



## MEMORANDUM

**To:** Craig Nicholson, Affirmative Investments, Inc.

**From:** Joe Henderson

**Date:** December 7, 2022

**Re:** Southern Tier Site Development - Nitrogen Loading Summary

**cc:** Michael Laham, HW; Derrill Bazy, Island Housing Trust

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HW has completed a nitrogen loading analysis for this project site based on MVC guidelines. The supporting calculations are attached. The proposed multifamily affordable housing project consists of 1- and 2- bedroom units with a total of 85 bedrooms. The water usage flow per bedroom used in the nitrogen loading analysis is based on water usage data obtained from Island Housing Trust (IHT). Based on similar housing projects, IHT found that the average water use is 41 gallons per day per bedroom. We have conservatively based our water use on 50 gallons per day per bedroom to provide a factor of safety from the observed data.

The project is located within the Sengekontacket Watershed which has an allowable adjusted nitrogen load limit of 2.02 kg/acre/yr. This project site of 7.78 acres has an allowable Nitrogen load of 15.72 kg per year.

The proposed project areas that will contribute to the nitrogen load are impervious roof and roadway areas along with the contribution from the site wastewater. No managed landscape area is proposed so there is no fertilization contribution is included. The road runoff and roof runoff nitrogen concentrations used in the calculations are as outlined in the MVC Water Quality Management Policy. This project is proposing to use a NitROE nitrogen reducing treatment system for treating the wastewater. The NitROE system has a track record of producing a highly treated effluent of 8 mg/L of Total Nitrogen (TN) on Martha Vineyard. HW has estimated the total site nitrogen loading based on the assumptions above at 47.89 kg/year.

To achieve the level of development as proposed, the applicant proposes to mitigate the additional nitrogen load generated by the proposed development by upgrading conventional Title 5 septic systems within the Sengekontacket Watershed using the nitrogen reducing system, NitROE. The estimated reduction in nitrogen load, based on 50 gallons per day per bedroom, when converting from a Conventional Title 5 system to a NitROE system is calculated as 1.13 kg N per bedroom per year. Alternatively, nitrogen credit land could be set aside under

a nitrogen loading restriction to compensate for the additional nitrogen load at the site. Further discussion with the Town is required for the credit land option.

Based on an estimated site nitrogen load of 47.89 kg per year and an allowable nitrogen load for the site of 15.72 kg per year, the required mitigation is 32.18 kg of nitrogen per year. With an estimated nitrogen reduction of 1.13 kg N per bedroom using the NitROE system upgrades, converting 28.36 bedrooms from Title 5 systems to NitROE treatment systems will meet the MVC requirements. Alternatively, approximately 15.93 acres of land would need to be set aside as credit land to compensate for the additional nitrogen load at the site.

**Nitrogen Loading Calculations**  
**Southern Tier Site Development**  
**Oak Bluffs, MA**  
**Revised December 8, 2022**

**Allowable Site Nitrogen Load**

Project Site Area	7.78	ac
Adjusted Nitrogen Load Limit	2.02	kg/acre/yr
Sengekontacket Pond Watershed, Table A column 7		
Allowable Site Nitrogen Load	15.72	kg N/yr

**Calculations Based on IHT Water Usage Data (50 gpd per Bedroom)**

Proposed Site Nitrogen Load (Water Usage Based on IHT Data)	47.89	kg N/yr
Mitigation Required for IHT Data (Proposed Site Load - Allowable Site Load)	32.18	kg N/yr
Calculated Reduction per NitROE System Upgrade (Title 5 to NitROE System)	1.13	kg N/bedroom/yr
<b>Estimated Mitigation</b>	<b>28.36</b>	<b>bedrooms</b>

**REFERENCE CALCULATIONS**

**Mitigation Calculations Assumptions (MVC Balance)**

Title 5 Effluent Nitrogen Concentration (MVC Guidance)	26.25	mg/L
NitROE System Effluent Nitrogen Concentration (from KleanTu)	8.00	mg/L
Nitrogen Concentration Reduction with NitROE System Upgrade (26 mg/L - 8 mg/L)	18.25	mg/L
Calculated Reduction per NitROE System Upgrade (Title 5 to NitROE System)	4.21	kg N/Unit/yr

**Calculations Based on MVC Wastewater Nitrogen Output Guidance (2 Bedrooms per Unit)**

Proposed Site Nitrogen Load (Flow based on MVC Guidance)	88.65	kg N/yr
Mitigation Required for MVC Balance (Proposed Site Load - Allowable Site Load)	72.93	kg N/yr
<b>Estimated Mitigation</b>	<b>17.33</b>	<b>Units</b>
<b>Estimated Mitigation</b>	<b>34.66</b>	<b>bedrooms</b>

**Calculations Based on MVC Wastewater Nitrogen Output Guidance (5 Bedrooms per Unit)**

Proposed Site Nitrogen Load (Flow based on MVC Guidance)	36.99	kg N/yr
Mitigation Required for MVC Balance (Proposed Site Load - Allowable Site Load)	21.27	kg N/yr
<b>Estimated Mitigation</b>	<b>5.05</b>	<b>Units</b>
<b>Estimated Mitigation</b>	<b>25.27</b>	<b>bedrooms</b>

**Notes:**

1. MVC Water Use data is from the Water Quality Management Policy and represents residential structures with 5 or fewer bedrooms (MVC Unit). The proposed 40 apartments/residences are a mix of 1, 2 and 3 bedrooms totaling 80 bedrooms.
2. IHT Water Usage data obtained from similar housing projects documents an average water use of 41 gpd per bedroom. The nitrogen loading calculations are conservatively based on a water use of 50 gpd per bedroom.

