The Comprehensive Water Review Exempt Well Bill: Recommendation of The Department of Natural Resources and Conservation, for Designation of Closure Areas and Monitoring Areas for Water Quantity

One of the main objectives of the Department of Natural Resources and Conservation's (the Department) Comprehensive Water Review Stakeholder Working Group was to understand the current use of exempt wells in Montana and develop recommendations for the future based upon scientific and legal criteria. The working group found that, while exempt wells are an appropriate tool in many areas of the state, in certain high-growth areas their cumulative impacts could be problematic. Instead of recommending a statewide, "one-size-fits-all" solution, the working group developed a geography-based policy based on site-specific scientific and legal criteria for closures and monitoring areas.

The working group developed an exempt well legislative bill that incorporates the new policy into the existing statutory framework for controlled groundwater areas. The bill contains a recommendation for four legislatively designated aquifer closures and two legislatively designated aquifer monitoring areas. It also establishes a pathway for the creation of new groundwater closure and monitoring areas by the Department through the rulemaking process.

The purpose of this report is to identify and explain the rationale for the scientific and legal criteria used to evaluate the groundwater closure and monitoring areas for water quantity, and to analyze how those criteria apply to the six focus aquifers. Although the bill also addresses groundwater closure and monitoring for water quality, this report is focused on applying the water quantity-related criteria to areas under consideration for legislative closure or monitoring area designation, i.e., places where the cumulative impacts of exempt wells are a growing concern for water quantity. For simplicity, controlled groundwater areas for water quantity and legislative closures will be titled **"closure areas"** and groundwater monitoring areas for water quantity and legislative monitoring areas will be titled "**monitoring areas**."

This report contains:

- a list of the scientific and legal criteria used to evaluate the designation of closure areas and monitoring areas;
- the scientific and legal rationale for each of the criterion;
- schedule for Department analysis of groundwater monitoring data;
- approach to delineating closure boundaries; and
- criteria application summary and Department recommendations.

Appendix A of this report contains aquifer-specific analyses of the scientific and legal criteria for each of the six aquifers being recommended for designation as a closure area or monitoring area. Appendix B of this report contains boundary maps for each of the legislatively designated aquifer closure and monitoring areas.

CLOSURE AREA CRITERIA:
The Department shall by rule designate or modify controlled groundwater areas for water quantity using the following criteria for designation:

- Where the department identifies a high concentration of exempt ground water use; and
- Where the department determines that 100% or more of the legally available hydraulically connected surface water has been appropriated for any month; or
- Where the department determines that 80% or more of the legally available groundwater has been appropriated; or
- Where the department determines ground water level is declining or is projected to decline due to pumping based on a ten-year period of record, which may result in a chronic lowering of the groundwater table or permanent loss of aquifer storage based on available data or consultation with Montana Bureau of Mines and Geology or other relevant agencies.

MONITORING AREA CRITERIA:
The Department shall designate or modify groundwater monitoring areas for water quantity if it finds by a preponderance of the evidence that any of the following criteria have been met:

- Where the department identifies a high concentration of exempt ground water use; and
- Where the department determines 90% or more of the legally available hydraulically connected surface water has been appropriated for any month; or
- Where the department determines 70% or more of the legally available groundwater has been appropriated; or
- Where the department identifies a decreasing ground water level trend in the aquifer, and long-term cause/effect and projected trend need to be analyzed based on data or consultation with Montana Bureau of Mines and Geology or other relevant agencies; or
- Where the department determines that aquifer recharge is reliant on irrigation losses or where the geologic structure or formation has limited storage or potential for storage based on data or consultation with Montana Bureau of Mines and Geology or other relevant agencies.

SCIENTIFIC & LEGAL CRITERIA: CLOSURES AND MONITORING AREAS
The criteria that the Department must evaluate to designate a closure or monitoring area are divided into two categories: those based on statutory requirements and case law (**legal based criteria**), and those that relate to the physical properties of the resources (**science-based criteria**). Each of the criteria rationale are described further below.

- <u>Closures and monitoring:</u> where the department identifies a high concentration of exempt ground water use;

The first criteria that must be met for the Department establish closures or monitoring is a **legal criterion**. The intent of this criterion is to focus on areas where the cumulative impacts from exempt wells may be significant, while excluding the large areas of the state where there is little cumulative impact (Figure 1).

The Courts have made it clear that exempt wells need to be very narrowly used, and not used extensively. For many years, the state has done otherwise; however, in *Clark Fork Coalition v. Tubbs* (2017), the Court held that the exempt well exception was a "narrow" exception to the permitting process. Thus, the 1993 rule, which had expanded that narrow exception, was inconsistent with the Water Use Act's stated purpose to protect senior water rights holders through the "rigorous" permitting process. In the 2024 *Upper Missouri Waterkeeper* decision (Upper Missouri Waterkeeper v. Broadwater County and DNRC, 2024 MT BDV-2022-38), the District Court criticized DNRC for "blatantly ignoring" the *Clark Fork* holding. Restricting the use of exempt wells in areas of the state where they have more significant cumulative impacts is consistent with the Court's direction that the exemptions should be narrowly used.

