COUNTY OF EAU CLAIRE
EAU CLAIRE, WISCONSIN
"NOTICE OF PUBLIC MEETING"

In Accordance with the provisions of Chapter 19, subchapter IV, Wisconsin Statutes, NOTICE IS HEREBY GIVEN of the following public meeting:

THE GROUNDWATER ADVISORY COMMITTEE

WILL MEET ON TUESDAY, JUNE 19, 2018 TIME: 5:00 P.M.

PLACE: EAU CLAIRE COUNTY COURT HOUSE ROOM 302

721 OXFORD AVENUE EAU CLAIRE, WI 54703

OPEN SESSION

AGENDA

1. Call to order by Chair
2. Confirmation of Compliance with Open Meeting Law
3. Public Comment Period
4. Review/Approval of April 24, 2018 meeting minutes.
5. Report by Sub- Committee on Groundwater Report/Discussion/Action

   -Draft Outline Reviewed

   -Progress on Issues by Sub-Committee members

   -Outstanding Issues
6. GW Committee Priority Recommendations on Draft Report/Discussion/Action

   (Goal: 1-3 recommendations per committee member)
7. Projected Planning and Development/Land Conservation Budget and grant Requests/Discussion/Action
8. Report on Testing Surveys from City-County Health Department
9. Next Meeting Date (July __, 2018)
10. Items for the Next Agenda
11. Adjourn

PLEASE NOTE: ***Upon reasonable notice, efforts will be made to accommodate the needs of individuals with disabilities through sign language, interpreters or other auxiliary aids. For additional information or to request the service, contact the County ADA Coordinator at 839-4710, (Fax:) 839-1669 or 839-4735, tty: use Relay (711), or by writing to the ADA Coordinator, Human Resources, Eau Claire County Courthouse, 721 Oxford Avenue, Eau Claire, WI 54703.***

RECEIVED _____

POSTED _____

COUNTY OF EAU CLAIRE

EAU CLAIRE, WISCONSIN

GROUNDWATER ADVISORY COMMITTEE

MEETING MINUTES – April 24, 2018
EAU CLAIRE COUNTY COURTHOUSE, Room 302
720 – 2ND AVENUE, EAU CLAIRE, WI 54701

MEMBERS PRESENT: Jim Dunning, Heather Deluka, Nancy Coffey, Mary Kenosian, Glory Adams, Sham Anderson, Sarah Vitale , Jennifer Eddy (arrived at 5:05 pm) , Anna Mares (arrived at 5:07 pm)

MEMBERS ABSENT: (none)

STAFF PRESENT: Audrey Boerner and Matt Steinbach (Eau Claire City-County Health Dept.); Chris Straight (West Central WI Regional Planning Commission); Liz Fagen and Greg Leonard (Eau Claire County Land Conservation)

OTHERS PRESENT: (none)

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1. **Call to order by Chair pro tempore**
   The meeting was called to order by Chair pro tempore Dunning at 5:01 pm. A quorum was present.

2. **Confirmation of Compliance with Open Meeting Law**
   Dunning confirmed compliance with the open meetings law.

3. **Election of Chair and Vice Chair/Discussion – Action**
   Dunning called for nominations for Chair. Adams nominated Jim Dunning. Dunning called 3 more times for nominations. None were received.
   ACTION: Motion by Deluka to close nominations and a unanimous vote be cast to elect Jim Dunning as Chair of the Groundwater Advisory Committee. Motion carried, 7-0-0. Dunning thanked everyone and accepted the position.

   Dunning called for nominations for Vice Chair. Coffey nominated Heather Deluka. Dunning called 3 more times for nominations. None were received.
   ACTION: Motion by Adams to close nominations and a unanimous vote be cast to elect Heather Deluka as Vice Chair of the Groundwater Advisory Committee. Motion carried, 7-0-0. Deluka thanked everyone and accepted the position.

4. **Appointment of Committee Clerk/Discussion – Action**
   ACTION: Motion by Kenosian to appoint Greg Leonard as Committee Clerk. Motion carried, 7-0-0.
   (Eddy arrived)

5. **Public Comment Period**
   (none)

6. **Review/Approval of February 8, 2018 minutes**
   ACTION: Motion by Kenosian/Anderson to approve the February 8, 2018 minutes as presented. Motion carried, 8-0-0.
   (Mares arrived)

7. **Introduction of New Board Members**
   Dunning announced that the entire membership of the Groundwater Advisory Committee was present. Everyone introduced themselves.

8. **Report from Sub-Committee**
   Chris Straight updated the Committee on the sub-committee scope of the report currently entitled "The State of the Groundwater in Eau Claire County". Draft versions of sections will be forwarded to Fagen for compiling. The report will be watershed centric, with the plan to complete this by July. Eddy wondered how technical does the committee want to go with this report. What can individuals or policy makers do? Vitale replied some of the gaps in policy may become evident upon completion of the report. Groundwater quantity data is lacking. Private well drilling provides data, but private wells may often be drilled shallow to keep costs down, and this can potentially test higher in nitrates. Priorities are expected to be the primary outcome of the report. Grant sources can be limited.

9. **Committee Priority Recommendations on Outstanding Issues**
   Priority recommendations on outstanding issues include groundwater nitrates not get any worse, not just agricultural sources, but also septic. Quantity of groundwater is also a concern, including the influence of high-capacity wells on local wells and groundwater. Straight mentioned the work his organization did with St Croix and Dunn Counties.

10. **Report from Sub-Committee on Grant Application Goals/Groundwater Information (Discussion only)**
    Most items discussed previously by sub-committee.

11. **Report from Land Conservation Department**
    Leonard reported on the colabrative efforts on the EPA Environmental Education grant and the DNR Targeted Runoff Management (TRM) grant applications, which both included the same groundwater education component targeted at area high-school FFA groups.

12. **Report from City-County Health Department**
    Boerner reported the nitrate source study will be finished by the end of June. Nearly 400 surveys were sent out, with approximately 100 samples being taken. Initial results are either low- or non-detections on the tracers. Final report will be completed soon. Matt Steinbach again introduced himself as the new Environmental Sciences Division Manager and looks forward to working with the committee.

13. **Report from Regional Planning Commission**
    Beyond what was reported earlier, there was no additional report.

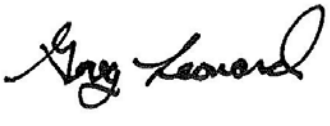
14. **Report from Planning and Development Department**
    The entire zoning code is in the process of a comprehensive review and update.

15. **Report from Planning and Development Regarding Town of Washington Groundwater Study**
    No formal report was given.

16. **Next Meeting Date**
    The next meeting date will be June 19, 2018 at 5:00 pm in the Eau Claire County Courthouse, Health Department room TBD.

17. **Adjourn**
    Dunning adjourned the meeting at 6:28 p.m.

Respectfully Submitted,



Greg Leonard
Land Conservation Manager

2018 State of Groundwater in Eau Claire County

ABSTRACT

Contents

I. REPORT PURPOSE & SCOPE

This report, entitled "*State of Groundwater in Eau Claire County - 2018*" was drafted by the Eau Claire County Groundwater Advisory Committee, with assistance from staff and advisors to the committee. The Groundwater Advisory Committee includes members of the County Board, Board of Health, the Towns Association, Wisconsin DNR, and citizen members including a member with expertise in hydrogeology. Staff members and advisors are from the Eau Claire County Planning and Development Department, Eau Claire County Land Conservation Division, and West Central Wisconsin Regional Planning Commission.

Though the report focuses on Eau Claire County, the Groundwater Advisory Committee recognizes the fact that as a natural resource, our groundwater does not follow political boundaries. As such, information when describing areas will be described by watershed areas, as our groundwater flow will generally follow surface water flow. Watershed boundaries provide the best identifiable areas for descriptions.

This report is a summary of existing groundwater information, and gaps where more information is needed. Topics include general groundwater information, land use trends potentially influencing groundwater, groundwater quality and quantity, and potential influence of climate change. Additional supplemental information is included within the appendixes.

It should be understood this report in not inclusive of all that is known, or unknown, about our groundwater resource, but is a starting point to better appreciate one of our precious natural resources.

II. Eau Claire County's Groundwater

A. General Information[1]

1. Occurrence

An aquifer is an underground layer of permeable or fractured material that can store, transmit and supply water. In Eau Claire County, groundwater is found in sandstones of the Cambrian age and in unconsolidated deposits of sand and gravel within glacial drift. The sand and gravel aquifer is not a continuous rock unit, as is the sandstone bedrock aquifer, but occurs as outwash deposits and valley alluvium. Sand and gravel aquifer is usually much shallower than the sandstone aquifer and is sometimes referred to as the upper aquifer. In the Chippewa River Valley, sand and gravel deposits can be more than 200 feet over bedrock. The sandstone (or 'lower') aquifer generally underlies much of the county, except in areas of Precambrian undifferentiated igneous and metamorphic bedrock. The sand and gravel aquifer is generally found overlaying bedrock.

The sandstone aquifer can provide an available supply of water for municipal water supplies, whereas the sand and gravel aquifer is suited to individual domestic water supplies. The hydrologic conditions of these aquifers can influence their use as water supplies. The rock formations of Cambrian sandstone

[1] Most of this information was originally reported in the 1994 Eau Claire Groundwater Management Plan, http://www.co.eau-claire.wi.us/home/showdocument?id=11566)

can yield more than 1,000 gallons of water per minute while sand and gravel deposits may yield up to 500 gallons per minute or more.

2. Recharge and Discharge

Recharge is the input of water to an aquifer system, and discharge is the output of that system. Topography influences recharge, such that recharge is often lower on steep slopes when compared to a flat plain. Recharge also occurs through rock fractures and exposed rock outcrops. Groundwater is discharged naturally by springs and into wetlands, streams, lakes and as a result, the Chippewa and Eau Claire River systems (including their tributaries) are major discharge areas for Eau Claire County groundwater. Wells pumping water from the aquifer is another form of discharge.

3. Movement

The movement of groundwater is generally influenced by gravity, from high areas where recharge occurs to lower areas where discharge occurs. Groundwater movement is also influenced by well pumping. In some parts of the state, for example, municipal wells have changed regional groundwater flow toward the wells instead of natural discharge areas. Changes in drawdown cones, regional flow, and the interface of upper and lower aquifers can be monitored to help identify potential problems before they become serious.

The greater the local topographic relief, such as in the unglaciated portion (Driftless Area) of southwestern Eau Claire County, the greater the impact on groundwater movement is from local flow systems. The natural rate of groundwater movement through sandstone is relatively slow, only a few inches to feet per day. The regional groundwater flow in Eau Claire County is generally from east to west. Local flow may vary, as smaller tributaries flow toward larger drainage systems. For example, Coon Fork Creek in eastern Eau Claire County flows north toward the Eau Claire River.

4. Water Levels

In Eau Claire County, the depth to the water table below the land surface varies from 0 (at lakes or rivers, where water is at the surface) to over 250 feet. The shape of the water table generally mimics topography. The depth to the water table depth is affected by topography, the amount and frequency of precipitation, permeability of subsurface materials, and well pumping.

5. Susceptibility of Groundwater to Pollutants

The US Geological Survey defines “susceptibility of groundwater to pollutants” as the ease with which a contaminant can be transported from the land surface to the water table.[2] There are several characteristics that are factors in the degree to which groundwater is susceptible, including depth to bedrock, type of bedrock, soil characteristics, depth to water table, and characteristics of surficial deposits. Surficial land use also plays a role in groundwater susceptibility, as areas that are intensely developed (crops, livestock, housing development, etc.) can be sources of contamination of groundwater.

[2] USGS. 2007. Eau Claire County Groundwater Report.
https://wi.water.usgs.gov/gwcomp/find/eauclaire/index_full.html

In addition, the characteristics of an aquifer are important in how it can attenuate pollutants entering the groundwater. A sandstone aquifer composed of coarse to fine grained material has many small openings which can help to transmit pollutants, or dilute pollutants due to more rapid groundwater movement. Aquifers of more fine-grained materials may more readily slow pollutant transport. In addition, some aquifers have bacterial communities that may readily breakdown contaminant substances. Fractures and joints in bedrock aquifers can permit rapid vertical flow of pollutants into deeper aquifers. Heavy drawdown from pumping wells have also been known to cause water from the upper aquifer to leak into a lower aquifer system, causing cross-contamination between two aquifers.

Due to the highly permeable nature of many of the soil and aquifer materials in Eau Claire county, there is at least a moderate risk for contamination throughout much of the county. The areas of highest susceptibility are the areas near the Eau Claire and Chippewa Rivers, where the subsurface materials are very coarse and groundwater is near the surface.

B. Eau Claire County Land Use Trends Potentially Influencing Groundwater

1. Residential Land Use

Eau Claire County is projected to grow from about 102,340 in 2017 to 111,610 residents in 2040.[3] For domestic use alone, this growth will result in about 159 million gallons per year being withdrawn based on current rates of about 47 gallons per person per day. This would be a 2% to 4% increase over estimated current withdrawals in the County (see Section E).

In 2016, the County had an overall population density of 161.4 persons per square mile, much higher than the 105 persons per square mile for the State of Wisconsin. Residential land use accounts for over 21 percent of assessed land in the County. Over 32 percent of all residential-improved parcels and over 83 percent of all residential assessed acreage in Eau Claire County is located in the unincorporated towns. Overall, the towns are projected to experience the highest growth (+15%), though the City of Eau Claire will grow most in terms of population numbers (+5,924 residents). The largest rates of increase are expected in the Town of Clear Creek, Town of Pleasant Valley, Town of Union, and the City of Altoona. Given these trends, the number of private wells for drinking water is expected to continue to increase.

Residential land use can pose risks to groundwater. For example, an estimated 20% of private septic systems in the Eau Claire River Watershed are failing.[4] Damaged well casings, improper disposal of household chemicals (e.g., motor oil, antifreeze paint, fertilizers, herbicides), pet waste, lack of backflow prevention, and abandoned wells all increase the threat of contamination.

2. Commercial and Industrial Land Use

Commercial land use accounts for nearly two percent of assessed land in the County with manufacturing accounting for roughly 0.5%. Over 80 percent of all commercial parcels and over 56 percent of commercial assessed acreage in Eau Claire County is located in the cities of Eau Claire and Altoona alone. Similarly, over 50 percent of manufacturing parcels and over 27 percent of manufacturing assessed acreage is

[3] based on Wisconsin Department of Administration official population estimates and projections.
[4] Eau Claire River Watershed Strategy Technical Memorandum, July 5, 2016

located in these same two cities. If not properly planned for and managed, commercial and industrial land uses can impact groundwater due to potential hazard materials used (see Section D.vi.), large rates of withdrawals (see Section E.ii.), and large amounts of hardscape (e.g., parking lots, roofs) that do not allow the infiltration of water. Activities that substantially modify key groundwater recharge areas or encroach upon the groundwater table, such as mining and cranberry bogs, require special attention due to elevated groundwater risks. There are currently 8non-metallic mining operations in Eau Claire County with one additional facility proposed, covering 324 acres.

3. Agriculture and Forest Land Use

The most prevalent land uses in Eau Claire County are agriculture and forest. In fact, almost 45 percent of the assessed land in the County is considered agriculture and over 21 percent is forest or agricultural forest. In addition, over 13% (56,000 acres) of the County is public, tax-exempt forest and other public resource lands as mentioned previously. As seen in Figure 1 (Appendix A), much of the eastern portion of the County is forested with the majority of agricultural land located in the central and southern portions of the County.

Over 5 percent of the County is assessed as "undeveloped" and when including the acres of public natural resource lands, over 75 percent of the County is agricultural, forest, wetlands, surface waters, or is otherwise undeveloped.

According to UW-Extension's Value & Economic Impact Brochure for Eau Claire County (2014), agriculture provided 4,641 jobs, or 6.3 percent, of the County's workforce of 73,590. Agriculture also accounts for $324.6 million, or 6.2 percent, of the County's total income. However, certain agricultural trends do pose risks to our groundwater. The number of high capacity wells for irrigation and larger livestock operations have been increasing in the County as discussed later in Section E. ii.

