

Buzzards Bay Project National Estuary Program

Stuart Richardson Chairman, Marion Housing Committee PO Box 924 Marion, MA 02738

May 26, 2005

Mr. Richardson:

With respect to a proposed Chapter 40B project in the Town of Marion on an 8.67-acre lot, you also requested nitrogen loading analysis comparison among different development scenarios. Specifically, you asked for a comparison of nitrogen loads for the following four hypothetical scenarios:

A) the current zoning presumably enabling 4 homes (presumably with 4 bedrooms),

B) a 40B plan with 28 three-bedroom homes with conventional septic systems,

C) a 40B plan with 28 three-bedroom homes with nitrogen removing systems (at 19 ppm) and D) with a single package treatment plant discharging 10 ppm nitrogen.

For this analysis, I used a modification of the spreadsheet posted at http://www.buzzardsbay.org/n-subdivision.xls.¹ Because this subdivision is less than 400 feet from the river, I presumed there was no attenuation of nitrogen in groundwater travel to coastal waters.

The attached four tables are my preliminary analysis based on various assumptions of road area, roof and sidewalk area, and the likely portions of the lot disturbed. As I do not have a copy of the plans, the impervious areas are estimated. However, these estimated nitrogen loadings are fairly robust with respect to impervious surface area because 59 to 77% of the nitrogen in the different development scenarios is derived from wastewater disposal.

As shown, the proposed 28 unit Chapter 40B project with conventional wastewater disposal exceeds by nearly 6-fold the nitrogen loading from the site if it were developed under current zoning.

I hope you find this information helpful.

Soseph E. Costa, PhD Executive Director

2870 Cranberry Highway, East Wareham, Massachusetts 02538 (508) 291-3625 Facsimile (508) 291-3628 www.buzzardsbay.org

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¹ I have used a 1.8 kg per capita per year loading rate used by the Massachusetts Estuaries Project, instead of the BBP's and Cape Cod Commissions previously adopted rate of 2.7 kg per capita per year.

Buzzards Bay Project Subdivision worksheet -5/25/05

Scenario A: Marion 40B Site, 4 units conventional Title 5 onsite systems								
				N Loading				
Sources		Total	I	Pounds/yr	Notes			
Subdivision area (land only)		8.67	acres		Enter actual area in column D			
Buildable lots, 1 house per lot	4 lots							
					Approximation after subtracting road			
avo lot size estimate	75 416 sq ft				layout and dividing by lot number			
Bedrooms (average number)	4 per house							
Total Bedrooms	16							
	10				set by policy or regulation, should be			
assumed assumancy T5	2 nor bodroom				bighor than actual			
assumed occupancy, 15								
		TRUE	110		Typical area occupancy, enter True to			
assumed occupancy, expected	3.2 per/unit	IRUE	Use?		use			
Wastewater Treatment by Septic?					if false, package facility calculation			
(F=package treatment)	IRUE (true or false)				used			
Wastewater N Loading								
units with conventional systems	4.0 units	12.8	persons	50.7				
units with N removal systems	0.0 units	0.0	persons	0.0				
			loading		enter 25, 19, 12, or 10 (note: no onsites			
Alternative N disharge rating	0.0 ppm rating	0.00	factor		currently rated at 10 ppm)			
					conventional assumed to be 27 ppm			
					x 110 gpd per cap to gw for loading			
Total onsite wastewater N				50.7	factor calculation			
					load based on planning occupancy, not			
Package facility est. actual flow	0 gpd				design flow			
					annual loading from community facility,			
Package facility discharge limit	10 ppm nitrogen			0.0	load based on planning occupancy			
Road Length	1900 feet							
Paved road width	24	1.0	acres	14.3				
Road Layout width, non paved								
load	40		acrea		non-paved road layout, assume grass			
Lot statistics		Subdivi	sion total					
driveway area	<mark>800</mark> sq. ft.	0.1	acres	1.0				
sidewalk - paved area	200 sq. ft.	0.0	acres	0.1				
roof area (house+garage)	<mark>3500</mark> sq. ft.	0.3	acres	2.1				
lawn size	5000	0.5	acres	10.7				
other disturbed	4000							
undisturbed lot area	<mark>61,916</mark> sq. ft.	5.7	acres	0.8				
Total Lot Area	75,416							
wetlands in subdivision	0.0 acres	0.0		0.0	n loading from wetlands is zero (a sink)			
unaltered upland on buidable					incl. additional 1000 sq. ft margin of			
parcels		2.1	acres	0.3	error altered			
proposed greenspace not								
included above			acres	0.0				
Total Nitrogen Loading				80.0				
net lb/acre				9.2				
					enter true if you want to use the loss			
Use Upper Watershed Attenuation	FALSE	0.7	coefficient		cooefficient shown			
Total Nitrogen Loading to Bay	_			80.0	use this value			
effective net lb/acre				9.2	pounds per acre to receiving waters			
Nitrogen Limit Policy or Bylaw	7.5 lbs/acre							
Subdivision Limit	65.0 pounds		Kg/y	%	Summary by source			
			50.7	64.3%	Wastewater			
enter values in shaded boxes			14.3	18.1%	Roads			

