APPENDIX 2-A

WWTP Analysis Procedure

Appendix 2-A WWTP Analysis Procedure

Step 1: Establish Limits

- Limits were obtained from Jim George at work session number 2 and can be seen in Appendix 2-b

Step 2: Calculate Current Loading Rates

- Shown in Appendix 2-I
- Based on Current Concentrations and Discharge
- Loads are in lbs/year and change from year to year
- Steps to establish loads are outlined power point presentation (Appendix 2-D)
  - Use the equation $Load = Q(MGD) \times C\left(\frac{mg}{l}\right) \times 8.34 \times 365\left(\frac{days}{year}\right)$
  - Q is current flow, taken from the 2002 Water and Sewer Plan + Updated Information provided by the County, detailed in (Appendix 2-H)
  - C was obtained from a variety of sources which are detailed in (Appendix 2-E)
    - Concentrations for Chestertown, Rock Hall, Galena, Millington, Kennedyville were obtained from the Discharge Monitoring Reports (Appendix 2-F)
    - Note: DMR are only available through 4/2008 and may not reflect the recent upgrades at the Chestertown WWTP Plant
    - Tolchester Concentrations were obtained by the county in the form of lb/first 2 months and converted to mg/liter (Appendix 2-G)
    - Betterton and Worton do not need to monitor their effluent and were assumed to be discharging at 18mg/liter of Nitrogen and 3 mg/liter of Phosphorus

Step 3: Calculate Loading Under Current Conditions & ENR at Chestertown and Rock Hall

- Shown in Appendix 2-I
- Same as above, except assume a concentration of 4mg/liter of Nitrogen and 0.3 mg/liter of Phosphorus for the Chestertown and Rock Hall WWTPs

Step 4: Calculate 2030 Loadings

- Shown in Appendix 2-K
- Based on Current Concentrations for minor plants and ENR Strategy concentrations for major plants and future flows
- Loads are in lbs/year and will change from year to year
- Steps to establish loads are outlined in attached power point presentation (Appendix 2-D)
  - Use the equation $Load = Q(MGD) \times C\left(\frac{mg}{l}\right) \times 8.34 \times 365\left(\frac{days}{year}\right)$
  - Q is computed using a ratio of existing sewer service area to proposed sewer service area (calculations can be seen in Appendix 2-J).
  - Concentration was the same as step 3

Step 5: Calculate 2030 Loading with Annexations

- Shown in Table Appendix 2-K
- Same as above but include annexation areas in 2030 Flow Calculation as seen in Appendix 2-J

Step 6a: Determine Hydraulic Surplus or Deficit

- Shown in Table 2-3
- Compare Hydraulic Design Capacity to current and future Discharge
- Establish Surplus or Deficit by subtracting discharge from design capacity for each

Step 6b: Determine Nutrient Surplus or Deficit

- Shown in Table 2-4 and 2-2
- Subtract the load from the limit
- The maximum Phosphorus limit, (427 lb/year), for expanded minor WWTP was used for Millington, Tolchester and Worton for the 2030 and 2030 plus annexation conditions (see power point presentation A-1 for more detail)
- Positive Number is a surplus and means more homes may be added to the system
- Negative Number is deficit and mean upgrades must be made to accommodate the flow

Step 7: Conversion to Equivalent Dwelling Units

- Shown in Table 2-4, 2-5, and summary is shown in table 2-6
- Use the following formula to convert nutrient surplus or deficit to equivalent dwelling units (EDUs) assuming 220 gpd/EDU and the same effluent concentration used in the load calculation

$$\boxed{Additonal\ EDUs = \frac{Limit - Load}{C \times 8.34 \times 365 \times 250} \times 1{,}000{,}000}$$

- For Hydraulic Capacity simply divide surplus or deficit by 220 gpd/edu

Step 8: Determine the limiting factor

- Shown in Table 2-6
- The limiting factor will either be the nutrient limit or the hydraulic capacity
- Determine the minimum EDU (Hydraulic, Nitrogen, and Phosphorus) for each treatment plant under each conditions and record
- This is your limiting factor for the treatment plant

APPENDIX 2-B

Kent County Tributary Strategy Point Source Nutrient Caps

Appendix 2-B

Kent County
Tributary Strategy Point Source Nutrient Caps

POINT SOURCE*	COUNTY	DESIGN CAPACITY (MGD)	SURFACE DISCHARGE (MONTHS)	PROJECTED 2020 FLOW (MGD)	2000 FLOW (MGD)	2000 TN (MG/L)	2000 TP (MG/L)	2000 TNL (LB/YR)	ENR STRATEGY TOTAL NITROGEN LOAD CAP (LBS/YR)	2000 TPL (LBS/YR)	ENR STRATEGY TOTAL PHOSPHORUS LOAD CAP (LBS/YR)
CHESTERTOWN	KENT	1.500		0.687	0.637	9.25	4.34	17,978	18,273	8,437	1,371
ROCK HALL	KENT	0.505		0.285	0.264	14.81	0.51	11,933	6,152	414	461
BETTERTON	KENT	0.200		0.022	0.021	18.00	3.00	1,137	1,224	189	204
GALENA	KENT	0.060		0.028	0.026	26.26	4.51	2,084	1,538	358	256
GREAT OAKS LANDING	KENT	0.014		0.006	0.006	18.00	3.00	308	332	51	55
KENNEDYVILLE	KENT	0.050		**0.026**	**0.022**	18.00	3.00	243	**1,399**	41	**233**
MILLINGTON	KENT	**0.105**		**0.061**	0.057	18.00	3.00	3,114	**3,344**	519	557
TOLCHESTER	KENT	0.265		0.102	0.088	18.00	3.00	4,827	5,584	805	931
WORTON-BUTLERTON	KENT	0.150		0.066	0.061	18.00	3.00	3,372	3,631	562	605

Source: MDE June 2008

APPENDIX 2-C

Permit Cap vs. Tributary Strategy Cap Comparison

Appendix 2-C: Permit Cap vs. Tributary Strategy (ENR) Cap Comparison

WWTP	MDE-projected "2020" Flow[1]	Permit No.		Permitted Flow	Current Flow		MDE 2020 exceeded?	Plant Design Flow
		NPDES	State			3 year avg ('05-'07)		
	MGD			MGD	MGD	MGD		MGD
Chestertown	0.687	MD0020010	01-DP-0592	0.900	0.684 (2007)	0.706	YES	1.500
Rock Hall[2]	0.285	MD0020303	00-DP-0575	0.485	0.220 (2008)	---	YES	0.510
Galena	0.028	MD0020605	01-DP-0528	0.060	0.050 (2008)	---	YES	0.080
Betterton	0.022	MD0020575	01-DP-0591		0.012 (2007)	---	YES	0.200
Millington	0.061	MD0020435	00-DP-0166	0.105	0.055 (2007)	0.055	NO	0.145
Kennedyville	0.026	MD0052671	06-DP-1142	0.060	0.023 (2007)	0.020	NO	0.060
Worton	0.066	MD0060585	00-DP-2109	0.150	0.103 (2007)	0.0997	YES	0.150
Tolchester	0.102	MD0067202	06-DP-3105	0.265	0.092 (2007)	0.094	NO	0.265

(1) Used to determine Tributary Strategy nutrient loading

(2) Rock Hall in process to reduce permitted flow from 0.505 MGD to 0.485 MGD

WWTP	Total Nitrogen		Total Phosphorus		Permit		
	ENR Strategy Load Cap	Current Permit Load Cap	ENR Strategy Load Cap	Current Permit Load Cap	Effective Date	Expiration Date	
	LBS/YR	LBS/YR	LBS/YR	LBS/YR			
Chestertown (1)	18,273	14,600	1,371	5,475	July 1, 2003	June 30, 2008	(under renewal)
"		18,273		1,371	2008	2013	(draft permit in progress)
Rock Hall (2) (3)	6,152	none ('03-'08)	461	1,533	November 1, 2003	October 31, 2008	(under renewal)
Galena (4)	1,538	1,460	256	1,948	January 1, 2004	December 31, 2008	
Betterton	1,224	none ('03-'07)	204	none ('03-'07)	January 1, 2003	December 31, 2007	(under renewal)
Millington (5)	3,344	none ('03-'08)	557	none ('03-'08)	April 1, 2003	March 31, 2008	(under renewal)
Kennedyville (6)	1,399	1,399	233	233	July 1, 2006	June 30, 2011	
Worton	3,631	3,631	605	457	July 1, 2008	June 30, 2013	
Tolchester (7)	5,584	5,584	931	931	April 1, 2008	March 31, 2013	

(1) When the BNR installation has been completed, the permittee is to operate the BNR process on a year-round basis and undertake best efforts to meet the nitrogen cap goal of 14,600 lbs/year. When a nutrient load goal for this facility is allocated under the Chesapeake Bay 2000 Agreement, this permit may be reopened and new goals added as appropriate. The permit may also be reopened to be issued in accordance with the requirements of MDE's Watershed Permitting Plan under which all discharge permits in a watershed are issued the same year.

(2) When the average flow for a calendar year equals or exceeds 0.500 MGD, it is expected that the facility will be upgraded to include Biological Nitrogen Removal (BNR). After completion of BNR upgrade, the permittee shall make every effort to meet a total nitrogen goal of 8 mg/l on an annual basis by operating the BNR process at the facility on year round basis. The 8.0 mg/l yearly average is to be achieved through installation of a BNR facility designed to meet a seasonal (May through October) average of 8.0 mg/l.