Agricultural land use has also changed within the past 100 years in Eau Claire County. Perennial hay crops, which allow greater infiltration, have been decreasing, and annual row crops have been increasing over the past 60 years. These shifts in agricultural systems, along with changes in fertilizer types, weed and pest management, further impact groundwater quantity and quality. Agricultural Best Management

Practices, such as Nutrient Management Planning, can help protect both surface and groundwater, yet only about 25% of cropland fields have a developed nutrient management plan.

4. Groundwater Programming in Eau Claire County

The goal of the drinking water protection program of the Eau Claire City-County Health Department is to assure that the public is provided a safe water supply that is protected from organic and inorganic chemical contamination and communicable diseases. Appendix C includes a summary of wellhead protection regulations and ordinances applicable to Eau Claire County.

Through the program, staff promote the testing of private water wells for contaminants, review and issue well permits to assure proper location of new wells, require abandonment of unused wells, and conduct inspections of existing wells to assess their risk of being or becoming contaminated; provide consultation and work with the public to correct their drinking water problems and on measures they can take to prevent contamination of their well; provide drinking water testing for contaminants such as fecal coliform bacteria, organic chemicals, nitrates, pesticides, lead, and copper; conduct epidemiological investigations of suspected and confirmed waterborne illness cases and outbreaks; and participate with the County Groundwater Advisory Committee to implement groundwater protection initiatives.

Regulations for public water systems contained in the SDWA are over seen by the WI DNR as they are granted primacy by the EPA. The DNR is responsible for ensuring that public water systems adhere to sampling requirements, correction and follow up of MCL (maximum contaminant levels) violations, customer notifications of drinking water information, regular inspections, enforcement action for code violation and response to customers complaints. More specifics on following types of water supplies is found below:

5. Municipal Drinking Water Supplies

Municipal and other than municipal systems (mobile home parks, condomium/apartment buildings, and sub-divisions that share a well) are required to test per SDWA requirements and this includes inorganic compounds, synthetic organic compounds, volatile organic compounds, radionuclides, lead and copper on three-year basis but more frequently if any contaminant is of concern. Bacteria is tested monthly and the number of samples is based on population size (example: as few as one sample or as many as 70 per month). Additional sampling may be required depending upon treatment systems that are installed. In addition, the Health Department collects municipal water samples to test for coliform bacteria and residual chlorine from Altoona, Augusta, Fairchild and Fall Creek. These samples are collected twice a month from various locations in each municipality as required by the safe drinking water law.

6. Private Drinking Water Supplies

The Eau Claire County Sanitary Code requires that all premises intended for human occupancy shall be provided with an adequate supply of water that is safe and acceptable to drink. Free testing for private water supplies serving families with newborn infants is offered for arsenic, fluoride, lead, copper bacteria, and nitrate through the Eau Claire City-County Health Department. Other Private

well owners may also have samples analyzed for these contaminants for a small fee at the Health Department. If a test indicates unsafe drinking water, recommendations are made by environmental health specialists to correct the water supply. The Health Department's lab also offers testing on new wells and well water after the pump is installed to ensure the supply is safe for consumption. One of the most common water tests at the Health Department is nitrate. Nearly 4,500 wells in the county have been tested, but approximately 4500 wells remain untested.

Nitrate is a widespread, highly mobile contaminant of groundwater, especially common in heavy agricultural areas. Potential sources of nitrate contamination include agricultural or lawn fertilizer application, onsite wastewater systems, animal feedlots and barnyards, and septage or sludge disposal. Pregnant women and infants have the highest risk for adverse health effects from high concentrations of nitrate in drinking water. Some studies also suggest poorer pregnancy outcomes among livestock that drink water high in nitrate. In addition, the presence of elevated nitrate may serve as an indicator of potential contamination by other compounds. Since nitrate contamination originates at or near the surface, shallow wells are more likely to be contaminated or become contaminated sooner than deeper wells. The public health enforcement standard for nitrate in drinking water is 10 mg/L (1 mg/L is equivalent to 1 part per million), and the preventative action limit is 2 mg/L.

The Health Department also regularly tests for bacterial contamination, which tends to be a point-source issue. Not all coliform bacteria pose a health risk, but it may signal the presence of feces or sewage waste has contaminated the well. In the last 10 years, over 16,800 bacteria samples have been taken at public water supplies in Eau Claire County. Of those samples, 612 (~3.6%) were total coliform positive while only one (~0.0059%) was *E. coli* positive. Disinfection, such as chlorination, is a standard practice for the treatment of bacterial pollution, but may not address the source of the contamination.

The WI DNR additionally conducts field inspections of well drillers and pump installs to ensure code requirements are followed and responds to home owner concerns of water quality changes and issues.

7. Other Public Water Supplies

The other two types of public water supplies are Transient- and Non-transient, non-community systems (TN and NN respectively). NN systems are regulated similarly to non-municipal systems except that they have less frequent bacteria sampling and do not sample for radionuclides. Since 1989, the Health Department has been given authority by the Wisconsin Department of Natural Resources to administer the portions of the Wisconsin well code that govern transient non-community water systems. Transient non-community water systems are individual water supply systems that serve facilities such as restaurants, motels, campgrounds and service stations. Transient non-community systems must be sampled for bacteria and nitrate annually. Action is initiated when problems with water safety or the condition of the system are encountered. Facilities with bacteriologically unsafe results are required to discontinue use of their water for drinking and food preparation until corrective actions were taken and follow-up samples test safe.

C. Groundwater Quality in Eau Claire County

1. General Condition (pH, hardness, etc.)

The Health Department has conducted limited sampling in the county for pH, a measure of groundwater acidity. The average concentration of pH samples from the health department is 6.5 (but has been recorded as low at 4.9), making it more acidic than pH neutral water of 7. Highest values post-treatment are pH 9.5. The more acidic water tends to be on the northern and eastern halves of the county. Acidic water causes corrosion of copper piping, leaded solder and leaded fixtures, which is considered a risk to personal health. Of hardness samples taken at public water supplies (since 2008), hardness is at an average of 68 mg/L with the highest value at 267 mg/L (this includes treated and untreated water values). The use of water softeners and iron filters is common when in geologic formations deeper than the sand and gravel.

2. Nitrate

As shown in Figure 2 (Appendix A), the majority of nitrate data available is from the western half of the county. The watersheds with the highest nitrate averages are Muddy and Elk Creek and Lower Eau Claire River. The eastern side of the county has only a few nitrate samples, as much of this area is forested and the population is lower density. Approximately 1 in 2 wells sampled have nitrate that exceeds naturally occurring concentrations (generally, 2 mg/L or less). Nearly 1 in 20 wells that have been sampled exceed the health-based standard for nitrate.

3. Coliform Bacteria

Coliform bacteria have been found in wells across Eau Claire County (Figure 3, Appendix A). The highest densities of positive coliform tests are in areas with high residential density, such as in subdivisions and developments bordering the cities of Eau Claire and Altoona, in the towns of Union, Washington, Pleasant Valley, and Seymour.

Unlike other areas of the state, Eau Claire County does not have karst which can lead to higher occurrences of e. coli positive bacteria samples. Most of Eau Claire's bacteria positive samples are coliform. Typical causes of bacteria positive wells are mostly related to well/system maintenance and upkeep. This includes cracked & loose well caps and broken conduit that provide and easy pathway for insects to enter the well. Poor system maintenance could include cross connections to dirty water, dead end lines and uncleaned treatment equipment (filters and softeners). Naturally occurring biofilms in the aquifer are fairly common as well. Septic system maintenance is still important to reduce the risk of *E. coli* contamination.

Further description of well casings, septic maintenance, etc. that can affect these results.

4. Metals: Phosphorus, Iron, etc.

Phosphorus (P) is a naturally occurring nutrient found in sedimentary rock, soil, manure, commercial fertilizers and wastewater discharges. Phosphorus loading causes intense eutrophication events in which excessive nutrient input stimulates an explosive growth of algae, producing algal blooms that deplete the oxygen content of lake waters, leading to toxic conditions that have strong negative impacts on aquatic life and adjacent communities (Smith et al., 1999). Phosphorus-laden runoff from farm fields, barnyards, suburban lawns, urban areas and wastewater treatment plant discharge has been implicated

in contamination of surface water throughout Wisconsin. These eutrophication events have been implicated in significant degradation of surface water quality across the state.

While the impact of P nutrient loading to the surface water system is well-known, the mechanics and physiochemistry of P transfer in the groundwater system is much more poorly understood. It has been previously assumed that P in groundwater was relatively immobile and was therefore of minimal ecological concern (Holman et al., 2008). Phosphorus tends to adsorb onto soil and sediments within the shallow subsurface and is not readily transported in groundwater, so P concentration in groundwater is typically quite low (Holman et al., 2008). However, ongoing water chemistry studies at UW-Eau Claire document highly elevated P levels in several regional aquifers across western Wisconsin, and suggest P is mobile and becoming concentrated in groundwater reservoirs.

A multidisciplinary approach has been used to assess the spatial and temporal distribution of P, and to constrain potential natural and human-contributed sources. Ongoing chemical analyses have documented differences in concentrations of P in geology, surface water, and groundwater. Surface water concentrations commonly exceed the Wisconsin surface water limit of 100 ppb, while groundwater concentrations are far higher (10 to >1000 ppb) in the Mt. Simon and Wonewoc Formations. Evidence to date suggests that P concentrations in the Mt. Simon formation may be elevated due to anaerobic conditions liberating P from the sandstone. The Wonewoc does not exhibit the same anaerobic conditions as the Mt. Simon suggesting excessive concentrations of P that exceed sorption capacity. The source of P in both aquifers is still unconfirmed. More analysis is required to determine the source, fate, and transport of P in groundwater in western Wisconsin.

Lead and copper, as mentioned previously, are more easily leached from household plumbing and distribution system when the water is acidic, along with other factors. Of 1,221 lead and copper samples (Eau Claire County public water supplies since 2018) the average copper level is 343 ug/L, with 18,400 ug/L as the highest sample result and 47 samples above the Action Level of 1,300 ug/L. The average lead level was 2.79 ug/L with the highest sample at 180 ug/L and 34 samples above the action level. All public water supply lead or copper action level exceedances are followed up on by DNR staff. Systems then employ some combination of corrosion control recommendations. Both contaminants have serious health effects in humans.

Iron and manganese are often tied together in that if one is high, the other is likely to be as well. Iron samples collected at Eau Claire County public water supplies since 2018 has shown an average of 0.173 mg/L iron, with the highest value of 5.1 mg/L. Seventeen public systems are above the secondary standard of 0.3 mg/L. Manganese at these systems is at an average of 0.045 mg/L with the highest value of 1.83 mg/L. Eight systems are above the secondary standard of 0.050 mg/L. Most of the system with secondary standard exceedances install a softening or filtering system (various kinds). Iron is considered an aesthetic contaminant that is a nuisance but not harmful to human health. Excessive amounts are hard on fixtures and could result in iron bacteria issues. Manganese is considered a nuisance at lower levels but at higher levels can be considered to have health effects.

5. Agricultural Chemicals

a) Atrazine

Atrazine is a herbicide, or weed killer, that has been used on corn and other crops for many years in Wisconsin. Today, we have restricted use of atrazine and prohibited it in some areas. This is because atrazine and its metabolites – substances formed as it breaks down in the environment – has been found to enter Wisconsin's groundwater from use on farm fields, spills or improper disposal.

At low levels in drinking water, atrazine does not cause immediate sickness or health problems. However, if people drink water for many years that contains 3 parts per billion or more of atrazine or its metabolites, they may develop cardiovascular, reproductive, or other health problems. This 3 ppb level is called an "enforcement standard," which means that if we find it at that level, we may move to prohibit its use in the area where we find it. We do this by changing an administrative rule, ATCP 30, or through administrative order.

The U.S. Environmental Protection Agency classified atrazine as "not likely to be carcinogenic"; that is, it is unlikely to cause cancer.

b) Restrictions On Use In Wisconsin

Wisconsin regulations restrict atrazine use beyond federal product label restrictions. It is important to remember that many products contain atrazine, even if it is not part of their name. These restrictions apply to all products that have atrazine as an ingredient.

Restrictions on use

- Apply only between April 1 and July 31
- All handlers and applicators must be certified
- Use only on agricultural row crops and in forestry
- Record on the day of application for each field treated and keep records for 3 years:
    - Applicator's name
    - Farmer's name and address if different from applicator
    - Field location
    - Date and time of application
    - Brand name of product
    - Manufacturer of EPA registration number of product
    - Application rate
    - Size of area treated
    - Location where the product was loaded into the sprayer

c) Application Rate Restrictions

Application rates depend on soil texture and prior use of atrazine on the field:

Soil Texture	Atrazine used on field last year	Atrazine not used on field last year
Coarse (at least 25 percent sand, loamy sand or sandy loam)	¾ pound active ingredient atrazine per acre per year	¾ pound active ingredient atrazine per acre per year
Medium/fine soils (loam, silt, silt loam, sandy clay loam, silty clay loam, sandy clay, silty clay, clay, peat, muck	1 pound active ingredient atrazine per acre per year	1½ pound active ingredient atrazine per acre per year

d) Atrazine Prohibition Areas in Eau Claire County

Areas of Atrazine prohibition are illustrated in Figures 4, 5, and 6 (Appendix A).

6. Other Hazardous Materials and Toxic Chemicals (e.g., VOCs)

There are many types of hazardous materials and toxic chemicals that pose a threat to groundwater. For example, the EPA toxic chemical list has 595 chemicals in 32 categories for which any releases or emissions must be reported.[5] There is also no single definition or list for what constitutes a hazardous materials or substance. For example, the EPA has specific definitions for hazardous substances, extremely hazardous substances, toxic chemicals, and hazardous wastes, while U.S. Department of Transportation and OSHA has slightly different definitions and risk. And these lists are always changing. At any one time, the EPA has an average of 300 new chemicals under review that are being proposed for commerce.[6]

The following is provided as an overview of the potential risks in Eau Claire County:

- Eau Claire County has 24 Extremely Hazardous Substance (EHS) planning facilities that have one or more extremely hazardous substance or chemical in such quantities that they are required to provide plans to the County's Local Emergency Planning Committee (LEPC) for review. All of these facilities are located in the City of Eau Claire, except 2 in Altoona, 2 in Fall Creek, 1 in Cleghorn, and 1 in the Town of Union. Any additional 31 Tier Two facilities store or use one or more than 300 extremely toxic chemicals on site and must provide an annual report to the LEPC and local

[5] U.S. Environmental Protection Agency. https://www.epa.gov/toxics-release-inventory-tri-program/tri-listed-chemicals

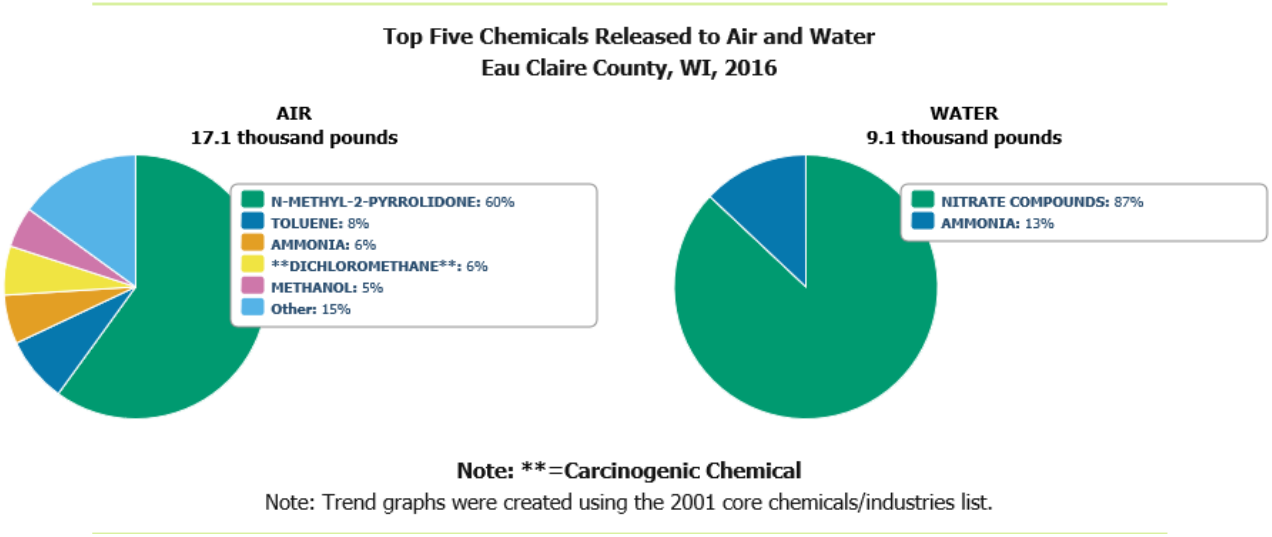
[6] U.S. Environmental Protection Agency. https://www.epa.gov/reviewing-new-chemicals-under-toxic-substances-control-act-tsca/statistics-new-chemicals-review

fire department. All but 3 of the Tier Two facilities are located in the City of Eau Claire and about one-half of these facilities were educational institutions.[7]

- Two locations in Eau Claire County were previously on the Superfund National Priority List due to severe contamination that posed a risk to human health or the environment.[8] The Eau Claire Municipal Well Field had elevated levels of volatile organic compounds (VOCs) in the mid-1980s due to a nearby industry. While some VOCs are natural, most VOCs in the environment come from gasoline, solvents, pains, refrigerants, cleaners, pesticides, and other human activity. VOCs can have very serious health consequences, including cancer, harming the liver and kidneys, and nervous system disorders. The clean-up has been completed and water levels at the wells have been in compliance for over five years.