Kg/y	%	Summary by source
50.7	64.3%	Wastewater
14.3	18.1%	Roads
3.2	4.1%	Other impervious
10.7	13.6%	Lawns
0.0	0.0%	Undisturbed area
78.8	100.0%	Total

Buzzards Bay Project Subdivision worksheet -5/25/05

report errors to jcosta@buzzardsbay.org

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Sources		Total		N Loading Pounds/vr	Notes
Subdivision area (land only)		8.67	acres		Enter actual area in column D
Duildable late 4 haves mandat	00	0.07	acres		
Buildable lots, 1 house per lot	28 lots				
					Approximation after subtracting road
avo lot size estimate	10 774 sa. ft.				lavout and dividing by lot number
Bedrooms (average number)	2 per bo				,
	5 per no	use			
lotal Bedrooms	84				
					set by policy or regulation, should be
assumed occupancy, T5	2 per be	droom			higher than actual
			1		Typical area occupancy, enter True to
			110		
assumed occupancy, expected	3.2 per/un		Use?		
Wastewater Treatment by Septic?					if false, package facility calculation
(F=package treatment)	TRUE (true c	r false)			used
Wastewater N Loading					
5					
unite with conventional evotome	20 Aunito	00.6	noroono	254.0	
	28.0 units	69.0	persons	304.6	
units with N removal systems	0.0 units	0.0	persons	0.0	
			loading		enter 25, 19, 12, or 10 (note: no onsites
Alternative N disharge rating	19.0 ppm ra	ating 0.57	factor		currently rated at 10 ppm)
3 3		5			conventional assumed to be 27 nnm
					the second secon
					x 110 gpd per cap to gw for loading
Total onsite wastewater N				354.8	factor calculation
					load based on planning occupancy, not
Package facility est, actual flow	0 apd				design flow
, see a s	011				
Package facility discharge limit	10 ppm n	itrogen		0.0	load based on planning occupancy
Road Length	1900 feet				
Paved road width	24	1.0	acres	14.3	
Road Lavout width non paved					
lood	40		ooroo		non poved read leveut, essume grass
	40				non-paved toad layout, assume grass
Lot statistics		Subdiv	ision total		
driveway area	500 sq. ft.	0.3	acres	4.4	
sidewalk - paved area	100 sq. ft.	0.1	acres	0.4	
roof area (house+garage)	2500 sq. ft.	16	acres	10.4	
lown size	<u>5000</u> 591 M	2.0	acres	74.9	
	5000	3.2	acres	74.0	
other disturbed	1000			-	
undisturbed lot area	1,674 sq. ft.	1.1	acres	0.2	
Total Lot Area	10,774				
					1
wetlands in subdivision		0.0		0.0	n loading from wetlands is zero (a sink)
	0.0 40103	0.0	1	0.0	
proposed greenspace not					
included above			acres	0.0	
Total Nitrogen Loading				459.3	
net lb/acre				53.0	
					enter true if you want to use the loss
Use Upper Watershed Attenuation	FALSE	0.7	coefficient		cooefficient shown
Total Nitrogon Londing to Pay	TALOL	0.7		450.0	
				459.3	
effective net lb/acre				53.0	pounds per acre to receiving waters
Nitrogen Limit Policy or Bylaw	7.5 lbs/ac	е			
Subdivision Limit	65.0 pound	S	Ka/v	%	Summary by source
		-	25/ 8	77 3%	Wastewater
ontor values in chaded haves			304.0	2 40/	Poode
CITCL VALUES III STIAUEU DUXES			14.3	3.1%	
			15.2	3.3%	
			74.8	16.3%	Lawns

