CURRENT EFFLUENT TN: 7.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 160 lbs/d
 58 1000 lbs/yr
 1168 1000 lbs/20 years

PE COD N/a mg/L
 PE TKN N/a mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

<input checked="" type="checkbox"/> MLE	Existing Aerated Volume (MG):	N/a
<input checked="" type="checkbox"/> BEPR (A2/O, VIP, etc)	Existing Anoxic Volume (MG):	N/a
<input type="checkbox"/> Bardenpho	Current MLSS at Winter ADF:	3500
<input type="checkbox"/> Oxidation Ditch		
<input type="checkbox"/> Lagoon (Biocac, etc.)		
<input type="checkbox"/> Cyclical Aeration		
<input type="checkbox"/> SBR		
<input type="checkbox"/> High-Rate Biofilter		
<input type="checkbox"/> Effluent Filtration		
<input checked="" type="checkbox"/> Other <u>An A2/O that can also be operated as an MLE</u>		

CURRENT EFFLUENT AMMONIA-N: <1.0 mg/L

<input checked="" type="checkbox"/> From Report
<input type="checkbox"/> From Model (at ADF and load 15 d MCRT 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L

<input checked="" type="checkbox"/> No modifications required		New MLSS
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		N/a
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd) <u>0</u>	
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd) <u>0</u>	
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate nit/denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other _____		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required	
<input checked="" type="checkbox"/> Add downstream DeNit filter with methanol	
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol	
<input type="checkbox"/> Add methanol to existing BNR process	
<input type="checkbox"/> Add downstream anoxic tank with methanol feed	
<input type="checkbox"/> Add effluent filtration	
<input type="checkbox"/> Other _____	

CAPITAL COST:

Equipment and Structures (from Page 2)		\$2,650,000
Electrical and Instrumentation	12%	\$318,000
Yard Piping and Site Work	15%	\$388,000
Subtotal:		\$3,370,000
Contractor OH&P	15%	\$506,000
Engineering and Constr. Mgmt	15%	\$506,000
Subtotal:		\$4,380,000
Contingency	30%	\$1,011,000
Total Capital Cost		\$6,390,000
Capital Cost per lb 20-Yr N removal		\$4.61

OPERATIONS COST:

Additional Horsepower (from Page 2)		100 HP
Electrical Power Cost	0.05 \$/kW	\$32,700 \$/year
Nitrate Reduction using Methanol		4.0 mg/L
Methanol Required		70 gals/d
Methanol Cost	0.75 \$/gal	\$19,200 \$/year
Separate Stage Ammonia Reduction		0.0 mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$43,800 \$/year
Denitrification Sludge Production w/Methanol		230 lbs/d
Sludge Disposal Cost	400 \$/ton	\$18,800 \$/year
Total Annual O&M Cost		\$112,500 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs		\$1,590,000

TOTAL 20-YEAR PRESENT WORTH COST: \$7,080,000
 Total Cost per lb 20-Yr N removal \$6.06

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 16, 2001
FACILITY: H. L. Mooney WWTP
LOCATION: Prince William County, VA
RATED FLOW: 18.0 mgd PE COD: 178 mg/L
CURRENT EFFLUENT TN: 8.0 mg/L PE TKN: 26 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 750 lbs/d
 274 1000 lbs/yr
 5475 1000 lbs/20-years

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE Existing Aerated Volume (MG) 1.82
 BEPR (A2/O VIP etc.) Existing Anoxic Volume (MG) 0.78
 Bardenpho Current MLSS at Winter ADF 2700
 Oxidation Ditch
 Lagoon (Biolac, etc.)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other: Step Feed MLE, no nitrate recycle

CURRENT EFFLUENT AMMONIA-N: 0.5 mg/L From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:
 No modifications required New MLSS N/A
 Raise MCRT/MLSS in existing tanks (check clarifier capacity)
 Construct additional aerated volume Flow (mgd) 0
 Construct additional clarifiers Flow (mgd) 0
 Use existing anoxic volume as aerobic (construct separate denit facility)
 Use aerated system for BOD removal only (construct separate nit/denit facility)
 Add influent flow equalization tank
 Other

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:
 No modifications required
 Add downstream DeNit filter with methanol
 Add downstream Nitrification Biofilter and DeNit filter with methanol
 Add methanol to existing BNR process
 Add downstream anoxic tank with methanol feed
 Add effluent filtration
 Other: Modify existing deep bed effluent filters to denitr filters.

CAPITAL COST:

Equipment and Structures (from Page 2)		\$1,870,000
Electrical and Instrumentation	12%	\$224,000
Yard Piping and Site Work	15%	\$281,000
Subtotal:		\$2,380,000
Contractor OH&P	15%	\$357,000
Engineering and Constr. Mgmt.	15%	\$357,000
Subtotal		\$3,090,000
Contingency	30%	\$714,000
Total Capital Cost		\$3,800,000
Capital Cost per lb 20-Yr N removal:		\$0.69

OPERATIONS COST:

Additional Horsepower (from Page 2)		0 HP
Electrical Power Cost	0.05 \$/kW	\$0 \$/year
Nitrate Reduction using Methanol		5.0 mg/L
Methanol Required		340 gals/d
Methanol Cost	0.76 \$/gal	\$93,100 \$/year
Separate Stage Ammonia Reduction:		0.0 mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$30,900 \$/year
Denitrification Sludge Production w/Methanol		1080 lbs/d
Sludge Disposal Cost	400 \$/ton	\$78,800 \$/year
Total Annual O&M Cost		\$202,900 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs		\$3,840,000

TOTAL 20-YEAR PRESENT WORTH COST: \$6,840,000
 Total Cost per lb 20-Yr N removal \$1.25

PROJECT:	Implementing a 3 mg/L Annual Average Total Nitrogen Limit	
PREPARED FOR	USEPA, Chesapeake Bay Office	
PREPARED BY	Virginia Tech with Stearns & Wheeler, LLC	
DATE:	March 19, 2001	
FACILITY:	Harrisonburg WWTP	
LOCATION:	Harrisonburg, VA	
RATED FLOW:	180 mgd	PE COD 340 mg/L
CURRENT EFFLUENT TN:	60 mg/L	PE TKN 34 mg/L
EFFLUENT TN GOAL:	30 mg/L	
NITROGEN REDUCTION:	400 lbs/d	
	146 1000 lbs/yr	
	2920 1000 lbs/20-years	

CURRENT PROCESS (CHECK ALL THAT APPLY):	<input type="checkbox"/> MLE	Existing Aerated Volume (MG):	N/a
	<input checked="" type="checkbox"/> BEPR (A2/O, VIP, etc.)	Existing Anoxic Volume (MG):	N/a
	<input type="checkbox"/> Bardenpho	Current MLSS at Winter ADF:	3800
	<input type="checkbox"/> Oxidation Ditch		
	<input type="checkbox"/> Lagoon (Biolac, etc.)		
	<input type="checkbox"/> Cyclical Aeration		
<input type="checkbox"/> SBR			
<input type="checkbox"/> High-Rate Biofilter			
<input checked="" type="checkbox"/> Effluent Filtration			
<input type="checkbox"/> Other:			

CURRENT EFFLUENT AMMONIA-N: 0.5 mg/L

From Report

From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input type="checkbox"/> No modifications required	New MLSS	N/a
<input checked="" type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd)	0
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd)	0
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate n/denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other:		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

Note: Existing Eff Filters only 30" deep, Replace with denite filters

<input type="checkbox"/> No modifications required	
<input checked="" type="checkbox"/> Add downstream DeNit filter with methanol	
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol	
<input type="checkbox"/> Add methanol to existing BNR process	
<input type="checkbox"/> Add downstream anoxic tank with methanol feed	
<input checked="" type="checkbox"/> Add effluent filtration	
<input type="checkbox"/> Other:	

CAPITAL COST:

Equipment and Structures (from Page 2)		\$6,550,000
Electrical and Instrumentation	12%	\$786,000
Yard Piping and Site Work	15%	\$883,000
Subtotal		\$8,320,000
Contractor O&M	15%	\$1,248,000
Engineering and Constr Mgmt	15%	\$1,248,000
Subtotal		\$10,820,000
Contingency	30%	\$2,496,000
Total Capital Cost		\$13,320,000
Capital Cost per lb 20-Yr N removal		\$4.66

OPERATIONS COST:

Additional Horsepower (from Page 2)		320 HP
Electrical Power Cost	0.05 \$/kWh	\$104,600 \$/year
Nitrate Reduction using Methanol		3.0 mg/L
Methanol Required		180 gals/d
Methanol Cost	0.75 \$/gal	\$49,300 \$/year
Separate Stage Ammonia Reduction		0.0 mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$108,200 \$/year
Denitrification Sludge Production w/Methanol		580 lbs/d
Sludge Disposal Cost	400 \$/ton	\$42,300 \$/year
Total Annual O&M Cost		\$304,400 \$/year
Effective Annual Interest Rate after Inflation		2.81%
20-Year Present Worth of O&M Costs		\$4,570,000

TOTAL 20-YEAR PRESENT WORTH COST:

	\$17,890,000
Total Cost per lb 20-Yr N removal	\$6.13

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 9, 2001
FACILITY: Front Royal
LOCATION: Front Royal, VA
RATED FLOW: 40 mgd
CURRENT EFFLUENT TN: 80 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 170 lbs/d
 62 1000 lbs/yr
 1241 1000 lbs/20-years

PE COD: 288 mg/L
PE TKN: 21 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE
 BEPR (A2O, VIP, etc)
 Bardenpho
 Oxidation Ditch
 Lagoon (Biocac, etc.)
 Cyclical Aeration
 SBR
 High-Rate Bioreactor
 Effluent Filtration
 Other

Existing Aerated Volume (MG): 1.728*
Existing Anoxic Volume (MG): Cyclical
Current MLSS at Winter ADF: N/A

*Note: Existing plant has 4 aeration tanks. Jan 1998 report recommend 2 additional tanks @ 0.288 mg each

CURRENT EFFLUENT AMMONIA-N: 0.5 mg/L From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	New MLSS
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)	N/A
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd): 0
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd): 0
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)	
<input type="checkbox"/> Use aerated system for BCO removal only (construct separate nitr/denit facility)	
<input type="checkbox"/> Add influent flow equalization tank	
<input type="checkbox"/> Other	

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required
<input checked="" type="checkbox"/> Add downstream DeNitr filter with methanol
<input type="checkbox"/> Add downstream Nitrification Bioreactor and DeNit filter with methanol
<input type="checkbox"/> Add methanol to existing BNR process
<input type="checkbox"/> Add downstream anoxic tank with methanol feed
<input type="checkbox"/> Add effluent filtration
<input type="checkbox"/> Other

CAPITAL COST:

Equipment and Structures (from Page 2)		\$2,350,000
Electrical and Instrumentation:	12%	\$282,000
Yard Piping and Site Work:	15%	\$353,000
Subtotal:		\$2,985,000
Contractor OH&P:	15%	\$449,000
Engineering and Constr. Mgmt.	15%	\$449,000
Subtotal:		\$3,890,000
Contingency	30%	\$897,000
Total Capital Cost		\$4,790,000
Capital Cost per lb. 20-Yr. N removal:		\$3.86

NOTE: Also need to implement recommended improvements for BNR at design flow found in the Jan 1998 report Cost (2 Add'l aeration basins, SE PE flow distribution)

OPERATIONS COST:

Additional Horsepower (from Page 2):	80 HP
Electrical Power Cost:	0.05 \$/kW \$26,100 \$/year
Nitrate Reduction using Methanol:	5.0 mg/L
Methanol Required:	60 gals/d
Methanol Cost:	0.75 \$/gal \$21,900 \$/year
Separate Stage Ammonia Reduction:	0.0 mg/L
Caustic Soda @ 25% conc.	0 gals/d
Caustic Soda Cost:	0.60 \$/gal \$0 \$/year
Equipment Maintenance Cost:	\$38,900 \$/year
Denitrification Sludge Production w/Methanol:	240 lbs/d
Sludge Disposal Cost:	400 \$/ton \$17,500 \$/year
Total Annual O&M Cost:	\$104,400 \$/year
Effective Annual Interest Rate after Inflation:	2.91%
20-Year Present Worth of O&M Costs:	\$1,570,000

TOTAL 20-YEAR PRESENT WORTH COST: \$6,360,000
Total Cost per lb. 20-Yr. N removal: \$5.12

PROJECT:	Implementing a 3 mg/L Annual Average Total Nitrogen Limit		
PREPARED FOR:	USEPA, Chesapeake Bay Office		
PREPARED BY:	Virginia Tech with Stearns & Wheeler, LLC		
DATE:	March 18, 2001		
FACILITY:	Fishersville WWTP		
LOCATION:	Augusta County, VA		
RATED FLOW:	2.0 mgd	PE COD:	N/A mg/L
CURRENT EFFLUENT TN	7.0 mg/L	PE TKN:	N/A mg/L
EFFLUENT TN GOAL:	3.0 mg/L		
NITROGEN REDUCTION:	70 lbs/d		
	26 1000 lbs/yr		
	511 1000 lbs/20-years		

CURRENT PROCESS (CHECK ALL THAT APPLY):	<input checked="" type="checkbox"/> MLE <input checked="" type="checkbox"/> BEPR (A2/O VIP, etc.) <input type="checkbox"/> Bardenpho <input type="checkbox"/> Oxidation Ditch <input type="checkbox"/> Lagoon (Biotac etc.) <input type="checkbox"/> Cyclical Aeration <input type="checkbox"/> SBR <input type="checkbox"/> High-Rate Biofilter <input type="checkbox"/> Effluent Filtration <input checked="" type="checkbox"/> Other Can be operated as either A2/O or MLE	Existing Aerated Volume (MG): <u>N/A</u> Existing Anoxic Volume (MG): <u>N/A</u> Current MLSS at Winter ADF: <u>3000</u>
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CURRENT EFFLUENT AMMONIA-N: <u><1.0 mg/L</u>	<input checked="" type="checkbox"/> From Report <input type="checkbox"/> From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)
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PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:	<input checked="" type="checkbox"/> No modifications required <input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity) New MLSS: <u>N/A</u> <input checked="" type="checkbox"/> Construct additional aerated volume Flow (mgd): <u>0.975</u> <input checked="" type="checkbox"/> Construct additional clarifiers Flow (mgd): <u>1.075</u> <input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility) <input type="checkbox"/> Use aerated system for BOD removal only (construct separate denit facility) <input type="checkbox"/> Add Influent flow equalization tank <input type="checkbox"/> Other
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PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:	<input type="checkbox"/> No modifications required <input checked="" type="checkbox"/> Add downstream DeNitr filter with methanol <input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol <input type="checkbox"/> Add methanol to existing BNR process <input type="checkbox"/> Add downstream anoxic tank with methanol feed <input type="checkbox"/> Add effluent filtration <input type="checkbox"/> Other
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CAPITAL COST:	Equipment and Structures (from Page 2) \$1,550,000 Electrical and Instrumentation 12% \$198,000 Yard Piping and Site Work 15% \$248,000 Subtotal \$2,100,000 Contractor OH&P 18% \$315,000 Engineering and Constr. Mgmt 15% \$315,000 Subtotal \$2,730,000 Contingency 30% \$830,000 Total Capital Cost: \$3,360,000 Capital Cost per lb. 20-Yr. N removal \$6.58
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OPERATIONS COST:	Additional Horsepower (from Page 2) 40 HP Electrical Power Cost 0.05 \$/kW \$13,100 \$/year Nitrate Reduction using Methanol 4.0 mg/L Methanol Required 30 gals/d Methanol Cost 0.78 \$/gal \$8,200 \$/year Separate Stage Ammonia Reduction 0.0 mg/L Caustic Soda @ 25% conc 0 gals/d Caustic Soda Cost 0.60 \$/gal \$0 \$/year Equipment Maintenance Cost \$27,300 \$/year Denitrification Sludge Production w/Methanol 100 lbs/d Sludge Disposal Cost 400 \$/ton \$7,300 \$/year Total Annual O&M Cost \$55,900 \$/year Effective Annual Interest Rate after Inflation 2.91% 20-Year Present Worth of O&M Costs \$840,000
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TOTAL 20-YEAR PRESENT WORTH COST:	\$4,200,000 Total Cost per lb 20-Yr N removal \$8.22
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PROJECT:	Implementing a 3 mg/L Annual Average Total Nitrogen Limit	
PREPARED FOR:	USEPA, Chesapeake Bay Office	
PREPARED BY:	Virginia Tech with Stearns & Wheeler, LLC	
DATE:	March 25, 2001	
FACILITY:	Henrico County WWTP	
LOCATION:	Henrico County, VA	
RATED FLOW:	40.0 mgd	PE COD: _____ mg/L
CURRENT EFFLUENT TN:	8.0 mg/L	PE TKN: _____ mg/L
EFFLUENT TN GOAL:	3.0 mg/L	
NITROGEN REDUCTION:	1000 lbs/d	
	365 1000 lbs/yr	
	7300 1000 lbs/20-years	

CURRENT PROCESS (CHECK ALL THAT APPLY):	<input type="checkbox"/> MLE <input checked="" type="checkbox"/> BEPR (A2/O, VIP, etc.) <input type="checkbox"/> Bardenpho <input type="checkbox"/> Oxidation Ditch <input type="checkbox"/> Lagoon (Biocac, etc.) <input type="checkbox"/> Cyclical Aeration <input type="checkbox"/> SBR <input type="checkbox"/> High-Rate Biofilter <input type="checkbox"/> Effluent Filtration <input checked="" type="checkbox"/> Other: <u>Two systems, a modified UCT & a modified pure Oxygen</u>	Existing Aerated Volume (MG) _____ Existing Anoxic Volume (MG) _____ Current MLSS at Winter ADF: _____
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CURRENT EFFLUENT AMMONIA-N:	<1.0 mg/L	<input checked="" type="checkbox"/> From Report <input type="checkbox"/> From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)
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PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:	<input checked="" type="checkbox"/> No modifications required <input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity) <input type="checkbox"/> Construct additional aerated volume Flow (mgd) <u>0</u> <input type="checkbox"/> Construct additional clarifiers Flow (mgd) <u>0</u> <input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility) <input type="checkbox"/> Use aerated system for BOD removal only (construct separate n/denit facility) <input type="checkbox"/> Add influent flow equalization tank <input type="checkbox"/> Other: _____	New MLSS N/A
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PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:	<input type="checkbox"/> No modifications required <input type="checkbox"/> Add downstream DeNit filter with methanol <input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol <input type="checkbox"/> Add methanol to existing BNR process <input type="checkbox"/> Add downstream anoxic tank with methanol feed <input type="checkbox"/> Add effluent filtration <input checked="" type="checkbox"/> Other: <u>modify existing effluent filters for denitrification with methanol addition</u>
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CAPITAL COST:	Equipment and Structures (from Page 2) \$2,000,000 Electrical and Instrumentation 12% \$240,000 Yard Piping and Site Work 15% \$300,000 Subtotal \$2,540,000 Contractor OH&P 15% \$381,000 Engineering and Constr Mgmt 15% \$381,000 Subtotal \$3,300,000 Contingency 30% \$762,000 Total Capital Cost \$4,060,000 Capital Cost per lb. 20-Yr N removal. \$0.56
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OPERATIONS COST:	Additional Horsepower (from Page 2) 0 HP Electrical Power Cost. 0.05 \$/kW \$0 \$/year Nitrate Reduction using Methanol. 3.0 mg/L Methanol Required 480 gals/d Methanol Cost: 0.75 \$/gal \$125,900 \$/year Separate Sludge Ammonia Reduction: 0.0 mg/L Caustic Soda @ 25% conc. 0 gals/d Caustic Soda Cost 0.60 \$/gal \$0 \$/year Equipment Maintenance Cost. \$33,000 \$/year Denitrification Sludge Production w/Methanol 1440 lbs/d Sludge Disposal Cost. 400 \$/ton \$105,100 \$/year Total Annual O&M Cost: \$284,000 \$/year Effective Annual Interest Rate after Inflation 2.91% 20-Year Present Worth of O&M Costs \$3,969,000
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TOTAL 20-YEAR PRESENT WORTH COST:	\$8,029,000
Total Cost per lb 20-Yr N removal	\$1.10

PROJECT:	Implementing a 3 mg/L Annual Average Total Nitrogen Limit		
PREPARED FOR:	USEPA, Chesapeake Bay Office		
PREPARED BY:	Virginia Tech with Stearns & Wheeler, LLC		
DATE:	March 25, 2001		
FACILITY:	Hopewell Regional WWTP		
LOCATION:	Hopewell, VA		
RATED FLOW:	50.0 mgd	PE COD	_____ mg/L
CURRENT EFFLUENT TN:	6.0 mg/L	PE TKN	_____ mg/L
EFFLUENT TN GOAL:	3.0 mg/L		
NITROGEN REDUCTION:	1250 lbs/d		
	456 1000 lbs/yr		
	8125 1000 lbs/20-years		

