

**Unit Conversions and Referenced Information/ Measurements:**

- 1 milligram/liter (mg/l) = 1 part per million (ppm)
- 1 acre = 43,560 sf
- 2.2lb = 1kg
- 1 gallon = 3.785 liters

**Measurements:**

- 5.43 acres = 236,530.8 sq-ft
- Land and buildings are currently valued at: \$1,441,600<sup>1</sup>
- Livable square feet for existing buildings on existing property is 14,220 SF<sup>2</sup>

<b>Existing</b>	<b>Overall Area</b>	<b>Green</b>	<b>Impervious</b>	<b>Roof</b>
Back Lot	83,928.44	30,654.51	32,963.93	20,310
Front Lot	152,602.36	45,151.49	87,568.87	19,882
Total Lot	236,530.8	75,806	120,532.8	40,192
<b>Proposed</b>				
Back Lot	83,928.44	48,457.72	15,870.72	19,600
Front Lot	152,602.36	45,151.49	87,568.87	19,882
Total Lot	236,530.8	93,609.21	103,439.59	39,482

**Project Information and Limitations:**

- Project is located within the main portion of the Lagoon Pond Watershed <sup>3</sup> identified as commercial use.
- Project site is zoned within the R20 district<sup>4,5</sup>, with use code, 3140, or 314, as "Trucking Terminal"<sup>6</sup>.

<sup>1</sup> Vision Property Card for 19-A-20, [https://www.axisgis.com/node/axisapi/document-view/TisburyMA?path=Docs/Batch/Vision\\_Property\\_Card/Vision%20ID\\_%201708.pdf](https://www.axisgis.com/node/axisapi/document-view/TisburyMA?path=Docs/Batch/Vision_Property_Card/Vision%20ID_%201708.pdf)

<sup>2</sup> Vision Property Card for 19-A-20

<sup>3</sup> MEP: Lagoon Pond <http://www.mvboh.org/images/mep-lagoon-isle.pdf>

<sup>4</sup> Zoning Map, Town of Tisbury, [https://www.tisburyma.gov/sites/tisburyma/files/uploads/tisbury\\_zoning\\_map-pdf.pdf](https://www.tisburyma.gov/sites/tisburyma/files/uploads/tisbury_zoning_map-pdf.pdf)

<sup>5</sup> Tisbury Map 19, lot 20 [https://www.tisburyma.gov/sites/tisburyma/files/uploads/t\\_19\\_0.pdf](https://www.tisburyma.gov/sites/tisburyma/files/uploads/t_19_0.pdf)

<sup>6</sup> Vision Property Card for 19-A-20

- Project site is **within the MVC DRI Zone II region**, and is currently flagged as a “Commercial Category of Potential Threats to Groundwater Sources” <sup>7</sup>
- In nitrogen sensitive areas the loading limits are 440 gallons per day (gpd) / acre = (5.43 acres)x(440 gpd/acre) = 2,389.2 gpd maximum flow, project is under the limit <sup>8</sup>
- Maximum allowed impervious surfaces for project (includes parking, building, or other purposes) is 15% of the overall square footage of the lot, or **35,479.8 sq-ft** <sup>9</sup>
- Project is located partially within a “Groundwater Protection District” <sup>10,11</sup>
- Groundwater annual recharge rate<sup>12</sup> based upon surficial map<sup>13</sup> and explanatory text<sup>14</sup>. According to the mapping data, project location is within glacial stratified deposits and is identified as a glaciodeltic outwash plain. **Annual recharge rate is 28.7 inches**

#### Calculate Nitrogen Load Limit for Lagoon Pond Watershed <sup>15</sup>

- (5.43 acres)x(2.87kg/acre/yr) = 15.5841 kg/yr Nitrogen

#### Calculate the Adjusted Nitrogen Load Limit for Lagoon Pond Watershed <sup>16</sup>

- (0.65 Nitrogen impairment Multiplier)x(15.5841 kg/year) = 10.129665 kg/yr Nitrogen

<sup>7</sup> Commercial Category of Potential Threats to Groundwater Sources, [http://www.mvcommission.org/sites/default/files/docs/MAP\\_A\\_8\\_PD.pdf](http://www.mvcommission.org/sites/default/files/docs/MAP_A_8_PD.pdf)

