



Summary of Groundwater and Drinking Water in Comprehensive Watershed Management Plans

By Julie Westerlund, March 2022

This memo summarizes how groundwater and drinking water (“GW/DW”) are addressed in comprehensive watershed management plans developed under BWSR’s One Watershed, One Plan program. To create this memo, I looked at the 25 BWSR-approved plans (as of January, 2022). I did a keyword search for relevant terms (*groundwater, drinking water, DWSMA, well, irrigation, etc.*), copied GW/DW related priorities, goals, and actions in a spreadsheet, and recorded observations in this memo.

Contents

Main Points	1
Policy on Including Groundwater and Drinking Water in Plans.....	2
Statewide Overview	2
Priority Issues / Resource Concerns.....	3
Goals	5
Strategies and Actions	12

Main Points

Main points from the memo:

- All 25 plans include GW/DW as one or more of their **priority concerns**; GWDW is a **high priority** (or equal in importance to other priorities) in 19 plans.
- All 25 plans had at least one **goal** related to GW/DW quality. Most goals were oriented around reducing risk of groundwater contamination or increasing awareness in areas where groundwater has known contaminants.
- Where drinking water comes from surface water for some watershed residents, plans always acknowledge the importance of improving **water quality for drinking water purposes**. Surface

water quality goals for sediment, nitrate, and other contaminants are incorporated in surface water quality priorities/resource concerns.

- Nineteen of the 25 plans have at least one goal pertaining to **groundwater quantity**. These were commonly lower tier issues except in areas of the state where sustainable use of groundwater is a present concern.
- My analysis identified 22 categories of **strategies and actions** to protect or improve GW/DW. The number of strategies for and the relative investment in GW/DW in a given plan generally track with the degree to which GW/DW vulnerability and sustainability is a concern in the watershed (considering hydrogeologic and land use context for the watershed).
- Many plans reflect the **difficulty of measurement** and understanding of this important resource and include actions for more data, studies, or inventories.

Policy on Including Groundwater and Drinking Water in Plans

The *One Watershed, One Plan – Plan Content Requirements*, list the following issues that must be addressed in comprehensive watershed management plans (according to Minnesota Statutes §103B.801, subdivision 4). Groundwater and drinking water items in bold for emphasis:

- Surface water and **ground water quality protection, restoration, and improvement**, including prevention of erosion and soil transport into surface water systems
- Restoration, protection, and **preservation of drinking water sources** and natural surface water and **groundwater storage and retention systems**
- Promotion of **groundwater recharge**
- Minimization of public capital expenditures needed to correct flooding and water quality problems
- Wetland enhancement, restoration, and establishment
- Identification of priority areas for riparian zone management and buffers
- Protection and enhancement of fish and wildlife habitat and water recreational facilities

Statewide Overview

Minnesota has a variety of [distinct hydrogeologic settings](#) and land uses, some of which result in drinking water and groundwater issues being more (or less) of a concern relative to other resource issues. For example, porous soils and karst formations in southeast Minnesota mean high susceptibility to groundwater contamination, making groundwater protection a key focus in the plans from that region. Central Minnesota has sandy soils and areas of high groundwater use, making sustainability and contamination a concern. On the other hand, the Red River Valley has clay soils that protect the underlying aquifers from contamination, so implementation priorities are more focused on surface water protection and restoration.

In the majority of planning areas, 100% of drinking water comes from groundwater. While some planning areas have localities that use surface water for drinking water, groundwater is the primary source of drinking water in all planning areas. Some plans refer to groundwater and drinking water interchangeably, especially regarding quality or contamination risk. The number of groundwater protection actions in plans tracks with the degree to which groundwater protection is a concern due to the hydrogeologic setting and land use. In the few places where drinking water supplies come from a river or lake, reducing pollutant loading to surface waters with the intent of protecting drinking water is always a priority. Some plans also acknowledged the importance of source water protection for users in downstream watersheds.