(3) The permit may be reopened to incorporate future Total Maximum Daily Load requirements. The permit may also be reopened to incorporate nitrogen and phosphorus load allocations contained in the Upper Eastern Shore Tributary Strategy now being developed.

(4) 1,948 lbs/yr Phosphorus is the maximum annual load based on EPA approved TMDL. Nitrogen limit based on ammonia limit yearly average.

(5) Permit requires monitoring of Total Nitrogen and Total Phosphorus: once per month 8 hour composite, but states no limits.

(6) The permittee shall make every effort to meet total nitrogen and phosphorus yearly goals based on Enhanced Nutrient Strategy (ENR) loads.

(7) Minor Facility Permit Language: "Under the Point Source Element of Maryland's Tributary Strategy, the _________ WWTP has been assigned annual nutrient loads of ____ lbs/year total nitrogen (TN) and ___ lbs/year total phosphorus (TP). As long as the design flow of the WWTP does not increase, these loads will remain only goals, not limitations. The permittee, however, shall make an effort to optimize the operation of the existing WWTP to meet these goals. Under any future expansion, the WWTP will be given permit limits of ____ lbs/year TN and ___ lbs/year TP."

APPENDIX 2-D

MDE Point Source Cap Power Point

Appendix 2-D

Department of the Environment

Point Source
Nutrient Loading Cap

&

WWTP Capacity Planning

MDE

Basic Load Calculation

MDE

Nutrient Load (lbs/year)= Q x C x 8.34 x 365

Q: Flow (Million Gallons per Day, MGD)
C: Effluent Nutrient Concentration (mg/L)
8.34: Conversion Factor
365 days/year

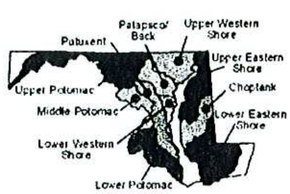
Example: 0.3 MGD, 18 mg/L TN in effluent

Annual Load = 0.3 x 18 x 8.34 x 365 = 16,425 lbs/yr

NOTE: Some plants have seasonal limits.

Tributary Strategy Point Source Load Cap

MDE



Information:

- ENR Strategy Nutrient Loading Caps
- Construction Schedule for Significant Point Sources
- Link: http://www.dnr.state.md.us/Bay/tribstrat/implementation_plan.html

Rules for Establishing Point Source Loads (Major Plant)

Major Plants (Daily Flow greater than 0.5 MGD)

1. Existing or Planned Flow Capacity

2. ENR treatment level: Annual average concentration (4.0 mg/L TN, 0.3 mg/L TP)

Estimating Treatment Concentration for Plant Expansion

Majors (Capacity greater than 0.5 MGD)

If Future Expansion is Contemplated

Nutrient Load Allocation remains the same*

Load	=	Flow	x	Concentration
fixed		↑		↓

* Unless an offset/trade is considered.

Estimating Load Above Cap for a Plant Expansion

Example: Expansion of Major WWTP

TN Allocation (Cap based on flow of 0.5 MGD):

0.5 MGD x 4 mg/L x 8.34 x 365 d/yr = **6,100 lbs/yr**

Consider Expansion to 0.75 MGD (0.25 MGD increase).

Increased TN Load:

0.25 MGD x 4 mg/L x 8.34 x 365 d/yr = **3,050 lbs/yr**

3,050 lbs/year needs to be offset in some way:
- Spray Irrigation,
- Trade,
- Additional Treatment.

MDE

Estimating Treatment Concentration for Plant Expansion

Example: Expansion of Major WWTP

TN Allocation (Cap based on flow of 0.5 MGD):

0.5 MGD x 4 mg/L x 8.34 x 365 d/yr = **6,100 lbs/yr**

Consider Expansion to 0.75 MGD.

Effluent TN Concentration Needed to Meet the TN Cap:

$$\frac{6.100 \text{ lbs/yr}}{0.75 \text{ MGD} \times 8.34 \times 365 \text{ d/yr}} = 2.7 \text{ mg/L}$$

Is this concentration technically feasible to achieve?
If not, other options can be considered.

MDE

Rules for Establishing Point Source Loads (Minor Plants)

Minor Plants (Capacity less than 0.5 MGD)

Basis for Nutrient Load Cap:

1. 2020 projected flow or Design Capacity flow (whichever is lower)
2. Secondary level annual average concentration (18 mg/L TN, 3 mg/L TP)

MDE

Rules for Establishing Point Source Capacity (Minor)

If Future Expansion of Minor Plant is Considered...

Case 1. Nutrient load allocations were LARGER THAN
6,100 lbs/yr for TN or
457 lbs/yr for TP

Load allocation will be "re-adjusted" DOWN to these values.

Case 2. Nutrient load allocations were LESS THAN
6,100 lbs/yr for TN or
457 lbs/yr for TP...

Load allocation will remained the same.

As a result of increased discharge flow, the new limits for effluent nutrient concentration will be more stringent.

MDE

Meeting Nutrient Allocation with Future Expansion (Minors)

Examples:

Case 1: Expansion beyond 6,100 lbs/yr will need BNR/ENR upgrade to meet TN limits.

Design or 2020 Flow: 0.12 MGD

Current Annual TN Load:

[illegible] D × 18 mg/L × 365 d/yr × 8.34 = 6,575 lbs/yr

Expansion Design Flow: 0.24 MGD

New TN Load: 6,100 lbs/yr

6,100 lbs/yr ÷ (365 d/yr × 8.34 × 0.24 MGD) = 8.4 mg/L TN

Rule-of-Thumb: 0.11 mgd is a planning threshold for TN.

MDE

Meeting Nutrient Allocation with Future Expansion (Minors)

Examples:

2. Expansion beyond 0.05 MGD will need phosphorus control to meet TP limits.

Design or 2020 Flow: 0.05 MGD

Current Annual TP Load:

0.05 MGD×3 mg/L×365 d/yr ×8.34 = 457 lbs/yr

Expansion Design Flow: 0.1 MGD

New Annual TP Load: 457 lbs/yr

457 lbs/yr ÷ (365 d/yr × 8.34 × 0.1 MGD) = 1.5 mg/L TP

MDE

Nutrient Limits or Goals ?

Before Expansion of Minor WWTP

Goals

After Expansion

Capacity < 0.1 MGD — Goals

Capacity ≥ 0.1 MGD — Limits

MDE

Options for Meeting the Load Limits:

1. ENR/BNR upgrades
2. Spray Irrigation
3. Nutrient Trading / Offset

http://www.mde.state.md.us/assets/document/NutrientCap_Trading_Policy.pdf

MDE

Status of Local WQ & TMDL Development

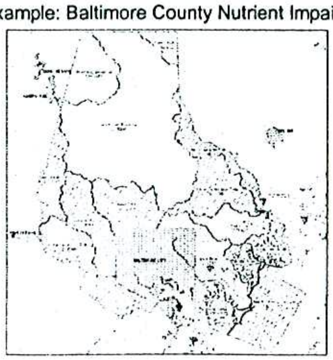
Status for local water quality in your watershed:

http://www.mde.state.md.us/Water/HB1141/Water_Quality_Maps.asp

MDE

Local WQ impairment Identification

Example: Baltimore County Nutrient Impairment Status.



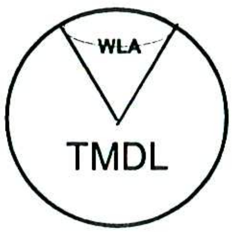
Legend

8-Digit Watershed Status
Impairment - Nutrients

- Impaired
- Impaired w/TMDL Completed
- Not Impaired
- Major WWTPs
- Baltimore County
- Municipalities
- Major Roads

MDE

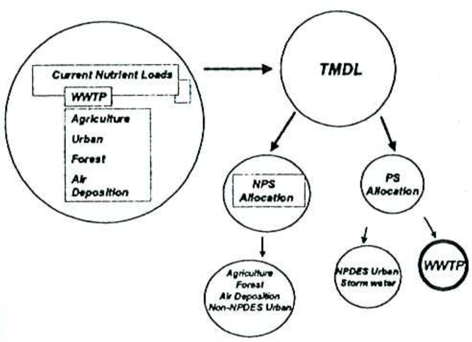
What Is TMDL Based Nutrient Cap ?



WLA = portion of the receiving water's total maximum daily load (TMDL) that is allocated to a specific point source

MDE

TMDL Allocation Process



MDE

TMDL Based Nutrient Cap

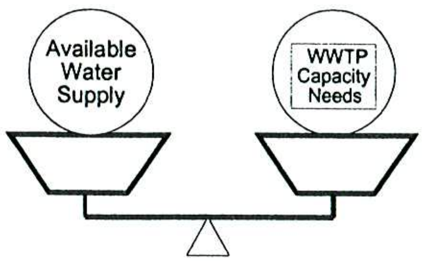
When will TMDL become permit limits?