**Nitrogen Loading Calculations**  
**Southern Tier Site Development**  
**Oak Bluffs, MA**  
**Revised December 8, 2022**  
**Calculations Based on IHT Water Usage Data (50 gpd per Bedroom)**

ALLOWABLE SITE NITROGEN LOAD	
Project Site Area (ac)	7.78
Adjusted Nitrogen Load Limit (kg/acre/yr) Sengekontacket Pond Watershed, Table A column 7	2.02
Allowable Site Nitrogen Load (kg/yr)	15.72

PROPOSED SITE NITROGEN LOAD	
<b>Input Data</b>	
Number of Bedrooms	85
Water Usage Flow per Bedroom (gpd) <sup>2</sup>	50
N-conc. in effluent (mg/L) <sup>1</sup>	8.00
Lawn/Landscape area (square feet)	Native Plantings Only, no Fertilizer Application Guaranteed
Pavement (square feet)	37,897
Gravel (square feet)	13,504
Road runoff N-conc. (mg/L) <sup>1</sup>	0.75
Roof area (square feet)	23,830
Roof runoff N-conc. (mg/L) <sup>1</sup>	0.75
Recharge rate for pervious area (in/yr) <sup>1</sup>	28.7
Recharge rate for impervious area (in/yr) <sup>1</sup>	46.9

<sup>1</sup> From MVC Water Quality Management Policy  
<sup>2</sup>Based on IHT Water Use Data from Similar Uses

Calculations Based on IHT Water Usage Data (50 gpd per Bedroom)

INPUT		CALCULATIONS	RESULTS
			CALCULATED LOADING (KG/YR)
Wastewater Load	Number bedrooms x flow per bedroom x 0.9 (10% outdoor use) x 365 x 3.785 L/gal x N-conc (mg/L)/1,000,000		42.3
Native Plantings Only, no Fertilizer Application Guaranteed			0.0
Pavement Load	SF Pavement x (46.9 in/yr x 90% ÷ 12 in/ft) x 28.3 L/ft <sup>3</sup> x N-conc (mg/L) ÷ 1,000,000 mg/kg		2.8
Gravel Road Load	SF Gravel Road x (46.9 in/yr x 65% ÷ 12 in/ft) x 28.3 L/ft <sup>3</sup> x N-conc (mg/L) x1,000,000 mg/kg		1.0
Roof Area Load	SF Roof Area x (46.9 in/yr x 90% ÷ 12 in/ft) x 28.3 L/ft <sup>3</sup> x N-conc (mg/L) ÷ 1,000,000 mg/kg		1.8
		TOTAL PROPOSED SITE NITROGEN LOADING (KG/YR)	47.9
		ALLOWABLE SITE NITROGEN LOAD (KG/YR)	15.72
		NITROGEN LOAD OVERAGE (KG/YR)	32.18

PREPARED BY HORSLEY WITTEN GROUP, INC.

Nitrogen Loading Calculations  
Southern Tier Site Development  
Oak Bluffs, MA  
Revised September 30, 2022

Calculated NitROE System Upgrade Nitrogen Reduction per BEDROOM (Title 5 to NitROE System)

Input Data

Residential Housing Flow (gpd/bedroom) <sup>2</sup>	50
Title 5 N-conc. in effluent (mg/L) <sup>1</sup>	26.25
NitROE System N-conc. in effluent (mg/L)	8.00

INPUT	CALCULATIONS	RESULTS
		CALCULATED LOADING (KG/BEDROOM/YR)
Title 5 Treated Effluent	flow per bedroom x 0.9 (10% outdoor use) x 3.785 L/gal x N-conc (mg/L)/1,000,000	1.6
NitROE System Effluent	flow per bedroom x 0.9 (10% outdoor use) x 3.785 L/gal x N-conc (mg/L)/1,000,000	0.5
NITROGEN REDUCTION WITH NITROE SYSTEM PER BEDROOM	Title 5 Treated Effluent - NitROE System Effluent	1.13

<sup>1</sup> From MVC Water Quality Management Policy  
<sup>2</sup>Based on IHT Water Use Data from Similar Uses  
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<b>Nitrogen Loading Calculations</b> <b>Southern Tier Site Development</b> <b>Oak Bluffs, MA</b> <b>Revised December 8, 2022</b>		
<b>Area Needed to Net Zero Nitrogen (IHT Water Use Data)</b>		
Project Site Area	7.78	ac
Adjusted Nitrogen Load Limit	2.02	kg/acre/yr
Sengekontacket Pond Watershed, Table A column 7		
Allowable Site Nitrogen Load	15.72	kg N/yr
Proposed Site Nitrogen Load	47.89	kg N/yr
Nitrogen Load Overage	32.18	kg N/yr
<b>Additional Area Required for MVC Balance</b>	<b>15.93</b>	<b>ac</b>
<b>Note:</b> 1. MVC Water Use data is from the Water Quality Management Policy and represents residential structures with 5 or fewer bedrooms (MVC Unit). The proposed 40 apartments/residences are a mix of 1, 2 and 3 bedrooms totaling 80 bedrooms.  2. IHT Water Usage data is from water meter data at similar housing projects.		

IHT WATER USE SUMMARY		
Location	Use	Average Water Use
Hanover House (2019 - 2022)	12- SRO, 3 1-bedroom	37
6 Water Street (2017, 2019 - 2022)	6 1-bedroom	44
Scotts Grove (2019 - 2022)	9 rentals w/ 18 total bedrooms	43
AVERAGE WATER USE AT ALL SITES		41