  Soil, surface water, and groundwater contamination from various VOCs were discovered at the Waste Research Reclamation site in the 1980s. Long-term remediation at the site continues and activities/uses are restructured. In 1993, the site was moved from the Superfund program to the Resource Conservation and Recovery Act (RCRA) program and deleted from the National Priorities List.

- In 2016, Eau Claire County had 12 facilities that released significant amounts of one or more toxic chemicals into the environment and required reporting by the EPA.[9] Releases include any toxic chemicals spilled, discharged, injected or otherwise released into the air, land, water, or underground. Most of these releases are permitted; not accidental. About 65% of the on-site releases were airborne, while the remaining releases were into surface waters as reflected in the charts below.



[7] EHS & Tier Two Reporting facilities lists maintained by Eau Claire County Emergency Management and Wisconsin Emergency Management.
[8] U.S. Environmental Protection Agency. https://cumulis.epa.gov/supercpad/CurSites/srchsites.cfm
[9] U.S. Environmental Protection Agency. https://www.epa.gov/toxics-release-inventory-tri-program

- The Wisconsin Bureau for Remediation & Redevelopment Tracking System tracks hazardous materials spills. As reflected in the table below, the number of reported spills has been decreasing. The large decrease in number of leaking underground storage tanks (LUSTs), typically containing petroleum, is a primary factor in this trend. Over 2/3 of recent events are spills that are generally cleaned-up immediately or within 60-90 days. Environmental repair (ERP) and LUST sites typically pose greater risk to groundwater contamination or health and may require costly and lengthy clean-up efforts. The map on the following page shows that the majority of these sites are located within the cities and villages. Fifteen LUST and fifteen ERP sites are currently open with analysis, remediation, or active monitoring underway.

BRRTS Records for Eau Claire County – 1978 thru 2017 report dates[10]

Activity	1978-1999		2000-2017	
Spills	373	44.1%	271	67.6%
Leaking Underground Storage Tanks	250	29.6%	20	5.0%
Environmental Repair (non-LUST)	62	7.3%	26	6.5%
No Action Required Discharge	158	18.7%	75	18.7%
Removed from Database	2	0.2%	1	0.2%
Abandoned Container	1	0.1%	8	2.0%
Totals	**846**	**100%**	**401**	**100%**
Average Reports per Year	**40.3**		**23.5**	

- Landfills and historic waste sites also have the potential to contaminate groundwater, especially if built prior to more current regulations in the 1980's. The map on the following page shows the location of known landfills in Eau Claire County including the 1,200 foot buffer area for each landfill in which a WDNR variance approval is required prior to construction of a water supply well. The map also includes one WDNR-designated special well casing depth area in the Town of Washington associated with a closed paper sludge waste site. In this area, any new water supply well shall be sampled upon completion and tested for volatile organic compounds (VOC's) to determine required casing depth prior to use.

- Wells used for public drinking water must report water test results to WDNR, including municipal or small community systems, churches, restaurants, and other public gathering places. Since January 2014, there were 64 reports for 19 public water systems that exceeded EPA Maximum Contaminant Levels (MCL).[11i] For some systems, the contaminant only exceeded the MCL in one test. The contaminants were:
    - Cooper (24 reports)
    - Lead (13 reports)
    - Nitrates (22 reports)
    - Radium (4 reports)

The location of facilities and spills are an important factor. Contamination risks are elevated in areas of high groundwater or near existing wells. For instance, County Groundwater Committee members

[10] Wisconsin Department of Natural Resources, WDNR BRRTS on the Web, http://dnr.wi.gov/topic/Brownfields/wrrd.html
[11] Wisconsin Department of Natural Resources. WDNR Drinking Water System. https://prodoasext.dnr.wi.gov/inter1/pws29$.startup

expressed the importance of evaluating and monitoring the groundwater impacts of industrial sand mining operations due to the possibility of increased dissolved metals (arsenic, aluminum, lead) in groundwater and the common use of polyacrylamides (acrylamide is a probable carcinogen) during processing at locations with high capacity wells, especially when close to wetlands or extraction sites. And while facilities using large amounts of the most toxic substances are tracked and monitored, the improper containment, storage, or disposal of chemicals and substances in smaller amounts also pose contamination risks.

It is important to note that the during the 2018 update of the Eau Claire County Multi-Hazard Mitigation Plan, transportation-related hazardous materials spills were most frequently mentioned by communities and responders as a larger concern compared to fixed facilities. This was largely due to the uncertainty of what types and quantities of chemicals and hazardous materials are being transported by highway or rail through the County and the potential for such a release to occur anywhere along major transportation routes. As a positive, the Eau Claire/Chippewa Falls Fire Departments are home to one of only two Type I Regional HazMat Response Teams in the State of Wisconsin. The Type I Team has the highest level of training and equipment to respond to a chemical, biological, or radiological emergency.


WC WI Regional Response Team Practice Drill

7. Emerging Contaminants (e.g., salt, pharmaceuticals)

There are a number of substances that have been identified in groundwater that have not historically been considered contaminants, but there is increasing evidence for their presence in the groundwater and potential negative impact to health. Some emerging contaminants have only recently become able to be detected due to new technology, other due to a change in use or disposal practice. Types of emerging contaminants include pharmaceuticals, personal care products (detergent, shampoo, non-prescription medication), viruses, and pesticides.

In 2016, the UW-Eau Claire and the Health Department began a joint project to better understand the potential source of nitrate by sampling for emerging contaminants indicating human wastewater (septic) and agricultural influence. By early 2018, 108 samples from private wells in Eau Claire County had been collected and analyzed. The majority of wells tested did not have any of these indicator contaminants present. However, 17 wells tested positive for herbicides or herbicide breakdown products. In addition four wells tested positive for caffeine, and two wells for carbamazepine (prescribed for epilepsy and nerve pain). All indicators were detected at levels below 1 part per billion. The full study report is available from the Health Department.

EPA uses the Unregulated Contaminant Monitoring Rule (UCMR) program to collect data for contaminants suspected to be present in drinking water, but that do not have health-based standards set under the Safe Drinking Water Act (SDWA). Every five years EPA develops a new list of UCMR

contaminants, largely based on the Contaminant Candidate List (CCL). The DNR administers this rule and ensures the larger communities follow through with appropriate sampling. The City of Eau Claire is included in the sampling pool. During the 2015 sampling period, The City of Eau Claire sampled for the contaminants shown in the tables below. The sample results showed detects for the following 21 contaminants: vanadium, strontium, PFOS, PFOA, PFNA, PFHxS, PFHpA, PFBS, molybdenum, HCFC-22, Halon 1011, cobalt, chromium-6, chromium, chloromethane, chlorate, bromomethane, 1,4-dioxane, 1,3-butadiene, 1,2,3-trichloropropane, 1,1-dichloroethane. :

UCMR 3 Chemical Contaminants and Methods

Contaminant	Contaminant Full Name	CAS[1] Number	Method ID	Method Name	Monitoring Requirement
1,2,3-trichloropropane	1,2,3-trichloropropane	96-18-4	524.3	Volatile Organic Compounds	AM
1,3-butadiene	1,3-butadiene	106-99-0	524.3	Volatile Organic Compounds	AM
Chloromethane	methyl chloride	74-87-3	524.3	Volatile Organic Compounds	AM
1,1-dichloroethane	1,1-dichloroethane	75-34-3	524.3	Volatile Organic Compounds	AM
Bromomethane	methyl bromide	74-83-9	524.3	Volatile Organic Compounds	AM
HCFC-22	chlorodifluoromethane	75-45-6	524.3	Volatile Organic Compounds	AM
Halon 1011	bromochloromethane	74-97-5	524.3	Volatile Organic Compounds	AM
1,4-dioxane	1,4-dioxane	123-91-1	522	Synthetic Organic Compound	AM
Vanadium	vanadium	7440-62-2	200.8	Metals	AM
Molybdenum	molybdenum	7439-98-7	200.8	Metals	AM
Cobalt	Cobalt	7440-48-4	200.8	Metals	AM
Strontium	Strontium	7440-24-6	200.8	Metals	AM
Chromium	total chromium	N/A	200.8	Metals	AM
Chromium-6	chromium-6	18540-29-9	218.7	Chromium-6	AM
Chlorate	Chlorate	14866-68-3	300.1	Oxyhalide Anion	AM
PFOS	perfluorooctanesulfonic acid	1763-23-1	537	Perfluorinated Compounds	AM
PFOA	perfluorooctanoic acid	335-67-1	537	Perfluorinated Compounds	AM
PFNA	perfluorononanoic acid	375-95-1	537	Perfluorinated Compounds	AM
PFHxS	perfluorohexanesulfonic acid	355-46-4	537	Perfluorinated Compounds	AM
PFHpA	perfluoroheptanoic acid	375-85-9	537	Perfluorinated Compounds	AM
PFBS	perfluorobutanesulfonic acid	375-73-5	537	Perfluorinated Compounds	AM
17β-estradiol	estradiol	50-28-2	539	Hormones	SS
17α-ethynylestradiol	ethinyl estradiol	57-63-6	539	Hormones	SS
Estriol	16-α-hydroxyestradiol	50-27-1	539	Hormones	SS
Equilin	Equilin	474-86-2	539	Hormones	SS
Estrone	Estrone	53-16-7	539	Hormones	SS
Testosterone	testosterone	58-22-0	539	Hormones	SS
4-androstene-3,17-dione	4-androstene-3,17-dione	63-05-8	539	Hormones	SS

[1]Chemical Abstract Service

UCMR 3 Microbiological Contaminants and Methods

Contaminant	Method ID	Method Name	Monitoring Requirement
Enteroviruses	EPA 1615A	Enterovirus cell culture	PST
Enteroviruses	EPA 1615B	Enterovirus RT-qPCR	PST
Noroviruses	EPA 1615C	Norovirus genogroup I with RT-qPCR primer set A	PST
Noroviruses	EPA 1615D	Norovirus genogroup I with RT-qPCR primer set B	PST
Noroviruses	EPA 1615E	Noroviruses genogroup II	PST
Total coliforms	SM 9223B	Colilert®	PST
E.coli	SM 9223B	Colilert®	PST
Enterococci	ASTM D6503-99	Enterolert®	PST
Aerobic spores	SM 9218	Aerobic endospores	PST
Somatic phage	EPA 1602	Bacteriophage	PST
Male specific phage	EPA 1602	Bacteriophage	PST

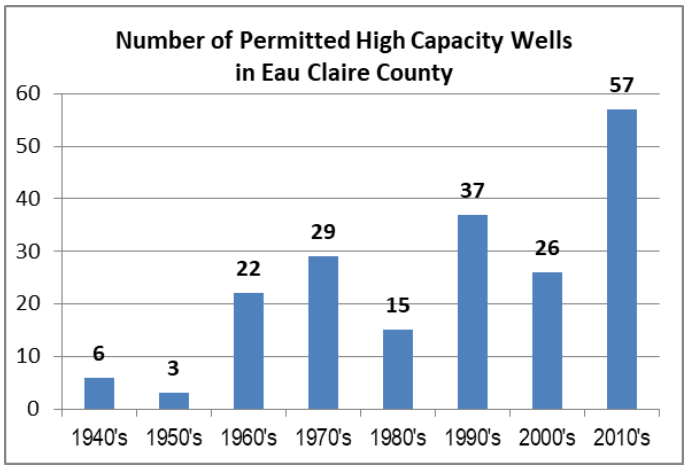
D. Groundwater Quantity and Use

1. Groundwater Availability and Usage

No current study or model is available providing a clear understanding of groundwater availability and geographic differences in groundwater quantity in Eau Claire County. Groundwater contributes nearly all of the water supply in Eau Claire County used for domestic, commercial, industrial, and agricultural purposes, including all municipal drinking water supplies and private potable wells. It is likely that somewhere between 5.0 to 6.5 billion total gallons of groundwater are withdrawn in Eau Claire County annually, with 80-85% of this withdrawal occurring through high-capacity wells.[12] Approximately 800-900 million gallons of groundwater is withdrawn from smaller, non-reporting wells (not high capacity wells) in Eau Claire County each year.[13] It is important to note that while demand continues to increase as population and development increases, conservation efforts have been effective in reducing the demand in many homes and businesses. For example, residential water use peaked at 61 gallons per day/person in 1990 and has declined slowly to about 47 gpd/person today.[14] The following are some highlights from the Eau Claire Groundwater Use data discussed and cited in Appendix B:

2. Low-Capacity Private Wells

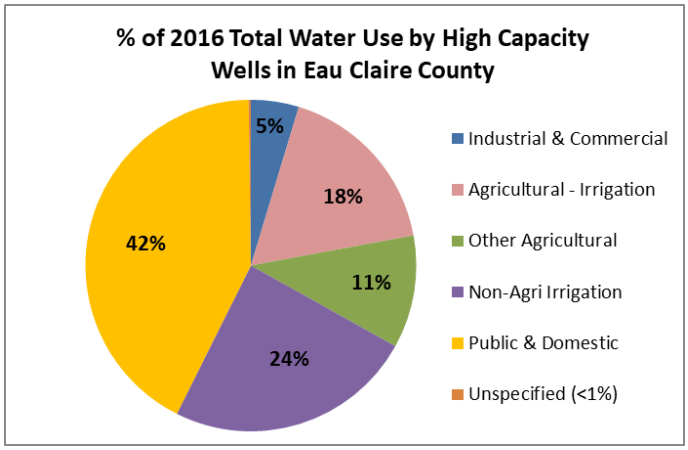
- There are roughly 9,000 smaller private wells in Eau Claire County. Approximately 25% of Eau Claire County residents receive their drinking water from a smaller, low-capacity private well. Water use for low-capacity private wells is not tracked.
- An robust study on the water supply sources for these smaller wells and any geographic variations across the County has not been completed. As discussed previously in Section II.A., a range of factors can influence susceptibility to contamination, including the depth of the aquifer from which groundwater is being drawn (i.e., static water level).



[12] Based on estimates of low-capacity private wells and high capacity wells identified and cited in Appendix B.
[13] Ibid.
[14] Center for Land Use Education—University of Wisconsin-Stevens Point and UW-Extension. Wisconsin Land Use Megatrends—Water. Summer 2014.

