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

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Virginia Tech
for the
Chesapeake Bay Program

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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.

**Table 3. The Estimated Cost of TN LOT Implementation at 7 James River WWTPs**

| 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$ 8 mg/L | 3 mg/L | Total | $ per lb N Removed 8 mg/L | 3 mg/L | 1000s lb N Removed 8 mg/L | 3 mg/L | Tot. Nrem 1000 lbs | Total $ per lb N Rem. |
|---|---|---|---|---|---|---|---|---|---|---|
| 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$ 8 mg/L | 3 mg/L | Total | $ per lb N Removed 8 mg/L | 3 mg/L | 1000s lb Ad'l N Rem. 8 mg/L | 3 mg/L | Tot. Nrem 1000 lbs | Total $ per lb N Rem. |
|---|---|---|---|---|---|---|---|---|---|---|
| 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$ 8 mg/L | 3 mg/L | Total | $ per lb N Removed 8 mg/L | 3 mg/L | 1000s lb Ad'l N Rem. 8 mg/L | 3 mg/L | Tot. Nrem 1000 lbs | Total $ per lb N Rem. |
|---|---|---|---|---|---|---|---|---|---|---|
| Binghampton | 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$ 8 mg/L | 3 mg/L | Total | $ per lb N Removed 8 mg/L | 3 mg/L | 1000s lb Ad'l N Rem. 8 mg/L | 3 mg/L | Tot. Nrem 1000 lbs | Total $ per lb N Rem. |
|---|---|---|---|---|---|---|---|---|---|---|
| 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$ 8 mg/L | 3 mg/L | Total | $ per lb N Removed 8 mg/L | 3 mg/L | 1000s lb Ad'l N Rem. 8 mg/L | 3 mg/L | Tot. Nrem 1000 lbs | Total $ per lb N Rem. |
|---|---|---|---|---|---|---|---|---|---|---|
| | **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. | Reco-mend. Mod. | SRT Days | Design Temp C | Effluent $NH_4^+$-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. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |
| Harris-burg | 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 |
| Lewis-burg | 2.4 | A2/0 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 Lane 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 | 2 Q | 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 | 3 Q | 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. | Reco-mend. 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 |
| Bruns-wick | 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 | Over-land 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 | DeniteF ilters | 7.2 | 14 | 0.5 | 3000 | 3Q(1.5) | 8.5 | 30 | 0.52 | 10.6 | 0.68 | 3.11 |
| Matta-Woman | 15 | Barden-pho 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 Barden-pho M | Constru ction | - | 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** | | | | | | | | | | | | | | |
| Bingham pton | 25 | MLE-BAF | DenitF ,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. | Recommend 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. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 47 | 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 Fermen. | 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 |
| Merck, 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 Win'chest | 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. | Reco-mend 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 |
| **Waynes-boro City** | 4.0 | TF-RBC-Filters | Add Meth. | - | 12 | 1.2 | - | - | 6.5 | 170 | 0 | 39.4 | 0.59 | 0.48 |
| **Wilder-ness** | 1.0 | Orbal 4 Ring | Add Meth. | | | <1.0 | | >50Q | | 40 | 0.52 | 14.1 | 0.73 | 2.50 |
| **Wood-stock** | 1.0 | OD | Denite Filters | | | 0.5 | 3200 | >50Q | | 40 | 2.65 | 37.9 | 3.22 | 11.03 |
| **VA 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** | **# of plants = 2** | | | | | | | | **8961.6** | **44.45** | **2420.6** | **80.75** | **1.234** |
| **15-50mgd** | **269.3** | **# of plants = 11** | | | | | | | | **9362.7** | **127.61** | **4187.9** | **190.4** | **2.786** |
| **5-15 mgd** | **92.7** | **# of plants = 11** | | | | | | | | **4139.6** | **77.6** | **2026.4** | **108.1** | **3.577** |
| **1-5 mgd** | **65.6** | **# of plants = 27** | | | | | | | | **3477.1** | **78.7** | **1571.5** | **102.3** | **4.030** |
| **<1 mgd** | **5.9** | **# of plants = 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 & Wheler, 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: | 6170 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):

- [ ] MLE
- [ ] BEPR (A2/0, VIP, etc )
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc )
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] Other: 3-Stage BNR System with Methanol Addition

Existing Aerated Volume (MG): N/a
Existing Anoxic Volume (MG): N/a
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:

- [X] 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
- [X] Other: Convert effluent filters to denit filters and add more methanol there

| 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: | | 2.0 mg/L |
| Methanol Required: | | 2810 gals/d |
| Methanol Cost: | 0.75 $/gal | $769,200 $/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: | | $257,500 $/year |
| Denitrification Sludge Production w/Methanol: | | 8890 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: | $1.26 |

# 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 & Wheler, LLC** |
| DATE: | **March 19, 2001** |
| FACILITY: | **Altoona East WWTP** |
| LOCATION: | Altoona, PA |
| RATED FLOW: | 9.0 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 CBOD5 77 mg/L
PE COD 213 mg/L
PE TKN: 15 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [X] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [ ] Other:

Existing Aerated Volume (MG): 2.27
Existing Anoxic Volume (MG): 0.76
Current MLSS at Winter ADF: 2200

CURRENT EFFLUENT AMMONIA-N: 1.0 mg/L

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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 nit/denit facility)
- [ ] Add influent flow equalization tank
- [ ] Other:

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

- [ ] No modifications required
- [X] 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% | $492,000 |
| 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: | | **$6,770,000** |
| Contingency: | 30% | $1,563,000 |
| Total Capital Cost: | | **$8,330,000** |
| Capital Cost per lb. 20-Yr. N removal: | | **$3.00** |

**OPERATIONS COST:**

| | | |
|---|---|---|
| Additional Horsepower (from Page 2) | | 180 HP |
| Electrical Power Cost: | 0.05 $/kW | $58,800 $/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 & Wheler, LLC** |
| DATE: | **March 19, 2001** |
| FACILITY: | **Altoona West WWTP** |
| LOCATION: | Altoona, PA |
| RATED FLOW: | 13.5 mgd |
| CURRENT EFFLUENT TN: | 7.0 mg/L |
| EFFLUENT TN GOAL: | 3.0 mg/L |
| NITROGEN REDUCTION: | 450 lbs/d |
| | 164 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):

- [X] MLE
- [ ] BEPR (A2/0, 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: 3524

CURRENT EFFLUENT AMMONIA-N: 0.9 mg/L

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

**PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:**

- [X] 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
- [X] 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% | $2,163,000 |
| **Total Capital Cost:** | | **$11,530,000** |
| 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: | | 4.0 mg/L |
| Methanol Required: | | 210 gals/d |
| Methanol Cost: | 0.75 $/gal | $57,500 $/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 | | $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 & Wheler, LLC |
| DATE: | March 19, 2001 |
| FACILITY: | Altoona West WWTP |
| LOCATION: | Altoona, PA |
| RATED FLOW: | 13.5 mgd |
| CURRENT EFFLUENT TN: | 7.0 mg/L |
| EFFLUENT TN GOAL: | 3.0 mg/L |
| NITROGEN REDUCTION: | 450 lbs/d |
| | 164 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):

- [X] MLE
- [ ] BEPR (A2/0, 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: 3524

CURRENT EFFLUENT AMMONIA-N: 0.9 mg/L

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] 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% | $2,163,000 |
| Total Capital Cost: | | $11,530,000 |
| 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: | | 4.0 mg/L |
| Methanol Required: | | 210 gals/d |
| Methanol Cost: | 0.75 $/gal | $57,500 $/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: | | $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 & Wheler, LLC | | |
| DATE: | March 19, 2001 | | |
| FACILITY: | Chambersburg WWTP | | |
| LOCATION: | Chambersburg, PA | | |
| RATED FLOW: | 6.8 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: | 60 lbs/d | | |
| | 22 1000 lbs/yr | | |
| | 438 1000 lbs/20-years | | |

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [ ] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [X] 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: <1.0 mg/L

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] 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 & Wheler, 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):

- [X] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [X] 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
- [X] 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
- [X] Other: Abandon activated sludge process and use biofilter for all flow

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

- [ ] No modifications required
- [X] Add downstream DeNit filter with methanol — For all 8.9 mgd
- [ ] 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
- [X] 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: | | $10,150,000 | |
| 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: | | 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: | | $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 & Wheler, LLC |
| DATE: | March 19, 2001 |
| FACILITY: | Hanover Area WWTP |
| LOCATION: | Hanover, PA |
| RATED FLOW: | 4.5 mgd |
| CURRENT EFFLUENT TN: | 6.0 mg/L |
| EFFLUENT TN GOAL: | 3.0 mg/L |
| NITROGEN REDUCTION: | 110 lbs/d |
| | 40 1000 lbs/yr |
| | 803 1000 lbs/20-years |

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

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [ ] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [X] Oxidation Ditch
- [ ] Lagoon (Biolac, 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

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

New MLSS: 3000

- [X] 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 nit/denit facility)
- [ ] Add influent flow equalization tank
- [ ] Other:

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

- [ ] No modifications required
- [X] 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: | 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: | | | $6.39 |

| 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: | | 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: | | $1,450,000 |

| 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 & Wheler, 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):

- [X] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [X] 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
- [X] From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

New MLSS N/a

- [ ] 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 nit/denit facility)
- [ ] Add influent flow equalization tank
- [X] Other: Abandon activated sludge process and use biofilter for all flow

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

- [ ] No modifications required
- [X] Add downstream DeNit filter with methanol — For all 8.9 mgd
- [ ] 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
- [X] 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: | | $10,150,000 | |
| 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: | | 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: | | $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 & Wheler, LLC |
| DATE: | March 19, 2001 |
| FACILITY: | Harrisburg WWTP |
| LOCATION: | Harrisburg, PA |
| RATED FLOW: | 30.0 mgd |
| CURRENT EFFLUENT TN: | 4.0 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 N/a mg/L
PE TKN 16 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [ ] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [X] Effluent Filtration
- [X] Other: UNOX Process, Aerobic-Anoxic BAFs