After a TMDL is approved by EPA, the WLA allocated for the WWTP will become limits at the next NPDES permit renewal

ENR limits *vs.* TMDL limits

NPDES permit will adapt the more stringent ones as the discharge limits

Water Supply Constraint



APPENDIX 2-E

WWTP Input Summary

Appendix 2-E

Input Summary

Concentration Input Summary

	Nitrogen			Phosphorus		
Name of Plant	**Source of Information**	**Length of Information**	**Nitrogen Value (mg/liter)**	**Source of Information**	**Length of Information**	**Phoshorus Value (mg/liter)**
Major Plants						
Chestertown WWTP	Assumed		4	Assumed		0.3
Minor Plants WWTP						
Rock Hall WWTP	DMR	1/2008-12/2008	7.32	DMR	1/2008 - 12/2008	0.195
Galena WWTP	DMR	1/2008 - 12/2008	11.48	DMR	1/2008-12/208	6.95
Millington WWTP	DMR	1/2006-3/2008	18.96	DMR	1/2006-3/2008	2.4
Worton WWTP	N/A	Assumed	18	N/A	Assumed	3
Tolchester WWTP[1]	Kent Co.	1/2008 - 5/2008	9.4	Kent Co.	1/2008 - 5/2008	2
Kennedyville WWTP	DMR	10/2006-3/2008	4.3	DMR	10/2006-3/2008	1
Betterton WWTP	N/A	Assumed	18	N/A	Assumed	3

1 Tolchester Nutrient Information was given in total pounds, conversion to mg/l can be seen in Appendix 2-F.
2 Chestertown is assumed to be operating at ENR.
3 Worton and Butterton do not record Nitrogen and Phosphorus, concentrations were assumed based on Tributary Strategy.

Flow Input Summary

	Current Flow		Future Flow	
Name of Plant	Source of Information	Value	Source of Information	Value
Major Plants				
Chestertown WWTP	Chestertown Fax	706,000	1/14/09 Meeting[1]	1,500,000
Minor Plants WWTP				
Rock Hall WWTP	2008 DMRs	220,000	Calculated	228,273
Galena WWTP	2008 DMRs	50,000	Calculated	50,000
Millington WWTP	Discharge Permit	140,000	1/14/209 Meeting	250,000
Worton WWTP[3]	Flow Capacity Report	99,000	Calculated	250,000
Tolchester WWTP	2008 Notes	94,000	Calculated	132,291
Kennedyville WWTP	2008 Notes	20,000	Calculated	41,395
Betterton WWTP	7/2007-12/2008 DMRS	12,000	7/2007-12/2008 DMRS	12,000

1 No Capacity will be left in the Chestertown System, based on 1/14/09 meeting.
2 Future Flow Capacity can be seen in Appendix 2H.
3 Worton uses spray irrigation and 1/2 of the current and future flow will be used in the nutrient calculations.

APPENDIX 2-F

Tolchester WWTP Concentration Calculations

Appendix 2-F

Tolchester Waste Water Treatment Plant

Loading for First 5 Months of 2008

Current Flow **55,000**

Nitrogen		Phosphorus	
651	lb/first 5 months	136	lb/first 5 months
151	days	151	days/first 5 months
4.3	lbs/day	0.9	lbs/day
0.00007839	lbs/gallon	0.00001638	lbs/gallon
35.6	mg/gallon	7.4	mg/gallon
9.4	mg/liter	2.0	mg/liter

APPENDIX 2-G

Current Loading Calculation

Appendix 2G - Current Loading

Plant Name	Current Flow	Concentration Nitrogen (mg/liter)	Concentration Phosphorus (mg/liter)	Nitrogen Load (lb/year)	Phosphorus Load (lb/year)
Major Plants and Significant Minor Plants					
Chestertown WWTP	706,000	4.00	0.30	8,597	645
Minor Plants					
Rock Hall WWTP	220,000	7.32	0.20	4,902	131
Galena WWTP	50,000	11.48	6.77	1,747	1,030
Millington WWTP	140,000	18.96	2.44	8,080	1,040
Worton WWTP	49,500	18.00	3.00	2,712	452
Tolchester WWTP	94,000	9.40	1.96	2,690	561
Kennedyville WWTP	20,000	4.34	1.01	264	61
Betterton WWTP	12,000	18.00	3.00	658	110

1 Current and 2030 Conditions Assume Chestertown is operating at ENR levels.
2 Effluent Concentrations were obtained from the most current DMR, with the exception of Tolchester Betterton and Worton
3 Tolchester Concentrations are based on loads over a five month period, can be seen in Appendix, 2G
4 Worton and Betterton do not have nutrient tests, 18 mg/l of Nitrogen and 3 mg/liter of Phosphorus were assumed based on Trib Strategy guidelines

$$\boxed{Nutrient \quad load = Q\,(MGD) \times C\,(\frac{mg}{liter}) \times 8.34 \times 365\,(\frac{days}{year})}$$

APPENDIX 2-H

2030 Flow Predictions

Appendix 2-H Flow Predictions

WWTP Name	Current Flow (gpd)	Current Service Area (Acres)	Future Area (acres)	Future Flow (gpd)
Betterton	12,000	562	562	12,000
Chestertown	706,000	N/A	N/A	1,500,000
Tolchester	94,000	1,252	1,762	132,291
Galena	50,000	235	235	50,000
Kennedyville	20,000	86	178	41,395
Millington	140,000	N/A	N/A	250,000
Rock Hall	220,000	2,287	2,373	228,273
Worton	99,000	N/A	N/A	250,000

1 Future Flows for Worton, Chestertown and Millington are based on information received from Towns and Kent County

$$\boxed{Future\,Flow = \frac{Future\,Area}{Current\,Area} \times Current\,Flow}$$

APPENDIX 2-I

2030 Loading Calculation

Appendix 2-I 2030 Loadings

Plant Name	Future Flow	Concentration Nitrogen (mg/liter)	Concentration Phosphorus (mg/liter)	Nitrogen Load (lb/year)	Phosphorus Load (lb/year)
Major Plants and Significant Minor Plants					
Chestertown WWTP	1,500,000	4.00	0.30	18,265	1,370
Minor Plants					
Rockhall WWTP	228,273	7.32	0.20	5,087	136
Galena WWTP	50,000	11.48	6.77	1,747	1,030
Millington WWTP	250,000	18.96	2.44	14,429	1,857
Worton WWTP	125,000	18.00	3.00	6,849	1,142
Tolchester WWTP	132,291	9.40	1.96	3,785	789
Kennedyville WWTP	41,395	4.34	1.01	547	127
Betterton WWTP	12,000	18.00	3.00	658	110

1 Current and 2030 Conditions Assume Chestertown is operating at ENR levels.
2 Effluent Concentrations were obtained from the most current DMR, with the exception of Tolchester Betterton and Worton
3 Tolchester Concentrations are based on loads over a five month period, can be seen in Appendix, 2G
4 Worton and Betterton do not have nutrient tests, 18 mg/l of Nitrogen and 3 mg/liter of Phosphorus were assumed based on Trib Strategy guidelines

$$Nutrient \quad load = Q(MGD) \times C\left(\frac{mg}{liter}\right) \times 8.34 \times 365\left(\frac{days}{year}\right)$$

APPENDIX 2-J

Town Meeting Worksheets

Appendix 2-J

WWTP Analysis:

Plant Name: Betterton
Classification: Minor WWTP

1) Determine Tributary Strategy Point Source Nutrient Caps

		Value	Units	Source of Information	Line #
Q (2020 Predicted Flow)[1]	=	21,000	gpd	Trib Strat Implementation Plan	1
C (Nitrogen)	=	18	mg/liter	Trib Strat Implementation Plan, Point Source Strategy for Minor Plants	2
C (Phosphorus)	=	3	mg/liter	Trib Strat Implementation Plan, Point Source Strategy for Minor Plants	3
Cap (Nitrogen)	=	1,224	lbs/year	MDE Worksheet	4
Cap (Phosphorus)	=	204	lbs/year	MDE Worksheet	5

* Nutrient Caps are taken directly from MDE worksheet

1a) Determine Cap if Minor WWTP is expanded[2]

If Nitrogen Cap > 6,100 lbs/year, expanded limit = 6,100 lbs/year; if not, it remains the same as line 4

If Phosphorus Cap > 457 lbs/year, expanded limit = 457 lbs/year; if not, it remains the same as line 5

		Value	Units	Source of Information	Line #
Nitrogen	=	1,224	lbs/year	Trib Strat Implementation Plan/ Calculated	6
Phosphorus	=	204	lbs/year	Trib Strat Implementation Plan/Calculated	7

			Source of Information	Line #

2) Calculate Current Loading Rates

$$Load = Q(mgd) \times C\left(\frac{mg}{l}\right) \times 8.34 \ x \ 365 \left(\frac{days}{year}\right)$$

			Source of Information	Line #
Q	=	12,000 gpd	2005 Water and Sewer Plan	8
C (Nitrogen)	=	18 mg/liter	Assumed Value	9
C (Phosphorus)	=	3 mg/liter	Assumed Value	10
Load (Nitrogen)	=	658 lbs/year	Calculated	11
Load (Phosphorus)	=	110 lbs/year	Calculated	12

*Betterton does not measure Nitrogen and Phosphorus concentrations in effluent

3) Determine Loads if Chestertown and Rock Hall are operating at ENR
Not Applicable to Minor WWTP

				Source of Information	Line #

4) Calculate 2030 Loading Rates

4a) Predict 2030 Flows

$$FutureFlow = \frac{FutureArea}{CurrentArea} \times CurrentFlow$$

				Source of Information	Line #
Current Flow	=	12,000	gpd	Line 8	13
Current Sewer Service Area	=	562	acres	Sewer Service GIS File from County (included no municipal service areas, used city boundary for service area)	14
Future Sewer Service Area	=	562	acres	Sewer Service GIS File from County (included no municipal service areas, used city boundary for service area)	15
Predicted Future Flow (2030)	=	12,000	gpd	Calculated	16

4b) Predict 2030 Loadings

$$Load = Q(MGD) \times C\left(\frac{mg}{l}\right) \times 8.34 \ x \ 365\left(\frac{days}{year}\right)$$

Assume current concentrations unless plant provides information on proposed treatment upgrades.