CURRENT PROCESS (CHECK ALL THAT APPLY):	<input type="checkbox"/> MLE <input type="checkbox"/> BEPR (A2/O, VIP etc.) <input type="checkbox"/> Bardenpho <input type="checkbox"/> Oxidation Ditch <input type="checkbox"/> Lagoon (Biotac etc.) <input type="checkbox"/> Cyclical Aeration <input type="checkbox"/> SBR <input type="checkbox"/> High-Rate Biofilter <input type="checkbox"/> Effluent Filtration <input checked="" type="checkbox"/> Other: <u>second stage denitrification with methanol addition</u>	Existing Aerated Volume (MG) _____ Existing Anoxic Volume (MG) _____ Current MLSS at Winter ADF _____
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CURRENT EFFLUENT AMMONIA-N:	< 1.0 mg/L	<input checked="" type="checkbox"/> From Report <input type="checkbox"/> From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)
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PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:	<input checked="" type="checkbox"/> No modifications required <input type="checkbox"/> Raise MCRT/MLSS on existing tanks (check clarifier capacity) <input type="checkbox"/> Construct additional aerated volume Flow (mgd) <u>0</u> <input type="checkbox"/> Construct additional clarifiers Flow (mgd) <u>0</u> <input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility) <input type="checkbox"/> Use aerated system for BOD removal only (construct separate nit/denit facility) <input type="checkbox"/> Add influent flow equalization tank <input type="checkbox"/> Other: _____	New MLSS = N/A
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PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:	<input type="checkbox"/> No modifications required <input type="checkbox"/> Add downstream DeNit filter with methanol <input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol <input checked="" type="checkbox"/> Add methanol to existing BNR process <input type="checkbox"/> Add downstream anoxic tank with methanol feed <input checked="" type="checkbox"/> Add effluent filtration <input type="checkbox"/> Other: _____
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CAPITAL COST:	<table border="0"> <tr> <td>Equipment and Structures (from Page 2):</td> <td></td> <td>\$20,950,000</td> </tr> <tr> <td>Electrical and Instrumentation</td> <td>12%</td> <td>\$2,514,000</td> </tr> <tr> <td>Yard Piping and Site Work</td> <td>15%</td> <td>\$3,143,000</td> </tr> <tr> <td>Subtotal:</td> <td></td> <td>\$26,607,000</td> </tr> <tr> <td>Contractor OH&P</td> <td>18%</td> <td>\$3,992,000</td> </tr> <tr> <td>Engineering and Constr. Mgmt.</td> <td>15%</td> <td>\$3,992,000</td> </tr> <tr> <td>Subtotal:</td> <td></td> <td>\$34,580,000</td> </tr> <tr> <td>Contingency:</td> <td>30%</td> <td>\$7,983,000</td> </tr> <tr> <td>Total Capital Cost:</td> <td></td> <td>\$42,570,000</td> </tr> <tr> <td>Capital Cost per lb. 20-Yr. N removal:</td> <td></td> <td>\$4.87</td> </tr> </table>	Equipment and Structures (from Page 2):		\$20,950,000	Electrical and Instrumentation	12%	\$2,514,000	Yard Piping and Site Work	15%	\$3,143,000	Subtotal:		\$26,607,000	Contractor OH&P	18%	\$3,992,000	Engineering and Constr. Mgmt.	15%	\$3,992,000	Subtotal:		\$34,580,000	Contingency:	30%	\$7,983,000	Total Capital Cost:		\$42,570,000	Capital Cost per lb. 20-Yr. N removal:		\$4.87
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OPERATIONS COST:	<table border="0"> <tr> <td>Additional Horsepower (from Page 2)</td> <td>500 HP</td> <td></td> </tr> <tr> <td>Electrical Power Cost</td> <td>0.05 \$/kW</td> <td>\$163,400 \$/year</td> </tr> <tr> <td>Nitrate Reduction using Methanol:</td> <td>3.0 mg/L</td> <td></td> </tr> <tr> <td>Methanol Required:</td> <td>570 gals/d</td> <td></td> </tr> <tr> <td>Methanol Cost:</td> <td>0.75 \$/gal</td> <td>\$158,000 \$/year</td> </tr> <tr> <td>Separate Stage Ammonia Reduction</td> <td>0.0 mg/L</td> <td></td> </tr> <tr> <td>Caustic Soda @ 25% conc.</td> <td>0 gals/d</td> <td></td> </tr> <tr> <td>Caustic Soda Cost</td> <td>0.80 \$/gal</td> <td>\$0 \$/year</td> </tr> <tr> <td>Equipment Maintenance Cost</td> <td></td> <td>\$345,900 \$/year</td> </tr> <tr> <td>Denitrification Sludge Production w/Methanol</td> <td>1800 lbs/d</td> <td></td> </tr> <tr> <td>Sludge Disposal Cost</td> <td>400 \$/ton</td> <td>\$131,400 \$/year</td> </tr> <tr> <td>Total Annual O&M Cost</td> <td></td> <td>\$766,700 \$/year</td> </tr> <tr> <td>Effective Annual Interest Rate after Inflation</td> <td>2.91%</td> <td></td> </tr> <tr> <td>20-Year Present Worth of O&M Costs:</td> <td></td> <td>\$11,950,000</td> </tr> </table>	Additional Horsepower (from Page 2)	500 HP		Electrical Power Cost	0.05 \$/kW	\$163,400 \$/year	Nitrate Reduction using Methanol:	3.0 mg/L		Methanol Required:	570 gals/d		Methanol Cost:	0.75 \$/gal	\$158,000 \$/year	Separate Stage Ammonia Reduction	0.0 mg/L		Caustic Soda @ 25% conc.	0 gals/d		Caustic Soda Cost	0.80 \$/gal	\$0 \$/year	Equipment Maintenance Cost		\$345,900 \$/year	Denitrification Sludge Production w/Methanol	1800 lbs/d		Sludge Disposal Cost	400 \$/ton	\$131,400 \$/year	Total Annual O&M Cost		\$766,700 \$/year	Effective Annual Interest Rate after Inflation	2.91%		20-Year Present Worth of O&M Costs:		\$11,950,000
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20-Year Present Worth of O&M Costs:		\$11,950,000																																									

TOTAL 20-YEAR PRESENT WORTH COST:	\$64,520,000
Total Cost per lb. 20-Yr. N removal:	\$5.97

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 26, 2001
FACILITY: Richmond WWTP
LOCATION: Richmond, VA
RATED FLOW: 50.0 mgd
CURRENT EFFLUENT TN: 18.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 5420 lbs/d
 1978 1000 lbs/yr
 39568 1000 lbs/20-years

PE COD _____ mg/L
 PE TKN _____ mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE Existing Aerated Volume (MG) _____
 BEPR (A2/O, VIP, etc) Existing Anoxic Volume (MG) _____
 Bardenpho Current MLSS at Winter ADF _____
 Oxidation Ditch
 Lagoon (Biolac, etc)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other Conventional Activated Sludge

CURRENT EFFLUENT AMMONIA-N: 0.5 mg/L From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:
 No modifications required New MLSS _____
 Raise MCRT/MLSS in existing tanks (check clarifier capacity) N/A
 Construct additional aerated volume Flow (mgd) 0
 Construct additional clarifiers Flow (mgd) 0
 Use existing anoxic volume as aerobic (construct separate denit facility)
 Use aerated system for BOD removal only (construct separate nitr/denit facility)
 Add influent flow equalization tank
 Other:

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:
 No modifications required
 Add downstream DeNit filter with methanol
 Add downstream Nitrification Biofilter and DeNit filter with methanol
 Add methanol to existing BNR process
 Add downstream anoxic tank with methanol feed
 Add effluent filtration
 Other: Modify for MLE Operation

CAPITAL COST.

Equipment and Structures (from Page 2)		\$22,740,000
Electrical and Instrumentation	12%	\$2,728,000
Yard Piping and Site Work	15%	\$3,411,000
Subtotal		\$28,880,000
Contractor OH&P	15%	\$4,332,000
Engineering and Constr Mgmt	15%	\$4,332,000
Subtotal		\$37,540,000
Contingency	30%	\$8,664,000
Total Capital Cost		\$46,200,000
Capital Cost per lb. 20-Yr. N removal.		\$1.17

OPERATIONS COST:

Additional Horsepower (from Page 2)		1,000 HP
Electrical Power Cost	0.05 \$/kW	\$326,700 \$/year
Nitrate Reduction using Methanol.		13.0 mg/L
Methanol Required:		2470 gals/d
Methanol Cost	0.75 \$/gal	\$676,200 \$/year
Separate Stage Ammonia Reduction		0.0 mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$375,400 \$/year
Denitrification Sludge Production w/Methanol		7810 lbs/d
Sludge Disposal Cost	400 \$/ton	\$570,100 \$/year
Total Annual O&M Cost		\$1,948,400 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs		\$29,220,000

TOTAL 20-YEAR PRESENT WORTH COST: \$75,420,000
 Total Cost per lb. 20-Yr. N removal \$1.91

**SUMMARY COST SHEETS FOR THE 7
JAMES RIVER, VIRGINIA WWTPS**

PROJECT:	Implementing a 3 mg/L Annual Average Total Nitrogen Limit		
PREPARED FOR:	USEPA, Chesapeake Bay Office		
PREPARED BY:	Virginia Tech with Stearns & Wheeler, LLC		
DATE:	March 19, 2001		
FACILITY:	Woodstock WWTP		
LOCATION:	Woodstock, VA		
RATED FLOW:	1.0 mgd	PE COD	308 mg/L
CURRENT EFFLUENT TN:	9.0 mg/L	PE TKN	20 mg/L
EFFLUENT TN GOAL:	3.0 mg/L		
NITROGEN REDUCTION	40 lbs/d		
	15 1000 lbs/yr		
	292 1000 lbs/20-years		

CURRENT PROCESS (CHECK ALL THAT APPLY):	<input type="checkbox"/> MLE	Existing Aerated Volume (MG)	13
	<input type="checkbox"/> BEPR (A2/O, VIP, etc.)	Existing Anoxic Volume (MG)	N/A
	<input type="checkbox"/> Bardenpho	Current MLSS at Winter ADF	3200
	<input checked="" type="checkbox"/> Oxidation Ditch	Note: Oxidation Ditches operate Cyclically	
	<input type="checkbox"/> Lagoon (Biolac, etc.)		
	<input type="checkbox"/> Cyclical Aeration		
	<input type="checkbox"/> SBR		
	<input checked="" type="checkbox"/> High-Rate Biofilter		
	<input checked="" type="checkbox"/> Effluent Filtration		
	<input type="checkbox"/> Other		

CURRENT EFFLUENT AMMONIA-N: 0.5 mg/L

From Report

From Model (at ADF end load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	New MLSS	N/A
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd)	0
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd)	0
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate nitr/denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required	
<input checked="" type="checkbox"/> Add downstream DeNit filter with methanol	
<input checked="" type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol	
<input checked="" type="checkbox"/> Add methanol to existing BNR process	
<input checked="" type="checkbox"/> Add downstream anoxic tank with methanol feed	
<input checked="" type="checkbox"/> Add effluent filtration	
<input type="checkbox"/> Other	

CAPITAL COST:

Equipment and Structures (from Page 2):		\$1,300,000
Electrical and Instrumentation	12%	\$156,000
Yard Piping and Site Work	15%	\$195,000
Subtotal		\$1,651,000
Contractor OH&P	15%	\$248,000
Engineering and Constr Mgmt	15%	\$248,000
Subtotal		\$2,150,000
Contingency	30%	\$495,000
Total Capital Cost		\$2,650,000
Capital Cost per lb 20-Yr N removal		\$9.08