Of the 25 plans reviewed, 15 had a completed Groundwater Restoration and Protection Strategies (GRAPS) report completed at the time the plan was written. My analysis did not include a cross-examination of the extent to which GRAPS information and/or strategies was reflected in plans.

Priority Issues / Resource Concerns

Of 25 plans reviewed, all of them addressed GW/DW in some way.

- GW/DW was identified as a primary resource concern or a high priority in 19 plans.
- GW/DW was identified as a medium/lower priority in 6 plans.

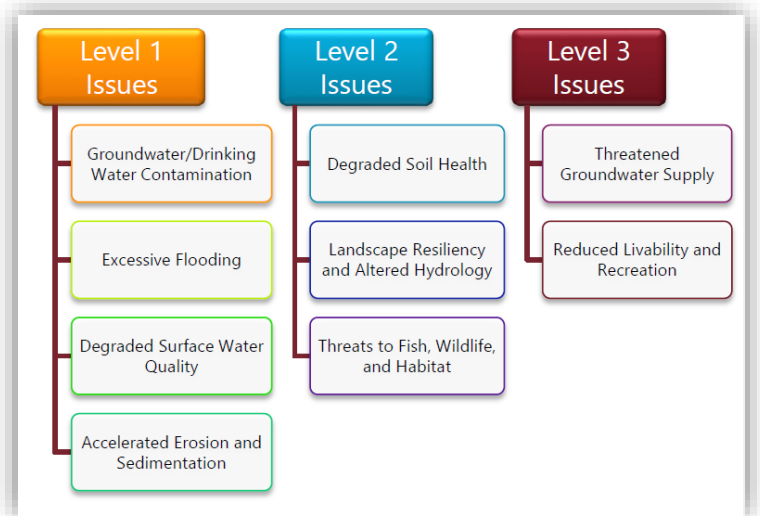
For context, plans identified between 3 and 19 resource concerns/issues. In plans with more than 4 or 5 resource concerns/issues, drinking water and or groundwater generally appeared as an element in more than one of them. For example, some plans identified risk of groundwater contamination and groundwater quantity/sustainability as two separate issues. Other plans acknowledged the multiple benefits, including groundwater, from activities like permanent forest protection or soil health practices in drinking water supply management areas.

The 6 plans that did not identify GW/DW as a high priority resource demonstrated that GW/DW was discussed and considered in planning and found that vulnerability is low due to the hydrogeologic setting and current or projected land use.

Every single plan identified at least one issue relating to groundwater or drinking water quality. In areas where groundwater quantity is a concern, the main theme was around human use and sustainability of groundwater supplies. Some plans acknowledged the importance of groundwater-dependent natural resources, but this was rarely a primary issue of concern.

Examples:

The [Watershed Alliance for the Greater Zumbro](#) plan identifies nine issues within three levels, Level 1 being the highest priority. “Groundwater/Drinking Water Contamination” is a Level 1 issue, while “Threatened Groundwater Supply” is a level 3 issue.

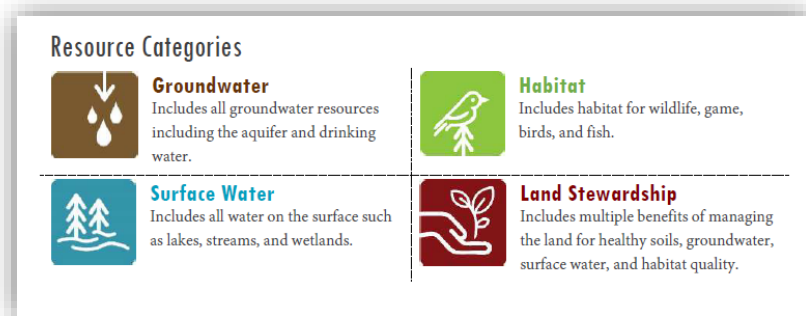


3.2.1 Groundwater/Drinking Water Contamination (Level 1)





Issue Statement: Groundwater quality and drinking water safety is threatened by pollutant loading.

3.2.8 Threatened Groundwater Supply (Level 3)

Issue Statement: Groundwater sustainability is at risk from consumptive use and loss of recharge.



