Protecting Drinking Water Through Septic Infrastructure Management

Septic System Database for Harvey and Northwood Lakes

Prepared by the

Strafford Regional Planning Commission
with the Town of Northwood

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Northwood Board of Selectmen
Northwood Land Use Department
Northwood Building, Health, and Code Enforcement
Northwood Lake Watershed Association
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Executive Summary

According to the New Hampshire Department of Environmental Services (NHDES), cyanobacteria blooms are becoming more common in New Hampshire and in other states due to increased nutrient availability, warming water temperatures, and changing rain patterns. Stormwater runoff due to development and land-use changes in the watersheds around a waterbody is usually the largest source of the excess nutrients that drive cyanobacteria blooms, as well as unmaintained septic systems.

In the Town of Northwood, several waterbodies have experienced recent cyanobacteria blooms, including Harvey Lake and Northwood Lake. Over the past five years, there have been eight recorded[1] events at Harvey Lake, which accounted for a total of 208 days, and twelve recorded events at Northwood Lake, which accounted for a total of 98 days.

In 2024, Strafford Regional Planning Commission (SRPC), in partnership with the Town of Northwood, was awarded a source water protection grant from the NHDES Source Water Protection Program. The project was to conduct a septic system inventory for a specific study area that included the residential neighborhoods surrounding Harvey and Northwood Lakes to determine groundwater contamination susceptibility. The purpose of this report is to provide a general recap of the project, summarize findings, and highlight the importance of managing private septic systems.

To begin the project, SRPC staff, with general guidance from the Project Steering Committee, obtained a U.S. Environmental Protection Agency (EPA) approved Quality Assurance Project Plan (QAPP). The QAPP outlines the necessary standards and procedures for the project to ensure the quality of environmental data being collected and analyzed.

The next step was to develop a data collection platform and process for building the inventory. This included a determination on what information was going to be gathered, as well as how it was going to be obtained and managed.

[1] The Cyanobacteria Harmful Algal Bloom Program at NHDES is a response-based program. This means that NHDES only collects samples when potential blooms are reported. The increased number of bloom reports in New Hampshire is, in part, a result of increasing public awareness and documentation of blooms.

Infrastructure data selected for inclusion were chosen based on project-relevant criteria, such as number of bedrooms, septic system type, installation designer, construction approval date, and operation approval date. SRPC staff distributed a septic survey to landowners within the study area and collected available data from the NHDES OneStop Septic System Database. All remaining records were attained from property files at the Northwood Town Hall. Environmental information was compiled using publicly available Geographic Information System (GIS) data. This included proximity to wetlands, waterbodies, and flood zones, as well as soil limitation factors.

SRPC utilized two existing septic system studies, including one for the Parson Creek Watershed in the Town of Rye (FB Environmental, 2014) and the other for the Sunnyside Drive, Woodridge Road, and Foss Farm Road Neighborhoods in the Town of Durham (SRPC, 2016), to develop the vulnerability methodology that was used for the project. The ranking method used environmental sensitivity and infrastructure data to measure potential risk of individual parcels from failing septic systems. From there, properties were prioritized based on total risk to provide municipal staff and local decision-makers with a well-researched basis for directing future resources in an efficient and timely manner.

The environmental sensitivity and infrastructure risk analysis reviewed a total of 394 parcels within the project area. Results produced from the analysis indicate that:

- 39 parcels were ranked as having the Lowest Priority Risk
- 63 parcels were ranked as having an Intermediate-Low Priority Risk
- 73 parcels were ranked as having a Moderate Priority Risk
- 144 parcels were ranked as having an Intermediate-High Priority Risk
- 75 parcels were ranked as having the Highest Priority Risk

Outcomes were displayed in a series of GIS-based maps.

During the project, SRPC provided outreach and awareness materials that depict proper septic maintenance and illustrate ways that property owners can improve the functionality of their systems. Flyers developed by the EPA as part of SepticSmart Week were distributed at the Town Offices, on the website, and shared through the Northwood Lake Watershed Association.

Lastly, a septic ordinance was developed by the project team. The ordinance, which was drafted as a Health Ordinance under NH RSA 147:1, seeks to safeguard public health by regulating wastewater disposal systems near all waterbodies that are subject to the provisions and requirements of the New Hampshire Shoreland Water Quality Protection Act. The Board of Selectmen adopted the ordinance on June 24, 2025.