3. Municipal, Agricultural, Industrial, and Other High Capacity Wells

- High capacity well use is regulated and tracked under Wisconsin law.
- The number of permitted high capacity wells in the County has been increasing.
- About 42% of groundwater withdrawals by high capacity wells in the County are for public and domestic uses (e.g., drinking water, fire protection). About 28% is for agriculture and 24% is for non-agricultural irrigation.
- Appendix B includes maps showing the distribution of high capacity wells in Eau Claire County. Not surprisingly, the highest concentrations are nearest the County's population centers.



E. Potential Influence of Climate Change on Groundwater

Analysis of historical data shows that groundwater and surface water resources are intimately linked to local and regional climate conditions. And regardless of the debate over the causes of climate change, there is clear evidence that Wisconsin's climate is changing significantly.

a) a. Our Changing Climate

The 2003 report entitled *Confronting Climate Change in the Great Lakes Region* published by the Union of Concerned Scientists and the Ecological Society of America projected that by 2030, summers in Wisconsin may resemble those in Illinois overall, in terms of temperature and rainfall. By 2100, the summer climate will generally resemble that of current-day Arkansas, and the winter will feel much like current-day Iowa.

To further document these climate changes and explore their impacts on our State, the Wisconsin Initiative on Climate Change Impacts (WICCI) was formed as a collaborative effort of the University of Wisconsin and the Wisconsin Department of Natural Resources. Much of the information in this section is adapted from the WICCI effort.

The following are some of the key climatic trends being experienced in Eau Claire County according to the WICCI analysis (www.wicci.wisc.edu):

1. Eau Claire County's average temperatures are rising and are projected to continue to rise. **Figure 8 (Appendix A)** shows that the annual average temperature in Eau Claire County increased between 1.5º F and 4.0º F between 1950 and 2006, with the greatest increases in the City of Eau Claire area. Between 1980 and 2055, annual average temperatures are projected to increase by about 6.5º F in the County, with the winter average temperatures increasing by 8.5º F.
2. Eau Claire County is projected to have more extreme heat events. **Figure 9** (Appendix A) shows that the number of days projected to be 90º F or greater will increase by 18-26 days in Eau Claire County between 1980 and 2055.

3. Eau Claire County is experiencing more annual precipitation than in the past. The County is expected to get even wetter in the future with a significant seasonal and geographic variation to the precipitation. **Figure 10** (Appendix A) shows that the annual average precipitation has increased in Eau Claire County over the past fifty years overall, with the greatest increases in the southeastern portions of the County. **Figure 11** (Appendix A) shows that changes in summer precipitation have not been decreasing like many areas to the north. Overall, WICCI projects Eau Claire County's annual average precipitation to increase by 1.5 inches per year between 1980 and 2055.

4. Heavy precipitation events are expected to increase in Eau Claire County. Currently, the region experiences heavy precipitation events of two or more inches about ten times per decade (once every year). Eau Claire County is projected to experience about two additional heavy precipitation events per decade by 2055. However, based on the frequency of heavy rainfall events over the past 5-10 years, this projection may be underestimated.

1. Between 2000 and 2013, the region experienced a series of agricultural droughts. Many farmers suffered crop losses and some seepage lakes and spring-fed streams were impacted. The Governor declared a State of Emergency and/or U.S. Secretary of Agriculture declared an agricultural disaster, which included Eau Claire County, on six different occasions (2003, 2005, 2006, 2007, 2009, 2012) with some drought impacts impacting crop yields over multiple years. It is uncertain if this "spurt of droughts" was related to climate change, since a drought year hasn't been experienced since 2013. If weather patterns return to longer-term trends, severe drought conditions can be expected to occur every four to five years on average (1 to 2 drought years per decade) in Eau Claire County.[15]

b) Potential Climate Change Impacts to Groundwater Supply

Overall, groundwater quantity has not been a significant concern in the County, though groundwater levels fluctuate seasonally and due to weather patterns. For instance, during the 1976-1977 drought years, some area shallow private wells dried up. It is not certain how Eau Claire County's groundwater supply (and quality) will be influenced by climate change:

- Initially, groundwater recharge is likely to increase due to the increased precipitation.
- Recharge will likely be offset, in part, by increased evapotranspiration due to the higher temperatures and longer growing season. As time goes on, higher temperatures and increased precipitation have the potential to exceed the added recharge from increased precipitation, resulting in lower groundwater levels overall. Changes in land use and land management may also influence recharge.

[15] Eau Claire County Multi-Hazard Mitigation Plan. May 2018 draft

- The amount of recharge will also be influenced by how and when the precipitation occurs. While increased winter precipitation is projected, warmer temperatures may result in more rain and less snow. Heavy rainfall events and fast snow melts can result in increased runoff and less infiltration, especially if the ground is frozen. Warmer summer and fall seasons as well as longer growing seasons can decrease recharge due to increase evaporation and plants using more soil moisture as soils dry out earlier in the year.
- If recharge is decreased over time, contaminants and dissolved solids in the groundwater can become more concentrated. Conversely, rapid recharge or large seasonal variance in recharge can make the groundwater more susceptible to contamination.

Projecting the potential impacts is complicated and will vary based on many factors. For example, sandy soils and areas of the County where the groundwater table is shallow will be the most impacted by the above trends. Localized groundwater flooding (i.e., groundwater table rises above ground level) may occur due to increases in winter precipitation and heavy rainfall events. And the future warmer, wetter winters could result in more icy roads, which increase the potential for contamination from chlorides. Contamination can also occur due to the inundation of drinking water wells during heavy rainfall events or due to increased microbial activity as water temperatures rise in areas of shallow groundwater.

c) Potential Climate Change Impacts to Groundwater Demand

With population growth and new development, the demands on our groundwater are increasing. Climate change will exacerbate this demand in three primary ways:

- Longer growing seasons without significant increased precipitation during summer months could lead to increased reliance on agricultural irrigation systems, especially in areas of sandier or droughty soils. The region may already be experiencing this impact as reflected in the previously discussed increase in the number of high capacity wells.

- Increased growing seasons could also result in land use changes and more land being put into crop production, which, in turn, has the potential to increase the use of nutrient and pesticide applications.
- Groundwater withdrawals for municipal systems would also likely increase due to elevated summer temperatures and a “longer summer season.”

Most of our existing planning models, standards, best practices, and infrastructure are based on historic events and do not fully accommodate the above mentioned climatic trends. Good soil health best management practices and drought-tolerant plant varieties or types of crops could help offset some of these impacts. While improvements to water conservation have occurred, more effort may be needed to encourage rural and urban water conservation. It is also important to promote integrated water management by planning water use in a manner that: (i.) considers natural systems (e.g., watersheds, the entire water cycle) as well as site-specific vulnerabilities; (ii.) are based on long-term projections of supply

and demand that reflect recent trends; and (iii.) by tying water use, management, and related policy to land use and economic growth forecasts.

WE NO LONGER HAVE A SEPARATE INFORMATION GAP PRIORITIES SECTION. FOR EACH OF THE PREVIOUS SUB-SECTIONS, END BY SUMMARIZING THE MOST IMPORTANT INFORMATION GAPS. A HYPOTHETICAL EXAMPLE:

Critical Information Gaps: *(a) More information is needed on flow and quantity for…. Flow and quantity must be understood prior to being able to collect information and allow for site- or project-specific analysis. (b) Additional time is needed to evaluate the compatibility of the Tinker Model to the more recent approach in Chippewa County. Once this evaluation is complete, a specific groundwater flow model approach for Eau Claire County needs to be identified.*

III. Priority Recommendations

may present this in a table format with columns for timelines, lead parties, resources, etc. for each recommendation

A. Understanding our Groundwater – Testing, Monitoring, and Modeling Recommendations

- Continue Public Health well testing with greatest focus on subwatershed that….
- Update the Tinker flow model. Is this model compatible with the Chippewa County approach? What State or USGS resources are available.

B. Protecting our Groundwater – Planning, Policies, and Program Recommendations

- expand this report?
-

C. Valuing our Groundwater – Educational and Civic Governance Recommendations

- complete and maintain the County's groundwater webpage
- pursue EPA environmental education, private foundation or other educational grant dollars to do....

