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MV 11579

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Martha's Vineyard Hospital – Navigator Homes Nitrogen Analysis

Acronyms:

MVH: Martha's Vineyard Hospital
NHMV: Navigator Homes of Martha's Vineyard, Inc.
WQMP: MVC Water Quality Management Policy v13 (1/12/18)

Site Conditions:

Locus lies entirely within the Sengekontacket Pond Watershed.
Adjusted Nitrogen Load Limit: 2.02 kg/acre/year per WQMP
Locus does NOT lie within Zone II of a municipal well
Total lot area: 27.53 acres

Project Notes:

Runoff Areas:

Roof area runoff to subsurface disposal:	86,475 sq ft
Roof area runoff to vegetated surface disposal:	0 sq ft
Impervious pavement to subsurface disposal:	0 sq ft
Impervious pavement to vegetated surface disposal:	90,637 sq ft
Pervious pavement to subsurface disposal:	0 sq ft
Pervious pavement to vegetated surface disposal:	0 sq ft

Wastewater Parameters:

Effluent strength: 5 mg/l (per MVC staff and Klean Tu denitrification system)

Flow Estimates per WQMP:
Green House Homes: (150 GPD/bedroom)(60%) = 90 GPD/bedroom
Workforce housing: (67,700 GPY/unit)(90%) / 365 days/yr = 167 GPD/unit

Analysis: Required: [N(r) + N(l) + N(w)] < N(a)

N(r) Runoff N-load:

Roof runoff to subsurface disposal:
(3.91 ft/yr)(90%)(87,475 sf)(28.32 l/cf)(0.75 mg/l) / (1M mg/kg) = 6.46 kg/yr

Roof runoff to vegetated surface disposal:
(3.91 ft/yr)(90%)(0 sf)(28.32 l/cf)(0.38 mg/l) / (1M mg/kg) = 0.00 kg/yr

Impervious pavement runoff to subsurface disposal:
(3.91 ft/yr)(90%)(0 sf)(28.32 l/cf)(1.50 mg/l) / (1M mg/kg) = 0.00 kg/yr

Impervious pavement runoff to vegetated surface disposal:
(3.91 ft/yr)(90%)(90,637 sf)(28.32 l/cf)(0.75 mg/l) / (1M mg/kg) = 6.77 kg/yr

Pervious pavement runoff to subsurface disposal:
(3.91 ft/yr)(65%)(0 sf)(28.32 l/cf)(1.50 mg/l) / (1M mg/kg) = 0.00 kg/yr

Pervious pavement runoff to vegetated surface disposal:
(3.91 ft/yr)(65%)(0 sf)(28.32 l/cf)(0.75mg/l) / (1M mg/kg) = 0.00 kg/yr

N(r) total: = 13.23 kg/yr

N(l): Landscape N-load:

(43,439 sf)(3 lb/1000 sf)(20%) / 2.205 lb/kg = 12.90 kg/yr.

N(w): Wastewater N-load:

Estimated flow:

66 bedrooms @ 90 GPD/bedroom =	5,940 GPD
48 units @ 167 GPD/unit =	8,016 GPD
Total:	13,956 GPD

(13,956 GPD)(3.785 l/gal)(5 mg/l)(365 days/year) / (1M kg/mg) = 96.40 kg/year

N(a): Allowable N-load:
(2.02 kg/acre/yr)(27.53 acres) = 55.61 kg/yr

N total = 13.23 kg/yr + 12.90 kg/yr + 96.40 kg/yr = 122.53 kg/yr
Overage: 122.53 kg/yr – 55.61 kg/yr = 66.92 kg/yr

Potential Mitigation (as calculated):

WQMP:
Overage: 66.92 kg/yr
Project Life: 40 years
Cost: $315/kg
Mitigation: (66.92 kg/yr)(40 year)($315/kg) = $843,192

TRI process:
Overage: 66.92 kg/yr
Credit: (67,700 GPY)(90%)(3.785 l/gal)(26.25-5 mg/l) / 1M kg/mg = 4.90 kg/yr/upgrade
Required upgrades: (66.92 kg/yr) / 4.90 kg/yr/upgrade = 13.65 (14 upgrades)
Cost: $53,336/upgrade (see below)
Mitigation: (14 upgrades) ($53,336/upgrade) = $746,704

Note: Estimated upgrade cost:

Design & Permitting:	$ 4,000	
Standard system upgrade:	$12,000	
NitROE upcharge:	$25,000	
5 years O&M:	$ 5,000	
	$46,000	
15% TRI management fee:	$ 6,900	
TOTAL:	$52,900	($53,336 used by TRI)

Suggested Mitigation Analysis:

N(a): allowable project N-load = 55.61 kg/yr (see above)
N(l): project landscape N-load = 12.90 kg/yr (see above)
N(r): project runoff N-load = 13.23 kg/yr (see above)
N(w-net allow): allowed net wastewater N-load
= N(a) – [N(l) + N(r)]
= 55.61 kg/yr – [12.90 kg/yr + 13.23 kg/yr]
= 29.48 kg/yr
N(w-net actual): actual net wastewater N-load
(project wastewater N-load - total mitigation delta)

W(dx): annual metered water use of duplex complex
W(gh): annual metered water use of greenhouse complex
W(at): annual metered water use of apartment/townhouse complex
W(mn): annual metered water use of mitigation dwelling #n

n(dx): effluent concentration of duplex systems
n(gh): effluent concentration of greenhouse system
n(at): effluent concentration of apartment/townhouse system
n(Δmn): influent concentration – effluent concentration of mitigation system #n

Requirement:

N(w-net actual) ≤ N(w-net allow)
N(w-net actual) ≤ 29.48 kg/yr

Duplex wastewater nitrogen load: N(w-dx) = [W(dx) x 90% x n(dx)]
Greenhouse wastewater nitrogen load: N(w-gh) = [W(gh) x 90% x n(gh)]
Apartment/Townhouse wastewater nitrogen load: N(w-at) = [W(at) x 90% x n(at)]
Mitigation wastewater nitrogen load (upgrade #n) N(w-mn) = [W(mn) x 90% x n(Δmn)]

Analysis:

[N(w-dx) + N (w-gh) + N (w-at)] - Σ N(w-mn) ≤ N(w-net)

[N(w-dx) + N (w-gh) + N (w-at)] - Σ N(w-mn) ≤ 29.48 kg/yr