1.0 Project Background

Located in Rockingham County, the Town of Northwood was founded in 1773 and is home to 4,664 year-round residents. At the headwaters of the coastal watershed, Northwood's water resources have a profound downstream impact as a part of both the Piscataqua-Salmon Falls Watershed and the Merrimack River Watershed. Most of the drinking water for homes and small businesses in Northwood comes from groundwater in bedrock aquifers that are not typically high-producing, and the aquifers surrounding the local lakes and ponds are already densely developed. As noted in NH's Drinking Water Source Assessment Program (DWSAP), this geology makes groundwater vulnerable to contamination.

Additionally, the DWSAP encourages municipalities to supplement existing data with land-use information such as septic systems on well drained soils near surface waters, to determine contamination susceptibility. While it is recommended that septic systems be pumped every 3-5 years, system maintenance history is often unknown to landowners, resulting in poorly maintained infrastructure at risk of polluting nearby waters. And, although a hydrogeologic study is required for larger developments, Northwood does not require annual evaluation of septic systems.

This project's primary goal is to maintain high water quality in the Town's existing public water systems by conducting an inventory of vulnerable septic infrastructure.

To determine the study area, SRPC cross-referenced waterbodies identified in the state's 303(d) list with community public water systems. Harvey Lake and Northwood Lake were chosen because of their proximity to Wellhead Protection Areas around Coe Brown Academy and the Loon Estates Cooperative, as well as existing water quality impairments. Northwood Lake

has an Escherichia coli impairment for primary contact recreation. Harvey Lake is also on NHDES's 303d list for aquatic life integrity due to pH levels.

Additionally, the Northwood Drinking Water Source Assessment Report indicates two of the three bedrock wells that support the Loon Estates Public Water Supply are ranked high for susceptibility to contamination by septic systems. The bedrock well that supplies Coe Brown Academy is also highly susceptible to septic system contamination, and the well supplying Coe Brown's Smith Hall has medium septic system contamination susceptibility. susceptibility rankings

2.0 Creation of the Database

There are two major components to the septic systems database: soil and environmental risk factors and system age as indicated by permit records.

2.1 Environmental Risk Factors

Soil and environmental risk factors refer to the sensitivity to septic failure in various areas of the town. Higher risk factors indicate a greater risk to health and safety if a septic system should malfunction, because fecal contamination and excess nutrients will have a more direct route to nearby waterbodies and swimming areas. These risk factors were determined using GIS, along with publicly available data. An outline of the data used to determine the risk factor, and each data source follows.

Northwood parcels: Northwood parcel data, which includes information on map/lot numbers and acreage, was obtained in 2024 by SRPC via permission from the Town of Northwood.

Environmental and Soil Risk Map: This layer indicates the risk to water quality if a septic system should malfunction, based on the following:

1. **Natural Resources Conservation Service (NRCS) Data**: The NRCS Web Soil Survey was queried for limitations for septic tank absorption fields. The resulting table was copied and adjusted in Excel to arrange limitation ratings into a coherent field/value format. Final map unit weighted rating values were developed for each of the following factors:

a. Depth to bedrock: Depth from soil surface to bedrock. A shallow depth to bedrock may limit installation/function of septic tanks, leach fields, etc.
b. Depth to saturated zone: Depth from soil surface to the zone of saturation. A shallow depth to the saturated zone may result in waterlogged septic systems during heavy rain events and/or groundwater contamination from sewage effluent.
c. Filtering capacity: The ability of the soil to filter sewage effluent. Reduced filtering capacity may result in groundwater contamination.
d. Flooding: Flooding may limit the function of septic fields and leach fields, leading to the contamination of nearby surface water bodies.
e. Large stones: The presence of large stones may make installation of a septic system difficult.
f. Ponding: The collection of standing water on the soil surface for a measurable period. Ponding may limit the function of septic fields and leach fields, resulting in surface water contamination.
g. Seepage, bottom layer: The movement of water through the lowest layer of the soil. Large seepage rates may result in sewage effluent moving into and contaminating groundwater before being fully filtered.
h. Slope: High slopes may limit the placement of a leach field, given the horizontal space required for the field.
i. Slow water movement: Slow water movement indicates low permeability, which in turn means that sewage effluent may not dilute and spread out sufficiently for filtration and biological decomposition to take place efficiently.

2. **Wetlands**: Wetland areas, as delineated in the National Hydrography Dataset and in the National Wetlands Inventory, were combined into a single dataset and assigned a risk value based on the percentage of wetlands within each parcel.

3. **Waterbodies**: All non-wetland waterbodies as delineated in the National Hydrography Dataset were buffered by 100 feet. The resulting areas were assigned a risk value; streams digitized only by center

flowline were buffered from that flowline and assigned a risk value. Both were combined and based on the percentage within each parcel.