APPENDIX A – FIGURES

Figure 1. Eau Claire County Land Cover

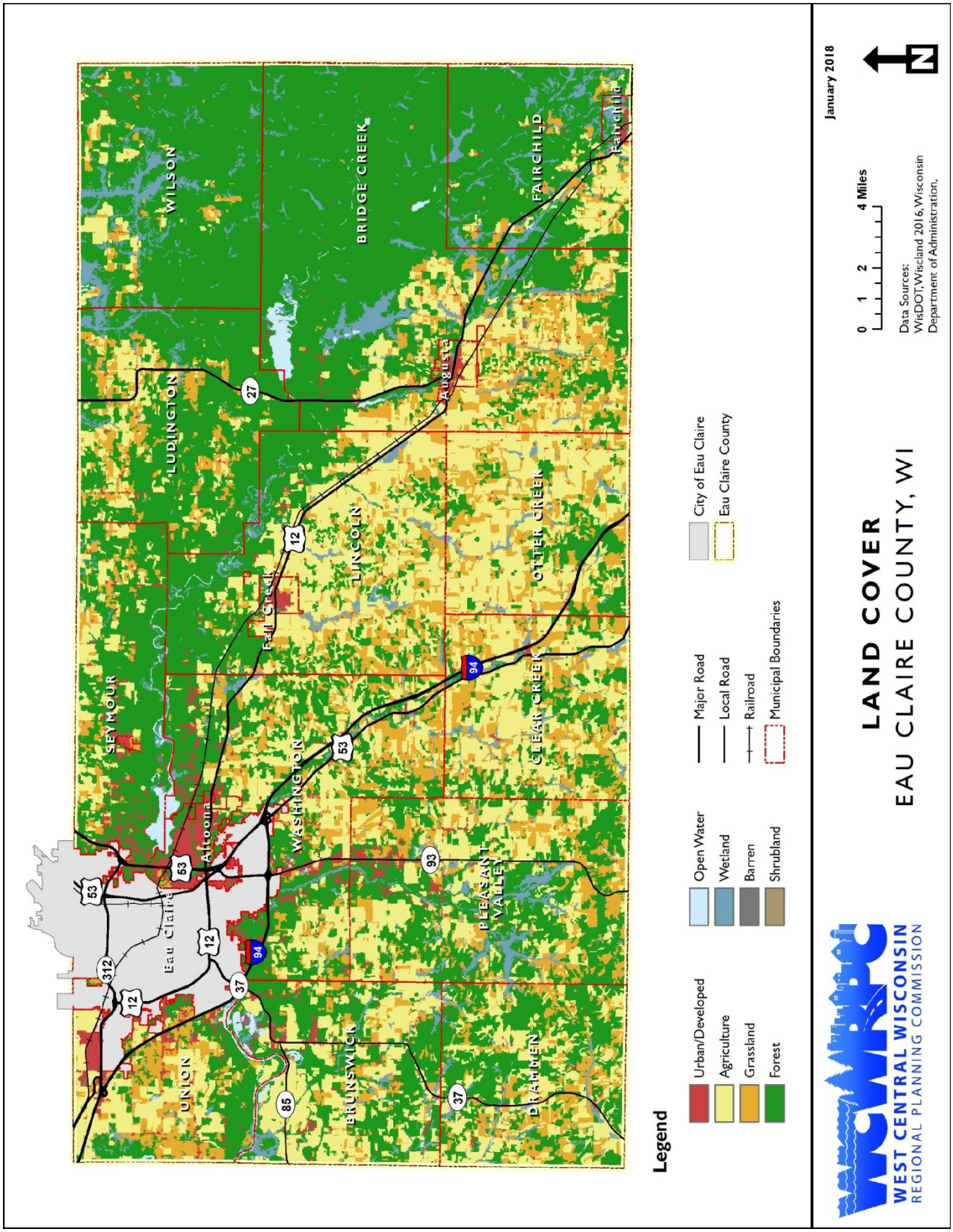


Figure 2 – Nitrates

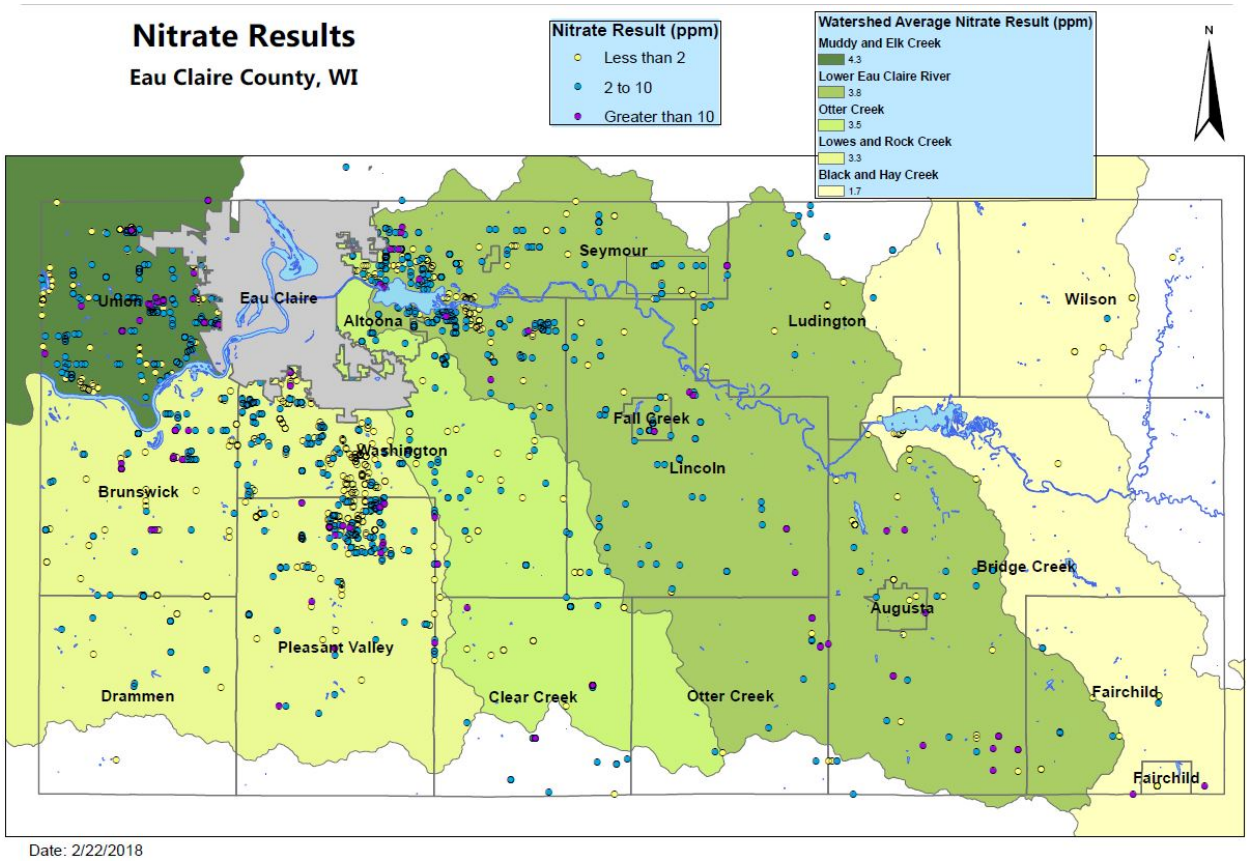


Figure 3 – Coliform

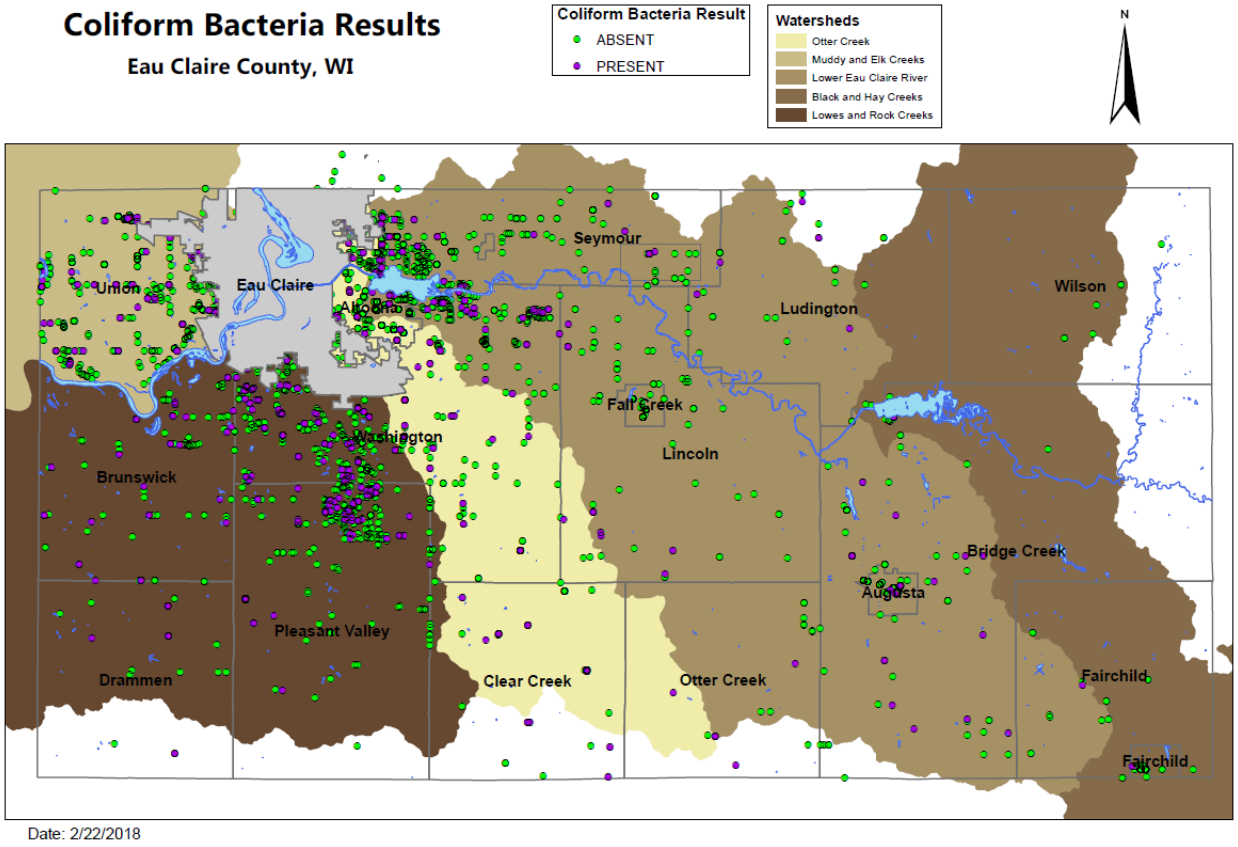


Figure 4 - Atrazine Prohibition Areas in Eau Claire County

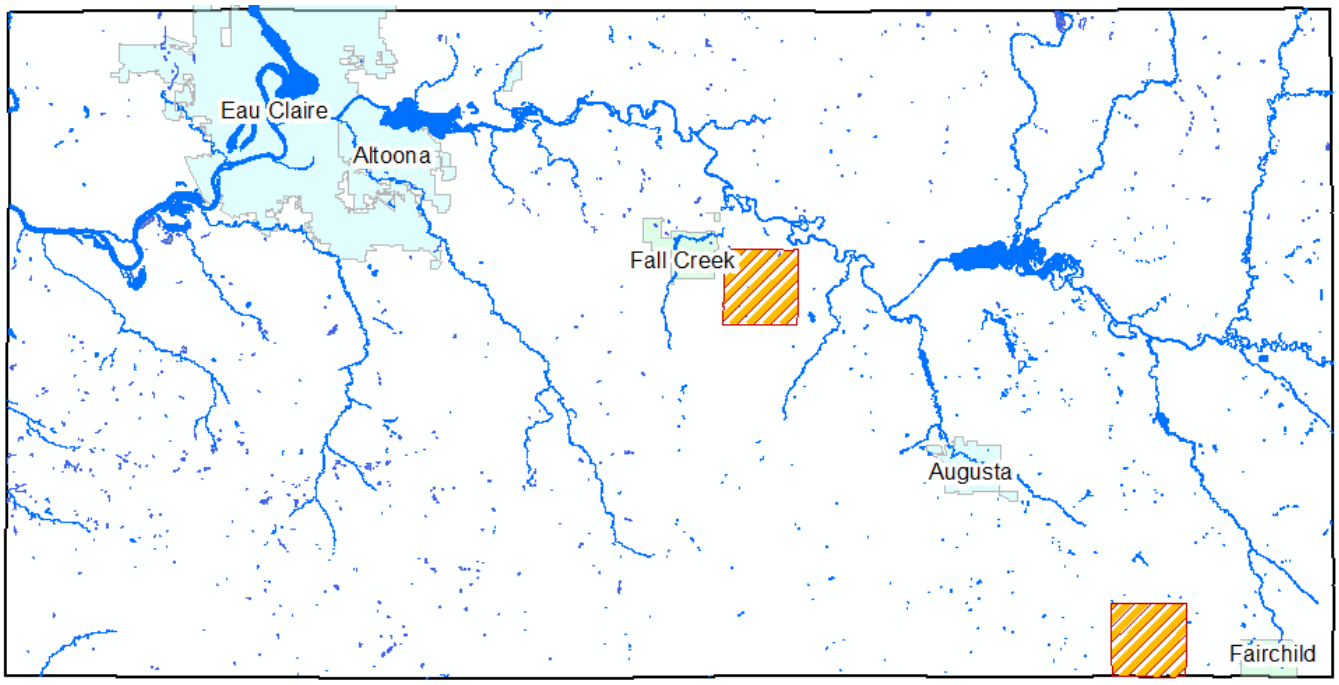


Figure 5 – Atrazine Prohibition area outside of Fall Creek, WI.

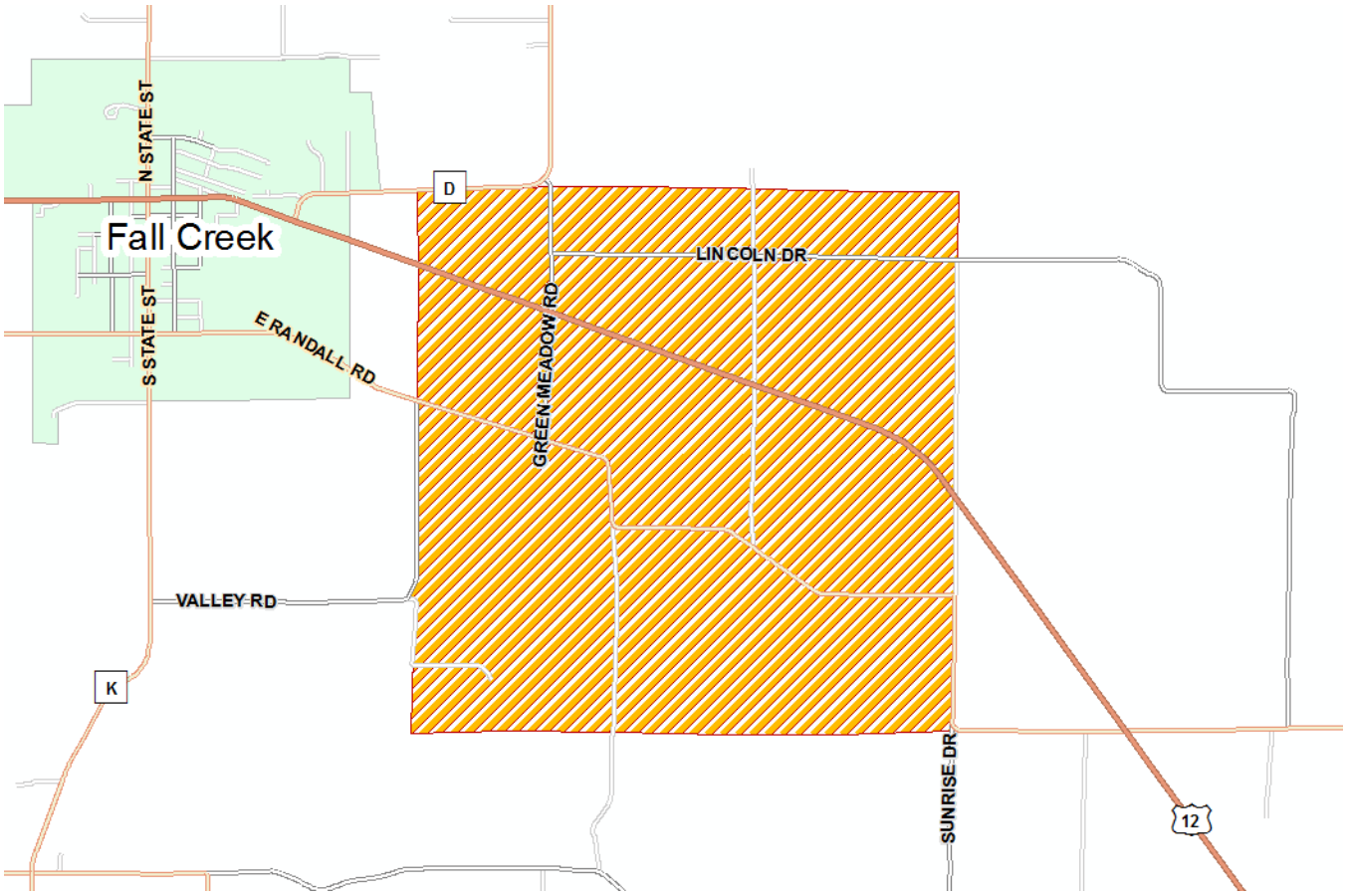


Figure 6 – Atrazine Prohabition Area outside of Fairchild, WI.