- Closure: Where the department determines that 100% or more of the legally available hydraulically connected surface water has been appropriated for any month.
- Monitoring: Where the department determines that 90% or more of the legally available hydraulically connected surface water has been appropriated for any month.

Within the State of Montana, the Department is required to manage groundwater and surface water as a connected resource (Trout Unlimited v. DNRC, 2006 MT 72, 41-43). In addition, numerous legal decisions have upheld that not only are the resources connected, but also that every drop of water matters and that surface water depletions related to groundwater use must be analyzed for impacts to senior water right holders (Trout Unlimited v. DNRC, 2006 MT 72; Sitz Ranch Management Partnership v. DNRC, Case No. DV-10-13390, Order Affirming DNRC Decision (5th Jud. Dist. CT., July 26, 2011); Bostwick Properties, Inc. v. DNRC, 2013 MT 48, 38).

The Department relies on research, studies, and data from other agencies (e.g., Montana Bureau of Mines and Geology (MBMG), and the United States Geological Survey (USGS)) to determine from a scientific perspective how closely surface water and groundwater are connected, and the amount and timing of that connection for management decisions is a legal criterion for new appropriations of water. Wells can decrease surface water flow in two different ways, either through "prestream capture" or through "induced infiltration." Prestream capture is the process in which a well captures groundwater that otherwise would have discharged to surface waters (Lohman, 1972). Induced infiltration occurs when groundwater wells pumping near a stream pull water directly from the streambed and towards the well (Theis, 1940). The effects of induced infiltration are more immediate, while the effects of prestream capture can take days to years to be realized in reduced streamflow.

The courts have stated that stream depletion related to either process must be considered and that often the effects of prestream capture of tributary groundwater have a more significant and longer lasting impact than does induced infiltration (Trout Unlimited v. DNRC, 2006 MT 72, ¶ 10). As groundwater-surface water connection relates to this criterion, in areas of the state with a large concentration of exempt wells and where surface water is fully appropriated or over appropriated, any further exempt groundwater use would deplete surface water causing an adverse effect to senior water right holders.

Closing an aquifer when 100% or more of the legally available hydraulically connected surface water has been appropriated eliminates further adverse impacts to senior surface water rights. Reducing this criterium by 10% to recommend an aquifer monitoring area prompts additional monitoring and analysis of these legal criteria before they become a more urgent problem.

- Closure: Where 80% or more of the legally available groundwater has been appropriated.
- Monitoring: Where the department determines 70% or more of the legally available groundwater has been appropriated

Closing an aquifer to exempt wells when 80% of the legal availability of groundwater has been appropriated provides a small buffer of aquifer resilience. The legal availability of groundwater is the product of the legal demand of groundwater minus the physical availability of groundwater. The physical availability of groundwater is the average annual amount of recharge to an aquifer. The aquifer resilience provides a small amount of groundwater that can buffer against abnormally dry years, as compared to mining groundwater when recharge volumes are small, which could lead to a permanent loss of aquifer storage. Although the negative effects of over appropriating a surface water source are generally temporary, especially given that instream flow rights often prevent a source from fully drying up, the negative effects of over appropriating a ground water aquifer can be a permanent loss of storage capacity, which would cause a permanent adverse effect to senior water right holders.

The criterion to designate a monitoring area is reduced to 70% (from the closure threshold of 80%) to prompt additional monitoring and analysis of these legal criteria before they become a more urgent problem.

- Closures: Where the department determines ground water level is declining or is projected to decline due to pumping based on a ten-year period of record which may result in a chronic lowering of the groundwater table or permanent loss of aquifer storage based on available data or consultation with Montana Bureau of Mines and Geology or other relevant agencies.
- Monitoring: Where the department identifies a decreasing ground water level trend in the aquifer, and long-term cause/effect and projected trend need to be analyzed based on data or consultation with Montana Bureau of Mines and Geology or other relevant agencies.
- Monitoring: Where the department determines that aquifer recharge is reliant on irrigation losses or where the geologic structure or formation has limited storage or potential for storage based on data or consultation with Montana Bureau of Mines and Geology or other relevant agencies.

For these scientific criteria, which require the analysis of the physical properties of the aquifer, the Department relies on analysis of aquifer testing data submitted as part of a water rights

application and on published literature and other available groundwater data published by agency partners, such as MBMG and USGS.

