

# Byron Township Forest-to-Field Water Quality Study

## A unique opportunity to study land use changes from the point of conversion

A multi-partner effort has begun to study the amount of nitrate nitrogen leaching loss that occurs below an agricultural field recently converted from forest to irrigated row crop production. The landowner, RDO Farms, has made the property and their staff available to better understand the deep drainage and nitrate-nitrogen leaching dynamics following this type of land use change.

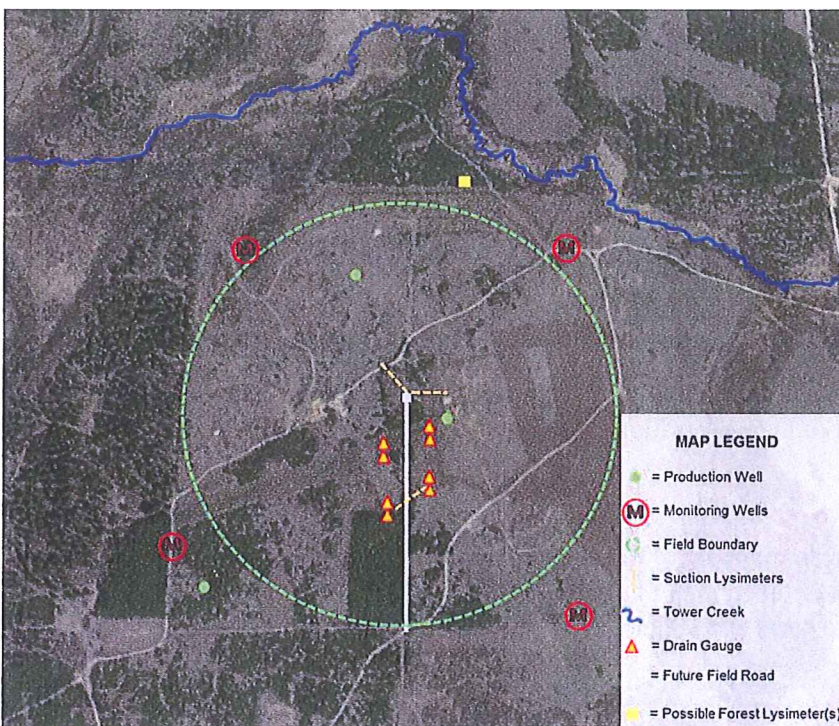
This study is unique. It is the first instance in the state, and perhaps nationally, where groundwater impacts from irrigated row crop agriculture on newly converted forest land will be studied long-term starting from the first year of conversion. Findings from the study will be valuable as additional forest land in Minnesota's Central Sands region is converted to irrigated crop land – a trend that has started and likely will continue as Potlatch Corporation sells off its forest land holdings in Minnesota. The study will help researchers, ag industry, and government better understand the potential groundwater quality impact of such land use conversions.

The study is also unique in its team of talented and dedicated partners:

- RDO Farms
- Central Lakes College, Staples (CLC)
- Minnesota Dept. of Agriculture (MDA)
- Minnesota Dept. of Natural Resources (DNR)
- University of Minnesota Extension (UM-Ext)
- Northeast Technical Services (NTS)
- Sustainable Farming Association of Minnesota
- Natural Resources Conservation Service (NRCS)

The 160 acre site is located in Byron Township, Cass County, 12 miles north of Staples, Minnesota. The soil is sandy loam and groundwater occurs at depths of 10 to 20 feet. RDO Farms will grow seed potatoes every fourth year and Central Lakes College will grow corn, soybeans, barley, and possibly edible beans during the other three rotational years. The land was cleared in 2013 and soybeans were planted in 2014 in the first crop production year.