<sup>8</sup> Title V 310 CMR 15, see section 15.214 Nitrogen Loading Limitations <https://www.mass.gov/files/documents/2017/09/27/310cmr15.pdf>

<sup>9</sup> MVC Water Quality Management Policy DRI Projects <http://www.mvcommission.org/sites/default/files/docs/MVC%20Water%20Quality%20Management%20Policy%20Draft%202018%20reduced.pdf>

<sup>10</sup> Zoning Map, Town of Tisbury

<sup>11</sup> Tisbury Special Overlay Districts, section 9.11

<https://www.tisburyma.gov/sites/tisburyma/files/uploads/0900.pdf>

<sup>12</sup> MVC Water Quality Management Policy DRI Projects, page 14, 5.4, section B

<sup>13</sup> Surficial map of Martha’s Vineyard, USGS

<https://drive.google.com/open?id=1PLpkb1acxwFsXxrs3tZew5zVw8gncEaE>

<sup>14</sup> Explanatory text to accompany USGS map entitled: Surficial Geologic Map of the Pocasset Provincetown-Cuttyhunk-Nantucket 24-Quadrangle

Area of Cape Cod and Islands, Southeast

Massachusetts, [https://pubs.usgs.gov/of/2006/1260/E/OFR2006-1260E\\_text.pdf](https://pubs.usgs.gov/of/2006/1260/E/OFR2006-1260E_text.pdf)

<sup>15</sup> MVC Water Quality Management Policy DRI Projects, page 11, section 4.2

<sup>16</sup> MVC Water Quality Management Policy DRI Projects, page 11, section 4.3

## Determine Total Nitrogen Output for the Project <sup>17</sup>

Calc average annual wastewater flow for DRI project at:

(a): 60% of the title V wastewater design flow 26.25mg/liter (15.75mg/liter)

(b): 90% of the water usage figures (see note below) <sup>18</sup>

\*\*Above (a) and (b) shall also be used to determine Nitrogen concentration in groundwater and water withdrawal requirements for all projects.

Existing Stormwater Calculations:

### **A: Roof Surfaces:**

$$[40,192 \text{ ft}^2 \times ((42.21\text{inch} \times (1\text{ft}/12\text{inch})) \times (28.3 \text{ liter}/\text{ft}^3) \times (0.38\text{mg}/\text{liter}) ] \times (1 \text{ kg}/1,000,000\text{mg}) = \mathbf{1.5201\text{kg}\text{-yr}^{-1}}$$

### **B: Impervious Surfaces:**

$$[120,532.8\text{ft}^2 \times ((30.485\text{inch} \times (1\text{ft}/12 \text{ inch})) \times (28.3 \text{ liter}/\text{ft}^3) \times (0.75\text{mg}/\text{liter}) ] \times (1\text{kg}/1,000,000\text{mg}) = \mathbf{6.4981 \text{ kg}\text{-yr}^{-1}}$$

Existing wastewater Calculations:

### **C: Wastewater (from Tisbury water meter data):**

$$[(401,967 \text{ liter}/\text{yr}) \times (15.75\text{mg}/\text{liter})] \times (1\text{kg}/1,000,000\text{mg}) = \mathbf{6.3310 \text{ kg}\text{-yr}^{-1}}$$

$$\text{Total A + B + C} = 1.5201 + 6.4981 + 6.3310 = \mathbf{14.3492 \text{ kg}\text{-yr}^{-1}}$$

Proposed Stormwater Calculations:

### **A: Roof Surfaces:**

$$[39,482 \text{ ft}^2 \times ((42.21\text{inch} \times (1\text{ft}/12\text{inch})) \times (28.3 \text{ liter}/\text{ft}^3) \times (0.38\text{mg}/\text{liter}) ] \times (1 \text{ kg}/1,000,000\text{mg}) = \mathbf{1.4933 \text{ kg}\text{-yr}^{-1}}$$

### **B: Impervious Surfaces:**

$$[103,439.59\text{ft}^2 \times ((30.485\text{inch} \times (1\text{ft}/12 \text{ inch})) \times (28.3 \text{ liter}/\text{ft}^3) \times (0.75\text{mg}/\text{liter}) ] \times (1\text{kg}/1,000,000\text{mg}) = \mathbf{5.5766 \text{ kg}\text{-yr}^{-1}}$$

### **C: Waterwater from (water use data)**

$$[(411,808^{19} \text{ liter}/\text{yr}) \times (15.75\text{mg}/\text{liter})] \times (1\text{kg}/1,000,000\text{mg}) = \mathbf{6.4860 \text{ kg}\text{-yr}^{-1}}$$

<sup>17</sup> MVC Water Quality Management Policy DRI Projects, page 12, section 4.4

<sup>18</sup> Tisbury Water Department, water meter report for 19-A-20, 2019. We were able to get the actual water usage data from the meter which was then used in lieu of the Table C estimate (which is based upon down-island water usage by class of industry). It is a more accurate calculation.