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

CURRENT EFFLUENT AMMONIA-N: <1.0 mg/L

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] 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 | | $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: | | 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: | | $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: | $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 & Wheler, 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<br>453 1000 lbs/yr<br>9052 1000 lbs/20-years |

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

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [X] MLE
- [ ] BEPR (A2/0, 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

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] 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% | $1,362,000 |
| 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: | | $23,080,000 |
| Capital Cost per lb. 20-Yr. N removal: | | $2.55 |

OPERATIONS COST:

| | | |
|---|---|---|
| Additional Horsepower (from Page 2): | | 590 HP |
| Electrical Power Cost: | 0.05 $/kW | $192,800 $/year |
| Nitrate Reduction using Methanol: | | 5.0 mg/L |
| Methanol Required: | | 560 gals/d |
| Methanol Cost: | 0.75 $/gal | $153,300 $/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: | | $187,500 $/year |
| Denitrification Sludge Production w/Methanol | | 1780 lbs/d |
| Sludge Disposal Cost: | 400 $/ton | $129,900 $/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 | $3.65 |

| | |
|---|---|
| PROJECT: | Implementing a 3 mg/L Annual Average Total Nitrogen Limit |
| PREPARED FOR: | USEPA, Chesapeake Bay Office |
| PREPARED BY: | Virginia Tech with Stearns & Wheler, 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):

- [X] MLE
- [ ] BEPR (A2/0, 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

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] 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: | | $4,760,000 |
| Contractor OH&P: | 15% | $714,000 |
| Engineering and Constr. Mgmt: | 15% | $714,000 |
| Subtotal: | | $6,190,000 |
| Contingency: | 30% | $1,428,000 |
| Total Capital Cost: | | $7,620,000 |
| 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: | | 150 gals/d |
| Methanol Cost: | 0.75 $/gal | $41,100 $/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: | | $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 & Wheler, LLC | | |
| DATE: | March 10, 2001 | | |
| FACILITY: | LJSA WWTP | | |
| LOCATION: | Lewisburg, PA | | |
| RATED FLOW: | 2.4 mgd | Current Eff. TN | PE COD: 450 mg/L |
| BNR EFFLUENT TN: | 8.0 mg/L | 27.5 | 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-yrs | |

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [ ] MLE
- [X] BEPR (A2/O, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [ ] Other:

Existing Aerated Volume (MG): 0.324/0.434
Existing Anoxic Volume (MG): 0.222/0.111
Current MLSS at Winter ADF: 4500

CURRENT EFFLUENT AMMONIA-N: 1.5 mg/L

- [ ] From Report
- [X] 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
- [X] Raise MCRT/MLSS in existing tanks (check clarifier capacity) — New MLSS: 4750
- [ ] 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
- [X] 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): | | $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% | $681,000 |
| | 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: | | $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 & Wheler, LLC |
| DATE: | March 19, 2001 |
| FACILITY: | Lock Haven WWTP |
| LOCATION: | Lock Haven, PA |
| RATED FLOW: | 3.8 mgd |
| CURRENT EFFLUENT TN: | 15.5 mg/L |
| EFFLUENT TN GOAL: | 3.0 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 (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] 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: 9.5 mg/L

- [X] 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
- [X] Raise MCRT/MLSS in existing tanks (check clarifier capacity) — New MLSS 4500
- [ ] 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
- [X] Other: Add Baffles, Mixers and nitrate recycle

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

- [ ] No modifications required
- [X] 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): | | | $2,260,000 |
| 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: | | | $4,590,000 |
| 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: | | $153,600 $/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 & Wheler, 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):

- [X] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [ ] Other:

Existing Aerated Volume (MG): 4.59
Existing Anoxic Volume (MG): 1.97
Current MLSS at Winter ADF: 2750

CURRENT EFFLUENT AMMONIA-N: 1.2 mg/L

- [X] 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
- [X] 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 nit/denit facility)
- [ ] Add influent flow equalization tank
- [ ] Other:

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

- [ ] No modifications required
- [X] 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): | | $6,550,000 |
| Electrical and Instrumentation | 12% | $786,000 |
| Yard Piping and Site Work: | 15% | $983,000 |
| Subtotal: | | $8,320,000 |
| Contractor OH&P: | 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 $/kW | $104,600 $/year |
| Nitrate Reduction using Methanol: | | 6.2 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 & Wheler, LLC |
| DATE: | March 19, 2001 |
| FACILITY: | UAJA WWTP |
| LOCATION: | State College, PA |
| RATED FLOW: | 6.0 mgd |
| CURRENT EFFLUENT TN: | 8.0 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 334 mg/L
PE TKN 36 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [X] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [X] 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
- [X] 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
- [X] 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 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
- [X] Add methanol to existing BNR process
- [ ] Add downstream anoxic tank with methanol feed
- [ ] Add effluent filtration
- [X] 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 $/kW | $0 $/year |
| Nitrate Reduction using Methanol: | | 5.0 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: | | $4,200 $/year |
| Denitrification Sludge Production w/Methanol: | | 360 lbs/d |
| Sludge Disposal Cost: | 400 $/ton | $26,300 $/year |
| Total Annual O&M Cost: | | $60,600 $/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 & Wheler, LLC |
| DATE: | March 19, 2001 |
| FACILITY: | Chambersburg WWTP |
| LOCATION: | Chambersburg, PA |
| RATED FLOW: | 6.8 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):

- [ ] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [X] 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: <1.0 mg/L

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] 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 & Wheler, 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):

- [X] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [X] 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
- [X] From Model (at ADF and load, 15 d MCRT, 12° C winter conditions)

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

New MLSS
N/a

- [ ] 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 nit/denit facility)
- [ ] Add influent flow equalization tank
- [X] Other: Abandon activated sludge process and use biofilter for all flow

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

- [ ] No modifications required
- [X] Add downstream DeNit filter with methanol — For all 8.9 mgd
- [ ] 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
- [X] 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: | | $10,150,000 | |
| 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: | | 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: | | **$5,860,000** | |

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

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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 & Wheler, LLC |
| DATE: | March 19, 2001 |
| FACILITY: | Hanover Area WWTP |
| LOCATION: | Hanover, PA |
| RATED FLOW: | 4.5 mgd |
| CURRENT EFFLUENT TN: | 6.0 mg/L |
| EFFLUENT TN GOAL: | 3.0 mg/L |
| NITROGEN REDUCTION: | 110 lbs/d |
| | 40 1000 lbs/yr |
| | 803 1000 lbs/20-years |

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

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [ ] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [X] Oxidation Ditch
- [ ] Lagoon (Biolac, 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

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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 nit/denit facility)
- [ ] Add influent flow equalization tank
- [ ] Other

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

- [ ] No modifications required
- [X] 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: | 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: | | | **$6.39** |

| 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 | | 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: | | **$1,450,000** | |

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

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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 & Wheler, LLC |
| DATE: | March 19, 2001 |
| FACILITY: | Harrisburg WWTP |
| LOCATION: | Harrisburg, PA |
| RATED FLOW: | 30.0 mgd |
| CURRENT EFFLUENT TN: | 4.0 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 N/a mg/L
PE TKN 16 mg/L

**CURRENT PROCESS (CHECK ALL THAT APPLY):**

- [ ] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [X] Effluent Filtration
- [X] Other: UNOX Process, Aerobic-Anoxic BAFs

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

**CURRENT EFFLUENT AMMONIA-N:** <1.0 mg/L

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

**PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:**

New MLSS

- [X] No modifications required — 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
- [X] 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 | | $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: | | 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: | | $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 |

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

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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 & Wheler, 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):

- [X] MLE
- [ ] BEPR (A2/0, 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

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] 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% | $1,362,000 |
| | 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: | | $23,080,000 |
| | Capital Cost per lb. 20-Yr. N removal: | | $2.55 |

| | | | |
|---|---|---|---|
| OPERATIONS COST: | Additional Horsepower (from Page 2): | | 590 HP |
| | Electrical Power Cost: | 0.05 $/kW | $192,800 $/year |
| | Nitrate Reduction using Methanol: | | 5.0 mg/L |
| | Methanol Required: | | 560 gals/d |
| | Methanol Cost: | 0.75 $/gal | $153,300 $/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 | | $187,500 $/year |
| | Denitrification Sludge Production w/Methanol | | 1780 lbs/d |
| | Sludge Disposal Cost | 400 $/ton | $129,900 $/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 | $3.65 |

| | |
|---|---|
| PROJECT: | Implementing a 3 mg/L Annual Average Total Nitrogen Limit |
| PREPARED FOR: | USEPA, Chesapeake Bay Office |
| PREPARED BY: | Virginia Tech with Stearns & Wheler, 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):

- [X] MLE
- [ ] BEPR (A2/0, 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

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] 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: | | $4,760,000 |
| Contractor OH&P: | 15% | $714,000 |
| Engineering and Constr. Mgmt: | 15% | $714,000 |
| Subtotal: | | $6,190,000 |
| Contingency: | 30% | $1,428,000 |
| **Total Capital Cost:** | | **$7,620,000** |
| 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: | | 150 gals/d |
| Methanol Cost: | 0.75 $/gal | $41,100 $/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: | | $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 |

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|---|---|
| **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 & Wheler, LLC | | | | |
| DATE: | March 10, 2001 | | | | |
| FACILITY: | LJSA WWTP | | | | |
| LOCATION: | Lewisburg, PA | | | | |
| RATED FLOW: | 2.4 mgd | Current Eff. TN | | PE COD: 450 mg/L | |
| BNR EFFLUENT TN: | 8.0 mg/L | 27.5 | | 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-yrs | | | |