For closure areas, this criterion identifies that a decreasing groundwater trend is present and confirms through data analyses that the cause of the decline is related to pumping and not to other factors, such as persistent drought. The distinction is important because a restriction on new pumping wells could have a positive impact on groundwater level decline but would not necessarily have a positive impact on the aquifer if the cause of decline were due to a persistent drought. Analyzing a groundwater monitoring record that extends to at least ten years (or more) is important for correlation of cause and effect of declining trends.

The criteria for consideration of monitoring areas also include a physical criterion related to groundwater decline, as well as one additional criterion related to the physical characteristics of an aquifer, "aquifer recharge is reliant on irrigation losses or where the geologic structure or formation has limited storage or potential for storage." These characteristics alone may not indicate an imminent problem with the aquifer or groundwater availability, but the aquifer should continue to be monitored because an aquifer with those characteristics could exhibit problems quickly if recharge rates decline.

Criteria Application and Analysis

The Department shall analyze groundwater monitoring data in the water monitoring areas at a frequency of not less than biennially and shall analyze petitions for aquifer closure areas and water monitoring areas that are submitted at a frequency of no more than two per year. The Department may initiate rulemaking for modification or removal of a designated area if the designated area no longer meets the criteria applicable to the designation. A petition which provides facts of how the designated area no longer meets the respective criteria for the designation may be filed by a number of different entities, depending on the type of ground water closure area.

Boundaries of the Closure and Monitoring Areas

The analysis of each criterion could result in a different scale of closure/monitoring area boundaries. The boundary is tailored to the problem. For example, a problem related to groundwater level decline in a small portion of the aquifer may result in a smaller, more localized closure boundary; whereas a problem related to using groundwater that is tributary to over appropriated surface water may result in a larger boundary.

The four aquifers recommended for "closure" (Helena Valley, Gallatin Valley, Bitterroot Valley, Missoula Valley) are all recommended due to the same criterion: "Where the department determines that 100% or more of the legally available hydraulically connected surface water has been appropriated for any month." The Department explored various options for delineating the closure boundaries for these four aquifers based on the problem identified. The boundary of "the entire regional aquifer" or "same-source-aquifer", was the selected scale for the criterion related to groundwater impacts to over appropriated surface water. As discussed, the

effects of prestream capture on fully appropriated streams could be realized from continued groundwater development in any part of the regional aquifer. Other boundary scale options were also considered, such as an arbitrary "stream buffer," which is similar to how Oregon approaches it (OAR 690-009-0040). This scale generally only recognizes impacts from induced infiltration and was deemed too arbitrary, not protective of senior water right holders, and no scientific justification was found to support this approach.

Another option considered was a larger "watershed scale" approach, which is how Colorado approaches this issue (CO Rev Stat § 37-90-103 (2022)). This scale recognizes that all groundwater is either tributary to surface water, or tributary to aquifers that are then tributary to surface water and so on. This scale was deemed too conservative and would result in closure of large areas of the state with very little cumulative impact. The "regional aquifer boundary" approach recommended by the Department is the most targeted option related to cumulative impact of exempt wells. This approach recognizes impacts to surface water that would occur from both induced infiltration and prestream capture. The "regional aquifer boundary" approach limits the closure area to the "first level" connection between the valley-fill sand/gravel/sediment aquifer and connected surface water. Or, where the closure would be limited to the aquifer that is directly tributary to surface water and not a further aquifer that contributes water to the valley-fill aquifer that then discharges to surface water and so on. The "regional aquifer boundary" approach is consistent with how the Department looks at a variety of different water rights permitting criteria related to groundwater, or the "same source aquifer" analysis required for the combined appropriations analysis, replacement well analysis, and the general minimum boundaries of what the department considers for physical and legal availability of groundwater analysis.

Regional aquifer boundaries for the closure and study areas boundaries were initially delineated by the Department using the statewide geologic map published by Montana Bureau of Mines and Geology (Vuke et. al., 2007). The boundaries were refined using the alluvial aquifer boundaries published in a 2024 MBMG study (Hanson et. al., 2024), as well as information presented in other reports on the hydrogeology of each of the aquifers. In general, the regional aquifer boundaries follow contact lines between the valley-fill alluvium and the surrounding bedrock, or hydrologic divides between larger regional valley-fill aquifers.

Regional aquifer boundary maps can be found in Appendix B.