4. **Flood Zones**: Flood zones as delineated by the Federal Emergency Management Agency to be Zone A, AE, AO, or VE were assigned a risk value based on the percentage of flood zones within each parcel.

Final risk value was determined by combining the delineated soil, wetland, waterbody proximity, and flood zone data layers in a 'union' function and adding the risk values for each component piece. All areas were rated in the twelve limitation categories (nine soil categories, three water/wetland categories) listed above.

Risks by parcel were spatially analyzed to calculate an area weighted rank for each parcel based on the underlying soil and environmental risk factors located within each individual parcel. The result is that each parcel has an associated environmental risk factor for septic system failures.

2.2 Infrastructure Risk Factors

In conjunction with the soil and environmental risk factors detailed above, certain infrastructure features bring a higher risk of septic system failure. These included the number of bedrooms, septic system type, installation designer, construction approval date, and operation approval date. According to the EPA, a typical system lifespan is often considered 30-40 years.

Information was obtained through landowner surveys, NHDES OneStop, and municipal records. Due to data challenges, including a modest survey response rate (18%) and limitations with using NHDES OneStop (subsurface records only go back to the year 1986), the best avenue to acquire information was through manual permit history review. This was completed by examining individual property files at the Town Hall.

Septic Infrastructure Risk Map: This layer indicates the risk of septic system malfunction and/or failure and is based on system age and availability of permit data.

1. **Septic Risk Scores**
    a. Parcels consisting of vacant land or with a non-dwelling building that lacks plumbing (e.g., storage shed) were assigned a risk value of zero (0).
    b. Parcels with a permit indicating the septic system was built within the last 10 years were assigned a risk value of one (1).
    c. Parcels with a permit indicating the septic system is between 10-30 years old were assigned a risk value of two (2).
    d. Parcels with a permit indicating the septic system is more than 30 years old were assigned a risk value of three (3).
    e. Parcels without a permit on file (i.e., there is no clear record of a septic system approval) were assigned a risk value of four (4).

The results of this analysis concluded that the biggest challenge was lack of available data. Of the total 394 parcels within the study area, 213 of them (54%) did not have septic information. The next largest cohort were parcels with a permit for a septic system between 10-30 years old (20%). A more detailed breakdown is detailed below.

Septic Risk Factor	Number of Parcels	Percentage
0	39	9.9%
1	41	10.4%
2	79	20.1%
3	22	5.6%
4	213	54.1%

2.3 Total Risk Score

To create a final map, environmental risk factors and septic age risk values were combined to produce a "total septic risk" value.

Total Septic Risk Map: This layer indicates the total environmental and infrastructure risk of a septic system failure and/or malfunction based on the following:

1. Existing soil risk data were averaged by parcel to provide an overall per parcel soil risk number.

a. The soil risk layer showing risk on a per-sub-parcel basis (soil type polygon, flood zone polygon, etc.) was 'unioned' with a parcel dataset to allow for summarizing soil risk on a per-parcel basis.
b. The area of each parcel was calculated, as was the area of each sub-parcel component (soil type, flood zone, wetland extent, etc.) for that parcel. The parcel sub-component's proportion of parcel coverage was calculated by dividing the sub-parcel component's area by its parent parcel's area.
c. The soil risk score for each sub-parcel component was multiplied by the appropriate proportion to obtain a proportional soil risk score for each component. Those proportional soil risk scores were added together for all sub-parcel components in each polygon, achieving a parcel-based weighted average soil risk score.

2. The "septic age risk" score, already calculated on a per-parcel basis, was added to the weighted-average "soil risk" score to get a "total priority risk" score.

2.4 Total Priority Risk Scores

1. **Lowest Priority Risk:** All parcels with a total septic risk score between 0.84 and 2.87. Generally, these parcels have a relatively low average environmental risk score ($\bar{x}$ 1.69) and there are no existing septic systems.

2. **Intermediate-Low Priority Risk:** All parcels with a total septic risk score between 2.88 and 4.20. Generally, these parcels have a slightly higher average environmental risk score ($\bar{x}$ 2.31) and an equal distribution of septic system age ranging from within the last 10 years (42.9%) and between 10-30 years old (41.3%).

3. **Moderate Priority Risk:** All parcels with a total septic risk score between 4.21 and 5.26. Generally, these parcels have a similar average environmental risk score compared to those with an intermediate-low priority risk ($\bar{x}$ 2.29) with a higher percentage of septic systems older than 30 years old (19.2%) and parcels without any septic data (20.5%).