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [ ] MLE
- [X] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [ ] Other:

Existing Aerated Volume (MG): 0.324/0.434
Existing Anoxic Volume (MG): 0.222/0.111
Current MLSS at Winter ADF: 4500

CURRENT EFFLUENT AMMONIA-N: 1.5 mg/L

- [ ] From Report
- [X] 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
- [X] Raise MCRT/MLSS in existing tanks (check clarifier capacity) — New MLSS: 4750
- [ ] 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
- [X] 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): | | $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% | $681,000 |
| | 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: | | $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 & Wheler, LLC** |
| DATE: | **March 19, 2001** |
| FACILITY: | Lock Haven WWTP |
| LOCATION: | Lock Haven, PA |
| RATED FLOW: | 3.8 mgd |
| CURRENT EFFLUENT TN: | 15.5 mg/L |
| EFFLUENT TN GOAL: | 3.0 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 (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] 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: 9.5 mg/L

- [X] 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
- [X] Raise MCRT/MLSS in existing tanks (check clarifier capacity) — New MLSS 4500
- [ ] 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
- [X] Other: Add Baffles, Mixers and nitrate recycle

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

- [ ] No modifications required
- [X] 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): | | | $2,260,000 |
| 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: | | | **$4,590,000** |
| Capital Cost per lb. 20-Yr N removal | | | **$1.61** |

| OPERATIONS COST: | | |
|---|---|---|
| Additional Horsepower (from Page 2) | | 60 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: | | $153,600 $/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 & Wheler, LLC** |
| DATE: | **March 19, 2001** |
| FACILITY: | **UAJA WWTP** |
| LOCATION: | State College, PA |
| RATED FLOW: | 6.0 mgd |
| CURRENT EFFLUENT TN: | 8.0 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: 334 mg/L
PE TKN: 36 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [X] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [X] 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
- [X] 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
- [X] 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 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
- [X] Add methanol to existing BNR process
- [ ] Add downstream anoxic tank with methanol feed
- [ ] Add effluent filtration
- [X] 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 $/kW | | $0 $/year |
| Nitrate Reduction using Methanol | | 5.0 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: | | $4,200 $/year |
| Denitrification Sludge Production w/Methanol: | | 360 lbs/d |
| Sludge Disposal Cost: 400 $/ton | | $26,300 $/year |
| Total Annual O&M Cost: | | $60,600 $/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 & Wheler, 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
PE TKN: 24 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [X] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [ ] Other

Existing Aerated Volume (MG): 1.9
Existing Anoxic Volume (MG): 0.944
Current MLSS at Winter ADF: 3600

CURRENT EFFLUENT AMMONIA-N: <1.0 mg/L

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] 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 |
| 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 | $52,600 $/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 & Wheler, LLC** |
| DATE: | **March 19, 2001** |
| FACILITY: | **Throop WWTP** |
| LOCATION: | Lackawanna RBSA, PA |
| RATED FLOW: | 7.0 mgd |
| CURRENT EFFLUENT TN: | 8.0 mg/L |
| EFFLUENT TN GOAL: | 3.0 mg/L |
| NITROGEN REDUCTION: | 290 lbs/d |
| | 106 1000 lbs/yr |
| | 2117 1000 lbs/20-years |

PE COD: 190 mg/L
PE TKN: 20 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [X] 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): 2.025
Existing Anoxic Volume (MG): 0.675
Current MLSS at Winter ADF: 2300

CURRENT EFFLUENT AMMONIA-N: 2.4 mg/L

- [ ] From Report
- [X] 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
- [X] Raise MCRT/MLSS in existing tanks (check clarifier capacity) — New MLSS: 3900
- [ ] 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
- [X] 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): | | $3,400,000 |
| Electrical and Instrumentation: | 12% | $408,000 |
| Yard Piping and Site Work: | 15% | $510,000 |
| 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: | | 5.0 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 | | 2.91% |
| 20-Year Present Worth of O&M Costs | | **$2,520,000** |

**TOTAL 20-YEAR PRESENT WORTH COST:** **$9,440,000**

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 & Wheler, 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
PE TKN: 24 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [X] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [ ] Other

Existing Aerated Volume (MG): 1.9
Existing Anoxic Volume (MG): 0.944
Current MLSS at Winter ADF: 3600

CURRENT EFFLUENT AMMONIA-N: <1.0 mg/L

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] 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 |
| 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 | $52,600 $/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 & Wheler, LLC |
| DATE: | March 19, 2001 |
| FACILITY: | Williamsport Central WWTP |
| LOCATION: | Williamsport, PA |
| RATED FLOW: | 7.2 mgd |
| CURRENT EFFLUENT TN: | 18.4 mg/L |
| EFFLUENT TN GOAL: | 3.0 mg/L |
| NITROGEN REDUCTION: | 920 lbs/d |
| | 336 1000 lbs/yr |
| | 6716 1000 lbs/20-years |

PE COD: 268 mg/L
PE TKN: 32 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [X] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [ ] Other:

Existing Aerated Volume (MG): 1.061
Existing Anoxic Volume (MG): 0.5225
Current MLSS at Winter ADF: 1318

CURRENT EFFLUENT AMMONIA-N: 16.7 mg/L

- [X] 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
- [X] Raise MCRT/MLSS in existing tanks (check clarifier capacity) — New MLSS: 4000
- [ ] Construct additional aerated volume — Flow (mgd): 0
- [X] 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
- [X] 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): | | $4,730,000 |
| 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: | | **$9,610,000** |
| 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: | | $193,500 $/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:** | **$12,510,000** |
| Total Cost per lb 20-Yr N removal: | **$1.86** |

| | |
|---|---|
| PROJECT: | Implementing a 3 mg/L Annual Average Total Nitrogen Limit |
| PREPARED FOR: | USEPA, Chesapeake Bay Office |
| PREPARED BY: | Virginia Tech with Stearns & Wheler, LLC |
| DATE: | March 19, 2001 |
| FACILITY: | Williamsport West WWTP |
| LOCATION: | Williamsport, PA |
| RATED FLOW: | 4.5 mgd |
| CURRENT EFFLUENT TN: | 8.0 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: 300 mg/L
PE TKN: 37 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [X] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [ ] Other

Existing Aerated Volume (MG): 0.89
Existing Anoxic Volume (MG): 0.33
Current MLSS at Winter ADF: 4500

CURRENT EFFLUENT AMMONIA-N: 2.6 mg/L

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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)
- [X] 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
- [X] 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) | | $4,800,000 |
| Electrical and Instrumentation: | 12% | $576,000 |
| Yard Piping and Site Work: | 15% | $720,000 |
| Subtotal: | | $6,100,000 |
| Contractor OH&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 $/kW | $58,800 $/year |
| Nitrate Reduction using Methanol: | | 5.0 mg/L |
| Methanol Required: | | 90 gals/d |
| Methanol Cost: | 0.75 $/gal | $24,600 $/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: | | $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 | **$9.01** |

| | |
|---|---|
| PROJECT: | **Implementing a 3 mg/L Annual Average Total Nitrogen Limit** |
| PREPARED FOR: | **USEPA, Chesapeake Bay Office** |
| PREPARED BY: | **Virginia Tech with Stearns & Wheler, LLC** |
| DATE: | **March 19, 2001** |
| FACILITY: | **Wyoming Valley WWTP** |
| LOCATION: | Luzerne Cty, PA |
| RATED FLOW: | 32.0 mgd |
| CURRENT EFFLUENT TN: | 8.0 mg/L |
| EFFLUENT TN GOAL: | 3.0 mg/L |
| NITROGEN REDUCTION: | 1330 lbs/d<br>485 1000 lbs/yr<br>9709 1000 lbs/20-years |

PE BOD5: 200 mg/L
PE COD: N/a mg/L
PE TKN: 27 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [X] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [X] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] Other: Schreiber Process

Existing Aerated Volume (MG): 1.34
Existing Anoxic Volume (MG): 0.334
Current MLSS at Winter ADF: 3000

CURRENT EFFLUENT AMMONIA-N: <1.0 mg/L

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] 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) | | $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: | | $20,060,000 |
| Contingency: | 30% | $4,629,000 |
| **Total Capital Cost:** | | **$24,690,000** |
| Capital Cost per lb 20-Yr. N removal: | | **$2.54** |

OPERATIONS COST:

| | | |
|---|---|---|
| Additional Horsepower (from Page 2): | | 640 HP |
| Electrical Power Cost: | 0.05 $/kW | $209,100 $/year |
| Nitrate Reduction using Methanol: | | 5.0 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 | | **$10,750,000** |

| | |
|---|---|
| **TOTAL 20-YEAR PRESENT WORTH COST:** | **$35,440,000** |
| 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 & Wheler, LLC** |
| **DATE:** | **March 19, 2001** |
| **FACILITY:** | York WWTP |
| **LOCATION:** | York, PA |
| **RATED FLOW:** | 26.0 mgd |
| **CURRENT EFFLUENT TN:** | 8.0 mg/L |
| **EFFLUENT TN GOAL:** | 3.0 mg/L |
| **NITROGEN REDUCTION:** | 1080 lbs/d |
| | 394 1000 lbs/yr |
| | 7884 1000 lbs/20-years |

PE COD 200 mg/L
PE TKN 16 mg/L

**CURRENT PROCESS (CHECK ALL THAT APPLY):**

- [X] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [ ] Other:

Existing Aerated Volume (MG): 9.01
Existing Anoxic Volume (MG): 2.05
Current MLSS at Winter ADF: 3600