				Source of Information	Line #
Q	=	12,000	gpd	Line 16	17
C (Nitrogen)[4]	=	18	mg/liter	Discharge Monitoring Reports[4], Average Concentration of Ammonia Nitrogen from, 1/2006 to 3/2008	18
C (Phosphorus)[4]	=	3	mg/liter	Discharge Monitroing Reports[4], Average Concentration of Total Phosphorus from 5/2006 to 10/2007	19
Load (Nitrogen)	=	658	lbs/year	Calculated	20
Load (Phosphorus)	=	110	lbs/year	Calculated	21

5) Predict 2030 Loadings with Annexations

Not Applicable to Betterton

				Source of Information	Line #

6) Determine Surplus or Deficit

6a) Hydraulic Surplus or Deficit

Hydraulic Surplus or Deficit = Capacity - Flow

Design Capacity	=	200,000	gpd	2005 Water and Sewer Plan	22
Current Flow	=	12,000	gpd	Line 8	23
Future Flow	=	12,000	gpd	Line 16	24
Current Hydraulic Surplus (+) / Deficit (-)	=	188,000		Calculated	25
Future Hydraulic Surplus (+) / Deficit (-)	=	188,000		Calculated	26

6b) Nutrient Surplus or Deficit

Surplus/Deficit = Tributary Strategy Cap - Loading

Nitrogen

Nitrogen Cap	=	1,224	lbs/year	Line 6	27
Current Load	=	658	lbs/year	Line 11	28
Predicted Future Load	=	658	lbs/year	Line 20	29
Current Nitrogen Surplus (+) / Deficit (-)	=	566	lbs/year	Calculated	30
Future Nitrogen Surplus (+) / Deficit (-)	=	566	lbs/year	Calculated	31

Phosphorus

Phosphorus Cap	=	204	lbs/year	Line 7	32
Current Load	=	110	lbs/year	Line 12	33
Predicted Future Load	=	110	lbs/year	Line 21	34
Current Phosphorus Surplus (+) / Deficit (-)	=	94	lbs/year	Calculated	35
Future Phosphorus Surplus (+) / Deficit (-)	=	94	lbs/year	Calculated	36

				Source of Information	Line #

7) Convert Surplus / Deficit to EDUs

7a) Convert Hydraulic Surplus / Deficit to Equivalent Dwelling Units (EDUs)

$$\boxed{Available \quad EDUs = \frac{Surplus\,/\,Deficit \quad (gpd)}{250\,\dfrac{gpd}{EDU}}}$$

Curent Hydraulic Surplus (+) / Deficit (-)	=	188,000	gpd	Line 25	37
Current Available EDUs	=	752	EDUs	Calculated	38
Future Hydraulic Surplus (+) / Deficit (-)	=	188,000	gpd	Line 26	39
Future Available EDUs	=	752	EDUs	Calculated	40

7b) Convert Nutrient Surplus/Deficit to EDUs

$$\boxed{Available\,EDUs = \frac{Surplus/Deficit\,(lb/\,year\,)}{C \times 8.34 \times 365 \times 250} \times 1{,}000{,}000}$$

Nitrogen (Current)					
Current Nitrogen Surplus (+) / Deficit (-)	=	566	lbs/year	Line 30	41
Concentration	=	18	mg/liter	Line 9	43
Current Available EDUs based on Nitrogen	=	41	EDUs	Calculated	44
Nitrogen (Future)					
Future Nitrogen Surplus (+) / Deficit (-)	=	566	lbs/year	Line 31	45
Concentration	=	18	mg/liter	Line 18	47
Future Available EDUs based on Nitrogen	=	41	EDUs	Calculated	48
Phosphorus (Current)					
Phosphorus Cap	=	94	lbs/year	Line 35	49
Concentration	=	3	mg/liter	Line 10	51
Current Available EDUs based on Phosphorus	=	41	EDUs	Calculated	52
Phosphorus (Future):					
Expadned Phosphorus Cap	=	94	lbs/year	Line 36	53
Concentration	=	3	mg/liter	Line 19	55
Future Available EDUs based on Phosphorus	=	41	EDUs	Calculated	56

			Source of Information	Line #
8) Determine the Limiting Factor[5]				
Current Available EDUs				
Hydraulic	=	752 EDUs	Line 38	57
Nitrogen	=	41 EDUs	Line 44	58
Phosphorus	=	41 EDUs	Line 52	59
Limiting Factor[5]	=	Phosphorus		60
Future Available EDUs				
Hydraulic	=	752 EDUs	Line 40	61
Nitrogen	=	41 EDUs	Line 48	62
Phosphorus	=	41 EDUs	Line 56	63
Limiting Factor[5]	=	Phosphorus		64

Notes

1) 2020 Predicted Flow was estimated by MDE in 2000 and may be lower than the actual current flow, Caps will still remain the same.
2) If an expansion of a minor WWTP is planned, the Caps cannot exceed 6,100 lbs/year of Nitrogen and 457 lbs/year of Phosphorus.
3) Current and Future Area were taken from GIS files delineating the current and proposed sewer service area (no proposed service areas for municipal plants included). Does not account for build-out. Other information from operating agency may be used in lieu of simplified area calculation; Refer to Wastewater Capacity Management Plan Guidance for recommendations and worksheet.)
4) Assume current concentrations unless operating agency provides information on proposed treatment upgrades.
5) Limiting Factor is the analysis (hydraulic, nitrogen, phosphorus) that produces the least # of available EDUs

Appendix 2-J

WWTP Analysis:

Plant Name: Rock Hall
Classification: Major WWTP

1) Determine Tributary Strategy Point Source Nutrient Caps
* Point Source Nutrient Caps taken directly from MDE worksheet shown in Appendix 2-B

			Source of Information	Line #
Q (Design Capacity)[1]	=	510,000 gpd	Trib Strat Implementation Plan	1
C (Nitrogen)	=	4 mg/liter	Trib Strat Implementation Plan, Point Source Strategy for Minor Plants	2
C (Phosphorus)	=	0.3 mg/liter	Trib Strat Implementation Plan, Point Source Strategy for Minor Plants	3
Cap (Nitrogen)	=	15,615 lbs/year	Trib Strat Implementation Plan	4
Cap (Phosphorus)	=	2,602 lbs/year	Trib Strat Implementation Plan	5

1a) Determine Cap if Minor WWTP is expanded[2] (Not Applicable)

If Nitrogen Cap > 6,100 lbs/year, expanded limit = 6,100 lbs/year; if not, it remains the same as line 4

If Phosphorus Cap > 457 lbs/year, expanded limit = 457 lbs/year; if not, it remains the same as line 5

Nitrogen	=	6,152 lbs/year	Trib Strat Implementation Plan/ Calculated	6
Phosphorus	=	461 lbs/year	Trib Strat Implementation Plan/Calculated	7

			Source of Information	Line #

2) Calculate Current Loading Rates

$$Load = Q(mgd) \times C\left(\frac{mg}{l}\right) \times 8.34\ x\ 365\left(\frac{days}{year}\right)$$

			Source of Information	Line #
Q	=	220,000 gpd	2005 Water and Sewer Plan	8
C (Nitrogen)	=	7.32 mg/liter	Discharge Monitoring Reports, Average Concentration of Toal Nitrogen from, 1/2006 to 4/2008	9
C (Phosphorus)	=	0.195 mg/liter	Discharge Monitroing Reports, Average Concentration of Total Phosphorus from 1/2006 to 4/2008	10
Load (Nitrogen)	=	4,902 lbs/year	Calculated	11
Load (Phosphorus)	=	131 lbs/year	Calculated	12

3) Determine Loads if Chestertown and Rock Hall are operating at ENR

See Alternate Worksheet

				Source of Information	Line #

4) Calculate 2030 Loading Rates

4a) Predict 2030 Flows

$$\boxed{Future\,Flow = \frac{Future\,Area}{Current\,Area} \times Current\,Flow}$$

				Source of Information	Line #
Current Flow	=	220,000	gpd	Line 8	13
Current Sewer Service Area	=	2,287	acres	Sewer Service GIS File from County (included no municipal service areas, used city boundary for service area)	14
Future Sewer Service Area	=	2373	acres	Sewer Service GIS File from County (included no municipal service areas, used city boundary for service area)	15
Predicted Future Flow (2030)	=	228,273	gpd	Calculated	16

4b) Predict 2030 Loadings

$$\boxed{Load = Q(MGD) \times C\left(\frac{mg}{l}\right) \times 8.34\ x\ 365\left(\frac{days}{year}\right)}$$

Assume current concentrations unless plant provides information on proposed treatment upgrades.