CRITERIA SUMMARY AND RECOMMENDATIONS

1. There is a large concentration of exempt well use in the each of the proposed aquifer closure and aquifer monitoring areas, especially in concentrated pockets throughout each aquifer.
2. Scientific criteria of groundwater level decline are not currently problematic in the Gallatin Valley Aquifer, Helena Valley Aquifer, Missoula Valley Aquifer, Bitterroot Valley Aquifer, or Billings Terrace Aquifer, based on information from previous hydrologic

studies. Groundwater levels in the Flathead Valley Aquifer are declining in parts of the aquifer and warrant additional investigation and monitoring.
    - Due to this criterion, the Department recommends the Flathead Valley Aquifer to be legislatively designated as an aquifer monitoring area for water quantity.
3. Scientific criteria of aquifer recharge and geologic structure are not problematic in the Gallatin Valley Aquifer, Helena Valley Aquifer, Missoula Valley Aquifer, Bitterroot Valley Aquifer, or Flathead Valley Aquifer, based on information from previous hydrologic studies. The Billings Terrace Aquifer has both limited storage potential and is highly dependent on recharge from irrigation losses, and, therefore, it should be monitored closely for any changes in land use that may quickly impact physical availability of groundwater in that aquifer.
    - Due to this criterion, the Department recommends the Billings Terrace Aquifer to be legislatively designated as an aquifer monitoring area for water quantity.
4. Science and legal criteria: Groundwater in each of the proposed aquifer closure areas is connected to surface water in the basins.
5. Legal criteria: Surface water in many of the basins is over appropriated for at least one month, and in many cases for every month of the year, and any further exempt groundwater use would deplete surface water causing an adverse effect to senior water right holders.
    - Due to this criterion, the Department recommends legislatively designated aquifer closure areas for the following aquifers: Gallatin Valley Aquifer, Helena Valley Aquifer, Missoula Valley Aquifer and Bitterroot Valley Aquifer.

Department's recommendation of legislatively designated aquifer closure areas:

- Gallatin Valley Aquifer
- Helena Valley Aquifer
- Bitterroot Valley Aquifer
- Missoula Valley Aquifer

Department's recommendation of legislatively designated aquifers monitoring areas:

- Flathead Valley Deep and Shallow Aquifer
- Billings Terrace Aquifer

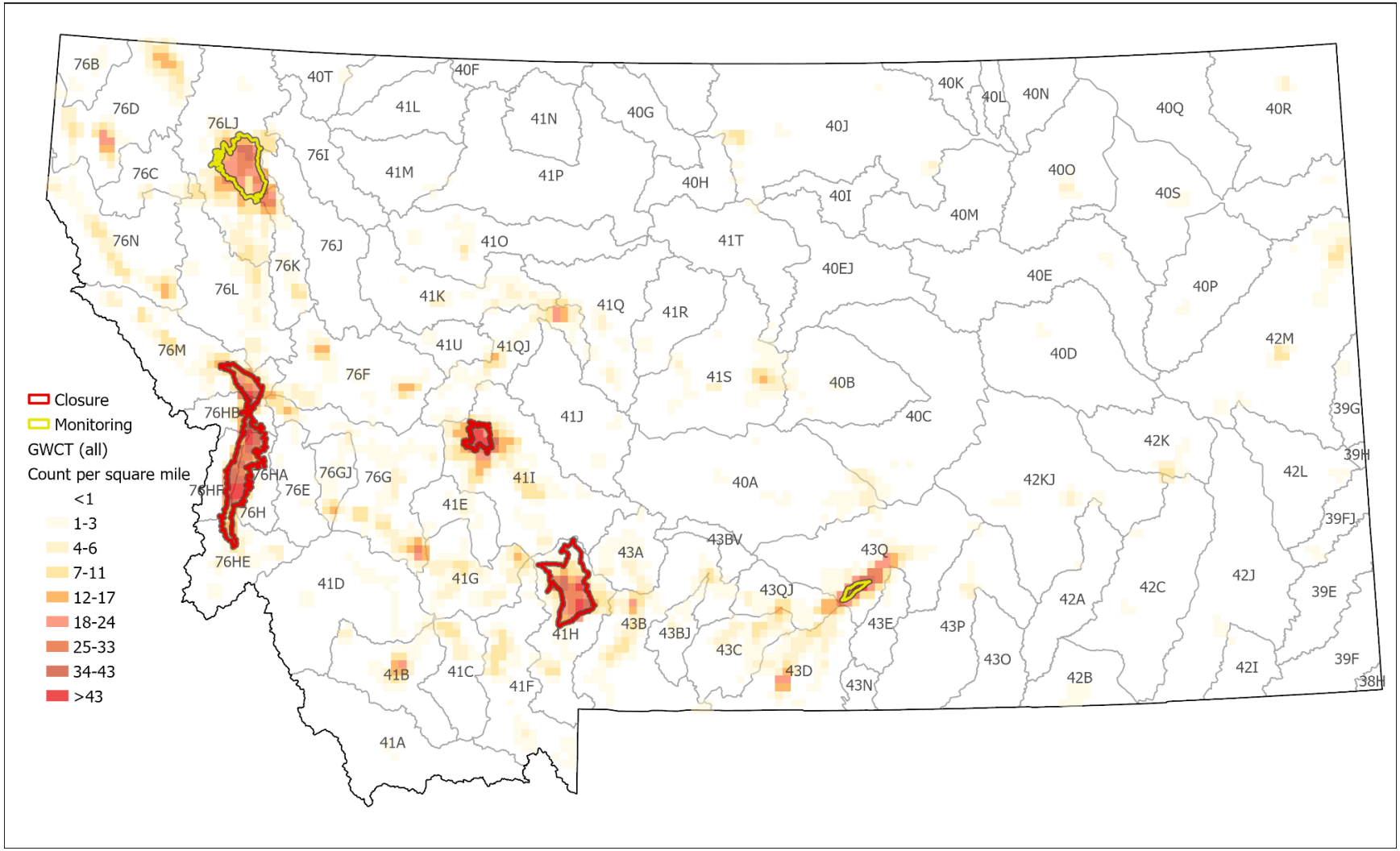

Figure 1. Concentration of exempt wells statewide, including the boundaries of the six aquifers underlying the six highest concentration pockets.

Appendix A. Aquifer specific Closure/Monitoring Area Criteria Analysis

1.0 Recommendation to Designate Gallatin Valley Aquifer an Aquifer Closure Area

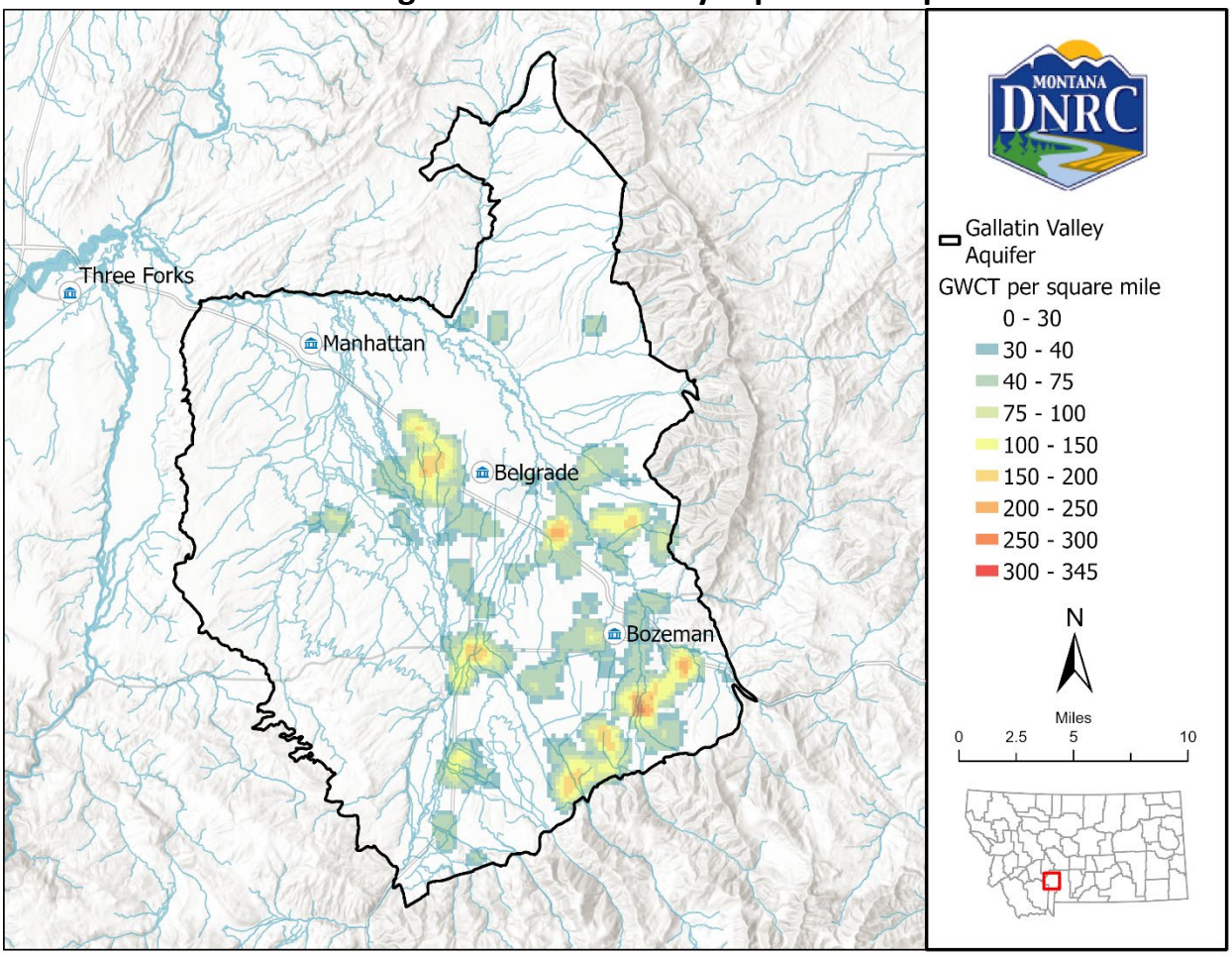

Figure 2. Gallatin Valley Aquifer boundary and concentration of exempt wells per square mile.