**CURRENT EFFLUENT AMMONIA-N:** 0.5 mg/L

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

**PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:**

New MLSS

- [X] No modifications required — 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
- [X] Add downstream anoxic tank with methanol feed
- [ ] Add effluent filtration
- [ ] 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: | | $6,920,000 |
| 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) | | 390 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 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: | | $90,000 $/year |
| Denitrification Sludge Production w/Methanol: | | 1560 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 & Wheler, 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):

- [ ] MLE
- [X] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [X] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] Other: Anaerobic Basin followed by 2-stage Brush Aerator Oxidation Ditches

Existing Aerated Volume (MG): N/a
Existing Anoxic Volume (MG): N/a
Current MLSS at Winter ADF: 4000

CURRENT EFFLUENT AMMONIA-N: 0.2 mg/L

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] 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: | | 0.5 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: | | $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 & Wheler, LLC |
| DATE: | March 11, 2001 |
| FACILITY: | Brunswick WWTP |
| LOCATION: | Brunswick, MD |
| RATED FLOW: | 0.7 mgd |
| CURRENT EFFLUENT TN: | 8.0 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: 280 mg/L
PE TKN: 34 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [ ] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [X] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [ ] Other:

Existing Aerated Volume (MG): 0.234
Existing Anoxic Volume (MG): *
Current MLSS at Winter ADF: 3500
* Cyclically Aerated

CURRENT EFFLUENT AMMONIA-N: <1.0 mg/L

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] 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): | | $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: | | **$12.10** |

OPERATIONS COST:

| | | |
|---|---|---|
| Additional Horsepower (from Page 2): | | 10 HP |
| Electrical Power Cost: | 0.05 $/kW | $3,300 $/year |
| Nitrate Reduction using Methanol: | | 5.0 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 | $2,900 $/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 & Wheler, LLC |
| DATE: | March 10, 2001 |
| FACILITY: | Chestertown WWTP |
| LOCATION: . | Kent County, MD |
| RATED FLOW: | 0.9 mgd |
| CURRENT EFFLUENT TN: | 8.0 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 (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [X] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [X] 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

- [X] 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
- [X] Other: Improve lagoon operation w/flow pattern and diffuser changes.

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
- [X] Other: Minor operational changes in lagoon

| 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 OH&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: | | 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: | | $800 $/year |
| | Denitrification Sludge Production w/Methanol: | | 0 lbs/d |
| | Sludge Disposal Cost: | 400 $/ton | $0 $/year |
| | Total Annual O&M Cost: | | $800 $/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 & Wheler, LLC | | | | |
| DATE: | March 19, 2001 | | | | |
| FACILITY: | Crisfield WWTP | | | | |
| LOCATION: | Crisfield, VA | | | | |
| RATED FLOW: | 1.2 | mgd | PE COD | 345 | mg/L |
| CURRENT EFFLUENT TN: | 8.0 | mg/L | PE TKN | 25 | mg/L |
| EFFLUENT TN GOAL: | 3.0 | mg/L | | | |
| NITROGEN REDUCTION: | 50 | lbs/d | | | |
| | 18 | 1000 lbs/yr | | | |
| | 365 | 1000 lbs/20-years | | | |

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [ ] MLE
- [X] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [ ] Other:

| | |
|---|---|
| Existing Aerated Volume (MG): | 0.349 |
| Existing Anoxic Volume (MG): | 0.167 |
| Current MLSS at Winter ADF: | 3700 |

CURRENT EFFLUENT AMMONIA-N: 0.5 mg/L

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

| | | New MLSS |
|---|---|---|
| [X] | No modifications required | 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
- [X] 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): | | $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: | | **$7.62** |

OPERATIONS COST:

| | | |
|---|---|---|
| Additional Horsepower (from Page 2) | | 20 HP |
| Electrical Power Cost: | 0.05 $/kW | $6,500 $/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: | | $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 & Wheler, 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 (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [X] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] 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

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

| | | New MLSS |
|---|---|---|
| [ ] | No modifications required | |
| [ ] | 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 nit/denit facility) | |
| [ ] | Add influent flow equalization tank | |
| [X] | Other: Nitrification BAF | |

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

- [ ] No modifications required
- [ ] Add downstream DeNit filter with methanol
- [X] 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:** | | **$5,700,000** |
| Capital Cost per lb. 20-Yr. N removal: | | **$7.81** |

OPERATIONS COST:

| | | |
|---|---|---|
| Additional Horsepower (from Page 2): | | 80 HP |
| Electrical Power Cost: | 0.05 $/kW | $26,100 $/year |
| Nitrate Reduction using Methanol: | | 6.1 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: | | $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 & Wheler, 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
PE TKN: 28 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [ ] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [X] 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: <1.0 mg/L

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] 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: | | $0.00 |

| | | | |
|---|---|---|---|
| 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: | | 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: | | $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 & Wheler, LLC |
| DATE: | March 9, 2001 |
| FACILITY: | Federalsburg WWTP |
| LOCATION: | Caroline County, MD |
| RATED FLOW: | 0.75 mgd |
| CURRENT EFFLUENT TN: | 18.0 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: 332 mg/L
PE TKN: 20 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [ ] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] 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

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] 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): | | | $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: | | 2.91% |
| 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 & Wheler, LLC | | | | |
| DATE: | March 19, 2001 | | | | |
| FACILITY: | Georges Creek WWTP | | | | |
| LOCATION: | Alleghany County, MD | | | | |
| RATED FLOW: | 0.6 | mgd | PE COD: | 365 | mg/L |
| CURRENT EFFLUENT TN: | 10.0 | mg/L | PE TKN: | 22 | 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):

- [X] MLE
- [ ] BEPR (A2/O, VIP etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] Other: Oxidation Ditch modified to two step-feed MLE Units

| | |
|---|---|
| Existing Aerated Volume (MG) | 0.4956 |
| Existing Anoxic Volume (MG) | 0.2124 |
| Current MLSS at Winter ADF | 2700 |

CURRENT EFFLUENT AMMONIA-N: 0.5 mg/L

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

| | | | |
|---|---|---|---|
| [X] | 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
- [X] 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) | | $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: | | **$9.08** |

OPERATIONS COST:

| | | |
|---|---|---|
| Additional Horsepower (from Page 2): | | 10 HP |
| Electrical Power Cost: | 0.05 $/kW | $3,300 $/year |
| Nitrate Reduction using Methanol: | | 7.0 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 | | 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 & Wheler, LLC |
| DATE: | March 19, 2001 |
| FACILITY: | Havre de Grace WWTP |
| LOCATION: | Havre de Grace, MD |
| RATED FLOW: | 1.9 mgd |
| CURRENT EFFLUENT TN: | 8.0 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):

- [X] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] Other: MLE with Recycle from RBCs in Series before Clarifier

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

CURRENT EFFLUENT AMMONIA-N: <1.0 mg/L

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] 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): | | $1,620,000 |
| Electrical and Instrumentation: | 12% | $194,000 |
| 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% | $618,000 |
| 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: | | $26,800 $/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 & Wheler, 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):

- [X] MLE
- [ ] BEPR (A2/0, 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): 0.259
Current MLSS at Winter ADF: 2800

CURRENT EFFLUENT AMMONIA-N: 0.5 mg/L

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] 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:** | | **$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 |
| Denitrification Sludge Production w/Methanol | | 50 lbs/d |
| Sludge Disposal Cost: | 400 $/ton | $3,700 $/year |
| Total Annual O&M Cost: | | $10,600 $/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 & Wheler, LLC |
| DATE: | March 9, 2001 |
| FACILITY: | Mattawoman WTTP |
| LOCATION: | Charles County, MD |
| RATED FLOW: | 15.0 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):

(Under Design - March 2001)

- [ ] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [X] 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

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

New MLSS

- [X] No modifications required — 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:

- [X] 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): | | $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: | | #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: | 0.60 $/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: | | 2.91% |
| 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 & Wheler, LLC |
| DATE: | March 11, 2001 |
| FACILITY: | Princess Anne WWTP |
| LOCATION: | Somerset County, MD |
| RATED FLOW: | 1.3 mgd |
| CURRENT EFFLUENT TN: | 18.0 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 260 mg/L
PE TKN 26 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [ ] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] Other: Currently Conventional Activated Sludge

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] Other: 5-Stage Bardenpho has been bid, will be constructed

CAPITAL COST:

| | | |
|---|---|---|
| Equipment and Structures (from Page 2): | | $1,309,230 |
| Electrical and Instrumentation: | 12% | $157,000 |
| Yard Piping and Site Work: | 15% | $196,000 |
| Subtotal: | | $1,662,722 |
| Contractor OH&P: | 15% | $249,000 |
| Engineering and Constr. Mgmt: | 15% | $249,000 |
| Subtotal: | | $2,161,536 |
| 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 & Wheler, LLC |
| DATE: | March 19, 2001 |
| FACILITY: | Western Branch WWTP |
| LOCATION: | Washington Suburban Sanitary Commission, MD |
| RATED FLOW: | 16.6 mgd |
| CURRENT EFFLUENT TN: | 8.0 mg/L |
| EFFLUENT TN GOAL: | 3.0 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):

- [X] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [X] Effluent Filtration
- [X] 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

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] Other: Add additonal 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 & Wheler, LLC |
| DATE: | March 19, 2001 |
| FACILITY: | Winebrenner WWTP |
| LOCATION: | Washington County, MD |
| RATED FLOW: | 0.6 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):

- [ ] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] Other: RBCs followed by Denite Filters

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

CURRENT EFFLUENT AMMONIA-N: 0.6 mg/L

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] 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 |

# 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 & Wheler, LLC |
| DATE: | March 11, 2001 |
| FACILITY: | Binghamton-Johnson City WWTP |
| LOCATION: | Binghamton, NY |
| RATED FLOW: | 25.0 mgd |
| CURRENT EFFLUENT TN: | 8.0 mg/L |
| EFFLUENT TN GOAL: | 3.0 mg/L |
| NITROGEN REDUCTION: | 1040 lbs/d |
| | 380 1000 lbs/yr |
| | 7592 1000 lbs/20-years |