OPERATIONS COST:

Additional Horsepower (from Page 2)		20 HP
Electrical Power Cost	0.05 \$/kW	\$8,500 \$/year
Nitrate Reduction using Methanol		5.0 mg/L
Methanol Required		20 gals/d
Methanol Cost	0.75 \$/gal	\$5,500 \$/year
Separate Stage Ammonia Reduction		0.0 mg/L
Caustic Soda @ 25% conc.		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$21,500 \$/year
Denitrification Sludge Production w/Methanol		60 lbs/d
Sludge Disposal Cost	400 \$/ton	\$4,400 \$/year
Total Annual O&M Cost		\$37,900 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs		\$570,000

TOTAL 20-YEAR PRESENT WORTH COST:

	\$3,220,000
Total Cost per lb 20-Yr N removal	\$11.03

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Wilderness WWTP
LOCATION: Ruckersville, VA
RATED FLOW: 1.0 mgd
CURRENT EFFLUENT TN: 8.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 40 lbs/d
 15 1000 lbs/yr
 282 1000 lbs/20-years

PE COD: 435 mg/L
PE TKN: 26 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

<input type="checkbox"/> MLE	Existing Aerated Volume (MG)	N/a
<input type="checkbox"/> BEPR (A2/O, VIP, etc.)	Existing Anoxic Volume (MG)	N/a
<input type="checkbox"/> Bardenpho	Current MLSS at Winter ADF	N/a
<input checked="" type="checkbox"/> Oxidation Ditch, 4 Ring Orbal		
<input type="checkbox"/> Lagoon (Biocac, etc.)		
<input type="checkbox"/> Cyclical Aeration		
<input type="checkbox"/> SBR		
<input type="checkbox"/> High-Rate Biofilter		
<input type="checkbox"/> Effluent Filtration		
<input type="checkbox"/> Other		

CURRENT EFFLUENT AMMONIA-N: 0.5 mg/L

<input checked="" type="checkbox"/> From Report
<input type="checkbox"/> From Model (at ADF and load, 16 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	New MLSS	N/a
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd):	10.11
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd):	0.3
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required
<input type="checkbox"/> Add downstream DeNit filter with methanol
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol
<input checked="" type="checkbox"/> Add methanol to existing BNR process
<input type="checkbox"/> Add downstream anoxic tank with methanol feed
<input type="checkbox"/> Add effluent filtration
<input type="checkbox"/> Other

CAPITAL COST:

Equipment and Structures (from Page 2)		\$250,000
Electrical and Instrumentation	12%	\$30,000
Yard Piping and Site Work	15%	\$38,000
Subtotal:		\$320,000
Contractor OH&P	15%	\$48,000
Engineering and Constr. Mgmt	15%	\$48,000
Subtotal:		\$420,000
Contingency	30%	\$86,000
Total Capital Cost:		\$520,000
Capital Cost per lb. 20-Yr. N removal:		\$1.78

OPERATIONS COST:

Additional Horsepower (from Page 2):		0 HP
Electrical Power Cost:	0.05 \$/kW	\$0 \$/year
Nitrate Reduction using Methanol:		5.0 mg/L
Methanol Required		20 gals/d
Methanol Cost	0.75 \$/gal	\$5,500 \$/year
Separate Stage Ammonia Reduction		0.0 mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost	0.80 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$4,200 \$/year
Denitrification Sludge Production w/Methanol		60 lbs/d
Sludge Disposal Cost	400 \$/ton	\$4,400 \$/year
Total Annual O&M Cost		\$14,100 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs		\$210,000

TOTAL 20-YEAR PRESENT WORTH COST: \$730,000
Total Cost per lb. 20-Yr. N removal: \$2.50

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001.
FACILITY: Waynesboro City WWTP
LOCATION: Waynesboro, VA
RATED FLOW: 40 mgd
CURRENT EFFLUENT TN: 80 mg/L
EFFLUENT TN GOAL: 30 mg/L
NITROGEN REDUCTION: 170 lbs/d
 82 1000 lbs/yr
 1241 1000 lbs/20 years

PE COD 270 mg/L
 PE TKN 20 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

<input type="checkbox"/> MLE	Existing Aerated Volume (MG)	N/a
<input type="checkbox"/> BEPR (A2/O, VIP, etc)	Existing Anoxic Volume (MG)	N/a
<input type="checkbox"/> Bardenpho	Current MLSS at Winter ADF.	N/a
<input type="checkbox"/> Oxidation Ditch		
<input type="checkbox"/> Lagoon (Biolac, etc)		
<input type="checkbox"/> Cyclical Aeration		
<input type="checkbox"/> SBR		
<input type="checkbox"/> High-Rate Biofilter		
<input type="checkbox"/> Effluent Filtration		
<input checked="" type="checkbox"/> Other: Trickling Filter-RBCs, Denite Filters		

CURRENT EFFLUENT AMMONIA-N: 0.5 mg/L

From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	New MLSS	N/a
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd)	0
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd)	0
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate nit/denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other:		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	
<input type="checkbox"/> Add downstream DeNitr filter with methanol	
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol	
<input type="checkbox"/> Add methanol to existing BNR process	
<input type="checkbox"/> Add downstream anoxic tank with methanol feed	
<input type="checkbox"/> Add effluent filtration	
<input checked="" type="checkbox"/> Other: Add Additional Methanol	

CAPITAL COST:

Equipment and Structures (from Page 2)		\$0
Electrical and Instrumentation	12%	\$0
Yard Piping and Site Work	15%	\$0
Subtotal		\$0
Contractor OH&P	15%	\$0
Engineering and Constr Mgmt.	15%	\$0
Subtotal		\$0
Contingency	30%	\$0
Total Capital Cost:		\$0
Capital Cost per lb 20-Yr N removal		\$0.00

OPERATIONS COST:

Additional Horsepower (from Page 2)		0 HP
Electrical Power Cost	0.05 \$/kW	\$0 \$/year
Nitrate Reduction using Methanol		50 mg/L
Methanol Required		80 gals/d
Methanol Cost	0.75 \$/gal	\$21,900 \$/year
Separate Stage Ammonia Reduction		0.0 mg/L
Caustic Soda @ 25% conc.		0 gals/d
Caustic Soda Cost	0.80 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$0 \$/year
Denitrification Sludge Production w/Methanol		240 lbs/d
Sludge Disposal Cost	400 \$/ton	\$17,500 \$/year
Total Annual O&M Cost		\$39,400 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs		\$690,000

TOTAL 20-YEAR PRESENT WORTH COST: \$690,000
 Total Cost per lb. 20-Yr N removal: \$0.45

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Tyson Foods, Inc. WWTP
LOCATION: Temperanceville, VA
RATED FLOW: 10 mgd
CURRENT EFFLUENT TN: 280 mg/L
EFFLUENT TN GOAL: 30 mg/L
NITROGEN REDUCTION: 210 lbs/d
 77 1000 lbs/yr
 1533 1000 lbs/20-years

PE COD 345 mg/L
PE TKN 172 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE
 BEPR (A2/O, VIP, etc)
 Bardenpho
 Oxidation Ditch
 Lagoon (Bioloc. etc)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other: DAF and Anaerobic Lagoon pretreatment

Existing Aerated Volume (MG) 4.5
Existing Anoxic Volume (MG) 4.5
Current MLSS at Winter ADF 4000

CURRENT EFFLUENT AMMONIA-N: 0.3 mg/L
 From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	New MLSS
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)	N/A
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd): 0.0
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd): 0.0
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)	
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate nit/denit facility)	
<input type="checkbox"/> Add influent flow equalization tank	
<input type="checkbox"/> Other	

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required
<input checked="" type="checkbox"/> Add downstream Denit filter with methanol
<input type="checkbox"/> Add downstream Nitrification Biofilter and Denit filter with methanol
<input type="checkbox"/> Add methanol to existing SNR process
<input type="checkbox"/> Add downstream anoxic tank with methanol feed
<input type="checkbox"/> Add effluent filtration
<input type="checkbox"/> Other

CAPITAL COST:

Equipment and Structures (from Page 2)		\$1,300,000
Electrical and Instrumentation	12%	\$166,000
Yard Piping and Site Work	15%	\$195,000
Subtotal		\$1,650,000
Contractor OH&P	15%	\$248,000
Engineering and Constr. Mgmt	15%	\$248,000
Subtotal		\$2,150,000
Contingency	30%	\$645,000
Total Capital Cost:		\$2,680,000
Capital Cost per lb. 20-Yr. N removal		\$1.73

OPERATIONS COST:

Additional Horsepower (from Page 2):		20 HP
Electrical Power Cost: 0.05 \$/kW		\$6,500 \$/year
Nitrate Reduction using Methanol		25.0 mg/L
Methanol Required		90 gals/d
Methanol Cost: 0.75 \$/gal		\$24,800 \$/year
Separate Stage Ammonia Reduction:		0.0 mg/L
Caustic Soda @ 25% conc.		0 gals/d
Caustic Soda Cost 0.60 \$/gal		\$0 \$/year
Equipment Maintenance Cost		\$21,500 \$/year
Denitrification Sludge Production w/Methanol		300 lbs/d
Sludge Disposal Cost 400 \$/ton		\$21,900 \$/year
Total Annual O&M Cost		\$74,500 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs		\$1,120,000

TOTAL 20-YEAR PRESENT WORTH COST: \$3,770,000
 Total Cost per lb 20-Yr N removal \$2.46

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 18, 2001
FACILITY: Stuarts Draft WWTP
LOCATION: Augusta County, VA
RATED FLOW: 1.4 mgd
CURRENT EFFLUENT TN: 3.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 20 lbs/d
 7 1000 lbs/yr
 146 1000 lbs/20-years

PE COD N/a mg/L
PE TKN N/a mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

<input type="checkbox"/> MLE	Existing Aerated Volume (MG)	<u>N/a</u>
<input type="checkbox"/> BEPR (A2/O, VIP, etc.)	Existing Anoxic Volume (MG)	<u>N/a</u>
<input type="checkbox"/> Bardenpho	Current MLSS at Winter ADF	<u>5000</u>
<input checked="" type="checkbox"/> Oxidation Ditch		
<input type="checkbox"/> Lagoon (Biotac, etc.)		
<input type="checkbox"/> Cyclical Aerobion		
<input type="checkbox"/> SBR		
<input type="checkbox"/> High-Rate Biofilter		
<input type="checkbox"/> Effluent Filtration		
<input checked="" type="checkbox"/> Other: <u>Brush Aerator Oxidation Ditches</u>		

CURRENT EFFLUENT AMMONIA-N <1.0 mg/L

From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	New MLSS	<u>N/a</u>
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd)	<u>0</u>
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd)	<u>0</u>
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate nit/denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other: _____		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	
<input type="checkbox"/> Add downstream DeNitr filter with methanol	
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol	
<input checked="" type="checkbox"/> Add methanol to existing BNR process	
<input type="checkbox"/> Add downstream anoxic tank with methanol feed	
<input type="checkbox"/> Add effluent filtration	
<input type="checkbox"/> Other: _____	

