



Groundwater Protection Guidelines for Agriculture

Introduction

Preventing groundwater contamination is a high priority involving collective efforts across public, private, residential, and commercial sectors. Groundwater protection is also critical for the agricultural sector to maintain local drinking water supplies for farms, homes, and communities while applying manure and other agricultural inputs essential for crop production, soil health, and environmental management. This factsheet describes areas associated with increased groundwater contamination risk and outlines manure management practices that can help mitigate risk.

Areas of Increased Contamination Risk

Areas of increased risk of groundwater contamination include glacial outwash soil and areas with rapid infiltration, soils <20 inches deep over non-carbonate bedrock, and soils <40 inches deep overlying carbonate bedrock and karst topography.

Glacial Outwash & Areas of Rapid Infiltration

These areas are often found on valley floors, but also occur in other upland locations around New York. Soils are deep, typically made up of relatively coarse sand, gravel, and cobble, and well- to excessively well-drained. Because these soils have high saturated hydraulic conductivity ("drainable porosity"), nutrients can rapidly move out of the root zone. Many public water supply wells are associated with such soils.

Soils <20-inch to Non-Carbonate Bedrock

These soils are often situated on fractured bedrock including shale, sandstone, or older metamorphic "basement" bedrock. When the soil is <20 inches deep over fractured bedrock, groundwater contamination risk is elevated. Shallow soils should be treated as though fractures are present as it is often difficult to know if there are critical fractures where manure can easily contaminate groundwater and nutrients quickly move great distances.

Soils <40-inch to Carbonate Bedrock and Karst
Soils <40 inches deep to carbonate bedrock and/or fields with karst features pose an

elevated risk for surface management induced groundwater contamination. "Carbonate" includes limestone, dolomite, calcareous shale, and other carbonate-containing sedimentary bedrock that can develop enhanced fracture pathways due to dissolution from groundwater. Bands of carbonate bedrock can be found (1) roughly parallel to the New York Thruway from Albany to Buffalo, (2) along the western side of the Hudson River south of Albany, and (3) in some portions of northern New York (Figure 1).

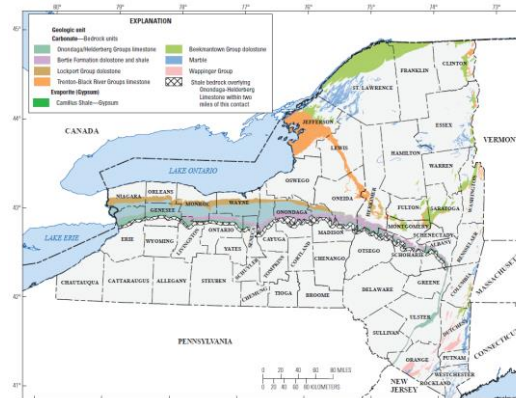


Figure 1. 1:250,000 scale carbonate bedrock unit map of New York State (Source: Kappel et al., 2020; reprinted with permission).

Some of the bedrock in these areas has developed what is known as "karst topography" where sinkholes, closed drainage depressions, dissolved caverns and solution enlarged fractures (zones of rapid flow) are often exhibited. These karst areas are at high risk for groundwater contamination. Special care must be taken when considering manure spreading. Localized areas of carbonate bedrock within all these broader units can be highly fractured, providing rapid drainage pathways for surface runoff to reach groundwater. The fractures are important pathways between the surface and the groundwater flow system providing rapid groundwater recharge, even when filtered by a few feet of soil. As water seeps into the cracks, the carbonate material is slowly dissolved causing further widening of fractures and increasing the capacity of such areas to accept shallow groundwater recharge making carbonate areas very vulnerable to rapid

recharge from the surface and to equally rapid changes in water quality when manure is moved offsite during periods of heavy rainfall or snow melt. Either type of event can cause rapid surface water runoff and subsequent infiltration into the bedrock aquifer system.

Soil and Landscape Feature Assessment

Management of areas with increased risk for groundwater contamination begins with an assessment of soil and landscape features. A step-by-step process is outlined in [Groundwater Protection Guidelines for Agriculture](#).

Manure Management Guidelines

Glacial Outwash & Areas of Rapid Infiltration

Guidelines for manure management of glacial outwash soils can be found in [The New York Nitrate Leaching Index](#).

Guidelines for Bedrock-Controlled Soils

- Manure should not be applied to saturated or frozen saturated soils ("concrete frost"), per NRCS CPS 590.
- Avoid manure applications on these fields during winter and wet weather conditions by storing manure or applying to lower risk fields.
 - Winter conditions are when soil is frozen (≥ 4 inches), snow covered (≥ 4 inches), or encumbered by significant surface icing.
 - Wet weather conditions are defined as times when significant precipitation (e.g., greater than 0.25 inches of rain within a 24-hour period when soils are approaching saturation or greater than 1 inch of rain independent of soil moisture content) and/or snowmelt events (e.g., greater than 40°F for 6 hours or more) are forecast within the next 48 hours.
- When applications to fields with bedrock-controlled soils are needed in winter and/or wet weather conditions, manure should be incorporated/injected on the day it is applied.
- Manure should not be applied within 100 feet of any water well or spring, per CPS 590. For wells with a history of water quality problems, or where wells are known to be of sub-standard construction, implementation of greater setback distances may be required. Application setback should be initiated from the adjacent property boundary or apparent lot boundary associated with a residence if well location is unknown. Establishment of perennial vegetation in setbacks from wells is encouraged.

- Application rates may need to be reduced and/or timing adjusted to account for high-risk fields.

For fields with karst features, additional manure management guidelines apply:

- Always use a vegetated buffer (≥ 35 feet) and a manure application setback (≥ 100 feet) from entry points to groundwater such as sinkholes, swallets, and exposed bedrock. Setbacks may need to be extended to include significant concentrated flows draining to karst features.
- Avoid manure applications in these areas during winter and wet weather conditions by storing manure or applying to lower risk fields not draining to karst features. When applications in these areas are necessary during winter and/or wet weather conditions, direct inject or incorporate manure the same calendar day as it is applied.

In Summary

Areas of increased risk of groundwater contamination include glacial outwash and soils with rapid infiltration, soils < 20 inches deep over non-carbonate bedrock, and soils < 40 inches deep overlying carbonate bedrock and karst topography. Careful manure management can help reduce the risk of groundwater contamination in such areas.

Additional Resources:

- Groundwater Protection Guidelines for Agriculture: <http://nmsp.cals.cornell.edu/publications/files/GroundwaterGuidelines2021.pdf>.

Disclaimer

This fact sheet reflects the current (and past) authors' best effort to interpret a complex body of scientific research, and to translate this into practical management options. Following the guidance provided in this fact sheet does not assure compliance with any applicable law, rule, regulation or standard, or the achievement of discharge levels from agricultural land.

For more information



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<http://nmsp.cals.cornell.edu>

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