PE COD: 240 mg/L
PE TKN: 18 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [X] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] Other: Nit-Denit BAFs for 12.5 mgd

Existing Aerated Volume (MG): 1.82
Existing Anoxic Volume (MG): 0.78
Current MLSS at Winter ADF: 2700

CURRENT EFFLUENT AMMONIA-N: 0.5 mg/L

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] 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): | | $9,700,000 |
| 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: | | $16,020,000 |
| 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 | $163,400 $/year |
| Nitrate Reduction using Methanol: | | 5.0 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** |

| | |
|---|---|
| PROJECT: | Implementing a 3 mg . Annual Average Total Nitrogen Limit |
| PREPARED FOR: | USEPA, Chesapeake Bay Office |
| PREPARED BY: | Virginia Tech with Stearns & Wheler, LLC |
| DATE: | March 11, 2001 |
| FACILITY: | Endicott WWTP |
| LOCATION: | Endicott, NY |
| 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: 100 mg/L
PE TKN: 26 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [ ] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [X] High-Rate Biofilter with Solids Contact Activated Sludge
- [ ] Effluent Filtration
- [X] Other: Denite Filters

Existing Aerated Volume (MG): 1.82
Existing Anoxic Volume (MG): 0.78
Current MLSS at Winter ADF: 2700

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:

- [X] 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
- [X] Other: Add Additional Methanol to 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: | | | $0.00 |

| 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: | | 150 gals/d |
| Methanol Cost: | 0.75 $/gal | $41,100 $/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: | | $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 |

| | |
|---|---|
| TOTAL 20-YEAR PRESENT WORTH COST: | $1,140,000 |
| Total Cost per lb. 20-Yr. N removal: | $0.47 |

# 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 & Wheler, LLC |
| DATE: | March 16, 2001 , |
| FACILITY: | Arlington WWTP |
| LOCATION: | Arlington, VA |
| RATED FLOW: | 30.0 mgd |
| CURRENT EFFLUENT TN: | 8.0 mg/L |
| EFFLUENT TN GOAL: | 3.0 mg/L |
| NITROGEN REDUCTION: | 1250 lbs/d |
| | 456 1000 lbs/yr |
| | 9125 1000 lbs/20-years |

PE COD: 300 mg/L
PE TKN: 27 mg/L

**CURRENT PROCESS (CHECK ALL THAT APPLY):**

- [X] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] Other: Step-Feed MLE, no nitrate recycle, Deep Bed Filters

Existing Aerated Volume (MG): 1.82
Existing Anoxic Volume (MG): 0.78
Current MLSS at Winter ADF: 3000

**CURRENT EFFLUENT AMMONIA-N:** <1.0 mg/L

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

**PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:**

- [X] 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
- [X] Add methanol to existing BNR process
- [ ] Add downstream anoxic tank with methanol feed
- [ ] Add effluent filtration
- [X] Other: Convert existing deep bed effluent filters to denite filters

**CAPITAL COST:**

| | | |
|---|---|---|
| Equipment and Structures (from Page 2): | | $2,950,000 |
| Electrical and Instrumentation: | 12% | $354,000 |
| Yard Piping and Site Work: | 15% | $443,000 |
| Subtotal: | | $3,750,000 |
| Contractor OH&P: | 15% | $563,000 |
| Engineering and Constr. Mgmt: | 15% | $563,000 |
| Subtotal: | | $4,880,000 |
| Contingency: | 30% | $1,125,000 |
| Total Capital Cost: | | **$6,010,000** |
| Capital Cost per lb. 20-Yr. N removal: | | **$0.66** |

**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: | | 570 gals/d |
| Methanol Cost: | 0.75 $/gal | $156,000 $/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: | | $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**

| | |
|---|---|
| PROJECT: | Implementing a 3 mg/L Annual Average Total Nitrogen Limit |
| PREPARED FOR: | USEPA, Chesapeake Bay Office |
| PREPARED BY: | Virginia Tech with Stearns & Wheler, 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 |
| | 26 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):

- [ ] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [X] 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

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] 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): | | $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: | | $2,730,000 |
| Contingency: | 30% | $630,000 |
| Total Capital Cost: | | $3,360,000 |
| Capital Cost per lb. 20-Yr. N removal: | | $6.58 |

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: | 0.60 $/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 |

| | |
|---|---|
| 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 & Wheler, 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):**

- [ ] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [X] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] Other: Orbal, 3 concentric rings

Existing Aerated Volume (MG): N/a
Existing Anoxic Volume (MG): N/a
Current MLSS at Winter ADF: 2700

**CURRENT EFFLUENT AMMONIA-N:** <1.0 mg/L

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

**PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:**

New MLSS

- [X] No modifications required — 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
- [X] 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: | | 3.0 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: | | $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 & Wheler, 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):

- [X] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] 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

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] Add methanol to existing BNR process
- [ ] Add downstream anoxic tank with methanol feed
- [ ] Add effluent filtration
- [X] 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: | | $860,000 |
| Contingency: | 30% | $198,000 |
| **Total Capital Cost:** | | **$1,060,000** |
| 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 | $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: | | 2.91% |
| 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 & Wheler, LLC | | | |
| DATE: | March 16, 2001 | | | |
| FACILITY: | Dale Services #8 WWTP | | | |
| LOCATION: | Dale City, VA | | | |
| RATED FLOW: | 3.0 | 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: | 80 | lbs/d | | |
| | 29 | 1000 lbs/yr | | |
| | 584 | 1000 lbs/20-years | | |

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [X] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] Other: pH adjustment to increase nitrification 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

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] Add methanol to existing BNR process
- [ ] Add downstream anoxic tank with methanol feed
- [ ] Add effluent filtration
- [X] 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: | | $860,000 |
| | Contingency: | 30% | $198,000 |
| | Total Capital Cost: | | **$1,060,000** |
| | 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 | $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: | | 2.91% |
| | 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 & Wheler, 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):**

- [ ] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [X] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [X] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [ ] Other:

Existing Aerated Volume (MG): 0.76
Existing Anoxic Volume (MG): N/a
Current MLSS at Winter ADF: 7140

**CURRENT EFFLUENT AMMONIA-N:** <1.0 mg/L

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

**PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:**

- [X] 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
- [X] 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: | | **$0.37** |

**OPERATIONS COST:**

| | | |
|---|---|---|
| Additional Horsepower (from Page 2): | | 0 HP |
| Electrical Power Cost: | 0.05 $/kW | $0 $/year |
| Nitrate Reduction using Methanol: | | 46.0 mg/L |
| Methanol Required: | | 90 gals/d |
| Methanol Cost: | 0.75 $/gal | $24,600 $/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: | | $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 & Wheler, LLC** |
| **DATE:** | **March 19, 2001** |
| **FACILITY:** | **Fishersville WWTP** |
| **LOCATION:** | Augusta County, 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 |
| | 26 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):**

- [X] MLE
- [X] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] Other: Can be operated as either A2/O or MLE

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

**CURRENT EFFLUENT AMMONIA-N:** <1.0 m mg/L

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

**PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:**

- [X] 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
- [X] 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): | | $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: | | $2,730,000 |
| Contingency: | 30% | $630,000 |
| **Total Capital Cost:** | | **$3,360,000** |
| Capital Cost per lb. 20-Yr. N removal: | | $6.58 |

**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: | 0.60 $/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 |

| | |
|---|---|
| **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 & Wheler, LLC** | | |
| **DATE:** | **March 9, 2001** | | |
| **FACILITY:** | Front Royal | | |
| **LOCATION:** | Front Royal, VA | | |
| **RATED FLOW:** | 4.0 mgd | PE COD: 286 | mg/L |
| **CURRENT EFFLUENT TN:** | 8.0 mg/L | PE TKN: 21 | mg/L |
| **EFFLUENT TN GOAL:** | 3.0 mg/L | | |
| **NITROGEN REDUCTION:** | 170 lbs/d | | |
| | 62 1000 lbs/yr | | |
| | 1241 1000 lbs/20-years | | |

**CURRENT PROCESS (CHECK ALL THAT APPLY):**

- [ ] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [X] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] 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

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

**PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:**

- [X] 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
- [X] 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): | | | $2,350,000 |
| Electrical and Instrumentation: | 12% | | $282,000 |
| Yard Piping and Site Work: | 15% | | $353,000 |
| Subtotal: | | | $2,990,000 |
| 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: | | 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: | 0.60 $/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 & Wheler, LLC |
| DATE: | March 19, 2001 |
| FACILITY: | Harrisonburg WWTP |
| LOCATION: | Harrisonburg, VA |
| RATED FLOW: | 16.0 mgd |
| CURRENT EFFLUENT TN: | 6.0 mg/L |
| EFFLUENT TN GOAL: | 3.0 mg/L |
| NITROGEN REDUCTION: | 400 lbs/d |
| | 146 1000 lbs/yr |
| | 2920 1000 lbs/20-years |

PE COD: 340 mg/L
PE TKN: 34 mg/L

**CURRENT PROCESS (CHECK ALL THAT APPLY):**

- [ ] MLE
- [X] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [X] Effluent Filtration
- [ ] Other:

Existing Aerated Volume (MG): N/a
Existing Anoxic Volume (MG): N/a
Current MLSS at Winter ADF: 3600

**CURRENT EFFLUENT AMMONIA-N:** 0.5 mg/L

- [X] 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
- [X] 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:**

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

- [ ] No modifications required
- [X] 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): | | $6,550,000 |
| Electrical and Instrumentation: | 12% | $786,000 |
| Yard Piping and Site Work: | 15% | $983,000 |
| Subtotal: | | $8,320,000 |
| Contractor OH&P: | 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: | | $4.56 |