The [Leaf, Wing, Redeye Plan](#) identifies four resource categories. Groundwater Contamination is a Tier 1 issue, while Groundwater Sustainability is a Tier 2 issue. Both will be addressed in the plan, according to their relative importance for each planning region.

Category	Resource	Issue Statement	NRCS Resource Concern	Planning Region
	Drinking water	Shallow groundwater is highly vulnerable to contamination from numerous sources.	Water Quality Degradation – Excess nutrients in groundwater	
	Aquifer	Groundwater sustainability, the amount of groundwater available, may be vulnerable in the face of increased agricultural irrigation withdrawal.		

For context: Other resource issues in the Leaf, Wing, Redeye Plan include soil erosion and runoff; *E. coli* impairments; development pressure; soil health, loss of perennial vegetative cover (Tier 1), wetlands; shallow lakes with high phosphorus sensitivity, outstanding biological significance, wild rice, and shallow depth; connectivity barriers in streams; and altered hydrology in streams (Tier 2).

Goals

Goals directly addressing groundwater and/or drinking water fall into three categories (examples below). Many groups found setting measurable goals for GW/DW challenging due to lack of information about groundwater resources and/or monitoring data; measurable goals tended to be output-oriented (e.g., number of wells sealed) as often as they were oriented around a resource outcome (e.g., number of private wells with drinking water below the safe drinking water standard).

Drinking Water Quality (surface water sources)

Where drinking water comes from surface water for some watershed residents*, groups already set surface water quality goals for sediment, nitrate, and other contaminants. These plans always acknowledged the importance of improving water quality for drinking water purposes.

Other plans** acknowledged the importance of protecting their surface water because it is a source of drinking water downstream.

*Red Lake River (East Grand Forks, Thief River Falls), Thief River (Thief River Falls),

**Buffalo-Red River – (Moorhead), Sauk River (St. Cloud), Pine River (Little Falls, St. Cloud, Twin Cities Metro Area), North Fork Crow River (Twin Cities), Watonwan River (Mankato)

Examples

From the [Thief River Plan](#):

3.2.2 Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load

This measurable goal category addresses six priority issues within the Aquatic Life and Aquatic Recreation (Surface Waters), Drinking Water (Surface Waters), Impoundments and Reservoirs (Surface Waters), Healthy Urban Landscapes (Local Development and Land Stewardship), and Wetlands (Surface Waters) resource concerns:

- Issue 2.5.1: Water Quality: Elevated concentrations of sediment and organic matter have a detrimental impact on drinking water quality

Short-Term Goal(s):

Short-term goals are set at planning region scales.

- **Planning Region scale (Total Phosphorus):** Use the phosphorus reduction targets outlined by HSPF and approved by the Thief River Watershed 1W1P Advisory Committee in each planning region:
- **Planning Region Scale (Sediment):** Use the sediment reduction targets outlined by the TMDL, HSPF and the Thief River 1W1P Advisory Committee in each planning region:
 - **Protection (Highest Quality):** Judicial Ditch 30/18/13: 5% or 70 tons/yr.

Long-Term Goal(s):

- **Planning Region Scale (Phosphorus):**
 - Extend short-term protection goals
- **Planning Region Scale (Sediment):**
 - Extend short-term protection and restoration goals
 - Restoration (Impaired): Lower Thief River 36.942% or 2,507 tons/yr.
 - Restoration (Potential Impairment): Middle Thief River: 24% or 2,303 tons/yr.
 - Protection (Nearly Impaired): Mud River: 32.5% or 342 tons/yr.