<sup>19</sup> Based on an assumption of an additional 10% of UPS water use, an additional 2,600 gallons/year

$$\text{Total A + B + C} = 1.4933 + 5.5766 + 6.4860 = \underline{13.5559 \text{ kg-yr}^{-1}}$$

Proposed project reduces load by 0.7932 kg-yr<sup>-1</sup>, but is over Adjusted Nitrogen Load Limit<sup>20</sup> by 3.4019 kg-yr<sup>-1</sup>

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Groundwater N Concentration (via the mass balance approach)

Calc groundwater recharge rate: for 18 inches per acre, is 5062 liter/day per acre<sup>21</sup>; then calculating for 28.7 inches:

$$(5062 \text{ liter/day})/18 \text{ inches} = 281.2 \text{ liter/day} \times 28.7 = 8071.07778 \text{ liters/day}$$

Wastewater loading: 645gpd x 132mg = 85,140mg N

$$645\text{gpd} \times 3.785\text{liter/gallon} = 2,441.325 \text{ liter/day}$$

Volume of wastewater and recharge water

$$\text{Property area: } 5.43\text{acre} \times 8071.07778 \text{ liter/day/acre} = 43,825.9523 \text{ liter/day}$$

$$2,441.325 \text{ liter/day} + 43,825.9523 \text{ liter/day} = 46,267.2773 \text{ liters/day}$$

[Groundwater N] = 85,140mg N / 46,267.2773 liters = 1.84mg/liter (ppm), below the 5ppm limit for groundwater protection requirements

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<sup>20</sup> Adjusted limit for Lagoon pond is 10.1541 kg-yr<sup>-1</sup> for project property

<sup>21</sup> Guidelines for Title 5 Aggregation of Flows and Nitrogen Loading 310 CMR 15.216  
<https://www.mass.gov/files/documents/2016/08/pu/nagg95p.pdf> , page 12

## Further reduction of Nitrogen Loading:

Septic system reduction with John Smith's IA SanTOE system (92,000g/yr from C+C + 2,600 g/yr from new building)

$$\text{C+C, New: } [(348,220 \text{ liter/yr}) \times (6 \text{ mg/liter})] \times (1 \text{ kg}/1,000,000 \text{ mg}) = 2.0893 \text{ kg-yr}^{-1}$$

$$\text{UPS: } [(63,588 \text{ liter/yr}) \times (15.75 \text{ mg/liter})] \times (1 \text{ kg}/1,000,000 \text{ mg}) = 1.0015 \text{ kg-yr}^{-1}$$

$$\text{Total wastewater N with IA reduction} = 3.0910 \text{ kg-yr}^{-1}$$

Total N including stormwater would be:

$$1.4933 + 5.5766 + 3.0910 = 10.1610 \text{ (versus } 13.5559 \text{ kg-yr}^{-1}\text{)}$$

(Limit for project is 10.129665 kg-yr<sup>-1</sup> Nitrogen)

