



141 Pine Tree Drive, Centerville, MA 02632  
Tel: 508-737-5991  
eichner@tmdlsolutions.net

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## Memorandum

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To: Jeff Hassett, Morse Engineering Company, Inc.  
From: Eduard Eichner, TMDL Solutions, Principal Water Scientist  
RE: Nitrogen Loading from horses (73 Atlantic Avenue, Cohasset, MA)  
Date: March 29, 2021

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As requested, I have reviewed the potential nitrogen loads associated with keeping 1 to 2 horses at 73 Atlantic Avenue. As currently proposed, these horses would be on site for four months each year (June through September) and all manure and stall bedding will be removed from the site.

Water quality impacts associated with horses are largely based on manure and stall bedding management and horse behavior. Horses have evolved to defecate and urinate in safe settings such as a barn, but may also do so infrequently on trails or in paddocks. The amount of urine or feces produced by a horse will vary by the horse and the season (*e.g.*, summer water retention is higher). Reviews from US agricultural universities generally find that an individual horse will produce 45 to 51 lbs of manure per day with approximately 60% of the weight as feces.<sup>1</sup> This mass would then be added to 8 to 15 lbs of bedding per day to result in 2 to 3 cubic feet of stall waste per horse per day. If a horse only defecates and urinates in its stall and all resulting waste is retained within a covered container and removed from the site, no nitrogen loading or water quality impacts would occur.

For the purposes of reviewing the potential water quality impacts at 73 Atlantic Avenue, it was assumed that the site would have two horses present on the site for four months (June through September). Total area of the parcel is 1.47 acres (64,033 sqft). Within this parcel area are proposed to be: a barn (2,520 sqft), a riding area (6,300 sqft), a gravel driveway (4,500 sqft), and pasture (15,280 sqft). If all horse and stall waste was covered and removed from the site, the overall annual nitrogen load would be 1.3 kg/yr. This load is exclusively based on nitrogen contained in precipitation on the project site.

If horses on the site urinated in the riding area or pasture one of the 10 times they urinated (*i.e.*, 90% of the waste was captured in the stalls), the annual load for the site would only increase to 1.8 kg/yr. Given usual horse behavior, this is a very conservative assumption, but provides some sense of the maximum potential load. As a further point of comparison, if one person lived on this site

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<sup>1</sup> *e.g.*, Rutgers Cooperative Extension Fact Sheet F5036, Horses and Manure, <https://njaes.rutgers.edu/fs036/>

and utilized a septic system, rather than the sewer system, the annual nitrogen load would be approximately 2 kg/yr.