**OPERATIONS COST:**

| | | |
|---|---|---|
| Additional Horsepower (from Page 2): | | 320 HP |
| Electrical Power Cost: | 0.05 $/kW | $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: | | 2.91% |
| 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 & Wheler, LLC |
| DATE: | March 16, 2001 |
| FACILITY: | H. L. Mooney WWTP |
| LOCATION: | Prince William County, VA |
| RATED FLOW: | 18.0 mgd |
| CURRENT EFFLUENT TN: | 8.0 mg/L |
| EFFLUENT TN GOAL: | 3.0 mg/L |
| NITROGEN REDUCTION: | 750 lbs/d |
| | 274 1000 lbs/yr |
| | 5475 1000 lbs/20-years |

PE COD: 176 mg/L
PE TKN: 26 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [X] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] Other: Step Feed MLE, no nitrate recycle

Existing Aerated Volume (MG): 1.82
Existing Anoxic Volume (MG): 0.78
Current MLSS at Winter ADF: 2700

CURRENT EFFLUENT AMMONIA-N: 0.5 mg/L

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

| | | New MLSS |
|---|---|---|
| [X] | No modifications required | |
| [ ] | 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 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
- [X] Add methanol to existing BNR process
- [ ] Add downstream anoxic tank with methanol feed
- [ ] Add effluent filtration
- [X] Other: Modify existing deep bed effluent filters to denite 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: | 0.75 $/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: | | $202,600 $/year |
| Effective Annual Interest Rate after Inflation: | | 2.91% |
| 20-Year Present Worth of O&M Costs: | | **$3,040,000** |

| | |
|---|---|
| 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 & Wheler, 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):**

- [X] MLE
- [X] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] Other: An A2/O that can also be operated as an MLE

Existing Aerated Volume (MG): N/a
Existing Anoxic Volume (MG): N/a
Current MLSS at Winter ADF: 3500

**CURRENT EFFLUENT AMMONIA-N:** <1.0 mg/L

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

**PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:**

- [X] 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
- [X] 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): | | $2,650,000 |
| Electrical and Instrumentation: | 12% | $318,000 |
| Yard Piping and Site Work: | 15% | $398,000 |
| 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: | | $5,390,000 |
| 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 | $16,800 $/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: | | $1,690,000 |

| | |
|---|---|
| **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 & Wheler, LLC |
| DATE: | March 16, 2001 |
| FACILITY: | Noman M. Cole WWTP (formerly Lower Potomac) |
| LOCATION: | Fairfax County, VA |
| RATED FLOW: | 67.0 mgd |
| CURRENT EFFLUENT TN: | 8.0 mg/L |
| EFFLUENT TN GOAL: | 3.0 mg/L |
| NITROGEN REDUCTION: | 2790 lbs/d<br>1018 1000 lbs/yr<br>20367 1000 lbs/20-years |

PE COD: 300 mg/L
PE TKN: 23 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [X] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] Other: Step Feed MLE, no nitrate recycle

Existing Aerated Volume (MG): 18.65
Existing Anoxic Volume (MG): 7.3
Current MLSS at Winter ADF: 2700

CURRENT EFFLUENT AMMONIA-N: <1.0 mg/L

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] Add methanol to existing BNR process
- [ ] Add downstream anoxic tank with methanol feed
- [ ] Add effluent filtration
- [X] Other: Convert existing deep bed effluent filters to denite filters

**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 | $293,500 $/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 & Wheler, LLC |
| DATE: | March 19, 2001 |
| FACILITY: | Luray WWTP |
| LOCATION: | Luray, PA |
| RATED FLOW: | 2.0 mgd |
| CURRENT EFFLUENT TN: | 7.0 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: N/a mg/L
PE TKN: N/a mg/L

**CURRENT PROCESS (CHECK ALL THAT APPLY):**

- [ ] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [X] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [X] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [ ] Other:

Existing Aerated Volume (MG): 1.96
Existing Anoxic Volume (MG): N/a
Current MLSS at Winter ADF: 5,500

**CURRENT EFFLUENT AMMONIA-N:** <1.0 mg/L

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

**PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:**

- [X] 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
- [X] 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): | | $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: | | $2,730,000 |
| Contingency: | 30% | $630,000 |
| **Total Capital Cost:** | | **$3,360,000** |
| Capital Cost per lb. 20-Yr. N removal: | | **$6.58** |

**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: | 0.60 $/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** |

| | |
|---|---|
| **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 & Wheler, 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: | 390 lbs/d<br>142 1000 lbs/yr<br>2847 1000 lbs/20-years |

PE COD: 5077 mg/L
PE TKN: 98 mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [ ] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [X] 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

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] Other: Add more 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: | | 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 | $40,900 $/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 & Wheler, LLC |
| DATE: | March 19, 2001 |
| FACILITY: | Middle River-Verona WWTP |
| LOCATION: | Augusta County, VA |
| RATED FLOW: | 4.5 mgd |
| CURRENT EFFLUENT TN: | 5.0 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 (A2/0, VIP, etc.)
- [ ] Bardenpho
- [X] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] 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

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

**PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:**

- [X] 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
- [X] 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: | 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 & Wheler, LLC |
| DATE: | March 19, 2001 |
| FACILITY: | Opequon WWTP |
| LOCATION: | Frederick County, VA |
| RATED FLOW: | 6.3 mgd |
| CURRENT EFFLUENT TN: | 8.0 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):

- [ ] MLE
- [X] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] Other: Step-feed A2/0 system

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

CURRENT EFFLUENT AMMONIA-N: 0.4 mg/L

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] 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): | | $3,140,000 |
| Electrical and Instrumentation: | 12% | $377,000 |
| Yard Piping and Site Work: | 15% | $471,000 |
| Subtotal: | | $3,990,000 |
| Contractor OH&P: | 15% | $599,000 |
| Engineering and Constr. Mgmt: | 15% | $599,000 |
| Subtotal: | | $5,190,000 |
| 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 & Wheler, LLC |
| DATE: | March 19, 2001 |
| FACILITY: | Parkins Mill WWTP |
| LOCATION: | Frederick County, VA |
| RATED FLOW: | 2.0 mgd |
| CURRENT EFFLUENT TN: | 4.0 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):**

- [ ] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [X] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] Other: Biodenipho Oxidation Ditch configuration

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

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

**PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:**

New MLSS

- [X] No modifications required — 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
- [X] 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): | | $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: | | $2,730,000 |
| Contingency: | 30% | $630,000 |
| 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 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: | | 20 lbs/d |
| Sludge Disposal Cost: | 400 $/ton | $1,500 $/year |
| Total Annual O&M Cost: | | $44,600 $/year |
| Effective Annual Interest Rate after Inflation: | | 2.91% |
| 20-Year Present Worth of O&M Costs: | | $670,000 |

| | |
|---|---|
| **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 & Wheler, LLC |
| DATE: | March 19, 2001 |
| FACILITY: | Purcellville WWTP |
| LOCATION: | Purcellville, VA |
| RATED FLOW: | 1.0 mgd |
| CURRENT EFFLUENT TN: | 6.0 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: N/a mg/L
PE TKN: N/a mg/L

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [X] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] Other: Step Feed MLE with Effluent 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

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] 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: | | $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 & Wheler, 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<br>183 1000 lbs/yr<br>3650 1000 lbs/20-years |

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

**CURRENT PROCESS (CHECK ALL THAT APPLY):**

- [X] MLE
- [X] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] Other: A2/O that also can be operated as an MLE

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

**CURRENT EFFLUENT AMMONIA-N:** 0.5 mg/L

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

**PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:**

New MLSS

- [X] No modifications required — 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
- [X] 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): | | $6,200,000 |
| Electrical and Instrumentation: | 12% | $744,000 |
| Yard Piping and Site Work: | 15% | $930,000 |
| Subtotal: | | $7,870,000 |
| Contractor OH&P: | 15% | $1,181,000 |
| Engineering and Constr. Mgmt: | 15% | $1,181,000 |
| Subtotal: | | $10,230,000 |
| Contingency: | 30% | $2,361,000 |
| Total Capital Cost: | | **$12,590,000** |
| 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 | $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: | | $102,300 $/year |
| Denitrification Sludge Production w/Methanol: | | 720 lbs/d |
| Sludge Disposal Cost: | 400 $/ton | $52,600 $/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 & Wheler, 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):

- [ ] MLE
- [X] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] Other: A2/O with integral Schreiber Process

Existing Aerated Volume (MG): N/a
Existing Anoxic Volume (MG): N/a
Current MLSS at Winter ADF: 4000

CURRENT EFFLUENT AMMONIA-N: <1.0 mg/L

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] 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): | | $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 | $6,500 $/year |
| | Nitrate Reduction using Methanol: | | 9.0 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: | | $22,600 $/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 & Wheler, LLC |
| DATE: | March 19, 2001 |
| FACILITY: | Strasburg WWTP |
| LOCATION: | Stasburg, 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 |
| | 146 1000 lbs/20-years |

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

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [ ] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [X] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] Other: Brush Aerator Oxidation Ditch

Existing Aerated Volume (MG): N/a
Existing Anoxic Volume (MG): N/a
Current MLSS at Winter ADF: 4000

CURRENT EFFLUENT AMMONIA-N: <1.0 mg/L

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] 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): | | $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: | | $18.15 |

OPERATIONS COST:

| | | |
|---|---|---|
| Additional Horsepower (from Page 2): | | 20 HP |
| Electrical Power Cost: | 0.05 $/kW | $6,500 $/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 | $2,900 $/year |
| Total Annual O&M Cost: | | $33,600 $/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 & Wheler, LLC |
| DATE: | March 19, 2001 |
| FACILITY: | Stuarts Draft WWTP |
| LOCATION: | Augusta County, VA |
| RATED FLOW: | 1.4 mgd |
| CURRENT EFFLUENT TN: | 5.0 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):**

