



September 20, 2016

Mr. Jonathan Mancini
BWC Wankico River LLC
137 Newbury Street, 4th Floor
Boston, Massachusetts 02116

Re: Professional Opinion
Potential Impact of Solar Array on Nutrient Loading at Lagoon Pond

Dear Mr. Mancini:

Bristol Engineering Advisors, Inc. (Bristol) has reviewed the proposal to develop a solar array adjacent to the Oak Bluffs Water District Public Water Supply Wells. We are pleased to provide you with this letter and professional opinion regarding the potential affect the project may have on nutrient loading within Lagoon Pond. This effort is being undertaken as the result of the Martha's Vineyard Commission (MVC) asserting that the Project must conduct an evaluation of – and comply with – nutrient loading provisions of Section 2 of the MVC Interim Policy for DRI (Development of Regional Impact) Review. The Project is sited within the surface watershed for Lagoon Pond, designated as a Category D Seriously Impaired Watershed¹.

It is our understanding that 10.37 acres of clearing will be required in the vicinity of Oak Bluffs Water Department water supply Wells No. 3 and No. 4. No clearing will be closer than 300 feet to either well. The purpose of the clearing is to construct the solar array as well as to minimize potential shading impacts to the proposed solar field that is to be located wholly outside the Zone 1 of either well. The depth to groundwater exceeds 55 feet at both locations.

In preparing this opinion letter, Bristol has reviewed the following documents:

- MVC Interim Policy for DRI Review, Chapter 2. Water Quality, 2007;
- Mass Estuaries Project Final Report on Farm Pond, 2010;
- Mass Estuaries Project Draft Report on Lagoon Pond, 2010;
- Nitrogen Loading Technical Manual, Cape Cod Commission, 1992;
- National Atmospheric Deposition Program (NADP), Illinois State Water Survey, Champaign, IL (<http://nadp.sws.uiuc.edu/NADP/>);
- “Nitrogen in the Nation’s Rain”, NADP, 2000;
- “A Mass-Balance Nitrate Model for Predicting the Effects of Land Use on Groundwater Quality in Municipal Wellhead Protection Areas”, Michael H. Frimpter, USGS Water Resources Division, July 1988;
- Project Documents provided by BWC Wankico River.

Project Understanding

¹ Table 2: Classification of Vineyard Watersheds (Section 2, p. 7)



The project is sited within the Lagoon Pond watershed, which drains into Lagoon Pond, a “Seriously Impaired” water body that connects to Vineyard Haven Harbor. Lagoon Pond is impaired due to excess nitrogen load it receives from watershed development activities that include septic systems and lawn fertilizers. Being an Impaired Water, development within the Lagoon Pond watershed must meet the requirements of Section 3.2.2 of Chapter 2 of the Interim DRI Policy.

Section 3.2.2 requires implementation of the more restrictive of either: 1) meet the nitrogen loading limit for the watershed (3.4 kg/ac/yr), or 2) implement the basic nitrogen reduction techniques. As will be shown below, the project will be substantially below the nitrogen loading limit. The nitrogen loading techniques presented in the Interim DRI Policy appear to be specifically designed for projects that generate wastewater, with the exception of a portion of the third bullet that describes landscaping practices. The Project, as proposed: will contain no landscaped areas (fertilized lawns, etc.); will use no fertilizer either during grow-in or maintenance; will have less than 25% impervious cover, and; will manage stormwater into grassed swales designed to infiltrate the 25-year, 24-hour storm. The Project meets this component of Section 3.2.2 without additional mitigation.

Nitrogen Loading Analysis

Nitrogen deposition in rainfall arises from multiple sources. The atmosphere is comprised of approximately 78% nitrogen, in the form of N_2 , which is for the most part biologically unavailable. A small amount of N_2 can be converted to nitrogen oxides via lightning; and some plants and soil microbes can fix molecular nitrogen to biologically available forms such as ammonia and ammonium.