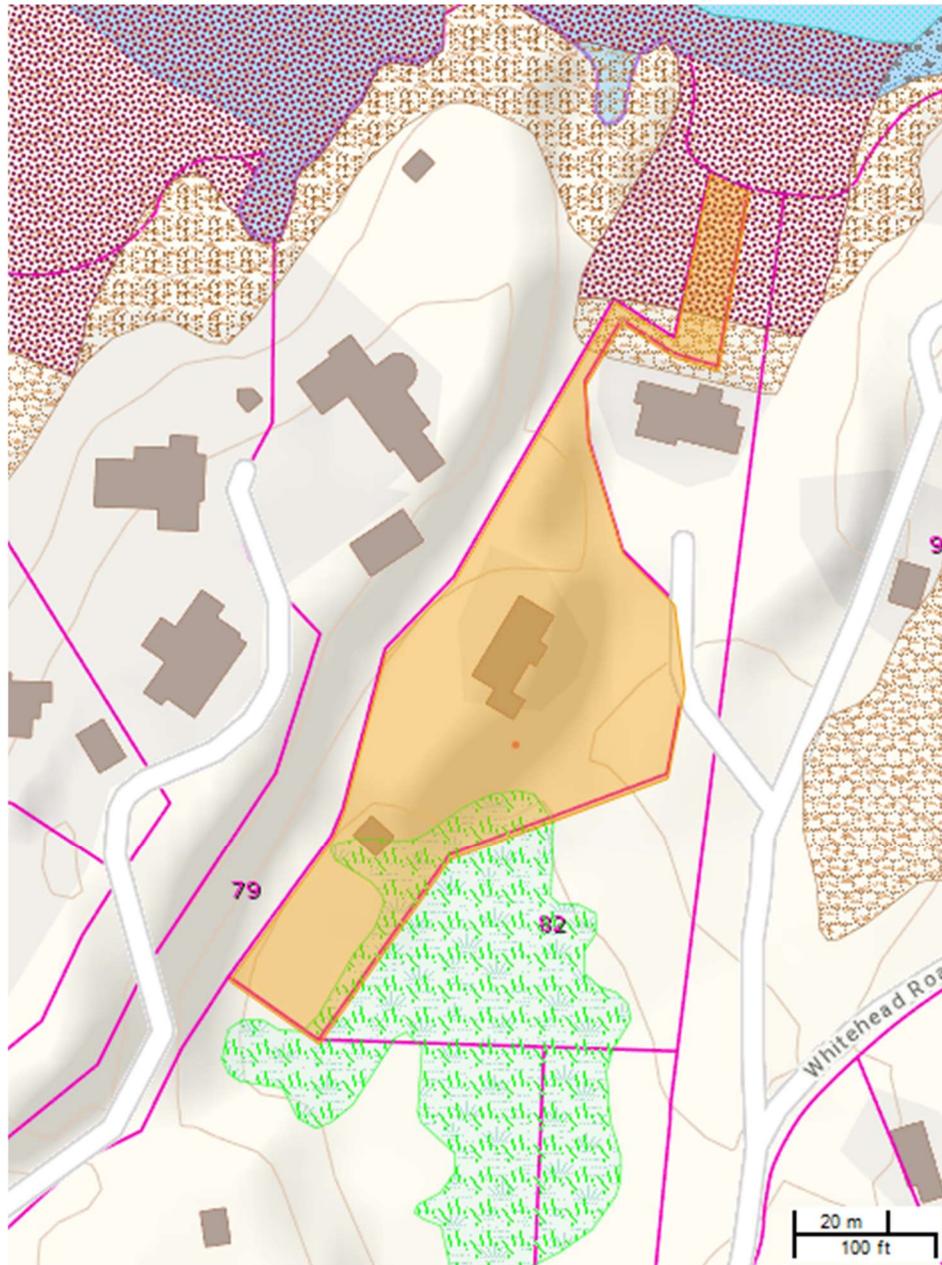
Further confidence in the minimal water quality impact that will be associated with project can be gained by looking at the tolerance of the salt marsh that will receive any potential runoff from the proposed development (Figure 1). Reviews of salt marsh systems have generally found that they are very nitrogen tolerant and detailed reviews have found that measured concentrations of up to 2 mg/L total nitrogen are found in healthy salt marsh ecosystems.<sup>2</sup> In the conservative nitrogen loading scenario for the 73 Atlantic site (*i.e.*, horses urinating outside of the barn 10% of the time), the projected nitrogen loading concentration from the site is 0.5 mg/L. This concentration is insufficient to sustain a healthy salt marsh and, so the potential nitrogen addition from the proposed development will likely be hard to discern in the salt marsh nitrogen concentrations and well below a concentration that should cause water quality concerns for a salt marsh.

Overall, the water quality impacts of having two horses on the site for four months will be minimal provided the horse bedding, feces, and urine are mostly confined to the barn and this collection of materials is stored in a covered container and removed from the site on a regular basis.

Please let me know if you have any questions or comments regarding this review.

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<sup>2</sup> *e.g.*, Howes B.L., E.M. Eichner, S.W. Kelley, J. S. Ramsey, R.I. Samimy, D.R. Schlezinger (2007). Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Little Namskaket Marsh Estuarine System, Orleans, MA. SMAST/DEP Massachusetts Estuaries Project, Massachusetts Department of Environmental Protection. Boston, MA. 116 pp.



**Figure 1. 73 Atlantic Avenue, Cohasset, MA locus.** Parcel is 1.47 acres and southern portion is abutted by a small area of salt marsh (green wetland pattern) identified in MassDEP state-wide wetlands coverage. Source: [http://maps.massgis.state.ma.us/map\\_ol/cohasset.php](http://maps.massgis.state.ma.us/map_ol/cohasset.php).