Please note: some images in this plan are composite screen shots “stitched together” with some content removed for brevity (the image looks different than what you will see in the plan)

From the [Sauk River Plan](#):

The Plan **ISSUE, DESIRED FUTURE OUTCOME, GOAL, AND MEASURE:**

- ▷ **ISSUE STATEMENT:**
The drinking water for the city of St. Cloud is impacted by the Sauk River's water quality.
- ▷ **DESIRED FUTURE CONDITION:**
The Sauk River will see improvements in terms of habitat and reductions to nutrient and sediment loading, which will lead to ecological and economic benefits.
- ▷ **10-YEAR PLAN GOAL:**
1) Reduce the severity and duration of pollutant loads in the lower Sauk River.
- ▷ **MEASURE OR INDICATOR OF GOAL ACHIEVEMENT:**
 - » Reestablish water quality monitoring program in the Lower Sauk River.
 - » Prioritize and implement projects that will reduce nutrient, sediment, and *E. coli* loading to the Sauk River.

Drinking Water Quality (groundwater sources)

All 25 plans had at least one goal related to GW/DW quality. Most goals were oriented around reducing risk of groundwater contamination or increasing awareness in areas where groundwater has known contaminants. Contaminants of concern listed in plans include:

- Nitrate was the most commonly referenced concern. In areas of the state where nitrate contamination is a concern, plans referenced safe drinking water standards for nitrate).
- Arsenic and manganese (almost always naturally occurring but still a health concern)
- Bacteria from subsurface sewage treatment systems or animal waste (feedlots)
- Pesticides
- Lead, Mercury, PCBs
- Chlorides
- Contaminants from stormwater discharge, household hazardous waste, spills (a few plans mentioned pipelines and rail lines as possible sources), leaking underground storage tanks, landfills, and other sources
- Pharmaceuticals and other contaminants of emerging concern

Goals are often generic “Protect public drinking water supplies...” or “Reduce risk of groundwater contamination,” especially for plans that articulated both long-term and short-term goals. Long-term

goals tend to be resource-oriented, referencing numbers or percentages of wells with particular contaminants.

It is very common that groundwater quality goals, especially short-term goals, reference specific actions such as well sealing, land management practices, private well testing, education, SSTS fixes, and more (see strategies and actions, below).

Finally, several plans included better understanding groundwater through continued or increased monitoring or studies, including requesting a county geologic atlas where they don't exist and working with state agencies to develop a GRAPS report if one was not available when the plan was written.

Examples:

From the [Missouri River Basin](#) Plan...

Resource Concern: Drinking Water.

Priority Issues:

- Elevated nitrate-nitrogen in groundwater wells
- Land use changes where water enters aquifers, including Wellhead Protection Areas (WPAs) or Drinking Water Supply Management Areas

Metrics:

- Number of private and public water supplies with nitrate-nitrogen concentrations in each

Goals:

Short-Term:
Develop and implement an action plan to establish a baseline evaluation of **bacteria (fecal coliform or *E. coli*)** levels in **public and private wells** within the plan area.

Long-Term:
Maintain zero **public and private wells** that test positive for **fecal coliform or *E. coli***.

Long-Term:

Protection Goal: Maintain unaffected private and public drinking water supply wells with **nitrate-nitrogen** concentrations at or near a concentration representative of background and transitional levels (**< 3 mg/l**).

Protection Goal: Reduce the number of public and private drinking water supplies that have **nitrate-nitrogen** concentrations considered moderately elevated above background concentrations (**≥ 3 mg/l but < 7 mg/l**).

High Priority Protection Goal: Reduce the number of private and public drinking water supplies that have **nitrate-nitrogen** concentrations representing a possible future health concern (**≥ 7 mg/l to < 10 mg/l**).

High Priority Restoration Goal: Restore private and public drinking water supplies that have **nitrate-nitrogen** concentrations that currently represent a health concern (**≥ 10 mg/l**).

Goals:

Short-Term:
Install structural or management practices within DSWMAs that promote soil health and nutrient management (e.g. cover crops, nutrient management plans, perennial crops) in areas at the highest risk of nitrate-nitrogen infiltration, therefore protecting groundwater drinking supplies. Goal acreage for structural and management practice implementation are set at the planning region scale:

- Upper Big Sioux River – 8 acres;
- Lower Big Sioux River – 1,483 acres;
- Rock River – 174 acres; and
- Little Sioux River – 227 acres.

category of protection or restoration.