If not utilized by plants or retained in soil organic material, nitrate from nitrogen fertilizer or breakdown of organic matter is moved by water down through the soil and into groundwater. Since water moves quickly through sandy soil the potential for nitrate contamination of groundwater on this site, and similar sites, is high. Because of this, RDO Farms and CLC will be using innovative cropping practices to reduce nitrate loss, including the use of nitrogen fertilizer best management practices, growing low-nitrogen demanding seed potatoes, using slow release nitrogen fertilizers, and using cover crops to capture and hold excess nitrate in the rooting zone until the following season.



### Byron Township Study Site

This aerial photo was taken before clearing operations were complete.

The site is located 12 miles north of Staples, Minnesota in Byron Township, Cass County.

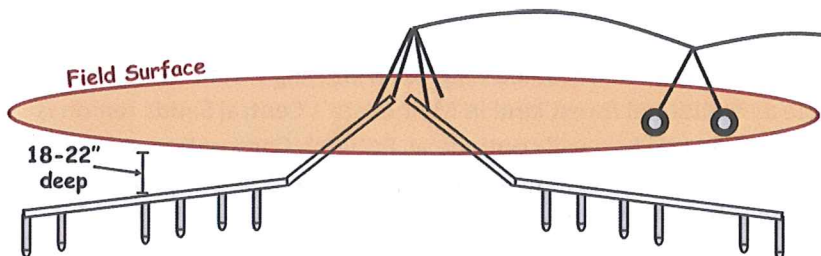
Marked on the photo are both installed and planned monitoring equipment. Locations of irrigation water wells are also shown.

Bordering the site to the north is Tower Creek. Possible impacts of pumping irrigation water on the flow of Tower Creek is being monitored by RDO/NTS with oversight by the DNR.

## Portions of the study that have begun and instrumentation installed:

### Collection of soil water samples with suction tube lysimeters

Soil water is being collected weekly from 12 suction tube lysimeters and samples are analyzed for nitrate-nitrogen. The lysimeters are installed at a 4-foot depth to collect soil water that has moved past crop rooting depth and could potentially move down into groundwater. The tips of the lysimeters are made of a porous ceramic material that water flows through when suction is placed on the tubes (diagrams below). The MDA and UM-Ext installed the lysimeters in June 2014, and monitoring started following the installation.



**Top:** Layout of 12 lysimeters installed at the Bryon Township site.

**Bottom right:** "See-through" diagram of a suction tube lysimeter.

**Bottom left:** Installation of lysimeters at Byron Township site. Lysimeters are installed in holes at the bottom of the trench. PVC pipe protects plastic sampling lines from rodents.



### Soil moisture monitoring

UM-Ext, CLC and RDO Farms staff are monitoring the soil water balance by comparing the amount of precipitation and irrigation the field receives with the amount of water use by the crop. The difference between these values is an estimate of the water that moves below the root zone.

### Detailed record keeping

RDO Farms and CLC are keeping detailed records of field management to compliment the monitoring work. The MDA serves as the clearinghouse for the field management information.

### Drain gauge installation

The MDA and UMN Ext staff collaborated on the installation of eight drain gauges placed at a 4-foot depth below the crop rooting zone in late October 2014. Drain gauges measure the volume of water that moves through the soil profile. By combining nitrate-nitrogen concentration data from lysimeters with drainage volume data from drain gauges, groundwater loading in terms of pounds of nitrate-nitrogen per acre can be estimated.

### Monitoring wells

In support of this field study, the DNR installed seven shallow monitoring wells around the field perimeter in early November 2014. These wells will enable us to better understand the movement of shallow groundwater below this field and also provide access to measure the nitrate concentration of this water throughout the year. Monthly groundwater sample collection for nitrate concentration began in December 2014.

### Grid soil sampling

Following the 2014 harvest, the MDA coordinated a 2.5 acre grid soil sampling of the field to a 2-foot depth. The results will provide a reference for the soil nutrient concentrations in the field following the first year of row crop production.

### Soil Texture Mapping

UM-Ext staff completed soil electrical conductivity mapping of this field following the 2014 harvest. The map compiled from these measurements provides a detailed map of soil texture variability across the field and assisted with locating the drain gauges in representative parts of the field.

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