0.0

459.1

0.0% Undisturbed area

100.0% Total

Buzzards Bay Project Subdivision worksheet -5/25/05 Scenario C: Marion 40B Site, 28 units, 19 ppm N removing onsites

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Scenario C. Marion 40B Sile, 20	units, 19 ppin N remov	ing onsites		
			N Loading	
Sources		Total	Pounds/yr	Notes
Subdivision area (land only)		8.67 acres	H	Enter actual area in column D
Buildable lots, 1 house per lot	28 lots			
			1	Approximation after subtracting road
avg lot size estimate	10,774 sq. ft.			ayout and dividing by lot number
Bedrooms (average number)	3 per house			
Total Bedrooms	84			
				set by policy or regulation, should be
assumed occupancy, T5	2 per bedroom		ł	higher than actual
				Typical area occupancy, enter True to
assumed assumption avported	2.2 por/upit		I .	
Westewater Treatment by Centic?	<u>3.2</u> per/unit	TRUE 036!		t folge peakers facility coloulation
(E nackage treatment)				
(F=package treatment)	TRUE (true or faise)		⁽	used
wastewater N Loading				
units with conventional systems	0.0 units	0.0 persons	0.0	
units with N removal systems	28.0 units	89.6 persons	203.1	
		loading	e	enter 25, 19, 12, or 10 (note: no onsites
Alternative N disharge rating	19.0 ppm rating	0.57 factor	(currently rated at 10 ppm)
				conventional assumed to be 27 ppm
)	x 110 gpd per cap to gw for loading
Total onsite wastewater N			203.1 f	factor calculation
				oad based on planning occupancy, not
Package facility est, actual flow	0 apd			design flow
	3 = -			
				annual loading from community facility
Package facility discharge limit	0 ppm nitrogen		0.01	load based on planning occupancy
Pood Longth	100 foot		0.0	oad based on planning occupancy
Road Length Deved read width		1.0.00000	14.2	
Paved load width	24	1.0 acres	14.3	
Road Layout width, non paved				
load	40	acrea	r	non-paved road layout, assume grass
Lot statistics		Subdivision total		
driveway area	<u>500</u> sq. ft.	0.3 acres	4.4	
sidewalk - paved area	<u>100</u> sq. ft.	0.1 acres	0.4	
roof area (house+garage)	2500 sq. ft.	1.6 acres	10.4	
lawn size	5000	3.2 acres	74.8	
other disturbed	1000			
undisturbed lot area	1,674 sq. ft.	1.1 acres	0.2	
Total Lot Area	10,774			
wetlands in subdivision	0.0 acres	0.0	0.0 r	n loading from wetlands is zero (a sink)
proposed greenspace not				5
included above		acres	0.0	
Total Nitrogen Loading		uoroo	307.5	
net lb/acre			35.5	
The the acte				enter true if you want to use the loss
Liss Lipper Watershed Attenuation				enter true il you want to use the loss
Tetel Nitre see Looding to Dou	FALSE			
offective pet lb (cere			307.5	
enective net ID/acre	J		35.5	pounds per acre to receiving waters
Nitrogen Limit Policy or Bylaw	7.5 lbs/acre			
Subdivision Limit	65.0 pounds	Kg/	y %	Summary by source
		203.1	66.0%	Wastewater
enter values in shaded boxes		14.3	3 4.6% I	Roads
		15.2	2 5.0% (Other impervious
		74.8	3 24.3% l	Lawns
		0.3	0.1%	Indisturbed area