CAPITAL COST:

Equipment and Structures (from Page 2)		\$250,000
Electrical and Instrumentation	12%	\$30,000
Yard Piping and Site Work	15%	\$38,000
Subtotal		\$320,000
Contractor OH&P:	15%	\$48,000
Engineering and Constr. Mgmt.	15%	\$48,000
Subtotal		\$420,000
Contingency	30%	\$96,000
Total Capital Cost		\$520,000
Capital Cost per lb 20-Yr N removal		\$3.68

OPERATIONS COST

Additional Horsepower (from Page 2)		0 HP
Electrical Power Cost	0.05 \$/kW	\$0 \$/year
Nitrate Reduction using Methanol		<u>2.0</u> mg/L
Methanol Required		10 gals/d
Methanol Cost	0.75 \$/gal	\$2,700 \$/year
Separate Stage Ammonia Reduction		<u>0.0</u> mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$4,200 \$/year
Denitrification Sludge Production w/Methanol		30 lbs/d
Sludge Disposal Cost	400 \$/ton	\$2,200 \$/year
Total Annual O&M Cost		\$9,100 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs		\$140,000

TOTAL 20-YEAR PRESENT WORTH COST: **\$660,000**
 Total Cost per lb 20-Yr N removal **\$4.52**

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 19, 2001
FACILITY: Strasburg WWTP
LOCATION: Strasburg, VA
RATED FLOW: 1.0 mgd
CURRENT EFFLUENT TN: 6.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 20 lbs/d
 7 1000 lbs/yr
 148 1000 lbs/20-years

PE COD: N/A mg/L
PE TKN: N/A mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

<input type="checkbox"/> MLE	Existing Aerated Volume (MG)	N/A
<input type="checkbox"/> BEPR (A2/O, VIP etc)	Existing Anoxic Volume (MG)	N/A
<input type="checkbox"/> Bardenpho	Current MLSS at Winter ADF	4000
<input checked="" type="checkbox"/> Oxidation Ditch		
<input type="checkbox"/> Lagoon (Biocac etc)		
<input type="checkbox"/> Cyclical Aeration		
<input type="checkbox"/> SBR		
<input type="checkbox"/> High-Rate Biofilter		
<input type="checkbox"/> Effluent Filtration		
<input checked="" type="checkbox"/> Other <u>Brush Aerator Oxidation Ditch</u>		

CURRENT EFFLUENT AMMONIA-N: <1.0 mg/L

From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

<input checked="" type="checkbox"/> No modifications required	New MLSS	N/A
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd)	0
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd)	0
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

<input type="checkbox"/> No modifications required	
<input checked="" type="checkbox"/> Add downstream DeNit filter with methanol	
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol	
<input type="checkbox"/> Add methanol to existing BNR process	
<input type="checkbox"/> Add downstream anoxic tank with methanol feed	
<input type="checkbox"/> Add effluent filtration	
<input type="checkbox"/> Other	

CAPITAL COST:

Equipment and Structures (from Page 2)		\$1,300,000
Electrical and Instrumentation	12%	\$166,000
Yard Piping and Site Work	15%	\$195,000
Subtotal		\$1,661,000
Contractor OH&P	15%	\$249,150
Engineering and Constr. Mgmt	15%	\$249,150
Subtotal		\$2,159,300
Contingency	30%	\$647,790
Total Capital Cost		\$2,807,090
Capital Cost per lb. 20-Yr N removal		\$18.15

OPERATIONS COST:

Additional Horsepower (from Page 2)		20 HP
Electrical Power Cost	0.05 \$/kW	\$8,500 \$/year
Nitrate Reduction using Methanol		3.0 mg/L
Methanol Required		10 gals/d
Methanol Cost	0.75 \$/gal	\$2,700 \$/year
Separate Stage Ammonia Reduction		0.0 mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$21,500 \$/year
Denitrification Sludge Production w/Methanol		40 lbs/d
Sludge Disposal Cost	400 \$/ton	\$2,800 \$/year
Total Annual O&M Cost		\$33,000 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs		\$500,000

TOTAL 20-YEAR PRESENT WORTH COST: \$3,150,000
 Total Cost per lb 20-Yr. N removal: \$21.58

PROJECT:	Implementing a 3 mg/L Annual Average Total Nitrogen Limit		
PREPARED FOR:	USEPA, Chesapeake Bay Office		
PREPARED BY:	Virginia Tech with Stearns & Wheeler, LLC		
DATE:	March 26, 2001		
FACILITY:	HRSD-VIP		
LOCATION:	Norfolk, VA		
RATED FLOW:	40.0 mgd	PE COD:	_____ mg/L
CURRENT EFFLUENT TN:	9.0 mg/L	PE TKN:	_____ mg/L
EFFLUENT TN GOAL:	3.0 mg/L		
NITROGEN REDUCTION:	1000 lbs/d		
	365 1000 lbs/yr		
	7300 1000 lbs/20-years		

CURRENT PROCESS (CHECK ALL THAT APPLY):	<input type="checkbox"/> MLE	Existing Aerated Volume (MG):	_____
	<input checked="" type="checkbox"/> BEPR (A2/O, VIP, etc.)	Existing Anoxic Volume (MG):	_____
	<input type="checkbox"/> Bardenpho	Current MLSS at Winter ADF:	_____
	<input type="checkbox"/> Oxidation Ditch		
	<input type="checkbox"/> Lagoon (Biolac, etc.)		
	<input type="checkbox"/> Cyclical Aeration		
	<input type="checkbox"/> SBR		
	<input type="checkbox"/> High-Rate Biofilter		
	<input type="checkbox"/> Effluent Filtration		
	<input checked="" type="checkbox"/> Other: The Original VIP Plant, no effluent filtration		

CURRENT EFFLUENT AMMONIA-N:	< 1.0 mg/L	<input checked="" type="checkbox"/> From Report
		<input type="checkbox"/> From Model (at ADF and load 15 d MCRT 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:		New MLSS
<input checked="" type="checkbox"/> No modifications required		N/A
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd) _____	
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd) _____	
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate nit/denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other: _____		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:	
<input checked="" type="checkbox"/> No modifications required	
<input type="checkbox"/> Add downstream Denit filter with methanol	
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNit filter with methanol	
<input type="checkbox"/> Add methanol to existing BNR process	
<input type="checkbox"/> Add downstream anoxic tank with methanol feed	
<input type="checkbox"/> Add effluent filtration	
<input type="checkbox"/> Other: _____	

CAPITAL COST:		
Equipment and Structures (from Page 2)		\$14,950,000
Electrical and Instrumentation	12%	\$1,794,000
Yard Piping and Site Work	15%	\$2,243,000
Subtotal		\$18,987,000
Contractor OH&P	15%	\$2,849,000
Engineering and Constr. Mgmt.	15%	\$2,849,000
Subtotal		\$24,690,000
Contingency:	30%	\$5,697,000
Total Capital Cost:		\$30,390,000
Capital Cost per lb. 20-Yr N removal:		\$4.16

OPERATIONS COST:		
Additional Horsepower (from Page 2)		800 HP
Electrical Power Cost	0.05 \$/kW	\$281,400 \$/year
Nitrate Reduction using Methanol		3.0 mg/L
Methanol Required:		480 gals/d
Methanol Cost:	0.75 \$/gal	\$125,000 \$/year
Separate Stage Ammonia Reduction		0.0 mg/L
Caustic Soda @ 25% conc.		0 gals/d
Caustic Soda Cost:	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost:		\$246,900 \$/year
Denitrification Sludge Production w/Methanol:		1440 lbs/d
Sludge Disposal Cost	400 \$/ton	\$105,100 \$/year
Total Annual O&M Cost		\$739,300 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs:		\$11,690,000

TOTAL 20-YEAR PRESENT WORTH COST:		\$41,480,000
Total Cost per lb. 20-Yr N removal:		\$5.68

PROJECT:	Implementing a 3 mg/L Annual Average Total Nitrogen Limit		
PREPARED FOR:	USEPA, Chesapeake Bay Office		
PREPARED BY:	Virginia Tech with Stearns & Wheeler, LLC		
DATE:	March 25, 2001		
FACILITY:	HRSD-Nansemond		
LOCATION:	Portsmouth, VA		
RATED FLOW:	30.0 mgd	PE COD	_____ mg/L
CURRENT EFFLUENT TN:	6.0 mg/L	PE TKN	_____ mg/L
EFFLUENT TN GOAL:	3.0 mg/L		
NITROGEN REDUCTION:	750 lbs/d		
	274 1000 lbs/yr		
	5475 1000 lbs/20-years		

CURRENT PROCESS (CHECK ALL THAT APPLY):	<input type="checkbox"/> MLE	Existing Aerated Volume (MG)	_____
	<input checked="" type="checkbox"/> BEPR (A2/O, VIP, etc.)	Existing Anoxic Volume (MG)	_____
	<input type="checkbox"/> Bardenpho	Current MLSS at Winter ADF	_____
	<input type="checkbox"/> Oxidation Ditch		
	<input type="checkbox"/> Lagoon (Biocac, etc.)		
<input type="checkbox"/> Cyclical Aeration			
<input type="checkbox"/> SBR			
<input type="checkbox"/> High-Rate Biofilter			
<input type="checkbox"/> Effluent Filtration			
<input checked="" type="checkbox"/> Other:	A2/O Plant w/o effluent filtration		

CURRENT EFFLUENT AMMONIA-N:	< 1.0 mg/L	<input checked="" type="checkbox"/> From Report
		<input type="checkbox"/> From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:		New MLSS
<input checked="" type="checkbox"/> No modifications required		N/A
<input type="checkbox"/> Raise MCRT/MLSS in existing tanks (check clarifier capacity)		
<input type="checkbox"/> Construct additional aerated volume	Flow (mgd): 0	
<input type="checkbox"/> Construct additional clarifiers	Flow (mgd): 0	
<input type="checkbox"/> Use existing anoxic volume as aerobic (construct separate denit facility)		
<input type="checkbox"/> Use aerated system for BOD removal only (construct separate n/denit facility)		
<input type="checkbox"/> Add influent flow equalization tank		
<input type="checkbox"/> Other:		

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:	
<input type="checkbox"/> No modifications required	
<input checked="" type="checkbox"/> Add downstream DeNitr filter with methanol	
<input type="checkbox"/> Add downstream Nitrification Biofilter and DeNitr filter with methanol	
<input type="checkbox"/> Add methanol to existing BNR process	
<input type="checkbox"/> Add downstream anoxic tank with methanol feed	
<input type="checkbox"/> Add effluent filtration	
<input type="checkbox"/> Other:	