				Source of Information	Line #
Q	=	228,273	gpd	Line 16	17
C (Nitrogen)[4]	=	7.32	mg/liter	Discharge Monitoring Reports[4], Average Concentration of Total Nitrogen from, 1/2006 to 4/2008	18
C (Phosphorus)[4]	=	0.195	mg/liter	Discharge Monitroing Reports[4], Average Concentration of Total Phosphorus from 1/2006 to 42008	19
Load (Nitrogen)	=	5,087	lbs/year	Calculated	20
Load (Phosphorus)	=	136	lbs/year	Calculated	21

5) Predict 2020 Loadings with Annexations

Not Applicable to Rock Hall

Source of Information	Line #

				Source of Information	Line #

6) Determine Surplus or Deficit

6a) Hydraulic Surplus or Deficit

Hydraulic Surplus or Deficit = Capacity - Flow

				Source of Information	Line #
Design Capacity	=	510,000	gpd	2005 Water and Sewer Plan	22
Current Flow	=	220,000	gpd	Line 8	23
Future Flow	=	228,273	gpd	Line 16	24
Current Hydraulic Surplus (+) / Deficit (-)	=	290,000	gpd	Calculated	25
Future Hydraulic Surplus (+) / Deficit (-)	=	281,727	gpd	Calculated	26

6b) Nutrient Surplus or Deficit

Surplus/Deficit = Tributary Strategy Cap - Loading

				Source of Information	Line #
Nitrogen					
Nitrogen Cap	=	15,615	lbs/year	Line 6	27
Current Load	=	4,902	lbs/year	Line 11	28
Predicted Future Load	=	5,087	lbs/year	Line 20	29
Current Nitrogen Surplus (+) / Deficit (-)	=	10,713	lbs/year	Calculated	30
Future Nitrogen Surplus (+) / Deficit (-)	=	10,528	lbs/year	Calculated	31
Phosphorus					
Phosphorus Cap	=	2,602	lbs/year	Line 7	32
Current Load	=	131	lbs/year	Line 12	33
Predicted Future Load	=	136	lbs/year	Line 21	34
Current Phosphorus Surplus (+) / Deficit (-)	=	2,471	lbs/year	Calculated	35
Future Phosphorus Surplus (+) / Deficit (-)	=	2,466	lbs/year	Calculated	36

7) Convert Surplus / Deficit to EDUs

7a) Convert Hydraulic Surplus / Deficit to Equivalent Dwelling Units (EDUs)

$$\boxed{Available \quad EDUs = \frac{Surplus\,/\,Deficit \quad (gpd)}{250\,\frac{gpd}{EDU}}}$$

				Source of Information	Line #
Curent Hydraulic Surplus (+) / Deficit (-)	=	290,000	gpd	Line 25	37
Current Available EDUs	=	1160	EDUs	Calculated	38
Future Hydraulic Surplus (+) / Deficit (-)	=	281,727	gpd	Line 26	39
Future Available EDUs	=	1127	EDUs	Calculated	40

7b) Convert Nutrient Surplus/Deficit to EDUs

$$\boxed{Available\,EDUs = \frac{Surplus/Deficit\,(lb/\,year\,)}{C \times 8.34 \times 365 \times 250} \times 1{,}000{,}000}$$

				Source of Information	Line #
Nitrogen (Current)					
Current Nitrogen Surplus (+) / Deficit (-)	=	10,713	lbs/year	Line 30	41
Concentration	=	7.32	mg/liter	Line 9	43
Current Available EDUs based on Nitrogen	=	1,923	EDUs	Calculated	44
Nitrogen (Future)					
Future Nitrogen Surplus (+) / Deficit (-)	=	10,528	lbs/year	Line 31	45
Concentration	=	7.32	mg/liter	Line 18	47
Future Available EDUs based on Nitrogen	=	1,890	EDUs	Calculated	48
Phosphorus (Current)					
Future Nitrogen Surplus + Annexation (+) / Deficit (-)	=	2,471	lbs/year	Line 35	49
Concentration	=	0.195	mg/liter	Line 10	51
Current Available EDUs based on Phosphorus	=	16,654	EDUs	Calculated	52
Phosphorus (Future):					
Future Phosphorus Surplus + Annexation (+) / Deficit (-)	=	2,466	lbs/year	Line 36	53
Concentration	=	0.195	mg/liter	Line 19	55
Future Available EDUs based on Phosphorus	=	16,621	EDUs	Calculated	56

			Source of Information	Line #
8) Determine the Limiting Factor[5]				
Current Available EDUs				
Hydraulic	=	1160 EDUs	Line 38	57
Nitrogen	=	1,923 EDUs	Line 44	58
Phosphorus	=	16,654 EDUs	Line 52	59
Limiting Factor[5]	=	Nitrogen		60
Future Available EDUs				
Hydraulic	=	1127 EDUs	Line 40	61
Nitrogen	=	1,890 EDUs	Line 48	62
Phosphorus	=	16,621 EDUs	Line 56	63
Limiting Factor[5]	=	Hydarulic		64

Notes

1) Design flow determines plant classification
2) If an expansion of a minor WWTP is planned, the Caps cannot exceed 6,100 lbs/year of Nitrogen and 457 lbs/year of Phosphorus.
3) Current and Future Area were taken from GIS files delineating the current and proposed sewer service area (no proposed service areas for municipal plants included). Does not account for build-out. Other information from operating agency may be used in lieu of simplified area calculation; Refer to Wastewater Capacity Management Plan Guidance for recommendations and worksheet.)
4) Assume current concentrations unless operating agency provides information on proposed treatment upgrades.
5) Limiting Factor is the analysis (hydraulic, nitrogen, phosphorus) that produces the least # of available EDUs

Appendix 2-J

WWTP Analysis:

Plant Name: Chestertown (ENR)
Classification: Major WWTP

1) Determine Tributary Strategy Point Source Nutrient Caps
* Point Source Nutrient Caps taken directly from MDE worksheet shown in Appendix 2-B

				Source of Information	Line #
Q (Design Capacity)[1]	=	1,500,000	gpd	Trib Strat Implementation Plan	1
C (Nitrogen)	=	4	mg/liter	Trib Strat Implementation Plan, Point Source Strategy for Minor Plants	2
C (Phosphorus)	=	0.3	mg/liter	Trib Strat Implementation Plan, Point Source Strategy for Minor Plants	3
Cap (Nitrogen)	=	18,273	lbs/year	Trib Strat Implementation Plan	4
Cap (Phosphorus)	=	1,371	lbs/year	Trib Strat Implementation Plan	5

1a) Determine Cap if Minor WWTP is expanded[2] (Not Applicable)

If Nitrogen Cap > 6,100 lbs/year, expanded limit = 6,100 lbs/year; if not, it remains the same as line 4

If Phosphorus Cap > 457 lbs/year, expanded limit = 457 lbs/year; if not, it remains the same as line 5

Nitrogen	=	N/A	lbs/year	Trib Strat Implementation Plan/ Calculated	6
Phosphorus	=	N/A	lbs/year	Trib Strat Implementation Plan/Calculated	7

				Source of Information	Line #
2) Calculate Current Loading Rates					

$$Load = Q(mgd) \times C\left(\frac{mg}{l}\right) \times 8.34\ x\ 365\left(\frac{days}{year}\right)$$

Q	=	706,000	gpd	2005 Water and Sewer Plan	8
C (Nitrogen)	=	4	mg/liter	Assumed	9
C (Phosphorus)	=	0.3	mg/liter	Assumed	10
Load (Nitrogen)	=	8,597	lbs/year	Calculated	11
Load (Phosphorus)	=	645	lbs/year	Calculated	12

3) Determine Loads if Chestertown and Rock Hall are operating at ENR
See Alternate Worksheet

				Source of Information	Line #

4) Calculate 2030 Loading Rates

4a) Predict 2030 Flows

$$\boxed{Future\,Flow = \frac{Future\,Area}{Current\,Area} \times Current\,Flow}$$

Current Flow	=	706,000	gpd	Line 8	13
Current Sewer Service Area	=	1,948	acres	Sewer Service GIS File from County (included no municipal service areas, used city boundary for service area)	14
Future Sewer Service Area	=	2091	acres	Sewer Service GIS File from County (included no municipal service areas, used city boundary for service area)	15
Predicted Future Flow (2030)	=	757,826	gpd	Calculated	16

* This result is superceded by the information received at the 1/14/09 meeting.

4b) Predict 2030 Loadings

$$\boxed{Load = Q(MGD) \times C\left(\frac{mg}{l}\right) \times 8.34\ x\ 365\left(\frac{days}{year}\right)}$$

Assume current concentrations unless plant provides information on proposed treatment upgrades.

Q	=	1,500,000	gpd	Line 16	17
C (Nitrogen)[4]	=	4	mg/liter	Assumed	18
C (Phosphorus)[4]	=	0.3	mg/liter	Assumed	19
Load (Nitrogen)	=	18,265	lbs/year	Calculated	20
Load (Phosphorus)	=	1,370	lbs/year	Calculated	21

					Source of Information	Line #

5) Predict 2030 Loadings with Annexations

5a) Predict 2030 Flows with Annexations

$$\boxed{Future\,Flow = \frac{Future\,Area}{Current\,Area} \times Current\,Flow}$$

				Source of Information	Line #
Current Flow	=	706,000	gpd	Line 8	13a
Current Sewer Service Area	=	1,948	acres	Sewer Service GIS File from County (included no municipal service areas, used city boundary for service area)	14a
Future Sewer Service Area + Annexations	=	3109	acres	Sewer Service GIS File from County (included no municipal service areas, used city boundary for service area)	15a
Predicted Future Flow (2030) + Annexations	=	1,126,773	gpd	Calculated	16a

* This result superceded by information received at 1/14/09 meeting.