307.5

100.0% Total

Scenario D, Marion 408 Site, 27 units, 10 ppm Package Treatment Plant, 1 lot for plant Sources Sources <	Buzzards Bay Project Subdivision worksheet -5/25/05 jcosta@buzzardsbay.org								
Sources Nuclearing Subdivision area (land only) Total 8.67 Borney Powersy Notes Subdivision area (land only) Enter actual area in column D Alternative actual area in column D Alternative actual area in column D Subdivision area (land only) Enter actual area in column D Approximation after autual area in column D Subdivision area (land only) Enter actual area in column D Approximation after autual area in column D Subdivision area (land only) Enter actual area in column D Approximation after autual area in column D Subdivision area (land only) Enter actual area in column D Approximation after autual area in column D Subdivision area (land only) Enter actual area in column D Approximation after autual area in column D Subdivision area (land only) Enter actual area in column D Approximation after autual area in column D Subdivision area (land only) Enter actual area in column D Approximation after autual area in column D Subdivision area (land only) Enter actual area in column D Approximation after autual and all approximation after autual at a antre	Scenario D: Marion 40B Site, 27	units, 10 p	pm Package	Treatme	ent Plant, 1	lot for pla	nt		
Sources Total Poundsyr Notes Boldbillow read (and only) Bold across Enter actual area in column D Buildable lots, 1 house per lot 27 lots Enter actual area in column D avg lot size estimate 11,173 sq. ft. Approximation after subtracting road Badrooms (average number) 32 per house Higher than actual assumed occupancy, expected 3.2 per unit Typical area occupancy, enter True to use Wastewater Treatment by Septro? FALSE (rue or false) Use Frankage training 0.0 units 0.0 persons 0.0 Natewater N Loading 0.0 print 0.0 per cap to gw for loading Alternative N disharge rating 0.0 per cap to gw for loading currently rated at 10 ppm) Total onsite wastewater N 4752 gpd 142 1.0 acres 42 Paved road width 792 gpd anual loading from community fasility, actuation Paved road width 100 ppm nitrogen 142 anual loading from ventional assumed to be 27 ppm kr 10 gpd per cap to gw for loading drow or paved road layout, ass			· · · · ·		*	N Loading			
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Junction Los, F. House per los 2 Los Approximation after subtracting road layout and dividing by lot number avg lot size estimate Bechroms (average number) 3 Ber house Int, Tray sq. ft. 3sumed occupancy, T5 2 per bedroom set by policy or regulation, should be higher than actual assumed occupancy, expected 3,2 per louis 0.0 per bedroom Wastewater N Loading 0.0 units 0.0 per bedroom use? FALSE (frue or false) 0.0 per bedroom use? If false, package facility calculation units with orwanional systems 0.0 units 0.0 per bedroom use? Alternative N disharge rating 0.0 units 0.0 per cap to gw for loading 0.0 Package facility discharge limit 0.0 ppom nitrogen 14.17 anual loading from community facility, anual loading from wetlands is zero (a sink) Package facility discharge limit 100 ppon nitrogen 10.2 anual loading from wetlands is zero (a sink) Paved road with 200 sq, ft. 1.3 acres <	Buildable lots 1 house per lot	27	ote	0.07	40100				
avg lot size estimate Bedrooms (average number) Total Bedrooms (average number) Total Development (Comparison (Compar	Buildable lots, 1 house per lot	21	013						
avg lot size estimate [11,172] sq. ft. [3] sper house [3] set was sumed occupancy, T5 [3] sper house [3] set by policy or regulation, should be higher than actual [5] tryplecial area occupancy, enter True to use assumed occupancy, exter True to use assumed occupancy, exter true to [5] set by policy or regulation, should be higher than actual [5] tryplecial area occupancy, enter True to use [3] per funct [7] set. [1] set. set. [Approximation after subtracting road		
Bedrooms (average number) Total Bedrooms assumed occupancy, TS assumed occupancy, expected Wastewater Treatment by Septic? FALSE (true or false) Wastewater X Loading units with A removal systems Use units with N removal systems Use Upper Watershed Attenuation FALSE Use Upper	avg lot size estimate	11,173 ទ	sq. ft.				layout and dividing by lot number		
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assumed occupancy, expected Wastewater Treatment by Septi? (FPackage treatment) Wastewater Treatment by Septi? (FPackage treatment) Wastewater N Loading units with 2 conventional systems 0.0 units with conventional systems 0.0 units 0.0 per sons 0.0 0.0 per rating 0.00 per rating 0.00	assumed becupancy, 15	<u> </u>	Ser beuroom						