CAPITAL COST:	Equipment and Structures (from Page 2):	\$11,450,000
	Electrical and Instrumentation: 12%	\$1,374,000
	Yard Piping and Site Work: 15%	\$1,718,000
	Subtotal:	\$14,540,000
	Contractor OH&P: 15%	\$2,181,000
	Engineering and Constr. Mgmt. 15%	\$2,181,000
	Subtotal:	\$18,900,000
	Contingency: 30%	\$4,362,000
	Total Capital Cost:	\$23,260,000
	Capital Cost per lb. 20-Yr. N removal:	\$4.25

OPERATIONS COST:	Additional Horsepower (from Page 2):	600 HP
	Electrical Power Cost 0.05 \$/kWh	\$198,000 \$/year
	Nitrate Reduction using Methanol	3.0 mg/L
	Methanol Required	340 gals/d
	Methanol Cost 0.75 \$/gal	\$93,100 \$/year
	Separate Stage Ammonia Reduction	0.0 mg/L
	Caustic Soda @ 25% conc	0 gals/d
	Caustic Soda Cost 0.80 \$/gal	\$0 \$/year
	Equipment Maintenance Cost	\$189,000 \$/year
	Denitrification Sludge Production w/Methanol:	1080 lbs/d
	Sludge Disposal Cost. 400 \$/ton	\$78,800 \$/year
	Total Annual O&M Cost:	\$566,900 \$/year
	Effective Annual Interest Rate after Inflation	2.91%
	20-Year Present Worth of O&M Costs:	\$8,360,000

TOTAL 20-YEAR PRESENT WORTH COST:	\$31,610,000
Total Cost per lb. 20-Yr N removal:	\$5.77

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 25, 2001
FACILITY: Proctor's Creek WWTP
LOCATION: Chesterfield County, VA
RATED FLOW: 20.0 mgd
CURRENT EFFLUENT TN: 6.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 500 lbs/d
 183 1000 lbs/yr
 3650 1000 lbs/20-years

PE COD _____ mg/L
 PE TKN _____ mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE
 SEPR (A2/O, VIP etc)
 Bardenpho
 Oxidation Ditch
 Lagoon (Biolac, etc)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other: _____

Existing Aerated Volume (MG) _____
 Existing Anoxic Volume (MG) _____
 Current MLSS at Winter ADF _____

CURRENT EFFLUENT AMMONIA-N: <1.0 mg/L
 From Report
 From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

No modifications required
 Raise MCRT/MLSS in existing tanks (check clarifier capacity) New MLSS _____
 Construct additional aerated volume Flow (mgd) 0
 Construct additional clarifiers Flow (mgd) 0
 Use existing anoxic volume as aerobic (construct separate denit facility)
 Use aerated system for BOD removal only (construct separate nit/denit facility)
 Add influent flow equalization tank
 Other: _____

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

No modifications required
 Add downstream DeNit filter with methanol
 Add downstream Nitrification Biofilter and DeNit filter with methanol
 Add methanol to existing BNR process
 Add downstream anoxic tank with methanol feed
 Add effluent filtration
 Other: _____

CAPITAL COST:

Equipment and Structures (from Page 2)		\$7,960,000
Electrical and Instrumentation	12%	\$954,000
Yard Piping and Site Work	15%	\$1,193,000
Subtotal:		\$10,100,000
Contractor OH&P	15%	\$1,515,000
Engineering and Constr. Mgmt.	15%	\$1,515,000
Subtotal:		\$3,030,000
Contingency	30%	\$3,030,000
Total Capital Cost		\$16,160,000
Capital Cost per lb. 20-Yr. N removal		\$4.43

OPERATIONS COST:

Additional Horsepower (from Page 2)		400 HP
Electrical Power Cost	0.05 \$/kW	\$130,700 \$/year
Nitrate Reduction using Methanol		3.0 mg/L
Methanol Required		230 gals/d
Methanol Cost	0.75 \$/gal	\$63,000 \$/year
Separate Stage Ammonia Reduction		0.0 mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$131,300 \$/year
Denitrification Sludge Production w/Methanol		720 lbs/d
Sludge Disposal Cost	400 \$/ton	\$52,600 \$/year
Total Annual O&M Cost		\$377,900 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs		\$5,660,000

TOTAL 20-YEAR PRESENT WORTH COST: \$21,820,000
 Total Cost per lb. 20-Yr. N removal \$5.98

PROJECT: Implementing a 3 mg/L Annual Average Total Nitrogen Limit
PREPARED FOR: USEPA, Chesapeake Bay Office
PREPARED BY: Virginia Tech with Stearns & Wheeler, LLC
DATE: March 25, 2001
FACILITY: Falling Creek WWTP
LOCATION: Chesterfield County, VA
RATED FLOW: 10.0 mgd
CURRENT EFFLUENT TN: 6.0 mg/L
EFFLUENT TN GOAL: 3.0 mg/L
NITROGEN REDUCTION: 250 lbs/d
 91 1000 lbs/yr
 1825 1000 lbs/20-years

PE COD _____ mg/L
 PE TKN _____ mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):
 MLE
 BEPR (A2/O, VIP, etc)
 Bardenpho
 Oxidation Ditch
 Lagoon (Biola. etc.)
 Cyclical Aeration
 SBR
 High-Rate Biofilter
 Effluent Filtration
 Other _____

Existing Aerated Volume (MG) _____
 Existing Anoxic Volume (MG) _____
 Current MLSS at Winter ADF _____

CURRENT EFFLUENT AMMONIA-N. <1.0 mg/L
 From Report
 From Model (at ADF and load, 15 d MCRT 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:
 No modifications required
 Raise MCRT/MLSS in existing tanks (check clarifier capacity)
 Construct additional aerated volume
 Construct additional clarifiers
 Use existing anoxic volume as aerobic (construct separate denit facility)
 Use aerated system for BOD removal only (construct separate nit/denit facility)
 Add influent flow equalization tank
 Other: _____

Flow (mgd) _____
 Flow (mgd): _____
 New MLSS _____
 N/A

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:
 No modifications required
 Add downstream DeNt filter with methanol
 Add downstream Nitrification Biofilter and DeNt filter with methanol
 Add methanol to existing BNR process
 Add downstream anoxic tank with methanol feed
 Add effluent filtration
 Other: _____

CAPITAL COST:

Equipment and Structures (from Page 2)		\$4 450,000
Electrical and Instrumentation	12%	\$534,000
Yard Piping and Site Work	15%	\$668,000
Subtotal		\$5 650,000
Contractor OH&P	15%	\$848,000
Engineering and Constr Mgmt	15%	\$848,000
Subtotal		\$7,350,000
Contingency:	30%	\$1,695,000
Total Capital Cost		\$9,050,000
Capital Cost per lb 20-Yr N removal		\$4.96

OPERATIONS COST.

Additional Horsepower (from Page 2)		200 HP
Electrical Power Cost	0.06 \$/kW	\$65,300 \$/year
Nitrate Reduction using Methanol		3.0 mg/L
Methanol Required		110 gals/d
Methanol Cost	0.75 \$/gal	\$30,100 \$/year
Separate Stage Ammonia Reduction:		0.0 mg/L
Caustic Soda @ 25% conc		0 gals/d
Caustic Soda Cost	0.60 \$/gal	\$0 \$/year
Equipment Maintenance Cost		\$73,600 \$/year
Denitrification Sludge Production w/Methanol		360 lbs/d
Sludge Disposal Cost	400 \$/ton	\$28,300 \$/year
Total Annual O&M Cost		\$195,200 \$/year
Effective Annual Interest Rate after Inflation		2.91%
20-Year Present Worth of O&M Costs		\$2,830,000

TOTAL 20-YEAR PRESENT WORTH COST: \$11,880,000
 Total Cost per lb 20-Yr N removal: \$6.56

APPENDIX B

COST INFORMATION FROM THE FINAL REPORT FOR 8 MG/L EFFLUENT TN UPGRADES AT 51 WWTPS IN THE CHESAPEAKE BAY WATERSHED

modification costs in this report were based on the "permanent modification" standards of each owner, if such standards were known.

Pennsylvania WWTPs

The results of the 16 Pennsylvania WWTP evaluations are summarized in Table 7.

Table 7. Pennsylvania WWTPs Evaluated for BNR Removal

WWTP	BNR Design Flow MGD	Total Capital Costs \$	Capital Cost/Flow \$/MGD	Cost per lb Add. N Removal
Altoona City (E)	9.0	1.230 x 10 ⁶	136,667	\$0.51
Altoona City (W)	13.5	1.233 x 10 ⁶	91,333	0.42
Chambersburg	4.5	6.347 x 10 ⁶	1,410,444	2.69
Greater Hazleton	8.9	7.84 x 10 ⁶	880,899	3.24
Hanover	4.5	0.060 x 10 ⁶	13,333	0.08
Harrisburg	30.0	25.448 x 10 ⁶	848,250	2.00
Lancaster	29.7	1.077 x 10 ⁶	36,263	0.19
Lebanon	8.0	4.039 x 10 ⁶	504,875	1.19
Scranton	16.0	2.815 x 10 ⁶	175,938	0.76
State College (UAJA)	6.0	0.780 x 10 ⁶	130,000	0.33
Susquehanna (Lancaster Area)	12.0	1.619 x 10 ⁶	134,917	1.12
Throop	7.0	3.320 x 10 ⁶	474,285	1.68
Williamsport (C)	7.2	6.339 x 10 ⁶	880,417	1.36
Williamsport W)	4.5	5.246 x 10 ⁶	1,165,778	2.58
Wyoming Valley	32.0	0.763 x 10 ⁶	23,843	0.18
York City	26.0	1.780 x 10 ⁶	68,462	0.42
Total/Average	218.8	69.936 x 10⁶	319,634	\$0.946

The 16 Pennsylvania WWTPs can be easily classified into two categories based on the capital costs of the needed modifications for BNR. Six of the plants, accounting for only 29% of the post BNR design flows, would account for 79% of the total capital costs. Of the six, the Harrisburg plant, alone, accounts for 36% of the total projected capital costs. The six plants, their post BNR design flows, their projected capital costs for BNR, and the BNR modification costs per MGD, are listed in Table 8. The capital cost per MGD would be nearly \$900,000, and the cost per pound additional N removal projects to \$2.09/lb.

Table 8. Pennsylvania High Cost BNR Modification Plants

WWTP	BNR Design Flow MGD	Total Capital Costs \$	Capital Cost/Flow \$/MGD	Cost per lb Add. N Removal
Chambersburg	4.5	6.347 x 10 ⁶	1.4104 x 10 ⁶	\$2.69/lb
Greater Hazleton	8.9	7.840 x 10 ⁶	880,899	\$3.24/lb
Harrisburg	30.0	25.448 x 10 ⁶	848,250	\$2.00/lb
Lebanon	8.0	4.039 x 10 ⁶	504,875	\$1.19/lb
W'msport Central	7.2	6.339 x 10 ⁶	880,474	\$1.36/lb
W'msport West	4.5	5.246 x 10 ⁶	1.166 x 10 ⁶	\$2.58/lb
Total/Average	63.1	55.26 x 10⁶	875,737	\$2.09/lb

The high capital investment and cost per pound projections suggest that these plants are good candidates for nutrient trading with non-point source controls or other WWTPs, if such an option is developed.