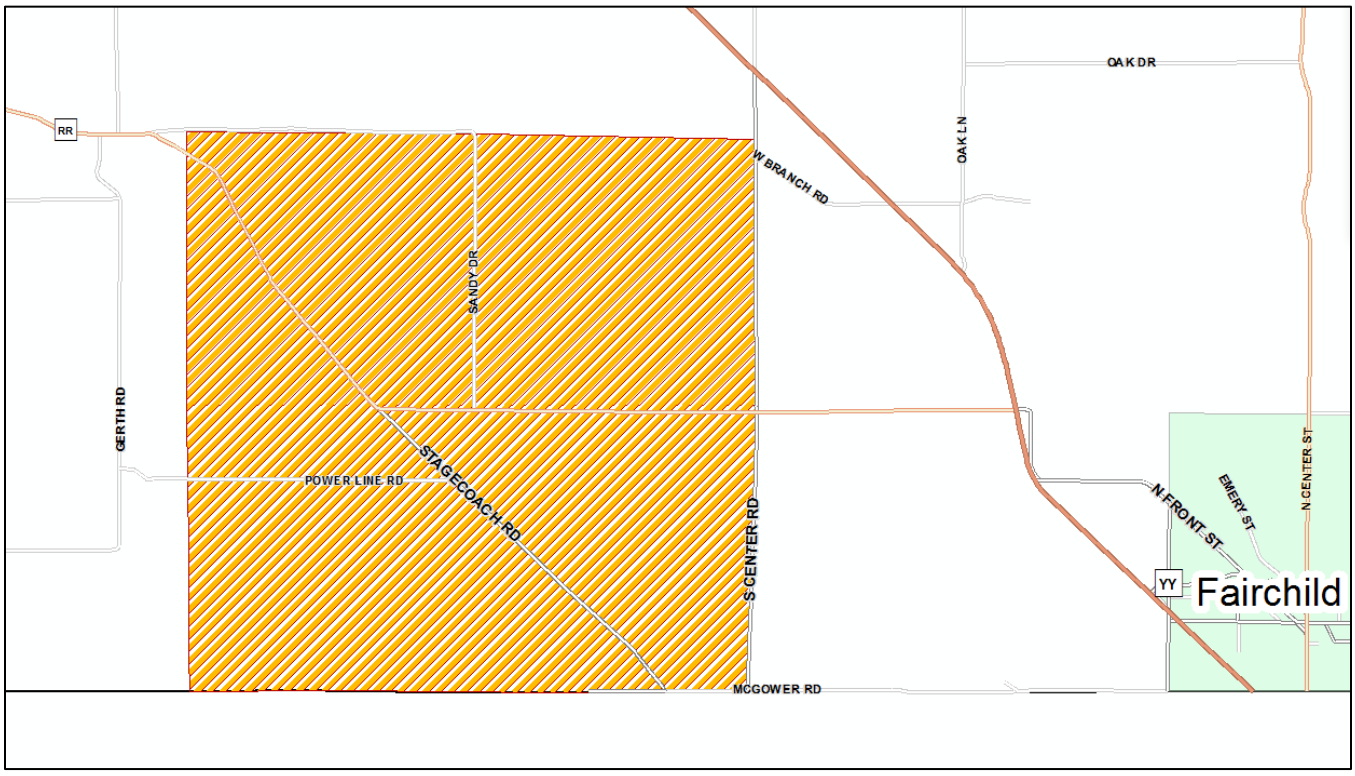


Figure 7 – Landfills and Hazardous Materials Spills, Eau Claire County

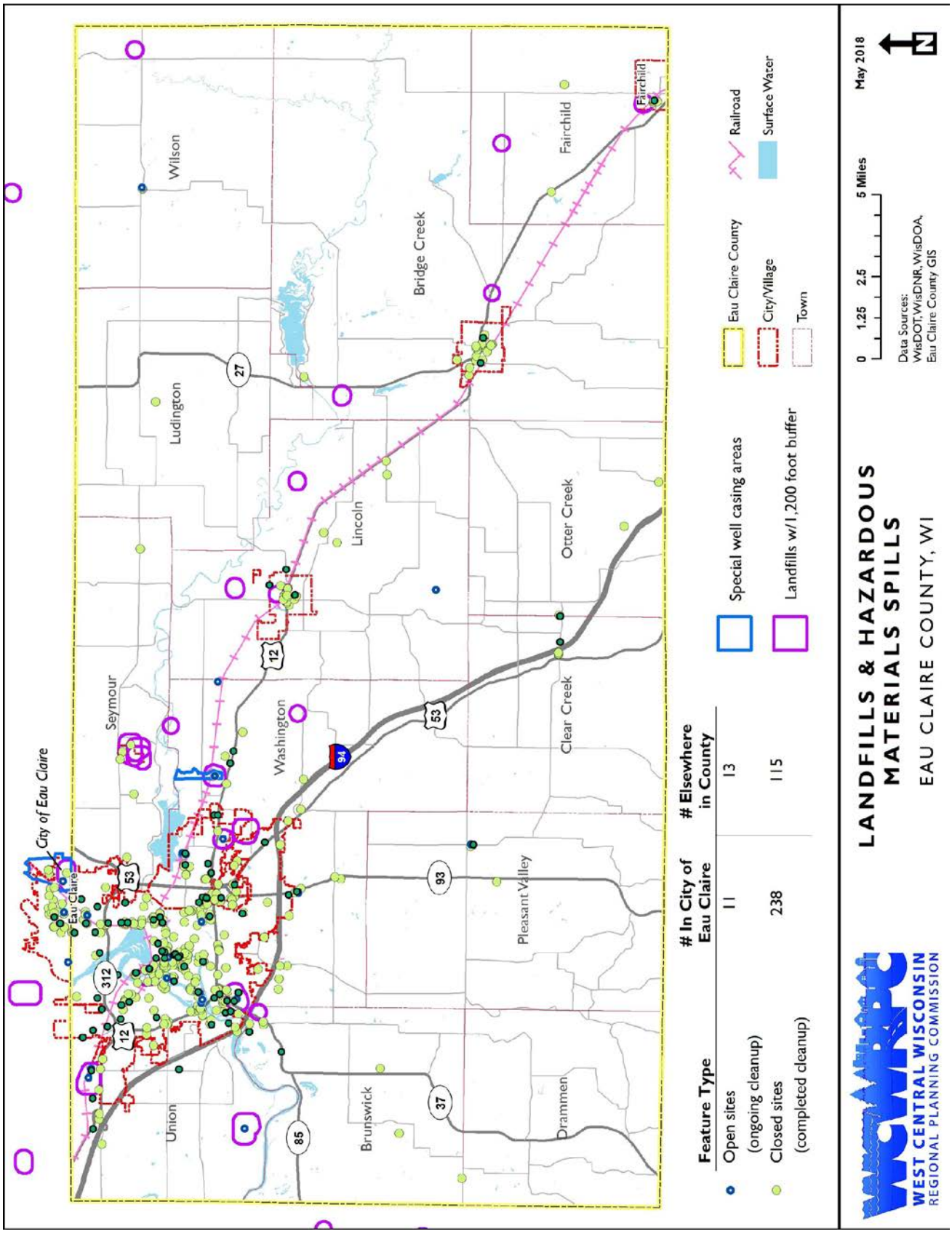


Figure 8 – Wisconsin Temperature Change

Figure 8. Wisconsin Temperature Change

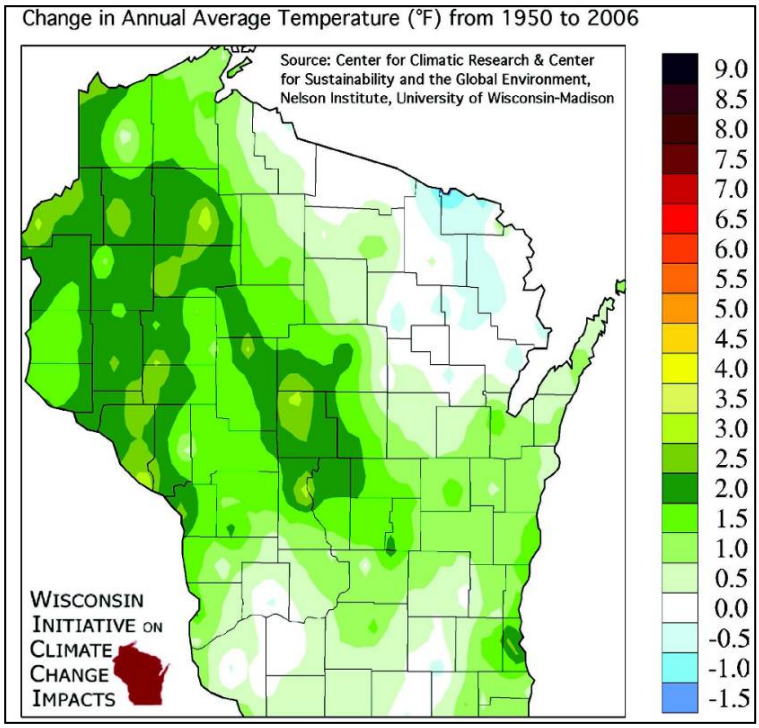


Figure 9 – Change in # of 90+ Degree Days

Figure 9. Change in # of 90+ Degree Days

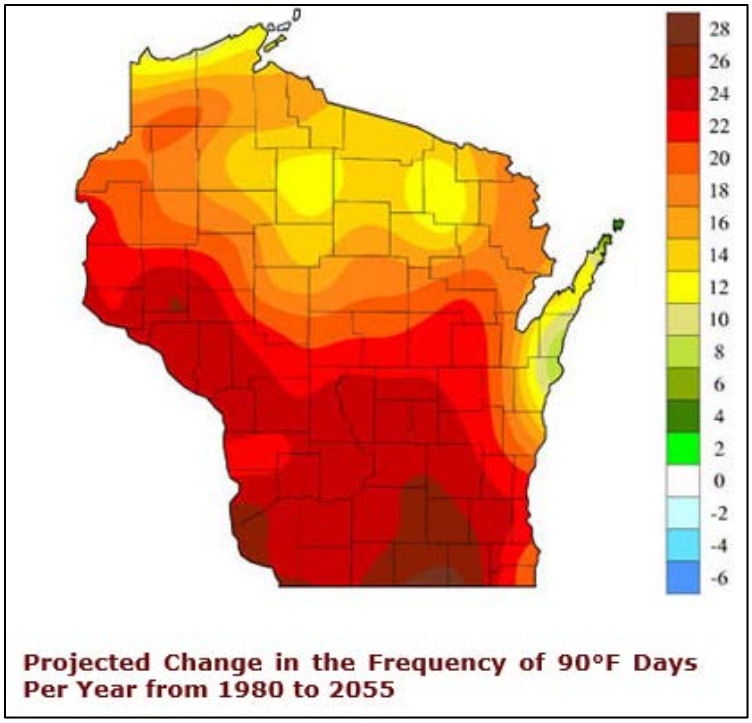


Figure 10 – Wisconsin Precipitation Change

Figure 10. Wisconsin Precipitation Change

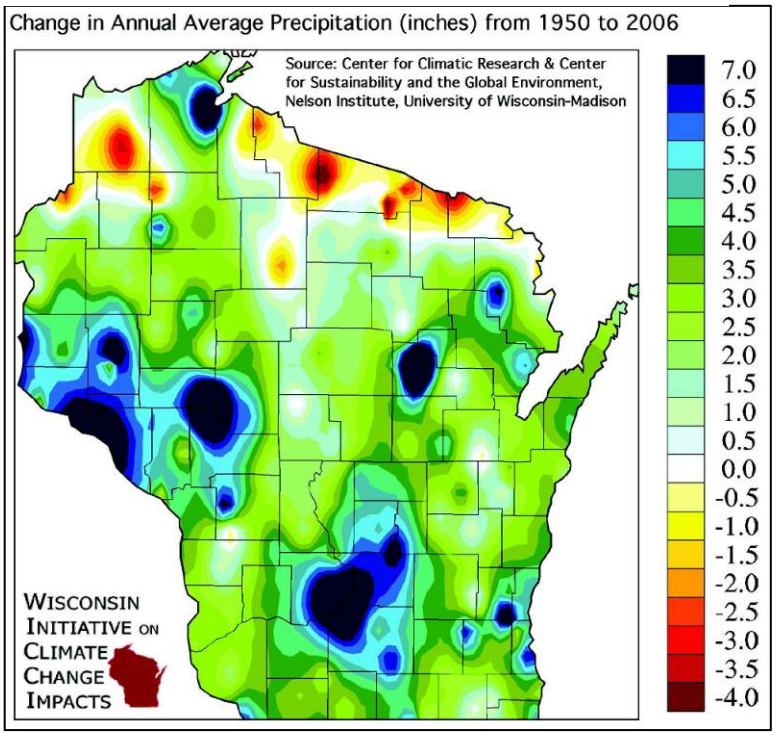
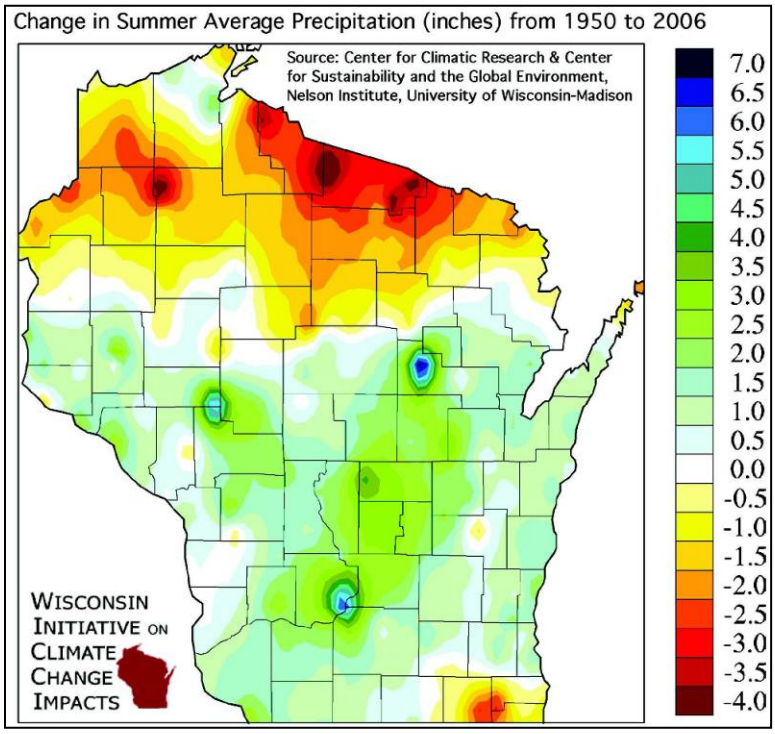


Figure 11 – Wisconsin Summery Precipitation Change

Figure 11. Wisc. Summer Precipitation Change



APPENDIX B: Eau Claire County Groundwater Use

I. Low-Capacity Private Wells

Approximately 25% of the Eau Claire County population receives their drinking water from a smaller, low-capacity private well.[i] There are roughly 9,000 smaller private wells in Eau Claire County.[ii] For most of these smaller wells, data is not readily available on groundwater or aquifer sources, type (e.g., dug, driven, drilled), and use (e.g., drinking, irrigation, farming). Understanding groundwater sources is important since shallower aquifers may be more susceptible to contamination. Low capacity private well owners are not required to register older wells or report water use. As such, accurate water withdrawal estimates for these smaller, private wells are not available. For rural residential wells, groundwater withdrawal is estimated at 640.7 million gallons per year (1.76 mil gpd) based on the following assumptions:

- Approximately 26,200 residents live in the unincorporated towns of Eau Claire County[iii], with nearly all using a private well for domestic purposes.
- WDNR uses an average of 67 gallons per day per person (or 24,455 gallons/year), though this may be a little high based on data from municipal systems that suggest 45-50 gpd/person may be more accurate.[iv] The higher estimate allows some additional flexibility to account for seasonal homes, cottage business, general farmstead use, etc.
- In 2017, there were 361 properties in the unincorporated towns with commercial or manufacturing assessed improvements.[v] We did not attempt to estimate these smaller, private well withdrawals. Many of the commercial properties have very limited or even seasonal hours with limited groundwater withdrawals. Some, such as commercial group homes and any rental apartments, are included in the residential estimates above. Others are provided service by high capacity wells discussed later.

For purposes of this report, an additional 160-260 million gallons per year from smaller, low-capacity wells for livestock is estimated based on the following assumptions:

- Estimating groundwater withdrawals from non-reporting wells for livestock is challenging. Water use by livestock varies significantly based on type, breed, and age of the livestock and facilities. For example, older facilities with Holsteins were near 45 gpd/cow, while newer facilities are closer to 30 gpd and down around 20gpd for milk Jerseys according to a 4/19/18 WDNR staff email.[vi] Milk cows have the highest demand for water, by far, among all local livestock; beef cattle average around 15 gpd.[vii]
- In 2012, the County had 13,020 beef cows and 11,543 milk cows.[viii] The County has other types of livestock, including about 573,000 broiler/meal-type chickens, that are not estimated here.[ix] Estimated water demand for all cattle is roughly 240 million gallons per year (657,000 gpd).
- A significant portion of this livestock is provided water from high capacity wells however. For rough estimating purposes, we can reduce the 240 mil. gallons/year withdrawal estimate for non-reporting wells by 50 mil. gallons/year (or more), based on the reported withdrawals by high capacity wells in 2016 for dairy and other farms discussed later in this appendix.

II. Municipal and Community Water Systems

Approximately 75% of the Eau Claire County population receives their drinking water from one of the following community water systems that use high capacity wells[x]:

Municipal and Community Water Systems in Eau Claire County

System Name/Owner	Municipality or P.O. Address	Approx. Population Served	# of Wells
Altoona Waterworks	City of Altoona	7,345	5
Augusta Waterworks	City of Augusta	1,450	4
Eau Claire Waterworks	City of Eau Claire	66,060	13
Fairchild Waterworks	Village of Fairchild	564	2
Fall Creek Waterworks	Village of Fall Creek	1,322	2
Berghs Mobile Home Park	S10876 Hwy 37 Mondovi area	60	1
Bonnie Vale Park #1	CTH "F" Eau Claire area	70	1
Bonnie Vale Park #2	Eau Claire area	51	1
Cozy Acres LLC Back	4900 Olson Dr. Eau Claire area	38	1
Cozy Acres LLC Front	4900 Olson Dr. Eau Claire area	111	2
Falls City Mobile Home Park #1	Fall Creek area	100	1
Falls City Mobile Home Park #2	RR 2 Fall Creek area	96	1
Falls City Mobile Home Park #3	Fall Creek area	52	1
Green Acres Mobile Homes	Mueller Road Fall Creek area	48	1
Hillcrest Estates Mobile Home Park	1000 Oak Drive Altoona Area	726	2
Pine Edge Mobile Home Park	W3940 Mitchell Rd. E.C. area	300	2
The Priory	1190 Priory Road, Eau Claire	150-185	1
Villa Diann Mobile Home Park	4400 LaSalle St. E.C. area	420	1

III. Municipal, Agricultural, Industrial, and Other High Capacity Wells [1]

High capacity wells are regulated and usage tracked under Wisconsin law. **High Capacity Well** means one or more wells, drillholes, or mine shafts used or to be used to withdraw water for any purpose on one property, if the total pumping or flowing capacity of all wells, drillholes, or mine shafts on one property is 70 or more gallons per minute (or 100,000 gallons per day) based on the pump curve at the lowest system pressure setting, or based on the highest flow rate from a flowing well or wells.

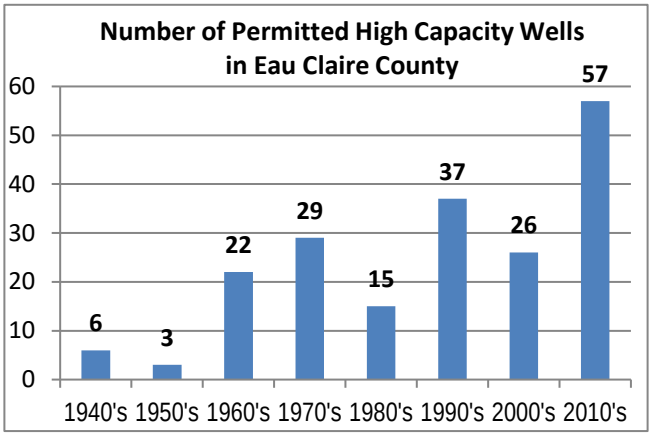
The following high capacity well data for Eau Claire County has been reported to WDNR through 2016:

- As of the end of 2016, about 206 high capacity wells have been permitted in Eau Claire County.
- In 2016, 118 active wells in Eau Claire County reported withdrawals totaling nearly 12.4 million gallons per day (or 4.5 billion gallons per year). Among Wisconsin's 72 counties, Eau Claire

[1] All high capacity well data in this subsection was compiled by West Central Wisconsin Regional Planning Commission based on high capacity well location, use, and withdrawal data provided by Wisconsin Department of Natural Resources through a Water Use Open Record Request data 4/20/18.

ranked #12 in 2016 in total groundwater high capacity well withdrawals. Dunn County, with its many agricultural irrigation wells, ranked #9.

- Recent high capacity well withdrawals in Eau Claire County peaked at about 5.4 billion gallons in 2013 from 116 active wells.
- From 2010-2016, there were 57 high capacity wells approved in Eau Claire County (or 9.5 wells/year on average).
- As shown in the table below, public and domestic uses constitute the largest percentage of high capacity well withdrawals. All agriculture (irrigation, dairy, and other) totals about 28.4% of withdrawals, closely followed by non-farming irrigation.