4. **Intermediate-High Priority Risk:** All parcels with a total septic risk score between 5.27 and 6.47. Generally, these parcels have a similar

average environmental risk score compared to those with an intermediate-low and moderate priority risk ($\bar{x}$ 2.15) with a much higher percentage of parcels without any septic data (86.1%).

5. **<u>Highest Priority Risk:</u>** All parcels with a total septic risk score between 6.48 and 8.30. Generally, these parcels have the highest average environmental risk score ($\bar{x}$ 3.11) with the highest percentage of parcels without any septic data (97.4%).

3.0 Map Process

Environmental and Soil Risk:
Risks by parcel were spatially analyzed to calculate an area weighted rank for each parcel based on the underlying soil and environmental risk factors located within each individual parcel. The result is that each parcel has an associated environmental risk factor for septic system failures.

Septic Infrastructure Risk:
This layer indicates the risk of septic system malfunction and/or failure and is based on system age and availability of permit data.

Total Septic Risk Map and Priority Risk Scores:
Environmental and soil risk plus septic infrastructure risk values combined.

4.0 Septic Database Spreadsheet

The resulting septic system database is a prioritized list of all parcels (built and unbuilt lots) within the study area. The spreadsheet contains a list of tax parcels which have been ranked according to environmental and infrastructure risk.

4.1 Description of Data Columns

1. Columns A - C: Map/Lot/Sub-Lot – Tax Map/Lot/Sub-Lot identification numbers available through Northwood's parcel data.

2. Columns D – F: Owner/Street & Mailing Address – Property owner information available through Northwood's assessing data.

3. Columns G – J: Assessing Data – Number of bedrooms, number of bathrooms, year built, and the size of the lot available through Northwood's assessing data.

4. Column L: Installer – Name of licensed installer.

5. Column M: Approval of Construction Date – Issued by the NHDES Subsurface Systems Bureau once design plans have been approved, which include specifications for proposed septic systems to ensure the proper siting, construction and operation of the systems. Information was compiled from both the OneStop database and municipal records.

6. Column N: Approval of Operation Date – Issued by NHDES once an approved septic system is installed and inspected. Information was compiled from both the OneStop database and municipal records.

7. Column O: Septic Infrastructure Risk Score – The risk to water quality if a septic system should malfunction is based on system age and availability of permit data.

8. Column P: Soil Limitation Risk Score – The risk to water quality if a septic system should malfunction is based on the NRCS data (see Section 2.1 (1)(a-i) for more details).

9. Column Q: Environmental Risk Score – The risk to water quality if a septic system should malfunction is based on proximity to wetlands, water bodies, and flood zones (See section 2.1 (2-4) for more details).

10. Column R: Total Risk Score – Septic infrastructure, soil limitation, and environmental risk scores combined.

11. Column S: Total Priority Risk Ranking – Five rankings based on risk.

Mapping Results

Map 1: Study Area (Town-wide)
Map 2: Study Area
Map 3: Environmental and Soil Risk
Map 4: Septic Infrastructure Risk
Map 4: Total Septic Risk

Northwood Septic Demographic and Environmental Vulnerability

Study Area (Town-wide)

Pittsfield
Epsom

Strafford
Barrington

Northwood Lake

Harvey Lake

Epsom
Deerfield

Barrington
Nottingham

N

0 0.45 0.9 1.8 Miles

Legend

- Full Study Area
- Wellhead Protection Area- Loon Estates Cooperative
- Wellhead Protection Area - Coe Brown