In contrast to the six plants listed in Table 8, the 10 other plants account for 155.7 MGD (71%) of the post BNR design flow, but only $\$14.676 \times 10^6$ (21%) of the projected capital costs, for a modification cost of only $\$94,258$ per MGD. Also, five of these 10 plants would have a reduction in annual O&M costs from converting to BNR. The projected average cost per pound of additional N removal by these 10 plants is only $\$0.41/\text{lb}$. It is unlikely that non-point controls could even remotely approach these costs, and obviously could not promise the same reliability of N reduction. Clearly, these plants are good candidates for economical BNR modification and operation.

Maryland and New York WWTPs

The nine Maryland WWTPs included in this draft report are small scale plants, with one exception, and, consequently, the projected costs per additional pound of nitrogen removed are very high for most of them. The information is tabulated in Table 9. The two New York plants are relatively large, but one is a trickling filter (TF) plant, and the other has very severe site constraints. Consequently, the projected costs for implementing BNR at the two NY plants are high. Their data also are included in Table 9.

Table 9. Maryland and New York WWTPs Evaluated for BNR Removal

WWTP	BNR Design Flow MGD	Total Capital Costs \$	Capital Cost/Flow \$/MGD	Cost per lb Add. N Removal
Brunswick	0.7	390,000	557,143	\$0.50/lb N
Chestertown	0.9	1.350×10^6	1.50×10^6	\$5.92/lb N
Crisfield	1.0	1.949×10^6	1.949×10^6	\$4.95/lb N
Elkton	2.7	1.970×10^6	729,630	\$1.87/lb N
Federalburg	0.75	1.525×10^6	2.033×10^6	\$3.34/lb N
Georges Creek (Alleghany Cty.)	0.6	1.663×10^6	2.772×10^6	\$3.55/lb N
Indian Head	0.49	532,000	1.085×10^6	\$2.90/lb N
Mattawoman	15	4.250×10^6	283,333	\$0.07/lb N
Winebrenner	0.6	1.480×10^6	2.467×10^6	\$3.77/lb N
MD Totals/Avg.	22.74	15.109×10^6	0.664×10^6	1.31/lb N
Binghampton	25	13.057×10^6	522,280	\$2.24/lb N
Endicott	8	6.656×10^6	832,000	\$3.35/lb N
NY Totals/Avg.	33	19.713×10^6	597,364	\$2.49/lb N

Only two of the Maryland WWTPs, Brunswick and Mattawoman, have the potential for low cost BNR modification. This is because most of the other plants have fixed-film biological processes, either trickling filters or rotating biological contactors, or are old facilities that need substantial upgrading before BNR is possible. One, Chestertown, is an aerated lagoon system that cannot maintain nitrification during the winter months. The cost per pound of additional nitrogen removed is relatively small for the nine plants collectively, but that is because the Mattawoman flow dominates the total flow, and it potentially can be modified for BNR very economically. The seven WWTPs other than Brunswick and Mattawoman account for only 31% of the design

BNR flow, but 69% of the projected capital costs. The cost per additional pound of N-removal for the seven "high cost" plants averages \$3.36/lb N, which is substantially higher than the \$2.09/lb N average of the high cost Pennsylvania WWTPs. Clearly, it would be economical to upgrade the Brunswick and Mattawoman WWTPs for BNR. The other plants do not fall into the low cost category based on cost per additional pound of potential nitrogen removal, and non-point pollution reduction trading may be more attractive. However, this cost per pound is still considerably less than the estimates for some types of non-point source controls. Also, some of the Maryland plants are in need of upgrades for conventional treatment. If they are to be upgraded or expanded, it may be possible to economically include modifications that enable BNR along with the expansions and upgrades.

Virginia WWTPs

The twenty-four Virginia WWTPs are primarily small plants, as shown by the data listed in Table 10.

Table 10. Virginia BNR Modification Plants

WWTP	BNR Design Flow MGD	Total Capital Costs \$	Capital Cost/Flow \$/MGD	Cost per lb Add. N removal
Arlington	30	560,000	18,667	\$0.605/lb
Colonial Beach	2.0	90,000	45,000	-\$0.065/lb
Dahlgren	0.325	30,000	92,000	-\$0.12/lb
Dale Services#1	3.0	220,000	73,000	\$0.29/lb
Dale Services#8	3.0	220,000	73,000	\$0.29/lb
DuPont, Waynesboro	2.0	0	-	-\$0.11/lb
Fishersville	2.0	790,000	395,000	\$2.20/lb
Front Royal	4.0	50,000	13,000	\$0.02/lb
Harrisonburg	16	4.688 x 10 ⁶	293,000	\$0.54/lb
H. L. Mooney	18	490,000	27,222	\$0.063/lb
Leesburg	4.85	2.980 x 10 ⁶	614,000	\$0.68/lb
Lower Potomac	67.0	20.800 x 10 ⁶	310,448	\$0.50/lb
Luray	2.0	0	0	N/A
Merck and Co.	1.2	0	0	0
Middle River/Verona	4.5	150,000	33,000	\$0.30/lb
Opequon	6.25	570,000	91,000	\$0.16/lb
Parkins Mill	2.0	97,000	49,000	-\$0.79/lb
Purcellville	1.0	1.3 x 10 ⁶	1.3 x 10 ⁶	\$1.80/lb
Rocco Foods, Edinburg	1.2	4.480 x 10 ⁶	3,733,000	\$0.338/lb
Strasburg	0.975	120,000	123,000	-\$0.14/lb
Stuarts Draft	1.4	1.240 x 10 ⁶	886,000	\$2.36/lb
Waynesboro	4.0	3.500 x 10 ⁶	875,000	\$1.27/lb
Woodstock	1.0	70,000	70,000	-\$0.22/lb
Total/Average	173.7	42.445 x 10 ⁶	244,358	\$0.48/lb

Four of the Virginia plants are large and collectively will be designed to treat 131 MGD by BNR, which is 75% of the Virginia total. The other 20 WWTPs treat an average flow of only 2.14 MGD and twelve of them are designed to treat 2 MGD or less. Although the plants are relatively small, they should be much more economical to modify for BNR removal than the typical Maryland WWTP. This is because nearly all of them are activated sludge (AS) process facilities, and several of them are oxidation ditch AS systems. Oxidation ditches typically are easy to operate for biological nitrogen removal, simply by changing the operating approach. The primary expense for most of them is the purchase and installation of timer switches for the aerators. Also, most of the Virginia facilities are not near design flow, and can be easily modified for BNR with the existing activated sludge basin volumes and clarifier capacities. However, the recommended constructive or operative modifications may lead to a downsizing of the plants' hydraulic design capacity. Therefore, the resulting BNR process might have a shorter useful service life (as plant flow increases) than a more permanent retrofit designed to maintain the existing permitted design capacity. The savings accumulated during the interim years, however, may be sufficient to pay for much of the subsequent expansion. Regardless, the average cost per additional pound of N removed for the Virginia plants is projected as only \$0.48/lb, the lowest of the three states. Even this figure is misleading because most of the projected capital costs would be expended on six of the WWTPs, and three plants project much higher costs per additional pound of N removed than the rest. The seven high capital outlay and/or high N removal cost plants are listed in Table 11.

Table 11. Virginia High Cost BNR Modification Plants.

WWTP	BNR Design Flow MGD	Total Capital Costs \$	Capital Cost/Flow \$/MGD	Cost per lb Add. N removal
Fishersville	2.0	790,000	395,000	\$2.20/lb
Harrisonburg	16	4.688 x 10 ⁶	293,000	\$0.54/lb
Leesburg	4.85	2.980 x 10 ⁶	614,000	\$0.68/lb
Lower Potomac, Fairfax County	67.0	20.8 x 10 ⁶	310 448	\$0.50/lb
Rocco Farm Foods, Edinburg	1.2	4.480 x 10 ⁶	3,733,000	\$0.338/lb
Stuarts Draft	1.4	1.240 x 10 ⁶	886,000	\$2.36/lb
Waynesboro	4.0	3.500 x 10 ⁶	875,000	\$1.27/lb
Total/Average	96.45	38.478 x 10⁶	398,942	\$0.61/lb

The seven plants listed above account for only 56% of the total discharge flow, but nearly 91% of the projected BNR modification capital costs. In spite of the high capital costs, the projected average cost per additional pound of nitrogen removed is only \$0.61/lb. The other 17 Virginia plants would have a cost per lb additional N removed of only \$0.27, and six of these plants should save money over 20 yrs by implementing the recommended BNR approach. Two of the evaluated plants, Merck, Inc. and Luray, have no reason to implement BNR because their wastewaters are nitrogen deficient for biological wastewater treatment, which necessitates nitrogen addition.

Table 1. Summary List of Plants and NPDES Permit Requirements

Maryland									
Plant	Permit Flow MGD	BOD5 mg/L	TSS mg/L	NH4-N mg/L	TN mg/L	TP mg/L	DO mg/L	pH	NOTES
Brunswick	0.7	30	30	-	-	2	>5.0	6.5-8.5	
Chester town	0.9	30	80	-	-	-	>5.0	6.5-8.5	
Crisfield	1.0	30	30	-	-	2	>5.0	6.5-8.5	
Elkton	1.6	30	30	20*	-	2	>5.0	6.5-8.5	*TKN
Federalsburg	0.75	30	30	-	10	2	>5.0	6.5-8.5	
Georges Creek	0.6	30	30	-	-	2	>5.0	6.5-8.5	
Indian Head	0.49	16	30	8*	-	2	>5.0	6.5-8.5	*TKN
Mattawoman	15	30	30	-	-	0.16	>5.0	6.5-8.5	
Winnebrenner	0.6	10	10	0.65	-	2	>5.0	6.5-8.5	
TOTAL	21.64								

All permits include a goal of a yearly average 6 mg/L TN, which go into effect once the average annual plant flow exceeds 0.50 MGD.