- [ ] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [X] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] Other: Brush Aerator Oxidation Ditches

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

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

**PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:**

- [X] 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:

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
- [X] 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: | | $3.56 |

**OPERATIONS COST:**

| | | |
|---|---|---|
| Additional Horsepower (from Page 2): | | 0 HP |
| Electrical Power Cost: | 0.05 $/kW | $0 $/year |
| Nitrate Reduction using Methanol: | | 2.0 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: | | 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 & Wheler, LLC |
| DATE: | March 19, 2001 |
| FACILITY: | Tyson Foods, Inc. WWTP |
| LOCATION: | Temperanceville, VA |
| RATED FLOW: | 1.0 mgd |
| CURRENT EFFLUENT TN: | 28.0 mg/L |
| EFFLUENT TN GOAL: | 3.0 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):**

- [X] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] 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

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

**PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:**

- [X] 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
- [X] 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): | | $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: | | **$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 | $24,600 $/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: | | $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 & Wheler, LLC | | |
| DATE: | March 19, 2001 | | |
| FACILITY: | Waynesboro City WWTP | | |
| LOCATION: | Waynesboro, VA | | |
| RATED FLOW: | 4.0 mgd | PE COD | 270 mg/L |
| CURRENT EFFLUENT TN: | 8.0 mg/L | PE TKN | 20 mg/L |
| EFFLUENT TN GOAL: | 3.0 mg/L | | |
| NITROGEN REDUCTION: | 170 lbs/d | | |
| | 62 1000 lbs/yr | | |
| | 1241 1000 lbs/20-years | | |

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [ ] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] Other: Trickling Filter-RBCs, Denite Filters

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

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] 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: | | 5.0 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: | 0.60 $/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: | | $590,000 |

| | |
|---|---|
| TOTAL 20-YEAR PRESENT WORTH COST: | $590,000 |
| 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 & Wheler, 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 |
| | 292 1000 lbs/20-years |

PE COD: 435 mg/L
PE TKN: 25 mg/L

**CURRENT PROCESS (CHECK ALL THAT APPLY):**

- [ ] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [X] Oxidation Ditch, 4 Ring Orbal
- [ ] 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

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

**PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:**

- [X] 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
- [X] 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: | | **$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: | 0.60 $/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 & Wheler, LLC | | |
| DATE: | March 19, 2001 | | |
| FACILITY: | Woodstock WWTP | | |
| LOCATION: | Woodstock,VA | | |
| RATED FLOW: | 1.0 mgd | PE COD: 306 | mg/L |
| CURRENT EFFLUENT TN: | 8.0 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):

- [ ] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [X] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [ ] Other:

Existing Aerated Volume (MG): 1.3
Existing Anoxic Volume (MG): N/a
Current MLSS at Winter ADF: 3200

Note: Oxidation Ditches operate Cyclically

CURRENT EFFLUENT AMMONIA-N: 0.5 mg/L

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] 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): | | | $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: | | | **$9.08** |

| OPERATIONS COST: | | |
|---|---|---|
| Additional Horsepower (from Page 2): | | 20 HP |
| Electrical Power Cost: | 0.05 $/kW | $6,500 $/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** |

# 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 & Wheler, LLC |
| DATE: | March 25, 2001 |
| FACILITY: | Richmond WWTP |
| LOCATION: | Richmond, VA |
| RATED FLOW: | 50.0 mgd |
| CURRENT EFFLUENT TN: | 16.0 mg/L |
| EFFLUENT TN GOAL: | 3.0 mg/L |
| NITROGEN REDUCTION: | 5420 lbs/d |
| | 1978 1000 lbs/yr |
| | 39566 1000 lbs/20-years |

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

**CURRENT PROCESS (CHECK ALL THAT APPLY):**

- [ ] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] Other: Conventional Activated Sludge

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

**CURRENT EFFLUENT AMMONIA-N:** 0.5 mg/L

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

**PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:**

- [X] 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
- [X] 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
- [X] Other: Modify for MLE Operation

**CAPITAL COST:**

| | | |
|---|---|---|
| Equipment and Structures (from Page 2): | | $22,740,000 |
| Electrical and Instrumentation: | 12% | $2,729,000 |
| 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**

| | |
|---|---|
| PROJECT: | Implementing a 3 mg/L Annual Average Total Nitrogen Limit |
| PREPARED FOR: | USEPA, Chesapeake Bay Office |
| PREPARED BY: | Virginia Tech with Stearns & Wheler, LLC |
| DATE: | March 25, 2001 |
| FACILITY: | Hopewell Regional WWTP |
| LOCATION: | Hopewell, VA |
| RATED FLOW: | 50.0 mgd |
| CURRENT EFFLUENT TN: | 6.0 mg/L |
| EFFLUENT TN GOAL: | 3.0 mg/L |
| NITROGEN REDUCTION: | 1250 lbs/d |
| | 456 1000 lbs/yr |
| | 9125 1000 lbs/20-years |

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

**CURRENT PROCESS (CHECK ALL THAT APPLY):**

- [ ] MLE
- [ ] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] Other: second stage denitrification with methanol addition

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

**CURRENT EFFLUENT AMMONIA-N:** <1.0 mg/L

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

**PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:**

New MLSS N/a

- [X] 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 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
- [X] Add methanol to existing BNR process
- [ ] Add downstream anoxic tank with methanol feed
- [X] Add effluent filtration
- [ ] Other:

**CAPITAL COST:**

| | | |
|---|---|---|
| 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: | | $26,610,000 |
| Contractor OH&P: | 15% | $3,992,000 |
| Engineering and Constr. Mgmt: | 15% | $3,992,000 |
| Subtotal: | | $34,590,000 |
| Contingency: | 30% | $7,983,000 |
| Total Capital Cost: | | $42,570,000 |
| Capital Cost per lb. 20-Yr. N removal: | | $4.67 |

**OPERATIONS COST:**

| | | |
|---|---|---|
| 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 | $156,000 $/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: | | $345,900 $/year |
| Denitrification Sludge Production w/Methanol: | | 1800 lbs/d |
| Sludge Disposal Cost: | 400 $/ton | $131,400 $/year |
| Total Annual O&M Cost: | | $796,700 $/year |
| Effective Annual Interest Rate after Inflation: | | 2.91% |
| 20-Year Present Worth of O&M Costs: | | $11,950,000 |

| | |
|---|---|
| **TOTAL 20-YEAR PRESENT WORTH COST:** | $54,520,000 |
| 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 & Wheler, LLC |
| DATE: | March 25, 2001 |
| FACILITY: | Henrico County WWTP |
| LOCATION: | Henrico County, VA |
| RATED FLOW: | 40.0 mgd |
| CURRENT EFFLUENT TN: | 6.0 mg/L |
| EFFLUENT TN GOAL: | 3.0 mg/L |
| NITROGEN REDUCTION: | 1000 lbs/d |
| | 365 1000 lbs/yr |
| | 7300 1000 lbs/20-years |

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

**CURRENT PROCESS (CHECK ALL THAT APPLY):**

- [ ] MLE
- [X] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] Other: Two systems, a modified UCT & a modified pure Oxygen

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

**CURRENT EFFLUENT AMMONIA-N:** <1.0 mg/L

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

**PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:**

- [X] 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
- [X] Other: modify existing effluent filters for denitrification with methanol addition

**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 |

**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: | | 460 gals/d |
| Methanol Cost: | 0.75 $/gal | $125,900 $/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: | | $33,000 $/year |
| Denitrification Sludge Production w/Methanol: | | 1440 lbs/d |
| Sludge Disposal Cost: | 400 $/ton | $105,100 $/year |
| Total Annual O&M Cost: | | $264,000 $/year |
| Effective Annual Interest Rate after Inflation: | | 2.91% |
| 20-Year Present Worth of O&M Costs: | | $3,960,000 |

**TOTAL 20-YEAR PRESENT WORTH COST:** $8,020,000
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 & Wheler, LLC |
| DATE: | March 25, 2001 |
| FACILITY: | HRSD-VIP |
| LOCATION: | Norfolk, VA |
| RATED FLOW: | 40.0 mgd |
| CURRENT EFFLUENT TN: | 6.0 mg/L |
| EFFLUENT TN GOAL: | 3.0 mg/L |
| NITROGEN REDUCTION: | 1000 lbs/d |
| | 365 1000 lbs/yr |
| | 7300 1000 lbs/20-years |

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

**CURRENT PROCESS (CHECK ALL THAT APPLY):**

- [ ] MLE
- [X] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] Other: The Original VIP Plant, no effluent filtration

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

**CURRENT EFFLUENT AMMONIA-N:** <1.0 mg/L

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

**PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:**

- [X] 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
- [X] 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): | | $14,950,000 |
| Electrical and Instrumentation: | 12% | $1,794,000 |
| Yard Piping and Site Work: | 15% | $2,243,000 |
| Subtotal: | | $18,990,000 |
| 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 | $261,400 $/year |
| Nitrate Reduction using Methanol: | | 3.0 mg/L |
| Methanol Required: | | 460 gals/d |
| Methanol Cost: | 0.75 $/gal | $125,900 $/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: | | $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: | | **$11,090,000** |

**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 & Wheler, LLC |
| DATE: | March 25, 2001 |
| FACILITY: | HRSD-Nansemond |
| LOCATION: | Portsmouth, VA |
| RATED FLOW: | 30.0 mgd |
| CURRENT EFFLUENT TN: | 6.0 mg/L |
| EFFLUENT TN GOAL: | 3.0 mg/L |
| NITROGEN REDUCTION: | 750 lbs/d |
| | 274 1000 lbs/yr |
| | 5475 1000 lbs/20-years |