Northwood Septic Demographic and Environmental Vulnerability

Study Area

Northwood Lake

Harvey Lake

Epsom

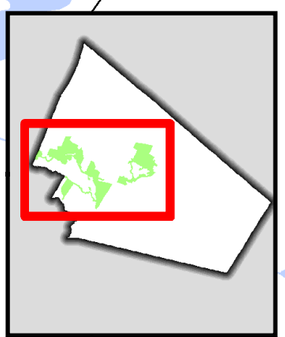
Deerfield

N

0 0.15 0.3 0.6 Miles

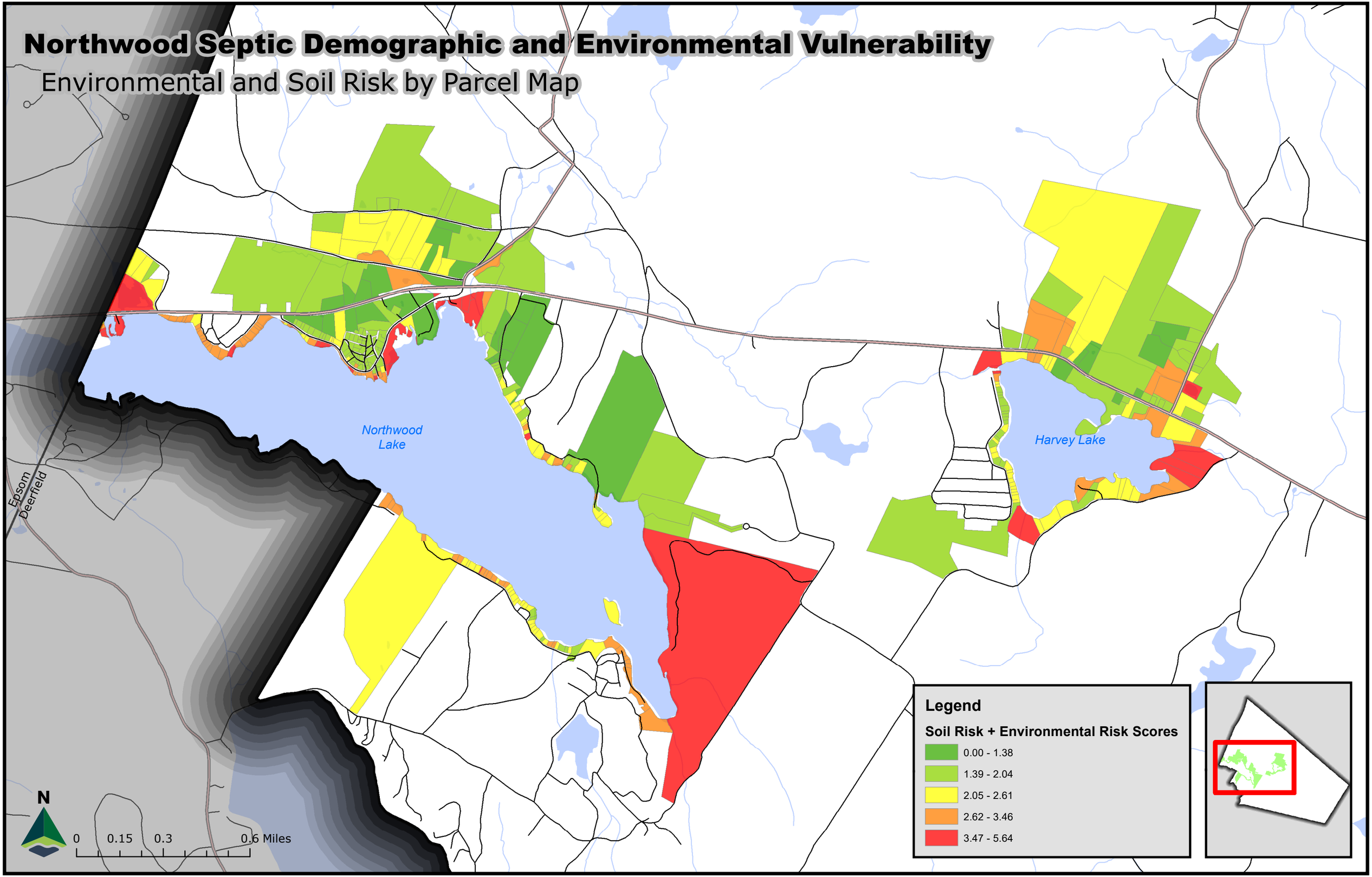
Legend

- Study Area 1: WHPA - Coe Brown
- Study Area 2: Harvey Lake Parcels
- Study Area 3: WHPA - Loon Estates
- Study Area 4: Northwood Lake Parcels



Northwood Septic Demographic and Environmental Vulnerability

Environmental and Soil Risk by Parcel Map



Northwood Septic Demographic and Environmental Vulnerability

Septic Infrastructure Risk Map

Northwood Lake

Harvey Lake

Epsom

Deerfield

N

0 0.15 0.3 0.6 Miles

Legend

Septic System Risk Score

- 0.00
- 0.01 - 1.00
- 1.01 - 2.00
- 2.01 - 3.00
- 3.01 - 4.00

Northwood Septic Demographic and Environmental Vulnerability

Total Septic Risk Map

Northwood Lake

Harvey Lake

Epsom

Deerfield

N

0 0.15 0.3 0.6 Miles

Legend

Soil + Environmental + Septic Risk Scores

- Lowest Priority Risk
- Intermediate-Low Priority Risk
- Moderate Priority Risk
- Intermediate-High Priority Risk
- Highest Priority Risk