Resource Concern: Drinking Water.

Priority Issue:

- Elevated bacteria (i.e. Escherichia coli (*E.coli*) and fecal coliform) in groundwater wells

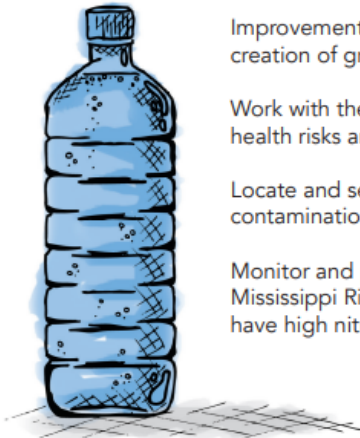
From the [Mississippi Headwaters](#) Plan:

Drinking Water Stewardship

Desired Future Condition

Protect the quality and quantity of drinking water resources from increasing land use pressures and mitigate the negative impacts of previous industrial and human activities.

10-Year Measurable Goals



- Improvement of protection practices and programs through inventories, databases, and the creation of groundwater information resources.
- Work with the Minnesota Department of Health (MDH) to inform the public of potential health risks and sealing of wells within the Special Well and Boring Construction Areas.
- Locate and seal 10 unused or flood-prone private wells per year to prevent groundwater contamination.
- Monitor and provide technical assistance to 10% of the existing private wells in the Mississippi River Headwaters Watershed, focusing on areas that are prone to flooding or have high nitrate (above 5.0 mg/L) or arsenic concentrations (above 5.0 µg/L).

122

Groundwater quantity

Nineteen of the 25 plans have at least one goal pertaining to groundwater quantity. When plans used a “Tiered” system to prioritize issues, groundwater quantity was often a middle or lower tier issue. In some cases, groups acknowledged the need to protect sustainable groundwater supplies for future use, while in others, overuse of groundwater is a present concern in the watershed.

Quantity goals typically were high level (e.g., “maintain sustainable groundwater supplies for future use” or referenced a specific activity such as conservation measures.)

Like with groundwater quality goals, some plans set goals to better understand groundwater through continued or increased monitoring or studies, including requesting a county geologic atlas where they don't exist and working with state agencies to develop a GRAPS report if one was not available when the plan was written.

Examples:

From the [Pomme de Terre](#) Plan:


3.1.2 Groundwater Conservation


Desired Future Condition (Long-Term Goal):
Sufficient groundwater is available in the Pomme de Terre Watershed to support a healthy natural resource base and economic uses. In addition, there is sufficient groundwater data to characterize quality and quantity trends.


10-Year Measurable Goals:


Goal 1: Assist agricultural producers with groundwater conservation by promoting water conservation measures that improve water use efficiencies; all counties will request the County Geologic Atlas to fill groundwater monitoring data gaps, and continue ongoing observation well monitoring efforts.

From the [North Fork Crow River](#) Plan:

 **Measurable Goal (Protection):** Treat 10% of land in "high" recharge areas with low nitrogen infiltration risk (see **Section 4**) with recharge management practices, defined as practices, which increase soil organic matter content or increase infiltration to the aquifer. Priority given to the Bonanza Valley Groundwater Management Area or areas covered by DWSMAs

 **Metric:** Number of acres in "high" recharge areas treated with recharge management practices.

 **Measurable Goal (Protection):** Sustain the groundwater basin, aquifer, or aquifer system without rendering groundwater supplies unreliable and causing a long-term progressive lowering of groundwater level.

 **Metric:** Number of groundwater basins, aquifer or aquifer systems not showing a statistically significant decrease in level, exceeding natural level changes caused by variations in recharge rates and climate.

More Quantity and Quality Goal Examples...

From the [Lake Superior North Plan](#):

ISSUE STATEMENT:

Increasing development pressure and existing land use practices have the potential to adversely impact groundwater quantity and quality resulting in reduced groundwater recharge and impacts to receiving waters and drinking water supplies. The LSNW planning group will support the activities of the Minnesota Department of Health Source Water Protection Program.