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

CURRENT PROCESS (CHECK ALL THAT APPLY):

- [ ] MLE
- [X] BEPR (A2/0, VIP, etc.)
- [ ] Bardenpho
- [ ] Oxidation Ditch
- [ ] Lagoon (Biolac, etc.)
- [ ] Cyclical Aeration
- [ ] SBR
- [ ] High-Rate Biofilter
- [ ] Effluent Filtration
- [X] Other: A VIP Plant w/o effluent filtration

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

CURRENT EFFLUENT AMMONIA-N: <1.0 mg/L

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] 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): | | $11,450,000 |
| | 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 $/kW | $196,000 $/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 | 0.60 $/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: | | $556,900 $/year |
| | Effective Annual Interest Rate after Inflation: | | 2.91% |
| | 20-Year Present Worth of O&M Costs: | | $8,350,000 |

| | | |
|---|---|---|
| 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 & Wheler, 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):

- [X] MLE
- [ ] BEPR (A2/0, 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

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

New MLSS N/a

- [X] 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 nit/denit facility)
- [ ] Add influent flow equalization tank
- [ ] Other:

PROPOSED MODIFICATIONS TO GET NITRATE < 1.0 mg/L:

- [ ] No modifications required
- [X] 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): | | $7,950,000 |
| 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: | | $13,130,000 |
| 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: | | $377,600 $/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 & Wheler, 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):

- [X] MLE
- [ ] BEPR (A2/0, 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

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

PROPOSED MODIFICATIONS TO GET AMMONIA < 1.0 mg/L:

- [X] 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
- [X] 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): | | $4,450,000 |
| 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: | 0.05 $/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: | | $73,500 $/year |
| Denitrification Sludge Production w/Methanol: | | 360 lbs/d |
| Sludge Disposal Cost: | 400 $/ton | $26,300 $/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: | | **$2,930,000** |

**TOTAL 20-YEAR PRESENT WORTH COST:** **$11,980,000**

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 | $1.230 \times 10^6$ | 136,667 | $0.51 |
| Altoona City (W) | 13.5 | $1.233 \times 10^6$ | 91,333 | 0.42 |
| Chambersburg | 4.5 | $6.347 \times 10^6$ | 1,410,444 | 2.69 |
| Greater Hazleton | 8.9 | $7.84 \times 10^6$ | 880,899 | 3.24 |
| Hanover | 4.5 | $0.060 \times 10^6$ | 13,333 | 0.08 |
| Harrisburg | 30.0 | $25.448 \times 10^6$ | 848,250 | 2.00 |
| Lancaster | 29.7 | $1.077 \times 10^6$ | 36,263 | 0.19 |
| Lebanon | 8.0 | $4.039 \times 10^6$ | 504,875 | 1.19 |
| Scranton | 16.0 | $2.815 \times 10^6$ | 175,938 | 0.76 |
| State College (UAJA) | 6.0 | $0.780 \times 10^6$ | 130,000 | 0.33 |
| Susquehanna (Lancaster Area) | 12.0 | $1.619 \times 10^6$ | 134,917 | 1.12 |
| Throop | 7.0 | $3.320 \times 10^6$ | 474,285 | 1.68 |
| Williamsport (C) | 7.2 | $6.339 \times 10^6$ | 880,417 | 1.36 |
| Williamsport W) | 4.5 | $5.246 \times 10^6$ | 1,165,778 | 2.58 |
| Wyoming Valley | 32.0 | $0.763 \times 10^6$ | 23,843 | 0.18 |
| York City | 26.0 | $1.780 \times 10^6$ | 68,462 | 0.42 |
| **Total/Average** | **218.8** | **$69.936 \times 10^6$** | **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 | $6.347 \times 10^6$ | $1.4104 \times 10^6$ | $2.69/lb |
| Greater Hazleton | 8.9 | $7.840 \times 10^6$ | 880,899 | $3.24/lb |
| Harrisburg | 30.0 | $25.448 \times 10^6$ | 848,250 | $2.00/lb |
| Lebanon | 8.0 | $4.039 \times 10^6$ | 504,875 | $1.19/lb |
| W'msport Central | 7.2 | $6.339 \times 10^6$ | 880,474 | $1.36/lb |
| W'msport West | 4.5 | $5.246 \times 10^6$ | $1.166 \times 10^6$ | $2.58/lb |
| **Total/Average** | **63.1** | **$55.26 \times 10^6$** | **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 x $10^6$ (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/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 | $1.350 \times 10^6$ | $1.50 \times 10^6$ | \$5.92/lb N |
| Crisfield | 1.0 | $1.949 \times 10^6$ | $1.949 \times 10^6$ | \$4.95/lb N |
| Elkton | 2.7 | $1.970 \times 10^6$ | 729,630 | \$1.87/lb N |
| Federalsburg | 0.75 | $1.525 \times 10^6$ | $2.033 \times 10^6$ | \$3.34/lb N |
| Georges Creek (Alleghany Cty.) | 0.6 | $1.663 \times 10^6$ | $2.772 \times 10^6$ | \$3.55/lb N |
| Indian Head | 0.49 | 532,000 | $1.085 \times 10^6$ | \$2.90/lb N |
| Mattawoman | 15 | $4.250 \times 10^6$ | 283,333 | \$0.07/lb N |
| Winebrenner | 0.6 | $1.480 \times 10^6$ | $2.467 \times 10^6$ | \$3.77/lb N |
| **MD Totals/Avg.** | **22.74** | **$15.109 \times 10^6$** | **$0.664 \times 10^6$** | **1.31/lb N** |
| Binghampton | 25 | $13.057 \times 10^6$ | 522,280 | \$2.24/lb N |
| Endicott | 8 | $6.656 \times 10^6$ | 832,000 | \$3.35/lb N |
| **NY Totals/Avg.** | **33** | **$19.713 \times 10^6$** | **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 | $4.688 \times 10^6$ | 293,000 | $0.54/lb |
| H. L. Mooney | 18 | 490,000 | 27,222 | $0.063/lb |
| Leesburg | 4.85 | $2.980 \times 10^6$ | 614,000 | $0.68/lb |
| Lower Potomac | 67.0 | $20.800 \times 10^6$ | 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 | $1.3 \times 10^6$ | $1.3 \times 10^6$ | $1.80/lb |
| Rocco Foods, Edinburg | 1.2 | $4.480 \times 10^6$ | 3,733,000 | $0.338/lb |
| Strasburg | 0.975 | 120,000 | 123,000 | -$0.14/lb |
| Stuarts Draft | 1.4 | $1.240 \times 10^6$ | 886,000 | $2.36/lb |
| Waynesboro | 4.0 | $3.500 \times 10^6$ | 875,000 | $1.27/lb |
| Woodstock | 1.0 | 70,000 | 70,000 | -$0.22/lb |
| **Total/Average** | **173.7** | **$42.445 \times 10^6$** | **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 | $4.688 \times 10^6$ | 293,000 | $0.54/lb |
| Leesburg | 4.85 | $2.980 \times 10^6$ | 614,000 | $0.68/lb |
| Lower Potomac, Fairfax County | 67.0 | $20.8 \times 10^6$ | 310 448 | $0.50/lb |
| Rocco Farm Foods,Edinburg | 1.2 | $4.480 \times 10^6$ | 3,733,000 | $0.338/lb |
| Stuarts Draft | 1.4 | $1.240 \times 10^6$ | 886,000 | $2.36/lb |
| Waynesboro | 4.0 | $3.500 \times 10^6$ | 875,000 | $1.27/lb |
| **Total/Average** | **96.45** | **$38.478 \times 10^6$** | **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 | |
| Chestertown | 0.9 | 30 | 90 | - | - | - | >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 | | | 0.18 | >5.0 | 6.5-8.5 | |
| Winebrenner | 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 8 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 | | V | | | |
| 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 |
| Hanover | 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 | | | >5 | 6.0-9.0 | I: All Year Round; III: May-Oct.; IV: Nov-Apr. |
| State College (UAJA) | 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 (Lancester 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 NPDES 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 5004 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 | 0.801 | - | - | | | *kg/d; All maximum values. Temp:31 C; III:Jun-Dec; IV:Jan-May. |
| Fishersville | 1.4 | 24 | | 24 | 8.14 | 10.6 | | | >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 | III: Year Round |
| Harrisonburg | 16 | | | | 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., Elkton | 11.5# | 1567 | | 2664 | 496 | | 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 | 4.5+ | 25 | | 30 | 3.1 | 3.8 | | | >5.0 | 6.5-9.5 | III: Jun-Oct; IV: Nov-May |
| Opequon, Wincester | 6.25 | 6 | 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 |
| Parkins 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 | 0.5 | 14.5 | | 14.5 | - | | - | - | >6.0 | 6.0-9.0 | |
| Rocco Farm Foods, Edinburg | 1.2 | 6 | 30 | - | 1.95 | 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 | 0.975 | 30 | | 30 | 4.9* | 10.4* | | | | | *Maximum; III: Jun-Dec, IV:Jan-May |
| Stuarts Draft | 1.4 | 14.5 | 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 | - | - | - | - | 7.2 | 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 |
| *Maryland Totals/Average* | *12.19* | *22.75* | *1540* | *9115* | *1.31* |
| **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 |
| *New York Totals/Average* | *32.29* | *33* | *3935* | *13257* | *2.49* |
| **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 |
| *Pennsylvania Totals/Average* | *163.2* | *218* | *18064* | *91574* | *0.97* |

**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 |
| *Virginia Totals/Average* | *130.8* | *164.2* | *16260* | *85703* | *0.48* |
| *GRAND TOTALS* | *339* | *438* | *39799* | *199649* | *0.94* |

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