4b) Predict 2030 + Annexation Loadings

$$\boxed{Load = Q(MGD) \times C\left(\frac{mg}{l}\right) \times 8.34\ x\ 365\left(\frac{days}{year}\right)}$$

Assume current concentrations unless plant provides information on proposed treatment upgrades.

				Source of Information	Line #
Q	=	1,500,000	gpd	Line 16	17a
C (Nitrogen)[4]	=	4	mg/liter	Assumed	18a
C (Phosphorus)[4]	=	0.3	mg/liter	Assumed	19a
Load (Nitrogen)	=	18,265	lbs/year	Calculated	20a
Load (Phosphorus)	=	1,370	lbs/year	Calculated	21a

			Source of Information	Line #

6) Determine Surplus or Deficit

6a) Hydraulic Surplus or Deficit

Hydraulic Surplus or Deficit = Capacity - Flow

Design Capacity	=	1,500,000 gpd	2005 Water and Sewer Plan	22
Current Flow	=	706,000 gpd	Line 8	23
Future Flow	=	1,500,000 gpd	Line 16	24
Future + Annexations Flow	=	1,500,000 gpd	Line 16	24a
Current Hydraulic Surplus (+) / Deficit (-)	=	794,000 gpd	Calculated	25
Future Hydraulic Surplus (+) / Deficit (-)	=	0 gpd	Calculated	26
Future + Annexations Surplus (+) / Deficit (-)	=	0 gpd	Calculated	26a

6b) Nutrient Surplus or Deficit

Surplus/Deficit = Tributary Strategy Cap - Loading

Nitrogen

Nitrogen Cap	=	18,273 lbs/year	Line 6	27
Current Load	=	8,597 lbs/year	Line 11	28
Predicted Future Load	=	18,265 lbs/year	Line 20	29
Predicted Future + Annexations Load	=	18,265 lbs/year	Line 20a	29a
Current Nitrogen Surplus (+) / Deficit (-)	=	9,676 lbs/year	Calculated	30
Future Nitrogen Surplus (+) / Deficit (-)	=	0 lbs/year	Calculated	31
Future + Annexations Surplus (+)/Deficit (-)	=	0 lbs/year	Calculated	31a

Phosphorus

Phosphorus Cap	=	1,371 lbs/year	Line 7	32
Current Load	=	645 lbs/year	Line 12	33
Predicted Future Load	=	1,370 lbs/year	Line 21	34
Predicted Future + Annexation Load	=	1,370 lbs/year	Line 22	34a
Current Phosphorus Surplus (+) / Deficit (-)	=	726 lbs/year	Calculated	35
Future Phosphorus Surplus (+) / Deficit (-)	=	0 lbs/year	Calculated	36
Future + Annexations Phosphorus Surplus (+) / Deficit (-)	=	0 lbs/yeaer	Calculated	36a

				Source of Information	Line #

7) Convert Surplus / Deficit to EDUs

7a) Convert Hydraulic Surplus / Deficit to Equivalent Dwelling Units (EDUs)

$$Available \quad EDUs = \frac{Surplus / Deficit \quad (gpd)}{250 \dfrac{gpd}{EDU}}$$

Curent Hydraulic Surplus (+) / Deficit (-)	=	794,000	gpd	Line 25	37
Current Available EDUs	=	3176	EDUs	Calculated	38
Future Hydraulic Surplus (+) / Deficit (-)	=	0	gpd	Line 26	39
Future Available EDUs	=	0	EDUs	Calculated	40
Future Hydraulic Surplus (+) / Deficit (-)	=	0	gpd	Line 26a	39a
Future Available EDUs	=	0	EDUs	Calculated	40a

7b) Convert Nutrient Surplus/Deficit to EDUs

$$Available\,EDUs = \frac{Surplus/Deficit\,(lb/\,year\,)}{C \times 8.34 \times 365 \times 250} \times 1{,}000{,}000$$

Nitrogen (Current)					
Current Nitrogen Surplus (+) / Deficit (-)	=	9,676	lbs/year	Line 30	41
Concentration	=	4	mg/liter	Line 9	43
Current Available EDUs based on Nitrogen	=	3,179	EDUs	Calculated	44
Nitrogen (Future)					
Future Nitrogen Surplus (+) / Deficit (-)	=	0	lbs/year	Line 31	45
Concentration	=	4	mg/liter	Line 18	47
Future Available EDUs based on Nitrogen	=	0	EDUs	Calculated	48
Nitrogen (Future + Annexation)					
Future Nitrogen Surplus + Annexation (+) / Deficit (-)	=	0	lbs/year	31a	45
Concentration	=	4	mg/liter	Line 18	47
Future Available EDUs based on Nitrogen	=	0	EDUs	Calculated	48
Phosphorus (Current)					
Future Nitrogen Surplus + Annexation (+) / Deficit (-)	=	726	lbs/year	Line 35	49
Concentration	=	0.3	mg/liter	Line 10	51
Current Available EDUs based on Phosphorus	=	3,181	EDUs	Calculated	52

				Source of Information	Line #
Phosphorus (Future):					
Future Phosphorus Surplus + Annexation (+) / Deficit (-)	=	0	lbs/year	Line 36	53
Concentration	=	0.3	mg/liter	Line 19	55
Future Available EDUs based on Phosphorus	=	0	EDUs	Calculated	56
Phosphorus (Future+Annexation):					
Future + Annexation Phosphorus Surplus + Annexation (+) / Deficit (-)	=	0	lbs/year	Line 36	53
Concentration	=	0.3	mg/liter	Line 19	55
Future+ Annexation Available EDUs based on Phosphorus	=	0	EDUs	Calculated	56

				Source of Information	Line #
8) Determine the Limiting Factor[5]					
Current Available EDUs					
Hydraulic	=	3176	EDUs	Line 38	57
Nitrogen	=	3,179	EDUs	Line 44	58
Phosphorus	=	3,181	EDUs	Line 52	59
Limiting Factor[5]	=	Hydraulic			60
Future Available EDUs					
Hydraulic	=	0	EDUs	Line 40	61
Nitrogen	=	0	EDUs	Line 48	62
Phosphorus	=	0	EDUs	Line 56	63
Limiting Factor[5]	=	Phosphorus			64
Future +Annexation Available EDUs					
Hydraulic	=	0	EDUs	Line 40	61
Nitrogen	=	0	EDUs	Line 48	62
Phosphorus	=	0	EDUs	Line 56	63
Limiting Factor[5]	=	Phosphorus			64

Notes
1) Design Flow determines whether or not a plant is classified as a major or minor plant
2) If an expansion of a minor WWTP is planned, the Caps cannot exceed 6,100 lbs/year of Nitrogen and 457 lbs/year of Phosphorus.
3) Current and Future Area were taken from GIS files delineating the current and proposed sewer service area (no proposed service areas for municipal plants included). Does not account for build-out. Other information from operating agency may be used in lieu of simplified area calculation; Refer to Wastewater Capacity Management Plan Guidance for recommendations and worksheet.)
4) Assume current concentrations unless operating agency provides information on proposed treatment upgrades.
5) Limiting Factor is the analysis (hydraulic, nitrogen, phosphorus) that produces the least # of available EDUs

Appendix 2-J

WWTP Analysis:

Plant Name: Millington
Classification: Minor WWTP

1) Determine Tributary Strategy Point Source Nutrient Caps
* Point Source Nutrient Caps taken directly from MDE worksheet shown in Appendix 2-B

		Value	Units	Source of Information	Line #
Q (2020 Predicted Flow)[1]	=	57,000	gpd	Trib Strat Implementation Plan	1
C (Nitrogen)	=	18	mg/liter	Trib Strat Implementation Plan, Point Source Strategy for Minor Plants	2
C (Phosphorus)	=	3	mg/liter	Trib Strat Implementation Plan, Point Source Strategy for Minor Plants	3
Cap (Nitrogen)	=	3,344	lbs/year	Trib Strat Implementation Plan	4
Cap (Phosphorus)	=	557	lbs/year	Trib Strat Implementation Plan	5

1a) Determine Cap if Minor WWTP is expanded[2]

If Nitrogen Cap > 6,100 lbs/year, expanded limit = 6,100 lbs/year; if not, it remains the same as line 4

If Phosphorus Cap > 457 lbs/year, expanded limit = 457 lbs/year; if not, it remains the same as line 5

		Value	Units	Source of Information	Line #
Nitrogen	=	3,344	lbs/year	Trib Strat Implementation Plan/ Calculated	6
Phosphorus	=	457	lbs/year	Trib Strat Implementation Plan/Calculated	7

				Source of Information	Line #

2) Calculate Current Loading Rates

$$Load = Q(mgd) \times C\left(\frac{mg}{l}\right) \times 8.34\ x\ 365\left(\frac{days}{year}\right)$$

				Source of Information	Line #
Q	=	140,000	gpd	2005 Water and Sewer Plan	8
C (Nitrogen)	=	18.96	mg/liter	Discharge Monitoring Reports, Average Concentration of Total Nitrogen from, 1/2006 to 3/2008	9
C (Phosphorus)	=	2.44	mg/liter	Discharge Monitroing Reports, Average Concentration of Total Phosphorus from 1/2006 to 3/2008	10
Load (Nitrogen)	=	8,080	lbs/year	Calculated	11
Load (Phosphorus)	=	1,040	lbs/year	Calculated	12

* 140,000 is used based on the information obtained at the 1/14/09 meeting

3) Determine Loads if Chestertown and Rock Hall are operating at ENR

Not Applicable to Minor WWTP

				Source of Information	Line #

4) Calculate 2030 Loading Rates

4a) Predict 2030 Flows

$$FutureFlow = \frac{FutureArea}{CurrentArea} \times CurrentFlow$$

				Source of Information	Line #
Current Flow	=	55,000	gpd	Line 8	13
Current Sewer Service Area	=	301	acres	Sewer Service GIS File from County (included no municipal service areas, used city boundary for service area)	14
Future Sewer Service Area	=	666	acres	Sewer Service GIS File from County (included no municipal service areas, used city boundary for service area)	15
Predicted Future Flow (2030)	=	250,000	gpd	Calculated	16

* 250,000 is used based on the information obtained at the 1/14/09 meeting.