Total Population[1]: 113,608
Area (sq miles): 523
Number of Exempt Wells: 9,337

The first criteria that must be met for the Department to recommend closure of an aquifer or part of an aquifer is that there must be a high concentration of exempt groundwater use. The intent of this criteria was to focus on areas where there may be a larger cumulative impact related to those exempt wells, and not include large areas of the state where there is little cumulative impact.

[1] Population calculated in GIS using 2020 Census Tracts that intersect aquifer boundaries. Selected census tracts extended beyond the boundaries of the aquifer and are presented for comparison only.

In the Gallatin Valley Aquifer, the overall density of exempt wells is 22 exempt wells per square mile of aquifer surface area. Wells are not evenly distributed throughout the valley, and the highest concentration of exempt wells is near the City of Bozeman at 220 wells per square mile (Figure 2). The cumulative use of groundwater from all exempt wells in the Gallatin Valley Aquifer is approximately 23,564ac-ft per year.

In addition to the first criterion of exempt well concentration, at least one of the other three criteria must be met for the Department to recommend closure of an aquifer or part of an aquifer. Those three other criteria are generalized as: 1.) decreasing groundwater level trend in the aquifer, 2.) legal demand of groundwater vs physical availability of groundwater within the aquifer, and 3.) legal availability of surface water limitation in connected surface water sources within the aquifer boundary.

In the Gallatin Valley Aquifer, criteria 1 and 2 have not been analyzed in detail by the Department, however, criteria 3 has and should be considered for the Department's recommendation of aquifer closure designation.

Criteria MCA 85-2-506(1)(a)(iv)

"Where the department determines that 100% or more of the legally available hydraulically connected surface water has been appropriated for any month."

This criterion includes two key parts that must be met for it to be considered. First, there must be connection between groundwater and surface water within the aquifer. Second, the legal demand on the connected surface water must exceed the appropriation threshold, or the "physical availability" of the connected surface water for any month of the year. In simple terms, there is no remaining surface water legally available, and any further reduction in flow would cause an adverse effect to existing water right holders.

Gallatin Valley Aquifer Connection to Surface Water

Numerous hydrologic studies have concluded that groundwater and surface water are connected within the Gallatin Valley Aquifer (Hackett et. al., 1960; Slagle, 1995; Kendy and Tresch, 1996; English, 2007; Sutherland, 2023). The Gallatin Local Water Quality District summarized the hydrogeology of the Gallatin Valley Aquifer to the Water Policy Interim Committee (WPIC) in 2007 by saying, "Groundwater generally flows from southeast to northwest across the Gallatin Valley following the slope of the land surface. In the north/northwestern area of the Gallatin Valley there is a large groundwater discharge area. This is the lowest area in the valley, the aquifer materials appear to become thinner and finer grained, and there is bedrock along the north side (Horseshoe Hills) and across the Gallatin River at Logan." In 2023, the Montana Bureau of Mines and Geology (MBMG) published a hydrogeologic investigation of the Belgrade-Manhattan area and said simply, "The aquifer displays a direct connection to surface water; consequently, both mitigation and pumping will directly influence surface-water flows."

Gallatin Valley Aquifer Legal Demand and Physical Availability

Almost all the groundwater flowing through the Gallatin Valley discharges to the lower West Gallatin, lower East Gallatin River, and the Main Gallatin River before Logan (Hackett et. al., 1960), therefore, surface water depletions caused by the cumulative consumptive use of groundwater within the Gallatin Valley Aquifer would be realized in diminished surface water flows measured on the Gallatin River at the basin pour point near Logan, MT. Physical availability of connected surface water of the Gallatin Valley was quantified by analyzing the median of the mean monthly flow at the U.S. Geological Survey (USGS) stream gage located on the Gallatin River near the point where water enters the Gallatin Valley near Gallatin Gateway, MT (Station: US06043500). Legal demand of surface water of the Gallatin Valley was quantified by adding all the claimed Gallatin River surface water flow rates downstream of Gallatin Gateway, MT, but upstream of Logan, MT, on a monthly scale. Figure 3 shows the physical availability of surface water and the legal demand of that surface water within the Gallatin Valley. The legal demand for surface water exceeds the physical availability of the surface water every month of the year (Figure 3).