## Reference documents

- **MVC Water Quality Management Policy**  
<http://www.mvcommission.org/sites/default/files/docs/MVC%20Water%20Quality%20Management%20Policy%20Draft%202018%20reduced.pdf>
- **MEP Lagoon Pond Nitrogen report:** <http://www.mvboh.org/images/mep-lagoon-isle.pdf>
- Vision Property Card for 19-A-20:  
[https://www.axisgis.com/node/axisapi/document-view/TisburyMA?path=Docs/Batch/Vision\\_Property\\_Card/Vision%20ID\\_%201708.pdf](https://www.axisgis.com/node/axisapi/document-view/TisburyMA?path=Docs/Batch/Vision_Property_Card/Vision%20ID_%201708.pdf)
- Map for surficial data: <https://pubs.usgs.gov/of/2006/1260/E/>
  - Explanatory Text:  
[https://pubs.usgs.gov/of/2006/1260/E/OFR2006-1260E\\_text.pdf](https://pubs.usgs.gov/of/2006/1260/E/OFR2006-1260E_text.pdf)
- MVC: Martha's Vineyard Zone II Hazards Map:  
[http://www.mvcommission.org/sites/default/files/docs/MAP\\_A\\_8\\_PD.pdf](http://www.mvcommission.org/sites/default/files/docs/MAP_A_8_PD.pdf)
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- Assessor's Map 19, lot 20:  
[https://www.tisburyma.gov/sites/tisburyma/files/uploads/t\\_19\\_0.pdf](https://www.tisburyma.gov/sites/tisburyma/files/uploads/t_19_0.pdf)
- Zoning Map Town of Tisbury (shows R20 zone):  
[https://www.tisburyma.gov/sites/tisburyma/files/uploads/tisbury\\_zoning\\_map-pdf.pdf](https://www.tisburyma.gov/sites/tisburyma/files/uploads/tisbury_zoning_map-pdf.pdf)
- Tisbury Special Overlay Districts (see sec. 9.11, page 124 for Groundwater Projection District): <https://www.tisburyma.gov/sites/tisburyma/files/uploads/0900.pdf>
- 
- Tisbury Water Works Meter Data for property:  
[https://drive.google.com/open?id=1sK1PXNveyB9gd6DivLMhcwh\\_MxgFGh02](https://drive.google.com/open?id=1sK1PXNveyB9gd6DivLMhcwh_MxgFGh02)
- Septic Plan SBH 1 of 2 UPS:  
<https://drive.google.com/open?id=121WXHVCaZSL7i897e4K41xl-L0RNS4xf>
- Septic Plan SBH 2 of 2 C+C:  
<https://drive.google.com/open?id=1Di8TpxyykGKHSWC64y6mC6g4O10y0X3N>
- Title V: <https://www.mass.gov/files/documents/2017/09/27/310cmr15.pdf>
- GUIDELINES FOR TITLE 5 AGGREGATION OF FLOWS AND NITROGEN LOADING 310 CMR 15.216: <https://www.mass.gov/files/documents/2016/08/pu/nagg95p.pdf>

- Property Assessors Codes:  
<https://www.mass.gov/files/documents/2018/05/21/ClassificationCodeBookMay2018.pdf>
- Wetland Mapping Tool: [http://maps.massgis.state.ma.us/map\\_ol/czm\\_shorelines.php](http://maps.massgis.state.ma.us/map_ol/czm_shorelines.php)
- ArcGIS and related datafiles for mapping, water, coastal information, etc:  
<https://docs.digital.mass.gov/dataset/massgis-data-tidelands-jurisdiction-mgl-c91-datalayers>
- Coastal Stormwater Management Through Green Infrastructure - A Handbook for Municipalities:  
[https://www.epa.gov/sites/production/files/2015-09/documents/massbays\\_handbook\\_combined\\_508-opt\\_1.pdf](https://www.epa.gov/sites/production/files/2015-09/documents/massbays_handbook_combined_508-opt_1.pdf)
- Water Resource Management Planning Guidance Document:  
<https://www.mass.gov/files/documents/2016/08/rz/mepmain.pdf>

## **Articles and Other Sources**

- Engineered Bioretention for removal of nitrate from stormwater runoff (2003):  
<https://pdfs.semanticscholar.org/e1ac/a946d2f5c5af49996fa36e75a8e3a584956a.pdf>
- Mitigation of Impervious Surface Hydrology Using Bioretention in North Carolina and Maryland (2009):  
<https://pdfs.semanticscholar.org/214c/20ceceb707738906ffac315d11fb7c25b8cb.pdf>
- Conversations with John R. Smith, Ph.D., P.E., (412) 719-5976,  
[john.r.smith@solutions-by-ces.com](mailto:john.r.smith@solutions-by-ces.com)  
<http://www.solutions-by-ces.com/water-wastewater-treatment/> beginning April 23rd 2019
- Meeting minutes when MVC enacted new N policy:  
<http://www.mvccommission.org/sites/default/files/docs/2018-03-29%20MVC%20Minutes%20%282%29.pdf>