4b) Predict 2030 Loadings

$$Load = Q(MGD) \times C\left(\frac{mg}{l}\right) \times 8.34 \ x \ 365\left(\frac{days}{year}\right)$$

Assume current concentrations unless plant provides information on proposed treatment upgrades.

				Source of Information	Line #
Q	=	250,000	gpd	Line 16	17
C (Nitrogen)[4]	=	18.9	mg/liter	Discharge Monitoring Reports[4], Average Concentration of Ammonia Nitrogen from, 1/2006 to 3/2008	18
C (Phosphorus)[4]	=	2.44	mg/liter	Discharge Monitroing Reports[4], Average Concentration of Total Phosphorus from 5/2006 to 10/2007	19
Load (Nitrogen)	=	14,383	lbs/year	Calculated	20
Load (Phosphorus)	=	1,857	lbs/year	Calculated	21

5) Predict 2030 Loadings with Annexations

5a) Predict 2030 Flows with Annexations

$$FutureFlow = \frac{FutureArea}{CurrentArea} \times CurrentFlow$$

$$Future\ Flow = \frac{Future\ Area}{Current\ Area} \times Current\ Flow$$

				Source of Information	Line #
Current Flow	=	55,000	gpd	Line 8	13a
Current Sewer Service Area	=	301	acres	Sewer Service GIS File from County (included no municipal service areas, used city boundary for service area)	14a
Future Sewer Service Area + Annexations	=	936	acres	Sewer Service GIS File from County (included no municipal service areas, used city boundary for service area)	15a
Predicted Future Flow (2030) + Annexations	=	250,000	gpd	Calculated	16a

4b) Predict 2030 + Annexation Loadings

$$Load = Q(MGD) \times C\left(\frac{mg}{l}\right) \times 8.34\ x\ 365\left(\frac{days}{year}\right)$$

Assume current concentrations unless plant provides information on proposed treatment upgrades.

Q	=	250,000	gpd	Line 16	17a
C (Nitrogen)[4]	=	18.9	mg/liter	Discharge Monitoring Reports[4], Average Concentration of Ammonia Nitrogen from, 1/2006 to 3/2008	18a
C (Phosphorus)[4]	=	2.44	mg/liter	Discharge Monitroing Reports[4], Average Concentration of Total Phosphorus from 5/2006 to 10/2007	19a
Load (Nitrogen)	=	14,383	lbs/year	Calculated	20a
Load (Phosphorus)	=	1,857	lbs/year	Calculated	21a

				Source of Information	Line #

6) Determine Surplus or Deficit

6a) Hydraulic Surplus or Deficit

Hydraulic Surplus or Deficit = Capacity - Flow

Design Capacity	=	145,000	gpd	2005 Water and Sewer Plan	22
Current Flow	=	140,000	gpd	Line 8	23
Future Flow	=	250,000	gpd	Line 16	24
Future + Annexations Flow	=	250,000	gpd	Line 16	24a
Current Hydraulic Surplus (+) / Deficit (-)	=	5,000	gpd	Calculated	25
Future Hydraulic Surplus (+) / Deficit (-)	=	-105,000	gpd	Calculated	26
Future + Annexations Surplus (+) / Deficit (-)	=	-105,000	gpd	Calculated	26a

6b) Nutrient Surplus or Deficit

Surplus/Deficit = Tributary Strategy Cap - Loading

Nitrogen

Nitrogen Cap	=	3,344	lbs/year	Line 6	27
Current Load	=	8,080	lbs/year	Line 11	28
Predicted Future Load	=	14,383	lbs/year	Line 20	29
Predicted Future + Annexations Load	=	14,383	lbs/year	Line 20a	29a
Current Nitrogen Surplus (+) / Deficit (-)	=	-4,736	lbs/year	Calculated	30
Future Nitrogen Surplus (+) / Deficit (-)	=	-11,039	lbs/year	Calculated	31
Future + Annexations Surplus (+)/Deficit (-)	=	-11,039	lbs/year	Calculated	31a

Phosphorus

Phosphorus Cap	=	557	lbs/year	Line 5	32
Expanded Phosphorus Cap		457	lbs/year	Line 7	32a
Current Load	=	1,040	lbs/year	Line 12	33
Predicted Future Load	=	1,857	lbs/year	Line 21	34
Predicted Future + Annexation Load	=	1,857	lbs/year	Line 22	34a
Current Phosphorus Surplus (+) / Deficit (-)	=	-483	lbs/year	Calculated	35
Future Phosphorus Surplus (+) / Deficit (-)	=	-1,400	lbs/year	Calculated	36
Future + Annexations Phosphorus Surplus (+) / Deficit (-)	=	-1,400	lbs/yeaer	Calculated	36a

			Source of Information	Line #

7) Convert Surplus / Deficit to EDUs

7a) Convert Hydraulic Surplus / Deficit to Equivalent Dwelling Units (EDUs)

$$Available \quad EDUs = \frac{Surplus\,/\,Deficit \quad (gpd)}{250\,\frac{gpd}{EDU}}$$

Curent Hydraulic Surplus (+) / Deficit (-)	=	5,000 gpd	Line 25	37
Current Available EDUs	=	20 EDUs	Calculated	38
Future Hydraulic Surplus (+) / Deficit (-)	=	-105,000 gpd	Line 26	39
Future Available EDUs	=	-420 EDUs	Calculated	40
Future Hydraulic Surplus (+) / Deficit (-)	=	-105,000 gpd	Line 26a	39a
Future Available EDUs	=	-420 EDUs	Calculated	40a

7b) Convert Nutrient Surplus/Deficit to EDUs

$$Available\,EDUs = \frac{Surplus/Deficit\,(lb/year)}{C \times 8.34 \times 365 \times 250} \times 1{,}000{,}000$$

Nitrogen (Current)				
Current Nitrogen Surplus (+) / Deficit (-)	=	-4,736 lbs/year	Line 30	41
Concentration	=	18.96 mg/liter	Line 9	43
Current Available EDUs based on Nitrogen	=	-328 EDUs	Calculated	44
Nitrogen (Future)				
Future Nitrogen Surplus (+) / Deficit (-)	=	-11,039 lbs/year	Line 31	45
Concentration	=	18.9 mg/liter	Line 18	47
Future Available EDUs based on Nitrogen	=	-768 EDUs	Calculated	48
Nitrogen (Future + Annexation)				
Future Nitrogen Surplus + Annexation (+) / Deficit (-)	=	-11,039 lbs/year	31a	45
Concentration	=	18.9 mg/liter	Line 18	47
Future Available EDUs based on Nitrogen	=	-768 EDUs	Calculated	48
Phosphorus (Current)				
Future Nitrogen Surplus + Annexation (+) / Deficit (-)	=	-483 lbs/year	Line 35	49
Concentration	=	2.44 mg/liter	Line 10	51
Current Available EDUs based on Phosphorus	=	-260 EDUs	Calculated	52

				Source of Information	Line #
Phosphorus (Future):					
Future Phosphorus Surplus + Annexation (+) / Deficit (-)	=	-1,400	lbs/year	Line 36	53
Concentration	=	2.44	mg/liter	Line 19	55
Future Available EDUs based on Phosphorus	=	-754	EUDs	Calculated	56
Phosphorus (Future+Annexation):					
Future + Annexation Phosphorus Surplus + Annexation (+) / Deficit (-)	=	-1,400	lbs/year	Line 36	53
Concentration	=	2.44	mg/liter	Line 19	55
Future+ Annexation Available EDUs based on Phosphorus	=	-754	EUDs	Calculated	56

				Source of Information	Line #
8) Determine the Limiting Factor[5]					
Current Available EDUs					
Hydraulic	=	20	EDUs	Line 38	57
Nitrogen	=	-328	EDUs	Line 44	58
Phosphorus	=	-260	EDUs	Line 52	59
Limiting Factor[5]	=	Nitrogen			60
Future Available EDUs					
Hydraulic	=	-420	EDUs	Line 40	61
Nitrogen	=	-768	EDUs	Line 48	62
Phosphorus	=	-754	EDUs	Line 56	63
Limiting Factor[5]	=	Nitrogen			64
Future +Annexation Available EDUs					
Hydraulic	=	-420	EDUs	Line 40	61
Nitrogen	=	-768	EDUs	Line 48	62
Phosphorus	=	-754	EDUs	Line 56	63
Limiting Factor[5]	=	Nitrogen			64

