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By Bourne Health Department at 8:49 am, Feb 09, 2023

Town of Bourne CONSERVATION COMMISSION

I/A SYSTEM
Pg 1

Nitrogen Loading Calculation Sheet for Residential Housing

The following calculation sheet is based upon Technical Bulletin 91-001 issued by the Cape Cod Commission and deals with nitrate nitrogen (NO₃-N). Use the information from your PLAN OF RECORD to provide the following:

Number of bedrooms (Title 5 definition)	=	<u>3</u>	bedrooms
Lot size (in square feet)	=	<u>4840</u>	sq. ft.
Impervious surfaces; **Roof area = <u>1044</u> sq. ft. **Paved area = <u>238</u> sq. ft.	=	<u>238</u>	sq. ft.
Natural Area = lot area minus all impervious surfaces	=	<u>3558</u>	sq. ft.
Lawn area in sq. ft.	=	<u>1160</u>	sq. ft.

TITLE 5 FLOW = 110 GAL. / DAY PER BEDROOM
WASTEWATER FLOWS (NITROGEN LOAD & WATER LOAD)

Nitrogen from Title 5 design = ~~14,572~~ ^{7909.7} mg NO₃-N / day / bedroom
 Water from Title 5 design = 416.3 L H₂O / day / bedroom

1a) Number of bedrooms = 3 X ~~14,572~~ ^{7909.7} = 23,729.1 mg. NO₃-N / day
 1b) Number of bedrooms = 3 X 416 = 1248.9 L H₂O / day

Actual Nitrogen load = ~~6071.5~~ ^{3296.5} mg NO₃-N / day / bedroom
 Actual Water load = 173.5 L H₂O / day / bedroom

*Note: This assumes 2.5 people / unit average occupancy within the Town.

2a) Number of bedrooms = 3 X ~~6071.5~~ ^{3296.5} = 9889.5 mg. NO₃-N / day
 2b) Number of bedrooms = 3 X 173.5 = 520.5 L H₂O / day

IMPERVIOUS SURFACES (NITROGEN LOAD & WATER LOAD)

NO ₃ -N load number sq. ft. of roof surface	X	0.19395 mg NO ₃ -N / sq. ft.
H ₂ O load number sq. ft. of roof surface	X	0.2586 L / sq. ft.
3a) Roof surface = <u>1044</u> sq. ft.	X	0.19395 = <u>202.48</u> mg NO ₃ -N
3b) Roof surface = <u>1044</u> sq. ft.	X	0.2586 = <u>270.6</u> L H ₂ O

NO ₃ -N load number sq. ft. of paved surface	X	0.388 mg / sq. ft.
H ₂ O load number sq. ft. of paved surface	X	0.2586 L / sq. ft.

4a) NO₃-N = 238 sq. ft. paved surface X 0.388 mg / sq. ft. = 92.34 mg NO₃-N
 4b) H₂O = 238 sq. ft. paved surface X 0.2586 L / sq. ft. = 61.55 L H₂O

LAWN NITROGEN LOAD = 0.933 mg / sq. ft. lawn surface

5) sq. ft. of lawn = 1160 X 0.933 = 1082.28 mg

NATURAL AREA WATER LOADING

Natural area = lot size - impervious surface = 3558 sq.ft.

6) Natural area = 3558 X water recharge factor = 483.2 L
(0.1358 L / sq. ft. for Bourne)¹

SUMMARY OF NITROGEN LOADING

Estimated Title 5 Nitrogen & Water Loading

7a) ADD the above NO₃N load:

1a + 3a + 4a + 5
23729.1 + 202.5 + 92.3 + 1082.3 = 25,106.2 mg NO₃-N / day

7b) ADD the above water (H₂O) load:

1b + 3b + 4b + 6
1248.9 + 270.0 + 61.6 + 483.2 = 2063.7 L H₂O / day

7c) DIVIDE 7a by 7b = 12.16 ppm NO₃-N*****

Actual Nitrogen & Water Loading

8a) ADD the above NO₃N load:

2a + 3a + 4a + 5
9889.5 + 202.5 + 92.3 + 1082.3 = 11,266.6 mg NO₃-N / day

8b) ADD the above water (H₂O) load:

2b + 3b + 4b + 6
520.5 + 270.0 + 61.6 + 483.2 = 1335.3 L H₂O / day

8c) DIVIDE 8a by 8b = 8.44 ppm NO₃-N*****

FINAL CALCULATION ADD 7c & 8c (ppm) = 20.6 divide by 2 = 10.3 ppm NO₃-N

This is the actual nitrate nitrogen load for the project as designed. The target for coastal areas is 5 ppm nitrate nitrogen. Certain critical embayments may require a LOWER figure to prevent degradation.

*****If your nitrate nitrogen load exceeds the target limit USE A SECOND CALCULATION SHEET TO SHOW ALTERNATIVES IN TRYING TO ACHIEVE THE 5 PPM NITRATE NITROGEN LEVEL*****

¹ Water recharge factors for data line 6: @21' / yr. use 0.1358 in Bourne and Falmouth; @ 19" / yr. use 0.1228 for Mashpee & Sandwich; @ 18" / yr. 0.1164 for Barnstable, Dennis & Yarmouth; @ 17" / yr. use 0.1101 for Brewster & Harwich; @ 16" / yr. use 0.1031 for Chatham, Eastham, Orleans, Provincetown, Truro & Wellfleet.