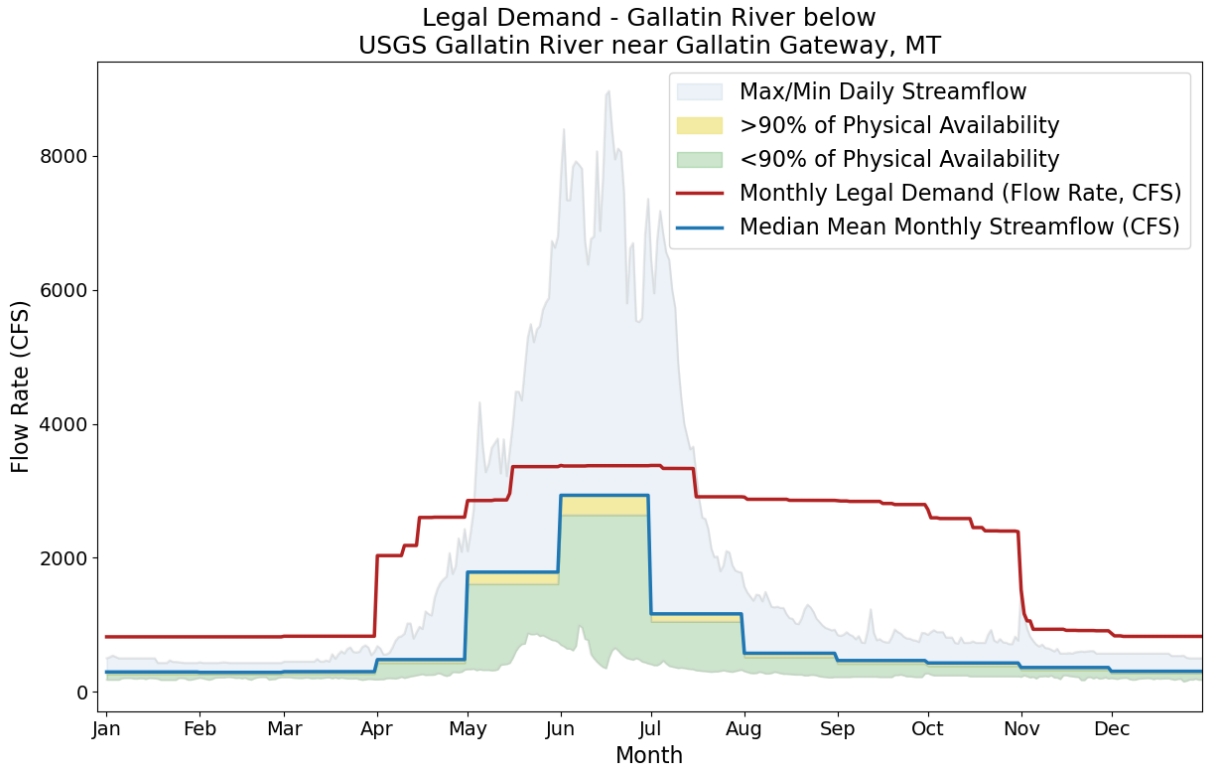

Figure 3. Physical availability and legal demand of surface water within the Gallatin Valley.

Conclusion and Recommendation

1. Physical criteria are not suspected to be a problem in the Gallatin Valley Aquifer based on previous hydrologic studies that have been conducted throughout the aquifer.
2. There is a large concentration of exempt well use in the Gallatin Valley Aquifer, especially in concentrated pockets throughout the aquifer.

3. Groundwater in the Gallatin Valley Aquifer is connected to surface water in the Gallatin Basin.
4. Surface water in the Gallatin Basin is over appropriated for every month of the year and any further exempt groundwater use would deplete surface water causing an adverse effect to senior water right holders.
5. DNRC recommends designation of the Gallatin Valley Aquifer as an aquifer closure area.