Notes

1) 2020 Predicted Flow was estimated by MDE in 2000 and may be lower than the actual current flow, Caps will still remain the same.
2) If an expansion of a minor WWTP is planned, the Caps cannot exceed 6,100 lbs/year of Nitrogen and 457 lbs/year of Phosphorus.
3) Current and Future Area were taken from GIS files delineating the current and proposed sewer service area (no proposed service areas for municipal plants included). Does not account for build-out. Other information from operating agency may be used in lieu of simplified area calculation; Refer to Wastewater Capacity Management Plan Guidance for recommendations and worksheet.)
4) Assume current concentrations unless operating agency provides information on proposed treatment upgrades.
5) Limiting Factor is the analysis (hydraulic, nitrogen, phosphorus) that produces the least # of available EDUs

Appendix 2-J

WWTP Analysis:

Plant Name: Galena
Classification: Minor WWTP

1) Determine Tributary Strategy Point Source Nutrient Caps

				Source of Information	Line #
Q (2020 Predicted Flow)[1]	=	28,000	gpd	Trib Strat Implementation Plan	1
C (Nitrogen)	=	18	mg/liter	Trib Strat Implementation Plan, Point Source Strategy for Minor Plants	2
C (Phosphorus)	=	3	mg/liter	Trib Strat Implementation Plan, Point Source Strategy for Minor Plants	3
Cap (Nitrogen)	=	1,538	lbs/year	MDE Worksheet	4
Cap (Phosphorus)	=	256	lbs/year	MDE Worksheet	5

1a) Determine Cap if Minor WWTP is expanded[2]

If Nitrogen Cap > 6,100 lbs/year, expanded limit = 6,100 lbs/year; if not, it remains the same as line 4

If Phosphorus Cap > 457 lbs/year, expanded limit = 457 lbs/year; if not, it remains the same as line 5

Nitrogen	=	1,538	lbs/year	Trib Strat Implementation Plan/ Calculated	6
Phosphorus	=	256	lbs/year	Trib Strat Implementation Plan/Calculated	7

				Source of Information	Line #

2) Calculate Current Loading Rates

$$Load = Q(mgd) \times C\left(\frac{mg}{l}\right) \times 8.34\ x\ 365\left(\frac{days}{year}\right)$$

				Source of Information	Line #
Q	=	50,000	gpd	2005 Water and Sewer Plan	8
C (Nitrogen)	=	11.48	mg/liter	Discharge Monitoring Reports, Average Concentration of Ammonia Nitrogen from, 1/2006 to 3/2008	9
C (Phosphorus)	=	6.77	mg/liter	Discharge Monitroing Reports, Average Concentration of Total Phosphorus from 5/2006 to 10/2007	10
Load (Nitrogen)	=	1,747	lbs/year	Calculated	11
Load (Phosphorus)	=	1,030	lbs/year	Calculated	12

3) Determine Loads if Chestertown and Rock Hall are operating at ENR

Not Applicable to Minor WWTP

				Source of Information	Line #

4) Calculate 2030 Loading Rates

4a) Predict 2030 Flows

$$Future\,Flow = \frac{Future\,Area}{Current\,Area} \times Current\,Flow$$

				Source of Information	Line #
Current Flow	=	50,000	gpd	Line 8	13
Current Sewer Service Area	=	235	acres	Sewer Service GIS File from County (included no municipal service areas, used city boundary for service area)	14
Future Sewer Service Area	=	235	acres	Sewer Service GIS File from County (included no municipal service areas, used city boundary for service area)	15
Predicted Future Flow (2030)	=	50,000	gpd	Calculated	16

4b) Predict 2030 Loadings

$$Load = Q(MGD) \times C\left(\frac{mg}{l}\right) \times 8.34 \ x \ 365\left(\frac{days}{year}\right)$$

Assume current concentrations unless plant provides information on proposed treatment upgrades.

				Source of Information	Line #
Q	=	50,000	gpd	Line 16	17
C (Nitrogen)[4]	=	11.48	mg/liter	Discharge Monitoring Reports[4], Average Concentration of Ammonia Nitrogen from, 1/2006 to 3/2008	18
C (Phosphorus)[4]	=	6.77	mg/liter	Discharge Monitroing Reports[4], Average Concentration of Total Phosphorus from 5/2006 to 10/2007	19
Load (Nitrogen)	=	1,747	lbs/year	Calculated	20
Load (Phosphorus)	=	1,030	lbs/year	Calculated	21

5) Predict 2030 Loadings with Annexations

Not Applicable to Galena

				Source of Information	Line #

6) Determine Surplus or Deficit

6a) Hydraulic Surplus or Deficit

Hydraulic Surplus or Deficit = Capacity - Flow

				Source of Information	Line #
Design Capacity	=	80,000	gpd	2005 Water and Sewer Plan	22
Current Flow	=	50,000	gpd	Line 8	23
Future Flow	=	50,000	gpd	Line 16	24
Current Hydraulic Surplus (+) / Deficit (-)	=	30,000		Calculated	25
Future Hydraulic Surplus (+) / Deficit (-)	=	30,000		Calculated	26

6b) Nutrient Surplus or Deficit

Surplus/Deficit = Tributary Strategy Cap - Loading

Nitrogen

Nitrogen Cap	=	1,538	lbs/year	Line 6	27
Current Load	=	1,747	lbs/year	Line 11	28
Predicted Future Load	=	1,747	lbs/year	Line 20	29
Current Nitrogen Surplus (+) / Deficit (-)	=	-209	lbs/year	Calculated	30
Future Nitrogen Surplus (+) / Deficit (-)	=	-209	lbs/year	Calculated	31

Phosphorus

Phosphorus Cap	=	256	lbs/year	Line 7	32
Current Load	=	1,030	lbs/year	Line 12	33
Predicted Future Load	=	1,030	lbs/year	Line 21	34
Current Phosphorus Surplus (+) / Deficit (-)	=	-775	lbs/year	Calculated	35
Future Phosphorus Surplus (+) / Deficit (-)	=	-775	lbs/year	Calculated	36

7) Convert Surplus / Deficit to EDUs

7a) Convert Hydraulic Surplus / Deficit to Equivalent Dwelling Units (EDUs)

$$\boxed{Available \quad EDUs = \frac{Surplus\,/\,Deficit \quad (gpd)}{250\,\dfrac{gpd}{EDU}}}$$

				Source of Information	Line #
Curent Hydraulic Surplus (+) / Deficit (-)	=	30,000	gpd	Line 25	37
Current Available EDUs	=	120	EDUs	Calculated	38
Future Hydraulic Surplus (+) / Deficit (-)	=	30,000	gpd	Line 26	39
Future Available EDUs	=	120	EDUs	Calculated	40

7b) Convert Nutrient Surplus/Deficit to EDUs

$$\boxed{Available\,EDUs = \frac{Surplus/Deficit\,(lb/\,year\,)}{C \times 8.34 \times 365 \times 250} \times 1{,}000{,}000}$$

				Source of Information	Line #
Nitrogen (Current)					
Current Nitrogen Surplus (+) / Deficit (-)	=	-209	lbs/year	Line 30	41
Concentration	=	11.48	mg/liter	Line 9	43
Current Available EDUs based on Nitrogen	=	-24	EUDs	Calculated	44
Nitrogen (Future)					
Future Nitrogen Surplus (+) / Deficit (-)	=	-209	lbs/year	Line 31	45
Concentration	=	11.48	mg/liter	Line 18	47
Future Available EDUs based on Nitrogen	=	-24	EUDs	Calculated	48
Phosphorus (Current)					
Phosphorus Cap	=	-775	lbs/year	Line 35	49
Concentration	=	6.77	mg/liter	Line 10	51
Current Available EDUs based on Phosphorus	=	-150	EUDs	Calculated	52
Phosphorus (Future):					
Expadned Phosphorus Cap	=	-775	lbs/year	Line 36	53
Concentration	=	6.77	mg/liter	Line 19	55
Future Available EDUs based on Phosphorus	=	-150	EUDs	Calculated	56

			Source of Information	Line #
8) Determine the Limiting Factor[5]				
Current Available EDUs				
Hydraulic	=	120 EDUs	Line 38	57
Nitrogen	=	-24 EDUs	Line 44	58
Phosphorus	=	-150 EDUs	Line 52	59
Limiting Factor[5]	=	Phosphorus		60
Future Available EDUs				
Hydraulic	=	120 EDUs	Line 40	61
Nitrogen	=	-24 EDUs	Line 48	62
Phosphorus	=	-150 EDUs	Line 56	63
Limiting Factor[5]	=	Phosphorus		64

Notes

1) 2020 Predicted Flow was estimated by MDE in 2000 and may be lower than the actual current flow, Caps will still remain the same.
2) If an expansion of a minor WWTP is planned, the Caps cannot exceed 6,100 lbs/year of Nitrogen and 457 lbs/year of Phosphorus.
3) Current and Future Area were taken from GIS files delineating the current and proposed sewer service area (no proposed service areas for municipal plants included).
   Does not account for build-out. Other information from operating agency may be used in lieu of simplified area calculation;
   Refer to Wastewater Capacity Management Plan Guidance for recommendations and worksheet.)
4) Assume current concentrations unless operating agency provides information on proposed treatment upgrades.
5) Limiting Factor is the analysis (hydraulic, nitrogen, phosphorus) that produces the least # of available EDUs