assumed occupancy, expected Wastewater Nearment by Septic? (F-package treatment) Wastewater N Loading units with conventional systems Alternative N disharge rating Atternative N di			, ·.				Typical area occupancy, enter True to		
Wastewater Treatment by Sepic? (FALSE (true or false) FALSE (true or false) If false, package facility calculation used Wastewater N Loading units with N removal systems units with N removal systems 0.0 0.0 0.0 units 0.0 persons 0.0 0.0 Atternative N disharge rating 0.0 0.0 persons 0.0 0.0 factor conventional assumed to be 27 ppm x 110 gpd reap to gw for loading 0.00 factor calculation load based on planning occupancy, not design flow Package facility est. actual flow 4752 gpd gpd nume loading from community facility, 100 ppm nitrogen Road Langth non-paved road layout, assume grass Paved road width Road Length 100 ppm nitrogen annual loading from community facility, 1900 feet 14.3 acrea non-paved road layout, assume grass Cot statistics torder disturbed undisturbed to area 100 go, ft. 1.1 acres 0.0 acrea 0.0 0.0 acres 0.0 0.0 acres 0.0 0.0 acres 0.0 0.0 0.0 acres 0.0 0.0 0.0 0.0 0.0 acres 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	assumed occupancy, expected	3.2	per/unit	TRUE	Use?		use		
(F=package treatment) FALSE (true or false) used Wastewater N Loading 0.0 units 0.0 persons 0.0 uits with Oromentional systems 0.0 units 0.0 persons 0.0 Alternative N disharge rating 0.0 persons 0.0 0.0 Total onsite wastewater N 0.0 persons 0.0 conventional assumed to be 27 ppm k 110 gpd per capt to gw for loading 0.0 Package facility est. actual flow 4752 gpd annual loading from community facility, 10 gpm nitrogen non-paved road hased on planning occupancy, not design flow Package facility discharge limit Road Length 10 ppm nitrogen 1.0 acres 1.43 Road Layout width, non paved load 500 sq. ft. 0.3 acres 0.0 Idriveway area 500 sq. ft. 1.3 acres 1.0 adriveway area 100 gs. ft. 1.3 acres 0.0 non-paved road layout, assume grass undisturbed tot area 2.073 sq. ft. 1.3 acres 0.0 noding from wetlands is zero (a sink) proposed greenspace not included above 0.0 acres 0.0 0.0 noding from we	Wastewater Treatment by Septic?						if false, package facility calculation		
Wastewater N Loading units with N removal systems units with N removal systems 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	(F=package treatment)	FALSE ((true or false)				used		
units with conventional systems uits with N removal systems Alternative N disharge rating Alternative N disharge rating 0.0 ppm rating 0.	Wastewater N Loading								
units with Noremoval systems units with Noremoval systems Alternative N disharge rating 100 ppm rating 0.00 ppm rating 0.00 factor 101 ppm rating 0.00 factor 102 ppm rating 0.00 factor 103 ppm rating 0.00 factor 103 ppm rating 0.00 factor 104 design flow 104 design flow 105 design flow 104 design flow 104 design flow 104 design flow 104 design flow 105 design flow 104 design flow 105 dest 105 dest 104 design flow 104 design flow 105 dest 105 dest 105 dest 106 dest 107 dest 107 dest 107 dest 108 dest 109 dest 100 flow 104 dest 104	-								
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units 0.0 persons 0.00 Atternative N disharge rating 0.0 ppm rating 0.00 factor Total onsite wastewater N 0.0 ppm rating 0.00 factor conventional assumed to be 27 ppm x 110 gpd per cap to gw for loading 0.00 factor Package facility est. actual flow 4752 gpd annual loading nounce to be 27 ppm x 110 gpd per cap to gw for loading 0.00 factor conventional assumed to be 27 ppm x 110 gpd per cap to gw for loading 0.00 factor calculation Package facility discharge limit Road Length 10 ppm nitrogen Paved road width 24 1.0 acres annual loading fom community facility, 144.7 Paved road width 24 1.0 acres 14.3 non-paved road layout, assume grass Atternative at house+garage) 500 sq. ft. 0.1 acres 0.4 24 Instructed 1000 sq. ft. 1.3 acres 0.2 10.1 non-paved road layout, assume grass Instructed 1000 sq. ft. 1.5 acres 0.0 non no-paved road layout, assume grass 0.0 Iawn size 5000 sq. ft. 1.3 acres 0.2 0.0 non-paved road layout, assume grass Iawn size 11,173 0.3 acres 0.0 <td>units with N removel evetems</td> <td>0.0</td> <td>unito</td> <td>0.0</td> <td>persons</td> <td>0.0</td> <td></td>	units with N removel evetems	0.0	unito	0.0	persons	0.0			
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					246.0	100.0%	Total		

report errors to