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Number of bedrooms (Title 5 definition)	=	<u>3</u>	bedrooms
Lot size (in square feet)	=	<u>4840</u>	sq. ft.
Impervious surfaces; **Roof area = <u>1044</u> sq. ft. **Paved area =	=	<u>238</u>	sq. ft.
Natural Area = lot area minus all impervious surfaces	=	<u>3558</u>	sq. ft.
Lawn area in sq. ft.	=	<u>1160</u>	sq. ft.

TITLE 5 FLOW = 110 GAL. / DAY PER BEDROOM
 WASTEWATER FLOWS (NITROGEN LOAD & WATER LOAD)

TITLE 5 ASSUMES 35 mg/l

Nitrogen from Title 5 design = 14,572 mg NO₃-N / day / bedroom

Water from Title 5 design = 416.3 L H₂O / day / bedroom

1a) Number of bedrooms = 3 X 14,572 = 43,716 mg. NO₃-N / day

1b) Number of bedrooms = 3 X 416 = 1248.9 L H₂O / day

Actual Nitrogen load = 6071.5 mg NO₃-N / day / bedroom

Actual Water load = 173.5 L H₂O / day / bedroom

*Note: This assumes 2.5 people / unit average occupancy within the Town.

2a) Number of bedrooms = 3 X 6071.5 = 18,214.5 mg. NO₃-N / day

2b) Number of bedrooms = 3 X 173.5 = 520.5 L H₂O / day

IMPERVIOUS SURFACES (NITROGEN LOAD & WATER LOAD)

NO₃-N load number sq. ft. of roof surface X 0.19395 mg NO₃-N / sq. ft.

H₂O load number sq. ft. of roof surface X 0.2586 L / sq. ft.

3a) Roof surface = 1044 sq. ft. X 0.19395 = 202.48 mg NO₃-N

3b) Roof surface = 1044 sq. ft. X 0.2586 = 270.0 L H₂O

NO₃-N load number sq. ft. of paved surface X 0.388 mg / sq. ft.

H₂O load number sq. ft. of paved surface X 0.2586 L / sq. ft.

4a) NO₃-N = 238 sq. ft. paved surface X 0.388 mg / sq. ft. = 92.34 mg NO₃-N

4b) H₂O = 238 sq. ft. paved surface X 0.2586 L / sq. ft. = 61.55 L H₂O

LAWN NITROGEN LOAD = 0.933 mg / sq. ft. lawn surface

5) sq. ft. of lawn = 1160 X 0.933

= 1082.28 mg

NATURAL AREA WATER LOADING

Natural area = lot size - impervious surface

= 3558 sq.ft.

6) Natural area = 3558 X water recharge factor (0.1358 L / sq. ft. for Bourne)¹

= 483.2 L

SUMMARY OF NITROGEN LOADING

Estimated Title 5 Nitrogen & Water Loading

7a) ADD the above NO₃N load:

1a + 3a + 4a + 5
43,716 + 202.5 + 92.3 + 1082.3 = 45,093.1 mg NO₃-N / day

7b) ADD the above water (H₂O) load:

1b + 3b + 4b + 6
1248.9 + 270.0 + 61.6 + 483.2 = 2063.7 L H₂O / day

7c) DIVIDE 7a by 7b = 21.85 ppm NO₃-N*****

Actual Nitrogen & Water Loading

8a) ADD the above NO₃N load:

2a + 3a + 4a + 5
18,214.5 + 202.5 + 92.3 + 1082.3 = 19,591.6 mg NO₃-N / day

8b) ADD the above water (H₂O) load:

2b + 3b + 4b + 6
520.5 + 270.0 + 61.6 + 483.2 = 1335.3 L H₂O / day

8c) DIVIDE 8a by 8b = 14.67 ppm NO₃-N*****

FINAL CALCULATION ADD 7c & 8c (ppm) = 36.52 divide by 2 = 18.26 ppm NO₃-N

This is the actual nitrate nitrogen load for the project as designed. The target for coastal areas is 5 ppm nitrate nitrogen. Certain critical embayments may require a LOWER figure to prevent degradation.

*****If your nitrate nitrogen load exceeds the target limit USE A SECOND CALCULATION SHEET TO SHOW ALTERNATIVES IN TRYING TO ACHIEVE THE 5 PPM NITRATE NITROGEN LEVEL*****

¹ Water recharge factors for data line 6: @21' / yr. use 0.1358 in Bourne and Falmouth; @ 19" / yr. use 0.1228 for Mashpee & Sandwich; @ 18" / yr. 0.1164 for Barnstable, Dennis & Yarmouth; @ 17" / yr. use 0.1101 for Brewster & Harwich; @ 16" / yr. use 0.1031 for Chatham, Eastham, Orleans, Provincetown, Truro & Wellfleet.