- GOAL 1:** Protect groundwater quality by addressing sources of potential contamination (MDH, 2015).
- GOAL 2:** Protect groundwater supplies and maintain baseflow contributions to groundwater-dependent natural resources.
- GOAL 3:** Develop a watershed-wide well monitoring program, in collaboration with the Minnesota Department of Health and Minnesota Geological Survey (Cook County LWMP, 2014).
- GOAL 4:** Secure funding and partners to develop a watershed-wide geological atlas. Potential funding sources include the MN Department of Health, the Minnesota Geological Survey and the LCCMR. (Cook County LWMP, 2014).

The [Lower St. Croix Plan](#) The Lower St. Croix Plan set five goals related to their three groundwater issues.

Table 3-1. Issues and Goals by Resource Area with Reference to Related Outputs and Priority Locations

Groundwater (GW)		
Issue	Goal	Related Outputs & Priority Locations 1 st Column, Table 5-1
1. Groundwater quality is impacted by land use and contamination	1A. Increase agricultural best management practices that improve soil health and reduce groundwater pollution	1
	1B. Reduce contamination from subsurface sewage treatment systems, household hazardous waste, pesticide use, leaky underground tanks, closed landfills, abandoned wells, etc.	8, 10, 18, 19
2. Groundwater quantity is impacted by consumption and reduced recharge areas	2A. Reduce or maintain groundwater consumption despite continued growth	4
	2B. Increase infiltration and recharge in rural and urban areas	1, 11, 12, 17
3. Data are lacking to fully understand groundwater resources	3A. Gather data needed to understand groundwater resources	44, 45, 46, 47

Strategies and Actions

All Plans included at least 5-10 actions to make progress on their GW/DW goals. Which strategies are emphasized depends on the relative importance of GW/DW in the plan (see the Statewide Overview section). When plans indicate how actions should be targeted, they indicate these actions should take place in wellhead protection and other sensitive areas, groundwater recharge areas, areas assigned at an MDA determined mitigation level under the Groundwater Protection Rule, and places with high densities of private wells impacted by nitrate contamination.

Below is a summary of Strategies and Actions that were included in plans (not a comprehensive list – some items that only appeared in one or two plans are not included).

Action	How to Get It Done
Land Management/Nutrient Management	
Land Protection (easements, CRP, CSP, SFIA, etc.)	<ul style="list-style-type: none"> • Prioritize based on groundwater recharge/drinking water vulnerability • Evaluate school trust fund lands classified for real estate and other high-risk land conversion areas for opportunities to implement land conservation and protection activities. • Monitor easements and acquisitions to ensure program compliance.
Nutrient Management (nutrient mgmt. plans, precision agriculture, prescribed grazing)	<ul style="list-style-type: none"> • financial assistance including increased cost-share rate within high vulnerability DWSMAs • technical assistance • Nutrient Management Initiative program (via MDA) • contact landowners in DWSMAs about doing projects • look for opportunities and programs to test and implement new nitrogen practices, innovative technology, or cropping systems that prevent or reduce nitrogen loss • enroll producers into the USDA's Nitrogen Management Plan
Structural Best Management Practices (grassed waterways, WASCOBs, two-stage ditches, wetland restoration, filter strips, rain gardens, water re-use systems, bio-retention/filtration)	<ul style="list-style-type: none"> • financial assistance • use the nitrogen infiltration risk analysis to prioritize • retrofit existing developments with recharge and reuse projects • promote via MIDS • outreach • create a stormwater task force • stormwater management plans for urban nodes, resorts and golf courses
Soil Health Practices (conservation tillage, cover crops, perennial cover)	<ul style="list-style-type: none"> • financial assistance • develop a soil health team
Restoration and land management	<ul style="list-style-type: none"> • forest stewardship plans