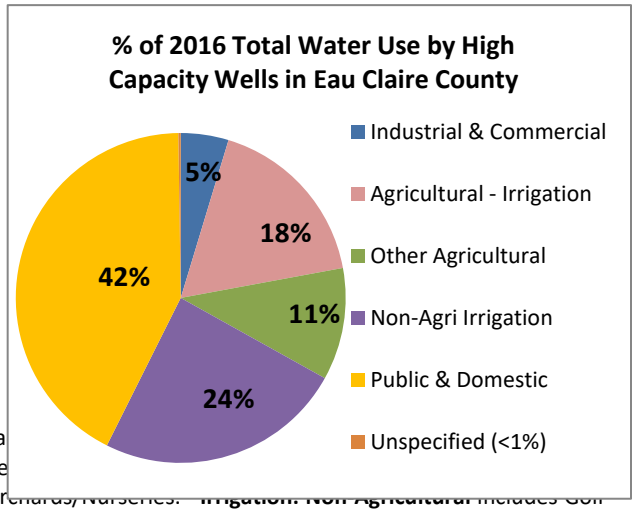


2016 High Capacity Well Annual Withdrawals (for wells with reported withdrawals)

Use[2]	# of Wells	% of Wells	Annual Gallons	% of Gallons
Commercial	8	3.9%	1,098,425	0.02%
Industrial	20	9.7%	210,978,115	4.66%
Domestic	15	7.3%	235,811,417	5.21%
Irrigation: Agricultural	33	16.0%	787,674,440	17.41%
Irrigation: Non-Agricultural	9	4.4%	1,099,561,000	24.30%
Non-Irrigation: Dairy Farming	1	0.5%	49,096,000	1.08%
Non-Irrigation: Other Farming	4	1.9%	448,800,400	9.92%
Public Water Supply	57	27.7%	1,682,145,991	37.17%
Unspecified *(gallons based on max. cap.)*	59	28.6%	10,198,560	0.23%
Totals	**206**	**100.0%**	**4,525,364,348**	**100.00%**

Source: WDNR Water Withdrawal Dataset, April 2018

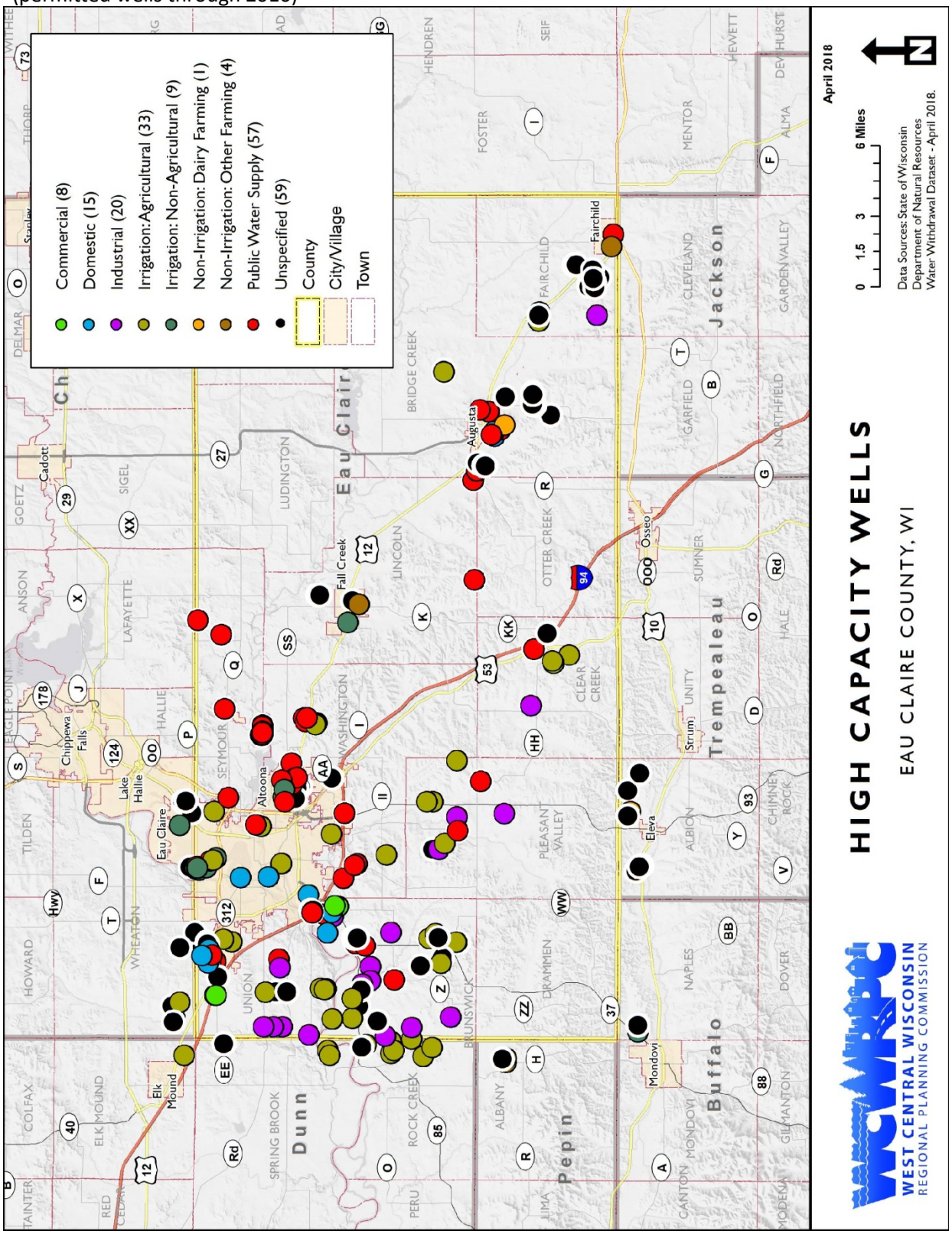
- Of the 2010-2016 approved wells, 66% had no "unspecified" use in the database. Based on ownership, the most of these new wells were industrial, public utility, and agricultural. 2016 water use data for unspecified wells was not available; the annual gallons in the table above for these wells is based on their maximum capacity.



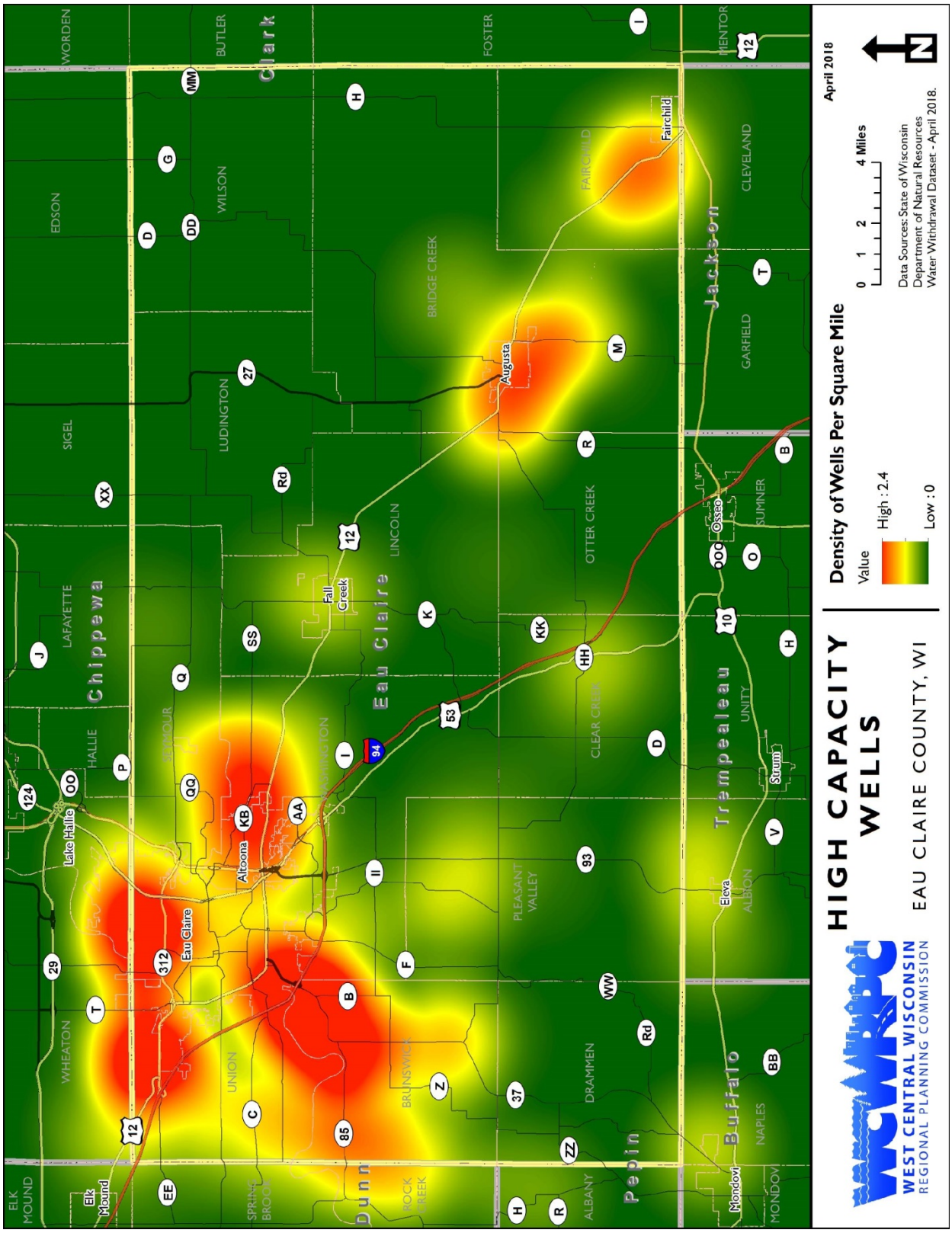
[2] **Industrial** includes Construction, Food Manufacturing, Fra
Preparations, Paper Manufacturing, and Other. **Domestic** include
Irrigation: Agricultural includes Berry, Cranberry, Forestry, and Or
Course and Other. **Public Water Supply** includes Business/Retail, Fire Protection, Groundwater Remediation/Testing, Lake & Pond Levels, Lodging, Municipal, Public, Public/Non-Transient Single-Unit House, Wastewater Treatment, and Other.

Seven of the unspecified wells and three other wells in the above table and represented on the following maps did not have an approval date. Wells within one mile of the Eau Claire County are reflected on the following maps, but are not included in the above table.

High Capacity Well Distribution
(permitted wells through 2016)



High Capacity Well Concentrations
(permitted wells through 2015)



[i] Based on the total County population minus the approximate population receiving drinking water from a municipal or community well as reflected in the table in the next subsection.

[ii] Eau Claire City-County Public Health Department estimate as of April 2018.

[iii] Wisconsin Department of Administration Population Estimates. https://doa.wi.gov/Pages/LocalGovtsGrants/Population_Estimates.aspx

[iv] Smail, Robert A. Wisconsin Department of Natural Resources email to Chris Straight, WCWRPC regarding water quatity/usage data. April 19, 2018.

[v] Wisconsin Department of Revenue. 2017 Statement of Assessments. https://www.revenue.wi.gov/Pages/SLF/2017-soa.aspx

[vi] Smail, Robert A. Wisconsin Department of Natural Resources email to Chris Straight, WCWRPC regarding water quatity/usage data. April 19, 2018.

[vii] North Dakota State University Extension Service. Livestock Water Requirements. https://www.ag.ndsu.edu/pubs/ansci/livestoc/as1763.pdf

[viii] USDA Census of Agriculture, 2012

[ix] Ibid.

[x] Wisconsin Department of Natural Resources. Wisconsin DNR Drinking Water Data. https://dnr.wi.gov/topic/drinkingWater/

Appendix C - Summary of Wellhead Protection Regulations and Ordinances for Eau Claire County, Wisconsin

Eau Claire County		
Fall Creek	Zoning Code- ARTICLE VII – 26801	•Zoning information is provided as well of a map of the various zones. •Zone 1 is the area of land which contributes the water to a municipal well in 30-days, permitted uses are provided in 268-85. prohibitted used are provided in 268-85.A.2. •Zone 2 is the area inbetweeen the 30-day zone and the 5 year zone. permitted and prohbitted uses provided in 268-85.B.1 and 268-85.B.2 respectively. •Zone 3 is the area between 5 and 10 year time to well boundaries, permitted and prohbitted uses are provided 268-85.C.1 and 268-85.C.2 respectively. •any use not listed as a permitted use, shall be considered prohibitted. •As technology changes, appeals can be made. •Provides a generalized enforcement procedure and some administrative details.
Augusta	Ordinance No: 2005-9-1	•50ft between storm sewer main and well, 200ft between a well and any sanitary sewer main, lift station, and single family fuel oil tank, 400ft between a well and cementary, septic tank, and storm water drainage pond, 600ft between a well and any gas or fuel storage tank, 1,000ft between a well and any land application of commercial, industrial, or municipal waste, 1200ft from other waste storage facilities (list provided in sect.4.1.F) •provides zoning similar to Fallcreek but is less exact with its termonology. •zone A is primary source •Zone B is secondary •Zone C is area not considered A or B. (permitted and prohibited are provided in Sect.4.2). •Sect.5 provides information about applying for a well. •Penalties and enforcement are covered in the final section.
Altoona	http://www.ci.altoona.wi.us/webfiles/fnitools/documents/municipal_code_title_13.pdf	•No sewage shall be discharged into the sewer system. •the city provides its rights regarding wells on its land in 13.39.060.B •groundwater monitoring wells and boreholes must have permission from the city prior to drilling in addition to of any DNR regulation requirements. •"What to do" in various pumping instances ar provided in 13.2 •application process is provided in 13.38 •exhaustive amounts of other information are provided
Eau Claire	http://www.ci.eau-claire.wi.us/home/showdocument?id=23067	•Zones are seperated by geographical location in EC 1. Northwest WHP Area. This area is delineated on the map which lies on the most northwest part of the WHP area at Rivercrest Drive to the south and east. 2. North WHP Area. This area is delineated on the map which lies on the most north part of the WHP area at Sundet Drive to the south. 3. Northeast WHP Area. This area is delineated on the map which lies on the most northeast part of the WHP area at Hastings Way and Village of Hallie to the south and west. 4. East WHP Area. This area is delineated on the map which lies on the east part of the WHP area at Hastings Way and Eddy Lane to the west. 5. Southeast WHP Area. This area is delineated on the map which lies on the most southeast part of the WHP area at Hastings Way and Jackson Street to the north and west. 6. South WHP Area. This area is delineated on the map which lies on the most south part of the WHP area at Redwood Drive to the north. 7. Southwest WHP Area. This area is delineated on the map which lies on the most southwest part of the WHP area at the Chippewa River and Riverview Drive to the north and east. 8. West WHP Area. This area is delineated on the map which lies on the most west part of the WHP area at the Chippewa River to the west of the Water Plant to the east." •Permitted and prohibitted uses are provided in 14.01.060 and 14.01.080 respectfully. •Conditional use permit process is explained in 14.10.090. •penalties and enforcement is covered in the final section