In the northeast United States, the majority of atmospheric nitrogen oxide (NO_x) is anthropogenic in origin. NO_x is created during high temperature combustion, often associated with the burning of fossil fuels. Other nitrogen species, including ammonia and ammonium enter the atmosphere as a result of farming activities, including fertilizer application as well as from livestock manure and urine. Ammonia is readily removed from the atmosphere by precipitation and as a result, in areas with high levels of atmospheric ammonia such as the Midwestern US it can represent a significant source of additional fertilizer for agricultural crops. It can also enter waterways and sensitive ecosystems where its presence may contribute to ecological impairment².

Total nitrogen concentration in rainfall in the northeast has been estimated at a low of 0.26 mg/L³ to as high as 1.09 mg/L⁴. Using the precipitation value used by the Massachusetts Estuaries Project (MEP) of 46.9 inches of rainfall per year over the 10.37 acres of the Project results in a total nitrogen budget from the Project Site of low of 13.0 kg/year (1.25 kg/ac/yr) to a high of 33.35 kg/yr (3.22 kg/ac/yr) from precipitation. These values represent what the total nitrogen loading to Lagoon Pond would be if the entirety of the site stormwater were directed to Upper Lagoon Pond without attenuation.

The Project site is located within the Upper Lagoon Pond subwatershed of Lagoon Pond. According to the

² Nitrogen in the Nations Rain, NADP Brochure 2000-01c (revised), 2000

³ Michael H. Frimpter, Donohue, John J., Rapacz, Michael V., A Mass-Balance Nitrate Model for Predicting the Effects of Land Use on Groundwater Quality in Municipal Wellhead Protection Areas, USGS Water Resources Division, 1988.

⁴ Draft Report on Lagoon Pond, Mass Estuaries Project, 2010.



MEP report, water passing through Upper Lagoon Pond achieves an 18% reduction in total nitrogen prior to discharging to Lagoon Pond. This “worst-case” situation would result in a total load to Lagoon Pond of 27 kg/yr (2.60 kg/ac/yr), less than the DRI threshold for new development of 3.4 kg/ac/yr.

A review of the design plans demonstrates that stormwater from the site is to be directed overland to two on-site swales that have been designed to accommodate the 20-year storm under the Massachusetts Stormwater Handbook criteria. As a result, precipitation from most storm events will be subject to groundwater recharge and evapotranspiration (ET), including mitigation by soil microbes and vegetation.

The MEP report estimates approximately 28.7 inches of recharge to groundwater per year. At this recharge rate, the loading to groundwater will be 0.77 kg/ac/yr. However, up to 80% of atmospheric nitrogen is removed from precipitation as it infiltrates to and flows within an aquifer⁵. The loss of nitrogen is presumably due to chemical and biological mineralization and incorporation into plant matter and soil microorganisms. Further denitrification occurs within aquifers, which tend to have low dissolved oxygen levels and support the biological conversion of nitrate to nitrogen gas.

The 1988 study by the USGS referenced above found that Cape Cod groundwater contained background levels of precipitation-induced nitrogen of 0.072 mg/L. This compares with the MEP value for total nitrogen in “Natural Area Recharge” of 0.072 mg/L⁶. Using MEP value for nitrogen levels in groundwater, the expected load to Lagoon Pond from this Project is estimated to be 2.20 kg/yr, or 0.21 kg/ac/yr. While the post-development Project site is not likely to be classified as a “Natural Area”, total nitrogen loading rates will likely be more similar to those associated with grassland values than to roof runoff.

In summary, the proposed Project will not have typical development related nitrogen inputs associated with fertilizer use or sanitary wastewater generation and has been designed to infiltrate stormwater to groundwater. It is my opinion that the Project, as proposed, is not be expected to increase nitrogen load to Lagoon Pond above pre-development levels.

If you have any questions regarding this matter, please feel free to contact me at (508) 758-8270.

Respectfully yours,

Bristol Engineering Advisors, Inc.

A handwritten signature in blue ink that reads "Peter L. Newton".

Peter Newton, PG

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⁵ Ibid.

⁶ Table IV-1, MEP Lagoon Pond Draft Report, 2010