Action	How to Get It Done
(forests, grasslands, wetlands, buffers, stream / ditch stabilization)	
Contaminant Management	
Well sealing	<ul style="list-style-type: none"> • financial assistance • education • inventory abandoned /unsealed wells
Upgrade failing septic systems	<ul style="list-style-type: none"> • financial assistance • low interest loans • education • ordinances and zoning requirements • point of sale inspections • inventories
Provide adequate wastewater treatment to unsewered communities/areas	
Animal waste management	<ul style="list-style-type: none"> • manure management plans • feedlot and manure storage facility upgrades / closures • pasture management • livestock exclusion • microbial source tracking for E. coli implement ordinances
Other contaminant prevention (pesticides, chloride, hazardous waste, heavy metals, contaminants of emerging concern, etc.)	<ul style="list-style-type: none"> • outreach and education • household hazardous waste collection program • solid waste comprehensive plans • emergency hazard management ordinances and plans, protocols and programs (pipeline, rail, roads spill action) • road salt management including cost share for equipment upgrades • license hazardous waste generators and pesticide applicators • pesticide management plans
Technical Assistance	
Private well testing (for nitrates, bacteria, arsenic, manganese, lead)	<ul style="list-style-type: none"> • screening program to test subset of wells • purchase equipment and materials for nitrate screening • testing clinics and/or test kits • point of sale inspections • cost share or loan programs for repair or replacement • assist MDA with township testing program • education and outreach ...to provide information about resources for testing...about health limits for contaminants, ...to gather information about status of private wells, ...to promote best management practices for well maintenance
Irrigation management and water conservation practices (scheduling, uniformity testing, low flow drip nozzles, moisture	<ul style="list-style-type: none"> • education • financial assistance • technical support • criteria for sustainable use of groundwater supply

Action	How to Get It Done
sensors, variable rate application, smart irrigation for urban and suburban)	<ul style="list-style-type: none"> • restrict use in highly vulnerable areas by requiring conditional use permits
Promote other water conservation practices (not irrigation specific)	<ul style="list-style-type: none"> • educational materials • outreach
Local Controls and State Rules	
Implement Ordinances and Rules (SSTS, Feedlots, Solid Waste, Groundwater Protection Rule, stormwater, buffer law, WCA, shoreland, well setbacks)	<ul style="list-style-type: none"> • meet to review ordinances • develop policies to streamline local permitting • use monitoring, education and technical assistance • enforcement
Permitting (GW appropriations, drain tile, mining)	<ul style="list-style-type: none"> • participate in technical review of groundwater appropriations permits within or upstream of trout streams • consider permitting all tile projects in the watershed • Review the impact of mining operations and determine if additional requirements should be established for conditional use permits (e.g., groundwater-level monitoring or density analysis over time).
Land Use Zoning and Planning	<ul style="list-style-type: none"> • incorporate GW/DW resources into local decision making process • administer adopted land use and zoning ordinances to manage contamination sources • model comprehensive plan language protecting groundwater recharge and preventing unsustainable harvest
Wellhead Protection Planning	<ul style="list-style-type: none"> • participate in wellhead protection planning and implementation
MIDS	<ul style="list-style-type: none"> • work with communities to adopt and implement Minimal Impact Design Standards
Information	
Data (water levels, aquifer safe yields)	<ul style="list-style-type: none"> • monitoring • evaluate trends • request county geologic atlas • work with agencies on GRAPS
Compile information	<ul style="list-style-type: none"> • identify information sources to better classify rural stewardship* within the plan area, including the locations of existing nutrient management plans, soil health and tillage practices, and irrigation best management practices.
Inventories and databases	<ul style="list-style-type: none"> • abandoned wells • septic systems • non-conforming feedlots • private wells • irrigation wells
Special studies and plans	<ul style="list-style-type: none"> • Initiate special study on emerging contaminants

Action	How to Get It Done
	<ul style="list-style-type: none"><li data-bbox="630 237 1365 369">• Conduct a feasibility study for alternatives related to ground water conservation, regional recharge potential and groundwater use offsets via rainwater and grey water harvesting for irrigation<li data-bbox="630 380 1365 512">• Create an Aggregate Extraction Management plan for each county by 2020 that evaluates available aggregate resources and considers potential effect on high quality ecological and groundwater resources.