Agency	Code	Focus	Who/What	Wellhead Protection
Department of Natural Resources	NR80	Pesticides	Any person desiring to use limited use pesticides	•must obtain permit •may not cause death/harm to wild life •must be covered •must follow label •must not allow to enter waters •shall not fill tanks near well that could potentially be affected •properly dispose (follow label).
	NR110	Sewerage Systems	Sewerage System Owners/Engineer	Sanitary sewers shall be located with a minimum separation distance of 60 meters (200 feet) from any community water system well. The separation distance between a community water system well and a sanitary sewer main may not be less than 50 feet. Sanitary sewers shall be located with a minimum separation distance of 15 meters (50 feet) from private water system wells. Cross-connections with public and private water supply systems are prohibited. Groundwater infiltration into sanitary sewer systems shall be minimized.
	NR113	Waste Storage	"This chapter applies to licensed haulers, owners and any person servicing private sewerage systems including septic and holding tanks, dosing chambers, grease interceptors, seepage beds, seepage pits, seepage trenches, privies and portable restrooms."	Waste must be disposed of in a publicly owned wastewater treatment plant (POTW). In the case of an emergancy, disposal can be done in an open area. Area must be less than 2% sloped, 750ft from water, not in a floodplain, less than 10,000gal (waste) /acre, and must get approval from the dept. When land is frozen or snow covered, no waste application is allowed, except if pumped more frequently than every 6 months, in this instance the language is "preferred" POTW over land application. The same requirements must be met, except a slope of 6% is allowed in winter months. Soil must have a permeability of less than 6in/hour but more than .2in/hour in order to be used for landspreading. No landspreading on an area that is susceptible to ponding. Must have landowners permission. Must prevent runoff, no application after rain event (oversaturated soil). Land must not be recieving or have recieved POTW sludge in the last crop year. For agriculture use: application can be no more than 10 months prior to crop planting. Must have a 2ft grass strip on property boundary downslope of waste. Fields must be revegetated after discontinued. Must follow nitrogen recomendations (based on soil/crop needs). Spreading may not harm an endangered or threatened species or its critical habitat or a historical site. A table for spreading, incorporation, and injection requirments is provided. May apply to a hay field thats been harvested, but not once the new growth is 6in. One of the following three req. must be met: no significant amount of sepage may be present on land after an hour, after 6 hours all septage must be incorporated in soil, or ph must be raised to 12 and remain at 12 for 30 minutes. Soil borings are required in high use fields and in low use fields where no soil information is provided. A table of application rates is provided. Septage may be landspread seasonally on or into soils with a seasonal high groundwater level at a depth greater than one foot but less than 3 feet from the surface if the landspreading is limited to times when the soil is not saturated within 3 feet of the surface.
	NR120	Priority Watershed and Lake Program	"this chapter applies to governmental units and state agencies when acting as nonpoint source grantees; to governmental units when acting as cost−share agreement grantors; and to landowners, land operators and state agencies when acting as cost−share recipients."	•All priority watersheds (“Priority watershed” is a watershed where the need for nonpoint source water pollution abatement is most critical.) must have a watershed plan which consist of an assesment, implementation, and evaluation portion. •Provides information about cost-share agreements for addressing watershed nonpoint sources of pollution for the following practices: contour farming, contour and field stripcropping, field diversions, terraces, grassed waterways, high residue managment systems, nutrient management, pesticide management, cropland protection cover, intensive grazing management, critical area stabilization, grade stabliziation structures, agricultural sediment basins, shoreline and streambank protection, riparian buffers, lake sediment treatment, wetland restoration, shoreline habitat restoration for developed areas, barnyard runoff management, animal lot abandonment or relocation, well abandonment, manure storage facilities, animal waste storage abandonment, milking center waste control systems, roofs for barnyard runoff management and manure storage facilities, livestock fencing, and urban best management practices.
	NR123	Well compensation program	Owners fo a contaminated well	•eligible parties must be replacing a contaminated private well •test analyses of at least 2 samples of water, taken at least 2 weeks apart and not more than 2 years apart must pass testing done by a certified lab •family income less than $65,000 (include tax return forms) •Eligible costs: equipment for clean up, new well, cost of sample analyses, well abandonment costs, etc.

	NR130	Nonferrous metallic mineral exploration	Explorers of nonferrous metallic minerals	•If a well is artesian, approval from the department is required •If a well is temporarily abondandoned, casing must be left in place and it needs to be capped •talks about requirements for fillings, 4in diameter or greater must be entirely concrete, etc.
	NR131	Nonferrous metallic mineral prospecting	Prospectors of nonferrous metallic minerals	•Most of the environmental concern is wetlands, as it states, "Groundwater may discharge to a wetland, recharge from a wetland to another area, evaporate from, and/or flow through a wetland." never mentioning how the groundwater may come into contact with humans •Description of how the prospectors will keep ground and surface waters clean must be submitted, but no specifics are given.
	NR133	Radioactive waste site exploration	Any person wishing to engage in radioactive waste site exploration	States the same requirements in NR130, only talking about drillhole fillings and casing rules.
	NR134	Oil and gas exploration	Any person wishing to engage in Oil &/or gas site exploration	Same rules as NR 130 & 133, including temp and perm abandonment.
	NR140	Groundwater Quality	Anyone who may affect groundwater quality	•Provides a table with substances preventative action limit and enforcement standards for primary and secondary contaminants •if any sample exceeds or meets an action limit, the responsible party must notify the appropriate regulatory agency. •sampling and lab requirements are specified by regulatory agency, in the instance that they are not, literature is provided to follow.
	NR142	Water management and conservation	Persons interested in withdrawing more than 2,000,000 gal/day	•Consumption: report total withdrawn x .7 if nondomestic irrigation, x .9 if non irrigation agriculture, x a coefficient determined by department for: thermalelectric, commericial, industrial, mining, or public water system •coefficients must be approved prior to use •Must get approved if withdrawal will exceed 2,000,000 gal/day •app info can be found within •6 or more residents may file a complaint for a withdrawal violation
	NR157	Polychlorinated biphenyls (PCBs)	Anyone handling PCBs	Must be stored, transported, and disposed of in a manner that prevents loss of PCB to the environment.
	NR182	Nonferrous metallic mineral mining wastes	"These rules govern all solid waste disposal sites and facilities for nonferrous metallic mineral mining and prospecting operations"	•No waste site shall be located within 1,000ft of any navigable lake, pond, or flowage. 300ft of a navigable river or stream, within a floodplain, within 1,200ft of a water supply well, or in an area that the dept. deems as having a reasonable chance of an exceedance of quality standards for surface or groundwater. •information about quality standard exceedance procedures is given. •No one is allowed to construct, establish, or expand a waste site without obtaining approval of a feasibility report and a plan of operation from the dept. •information about feasibility reports are provided (NR182.08) •information about plan of operation requirements are provided (NR182.09) •Specifies requirements for monitoring groundwater and leachate as well as testing of the samples.
	NR204	Domestic Sewage Sludge Management	"Any person who treats or generates sludge, applies sludge to land or places sludge in a landfill"	•Anyone who owns or operates a treatment works must obtain a WPDES permit. •provides a table for required frequency of monitoring for various amounts of applied sewage and sludge. •before sludge is applied, permittee must receive approval for each site on which sludge is applied. •provides a list and table (Table B in NR204.07) of requirements for applications sites. •Quality of sludge is based on metal concentrations, pathogen densities and treatment processes, and vector attraction reduction. •Minimum duration between application and use is provided in a table (Table C in NR204.07). •Tables for pollutant concentration standards are provided. •Tables for application rates are provided. •Tables for pathogen densities are provided. •vector attraction reduction tables are provided. •Storage facilities must gain approval from dept. •The dept. may require the permittee develop a sludge managment plan, if sludge is imported from outside of state, a management plan is required.
	NR206	Land Disposal of Municpal and Domestic Wastewaters	"discharges to land disposal systems of liquid wastewaters from publicly owned wastewater treatment works and from privately owned domestic wastewater treatment works"	•Provides a table of effluent limits, based on system type and date of approval. •"The underground injection of municipal and domestic wastewaters through a well is prohibited." •if discharge may result in an increased possibility of groundwater contamination, further treatment may be required. •land disposal systems must comply with NR110 and 140. •provides limitations (NR206.08) for: absorption pond systems, spray irrigation systems, ridge and furrow systems, overland flow systems, while all other systems will be evaluated on a case-by-case basis. •if average daily flow is greater than 0.015MGD. groundwater monitoring is required as mentioned in the permit.

	NR213	Lining of Industrial Lagoons and Design of Storage Structures	"all lagoons, tanks, stacking structures, and other storage or treatment structures that receive industrial, commercial or agricultural wastewaters, associated sludges from industrial, commercial or agricultural sources, by−product solids and any resulting leachates."	•must be 1,000ft from a well serving a community public water supply system, 250ft from other potable water supply wells, not in wetlands, shall be designed to minimize the level of substances in the groundwater, lagoon basement must be 5 feet from bedrock or water table. •Provides liner requirements and specifications. •liners must be tested before lagoons are put into operation. •Storage tanks must be designed, installed and maintained to prevent leaks to corrosion or structural failure.
	NR214	Land Treatment of Industrial Liquid Wastes, By-product Solids and Sludges	Industrial waste operators	•Discharge of these wastes are prohibited unless the operator can demonstrate that the environment will not exceed standards in NR140. •absorption ponds must be 1,000ft from a well serving a community public water supply system and 250ft from other potable water supply wells. must be 5 feet above water table or bedrock. must not be in a floodway. •discharge shall contain the minimum amount of substance that is technically and economically feasible. •ridge and furrow systems shall be 1000ft from a community public water supply system well, 250ft from any other potable water supply well, the bottom must be 5ft above beckrock and groundwater and not in a floodway. •provides site location criteria, design and construction criteria, discharge limitations, discharge monitoring requirements, operating requirements, and soil investigation and groundwater monitoring requirements for absorption ponds, ridge and furrow systems, irrigation systems, overland flow systems, subsurface absorption systsems, landspreading systems for liquid wastes and by-product solids, and sludge spreading systems. •Soil investigation requirements are given.
	NR500	General Solid Waste Management Requirements	Solid waste facilities	•Provides information for site inspection, licensing, and approval processe for starting and operating a solid waste facility. •If the dept. believes that a solid waste facility is in violation, they may take enforcement action. •Provides definitions for chapters 500-538.
	NR502	Solid Waste	Solid waste storage, transportation, transfer, incinerators, air curtain destructors, processing, woodburning, composting, and municipal solid waste combustors	•No one is allowed to operate a facility if it will cause a detrimental effect on surface water or groundwater or a significant adverse impact on wetlands •storage facilities and air curtain destructors cannot be located in a floodplain, within 250ft from any private well, navigable lake, pond, flowage, river, or stream, and 1200ft from any public water supply. composting facilities have the same location requirements but **must also be 5 feet above the seasonal high groundwater table** •storage facilities that are placed in an enclosed building do not have location criteria, except that they cannot be in a floodplain. •provides operational requirements for containerized storage facilities, noncontainerized storage facilities, and municipal solid waste combustor residue storage facilities. •runoff that interacts with waste, must be treated like leachate. •provides requirements for municipal solid waste combustors including a table for limits.
	NR503	Landfills	Applicants for new small scale landfills	•Must not be within 1,000ft of a lake, pond, or flowage. 300ft of a river or stream, 1,200ft from a water supply and can't be within a floodplain. •Must not adversly affect water supply or surface waters. •dept. MAY require wells to monitor GW and leachate. •To close, 2feet of compacted soil must cover the old landfill, and must slope to allow runoff, the soil must be very fine grain to prevent infiltration. A six inch layer of top soil shall cover this layer. •For one-time and small scale landfills, wellhead protection rules are the same. Intermediate landfills have slightly different regulations. For coarse grained soil environments: 3 observation wells and 5 borings must be in place in the first 20 or less acres. 1 observation well and 1 boring for each additional 10 or less acres. For fine grained soil environments: the requirments are the same, however for each 20 or less acres a piezometer is required. •must have a clay liner. •must have a leachate collection system. •must have stormwater drainage ditches •minimum of 2 leachate head wells •provides table of required parameters for baseline sampling. 4 samples (30days apart) must be submitted with contruction proposal. •provides table with leachate sampling requirements. •must keep track of leachate volume pumped monthly, and semi-annual sampling for the first two years, followed by annual sampling after the first 2 years.

	NR504	Landfills	"Except as otherwise provided, this chapter governs all landfills"	•provides same location criteria as NR503. •defines liner requirements, both clay and composite are included. •defines requirements for leachate collection systems. •defines requirements for cover. •defines requirements for gas extraction systems •storm water management criteria
	NR506	Landfills	all solid waste disposal facilities	•all solid wastes must be covered by a 6in compacted soil layer at the end of each day. Industrial waste is not subject to daily cover. •Stormwater must be diverted away from site. •erosion shall be minimized and any windblown material shall be collected at the end of each day. •explains how to properly place waste. •final use must not be agriculture, building, or excavation. •prohibited items: lead acid batteries, major appliances, waste oil, yard waste, or asbestos (there are exceptions). •Provides requirements and procedures for various hazardous wastes and other wastes that require extra attention •landfills must submit compliance certificates every year.
	NR507	Landfills	"governs all environmental monitoring for solid waste disposal facilities"	"The department may require an owner or operator of a solid waste disposal facility to install, sample and document environmental monitoring devices" the design, installation, maintenance, and operation requirements for these devices are specified in this chapter.
	NR508	Groundwater standards	Anyone in charge of responding to an attained or exceeded GW standard	•If any standards are met or exceeded according to NR140, in a GW monitoring well the dept. must be notified (NR507). The owner is responsible for a site investigation. The dept. and owner will select a remedial action plan, and evaluate the results, dept. decides if the requirements (NR140) are met. •For a subtitle D well: the owner may demonstrate that the exceeded values are false. If the dept. does not concur with the owner within 30days, the owner must begin assesment monitoring. The owner must test for all parameters listed in NR 507 the first monitoring event following receipt of the exceedance. Annually, they must test for parameters in NR 507, and within 60 days of recieving the results, submit them to the dept. Semmiannually, the owner must sample their wells for NR507 parameters using the low-flor sampling technique. •Owners can request to eliminate select parameters, after 4 assesment events, if those select parameters were not detected. •The owner may request to end the assesment program after 2 consecutive semi-annual sampling rounds show that all detected parameters are below their standards. •If an ES is attained or exceed, the owner must notify the clerk within 14 days of the receipt. They must develop a site investigation and a remedial action plan.
	NR510	Landfills	Landfill owner/engineer	Wells within landfill must be contsructed so that the water table interects the well screen at all times during the year. Located no more than 300 feet from the limits of filling.
	NR512	Landfills	Landfill owner/engineer	Leachate collection program must be specified. In a coarse grained soil environment: 2 piezometers, 5 observation wells, and 10 borings must be in place within the first 5 or less acres. Each additional 5 or less acres requires another 1 observation well and 2 borings. Each additional 10 or less acres requires only 1 piezometer. For fine grained soil environments: all is the same except twice the number (compared to coarse grain soil environment) of piezometers are required. Must determine water quality and hydraulic conductivity. Two water table contour maps must be submitted, one showing the highest and one showing the lowest values.
	NR518	Landspreading of Solid Waste	"governs all solid waste landspreading facilities, except hazardous waste facilities"	•must first obtain written approval to operate a landspreading facility. •cannot be within 100ft of a navigable body of water, 1000ft of a public water supply well, 200ft from a private water supply well. •landspreading may not occur if it will cause a significant adverse impact on wetlands, a detrimental effect on surface or groundwater. •No waste shall be disposed in areas of standing or ponded water.
	NR528	Accumulated sediment	Anyone interested in spreading sediment	•a site where sediment is used or deposited must be, 3ft away from bedrock or water table, 1,200ft from water supply well, 250ft private supply well, and 200ft from any surface water. •no person may use or dispose of sediment if it will adversly affect water (bring any contaminant/parameter above action level) • if sample shows exceedence of ceiling levels, "sediment manager" must ensure that sediment is disposed of in a licensed landfill. No mention of when testing is required, no mention of remediation/clean up. • sediment may not be spread when precipitation may cause runoff

	NR538	Industrial byproducts	Anyone using industrial byproducts	•may not use in a manner that would cause: adverse impacts on wetlands, detrimental effect on surface or ground water. •if byproduct shall be placed on the surface, it must be 6in or less thick and 25 feet (and buffered by vegetation) away from surface water. Placement of byproducts must not be below the water table or in permanent standing water. •if volume exceeds 5000cubic yards, the byproducts must not be within 200 feet from a well and 3 feet above the water table.
	NR540	Waste and recycling facilities	Waste and recycling facility owners	Must not be in a floodplain or wetland.
Department of Transportation	TRANS27	Highway salt storage requirements	"This chapter shall apply to any person who stores highway salt or liquid calcium chloride within the boundaries or jurisdiction of this state in the course of manufacturing, distributing or using highway salt or liquid calcium chloride"	•must prevent salt and/or liquid calcium chloride from entering surface or groundwater •must be stored on an impermeable base, and must divert runoff to a drainage basin. •must be covered by a building or structure that prevents interaction with precipitation. •the storage location must be further than 50ft from a lake or stream. •the dept. will inspect each facility atleast once every year to ensure compliance.