Pennsylvania											
Plant	Permit Flow MGD	BOD5 mg/L		TSS mg/L	NH4-N mg/L		TN mg/L	TP mg/L	DO mg/L	pH	NOTES
		I	II		III	IV					
Altoona City(E)	9	20	25	30	2.5	4			>5	6.0-9.0	I and III: May-Oct; II and IV: Nov-Apr.
Altoona City(W)	9	20	25	30	2.5	4			>5	6.0-9.0	I and III: May-Oct; II and IV: Nov-Apr.
Chambersburg	4.5	15	25	30	3.5	10			>5	6.0-9.0	I and III: May-Oct; II and IV: Nov-Apr.
Greater Hazleton	8.9	25		30						6.0-9.0	I: All Year Round
Kanover	5.5	15	25	30	1.5	4.5		2	>5	6.0-9.0	I and III: May-Oct; II and IV: Nov-Apr; V: All Year Round
Harrisburg	30	25		30	15			2	>5	6.0-9.0	I and V: All Year Round; III: May-Oct;
Lancaster City	29.7	15	25	30	2.5	7.5		2	>5	6.0-9.0	I and III: May-Oct; II and IV: Nov-Apr; V: All Year Round
Lebanon	8	10	20	30	2.5	7.5		2	>5	6.0-9.0	I and III: May-Oct; II and IV: Nov-Apr; V: All Year Round
Scranton	20	25		30	3	9			>6	6.0-9.0	I: All Year Round; III: May-Oct.; IV: Nov-Apr.
State College (LJAJA)	6	10		10	1	varies		0.13	>5	6.0-9.0	III: Jul-Nov; IV: 2.5-5.5 mg/L; V: Dissolved P, Mar-Oct; I: All Year Round
Susquehanna (Lancaster Area)	12	25		30	15			2	>5	6.0-9.0	I and V: All Year Round; III: May-Oct.
Throop	7	25		30	4.5	13.5			>5	6.0-9.0	I: All Year Round; III: May-Oct; IV: Nov-Apr.
Williamsport(C)	7.2	25		30						6.0-9.0	I: All Year Round
Williamsport(W)	4.5	54		50						6.0-9.0	I: All Year Round
Wyoming Valley (Luzerne County)	32	25		30						6.0-9.0	I: All Year Round
York City	26	15	20	30	1.7	2.1		2	>5	6.0-9.0	I and III: May-Oct.; II and IV: Nov-Apr.
TOTAL	218.3										

Table 1. Summary List of Plants and NPOES Permit Requirements

New York											
Plant	Permit Flow MGD	BOD5 mg/L		TSS mg/L	NH4-N mg/L		TN mg/L	TP mg/L	DO mg/L	pH	NOTES
		I	II		III	IV					
Binghamton-Johnson City	20	24*		24*	11						*At 25 MGD (i.e. the limit is 3004 lbs/d) , III, Jun-Oct
Village of Endicott	8	30		30	12.5*						*At 8 MGD (i.e. the limit is 830 lbs/d) Jun-Oct
TOTAL	28										

Virginia											
Plant	Permit Flow MGD	BOD5 mg/L		TSS mg/L	NH4-N mg/L		TN mg/L	TP mg/L	DO mg/L	pH	NOTES
		I	II		III	IV					
Arlington	30	10		10	1			0.18	>6.0	6.0-9.0	III, Year Round
Colonial Beach	2	21		28	4.63	-	-	-	>6.5		III, Apr-Sep
Dahlgren	0.325	30		30	1.35			2	>5.0	6.0	
Dale Services; #1	3	2		3				0.1*			*PO4-P
Dale Services; #8	3	2		3				0.1*			*PO4-P
DuPont, Waynesboro	2	218.84*			0.689	0.601	-	-			*kg/d; All maximum values. Temp 31 C, III Jun-Dec, IV Jan-May
Fishersville	1.4	24		24	8.14	10.8			>5.0	6.5-9.5	III, Jun-Dec; IV, Jan-May
Front Royal	4	30		30	7	13				6.5-9.0	III, Jun-Dec; IV, Jan-May
H.L. Mooney, Prince William Cty.	18	10		10	1			0.18	>6.0	6.0-9.0	II, Year Round
Harrisonburg	18				4*	9*					*TKN; III, Jun-Dec, IV, Jan-May.
Leesburg	4.85	12		20	3		6*	2	>5.0	6.5-8.5	*TKN for May-Oct; III, May-Oct
Lower Potomac, Fairfax Cty.	54	10		10	1			0.18	>6.0	6.0-9.0	I and III Year Round
Luray	2	22.5		30	3				>6.5	6.5-9.0	
Merck&Co., Inc., Elton	11.56	1567		2664	486		1291*	Monitor	>4.5	6.5-9.5	All values in kg/d; *TKN; Total Cyanide=2.9kg/d; Temp= 37 C
Middle River/Verona	4.9*	25		30	3.1	3.8			>5.0	6.5-9.5	III, Jun-Oct; IV, Nov-May
Opequon, Winchester	6.25	8	18.4	30	0.44	0.9			7.1	6.5-9.5	I, Jun-Sep; II, Oct-May; III, May-Jan; IV, Feb-Apr
Perkins Mill	2	7.5	23	30	1.5	1.7			7.2		I and III, May-Nov; II and IV, Dec-Apr
Purcellville, New	1	14.5		14.5	1		8	1.5	>6.0	6.0-9.0	
Purcellville, Old	0.6	14.5		14.5	-				>6.0	6.0-9.0	
Rocco Farm Foods, Edinburg	1.2	8	30	-	1.85	6.84	4.15 / 50.0*			6.5-9.5	*TKN for Jun-Dec, Jan-May; I and III Jun-Dec, II and IV Jan-May
Strasburg	0.978	30		30	4.6*	10.4*					*Maximum; III, Jun-Dec, IV, Jan-May
Stuarts Draft	1.4	14.8	25	30	4*	12.6*			>7.1	6.5-9.5	*TKN; I and III, Jun-Dec, II and IV, Jan-May
Waynesboro	4	7.5	15	30	2				>6.0		I and III, Jun-Oct; II, Nov-May
Woodstock	1	30		30	-					6.5-9.5	
TOTAL	164.6										

Includes cooling water.

Table 2. Summary of Projected Nitrogen Removals and Costs

	Qcurrent MGD	Qdesign MGD	Ncurrent lb/d	Nreduc. lb/20yrs in thousand	Cost \$/lb N
Maryland					
BRUNSWICK WWTP	0.325	0.7	68	530	0.5
CHESTERTOWN WWTP	0.65	0.9	58	247	5.92
CRISFIELD WWTP	0.7	1	91	379	4.95
ELKTON WWTP	1.37	2.7	206	1452	1.87
FEDERALSBURG WWTP	0.355	0.75	54	507	3.34
GEORGES CREEK WWTP, ALLEGANY COUNTY	0.626	0.6	107	457	3.55
INDIAN HEAD WWTP	0.314	0.5	43	219	2.9
MATTAWOMAN WWTP	7.55	15	869	4913	0.07
WINEBRENNER WWTP, WASHINGTON COUNTY	0.3	0.6	44	411	3.77
<i><u>Maryland Totals/Average</u></i>	<u>12.19</u>	<u>22.75</u>	<u>1540</u>	<u>9115</u>	<u>1.31</u>
New York					
BINGHAMTON-JOHNSON CITY JOINT SEWAGE TREATMENT PLANT	24.9	25	3011	9965	2.24
VILLAGE OF ENDICOTT WWTP	7.39	8	924	3292	3.35
<i><u>New York Totals/Average</u></i>	<u>32.29</u>	<u>33</u>	<u>3935</u>	<u>13257</u>	<u>2.49</u>
Pennsylvania					
ALTOONA CITY AUTHORITY EASTERLY PLANT	6.67	9	645	3185	0.51
ALTOONA CITY AUTHORITY WESTERLY PLANT	9.14	13.5	1052	3880	0.42
CHAMBERSBURG WWTP	4.5	4.5	563	2841	2.69
GREATER HAZLETON JOINT SEWER AUTHORITY WWTP	6.2	8.9	765	3860	3.24
HANOVER AREA REGIONAL WWTP	3.46	3.65**	568	3046	-0.08
HARRISBURG WWTP	24	30	4003	27635	2.00
LANCASTER CITY WWTP	23.4	29.7	1971	9230	0.19
LEBANON WWTP	5.7	8	870	4652	1.19
SCRANTON SEWER AUTHORITY WWTP	13.8	16	1266	4464	0.76
STATE COLLEGE UAJA WWTP	4.5	6	582	3330	0.33
SUSQUEHANNA WWTP, LANCASTER AREA AUTHORITY	9.45	12	796	2288	1.12
THROOP WWTP, LACKAWANNA RBSA,	4.5	7	499	1982	1.68 "
WILLIAMSPORT SANITARY AUTHORITY CENTRAL PLANT	8.98	7.2	1296	6600	1.36
WILLIAMSPORT SANITARY AUTHORITY WEST PLANT	3.5	4.5	686	3200	2.58
WYOMING VALLEY SANITARY AUTHORITY WWTP, LUZERNE CTY.	22.3	32	1213	5575	0.17
YORK CITY SEWER AUTHORITY STP	13.1	26	1289	5806	0.36
<i><u>Pennsylvania Totals/Average</u></i>	<u>163.2</u>	<u>218</u>	<u>18064</u>	<u>91574</u>	<u>0.97</u>

Table 2. Summary of Projected Nitrogen Removals and Costs

	Qcurrent MGD	Qdesign MGD	Ncurrent lb/d	Nreduc. lb/20yrs in thousand	Cost \$/lb N
Virginia					
ARLINGTON WWTP	32.4	30	2432	1973	0.605
COLONIAL BEACH WWTP	0.64	2	72	431	-0.065
DAHLGREN WWTP	0.28	0.325	41	218	-0.12
DALE SERVICES Section 1 WWTP	3	3	300	730	0.29
DALE SERVICES Section 8 WWTP	2.12	3	210	500	0.29
DUPONT WAYNESBORO WWTP	0.491	2	188	3184	-0.11
FISHERSVILLE WWTP	1.3	2*	121	260	2.2
FRONT ROYAL WWTP	2.27	4	284	1023	0.02
HARRISONBURG WWTP	8	16	1334	8712	0.54
H L. MOONEY WWTP, PRINCE WILLIAM COUNTY	12.8	18	1858	8820	0.06
LEESBURG WATER POLLUTION CONTROL FACILITY	2.86	4.85	382	1560	0.68
LOWER POTOMAC WWTP, FAIRFAX COUNTY	45	54/67	5630	34,094	0.5
LURAY WWTP	1.5	2	300	NA	NA
MERCK AND CO., INC WWTP	0.906	1.2	27	NA	0
MIDDLE RIVER/VERONA WWTP	3.65	4.5#	180	420	0.3
OPEQUON WRF, CITY OF WINCHESTER	5.14	6.25*	857	5328	0.16
PARKINS MILL WWTP	1.09	2	82	200	-0.79
PURCELLVILLE EXISTING WWTP	0.315	0.5	63	-	-
PURCELLVILLE NEW DESIGN WWTP	-	1	67	720	1.8
ROCCO FARM FOODS WWTP	1.1	1.2	1238	8840	0.338
STRASBURG WWTP	0.6	0.975	75	4366	-0.14
STUARTS DRAFT WWTP	0.98	1.4*	85	484	2.36
WAYNESBORO WWTP	3.63	4	424	3548	1.27
WOODSTOCK WWTP	0.77	1	77	292	-0.22
<u>Virginia Totals/Average</u>	<u>130.8</u>	<u>164.2</u>	<u>16260</u>	<u>85703</u>	<u>0.48</u>
GRAND TOTALS	339	438	39799	199649	0.94

*Average daily flows **Design flow less than permit flow #Combined Effluent NA: Not Applicable