2.0 Recommendation to Designate Helena Valley Aquifer an Aquifer Closure Area

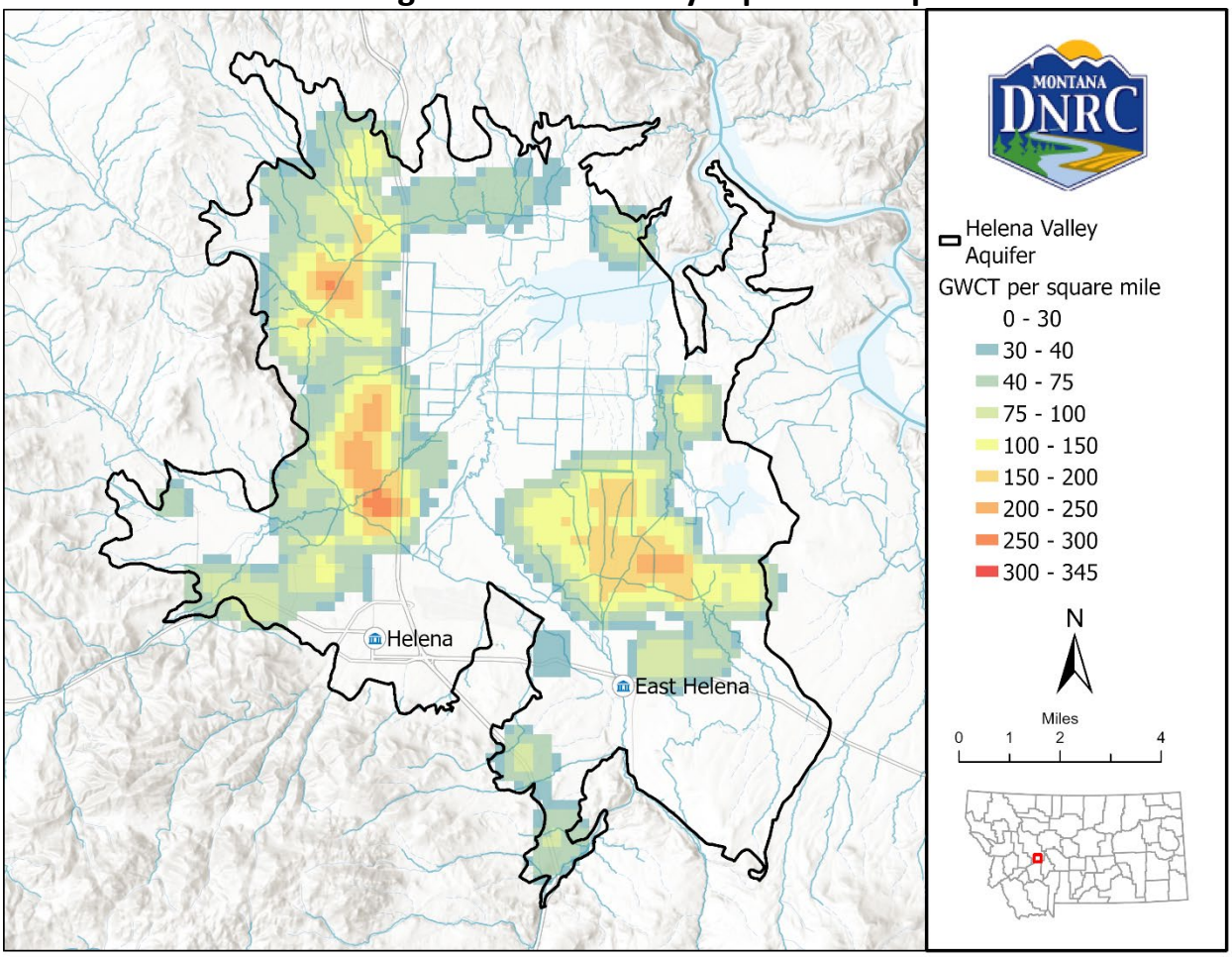

Figure 4. Helena Valley Aquifer boundary and concentration of exempt wells per square mile.

Total Population[2]: 73,115
Area (sq miles): 122
Number of Exempt Wells: 5,507

The first criteria that must be met for the Department to recommend closure of an aquifer or part of an aquifer is that there must be a high concentration of exempt groundwater use. The intent of this criteria was to focus on areas where there may be a larger cumulative impact related to those exempt wells, and not include large areas of the state where there is little cumulative impact.

[2] Population calculated in GIS using 2020 Census Tracts that intersect aquifer boundaries. Selected census tracts extended beyond the boundaries of the aquifer and are presented for comparison only.

In the Helena Valley Aquifer, the overall density of exempt wells is 54 exempt wells per square mile of aquifer surface area. Wells are not evenly distributed throughout the valley, and the highest concentration of exempt wells is in the west/central portion of the valley at 280 wells per square mile (Figure 4). The cumulative use of all exempt wells in the Helena Valley Aquifer is approximately 14,618ac-ft per year of groundwater use.

In addition to the first criteria of exempt well concentration, at least one of the other three criteria must be met for the Department to recommend closure of an aquifer or part of an aquifer. Those three other criteria are generalized as: 1.) decreasing groundwater level trend in the aquifer, 2.) legal demand of groundwater vs physical availability of groundwater within the aquifer, and 3.) legal availability of surface water limitation in connected surface water sources within the aquifer.

In the Helena Valley Aquifer, criteria 1 and 2 have not been analyzed in detail by the Department, however, criteria 3 has and should be considered for the Department's recommendation to create a controlled groundwater area for water quantity.

Criteria MCA 85-2-506(1)(a)(iv)

"Where the department determines that 100% or more of the legally available hydraulically connected surface water has been appropriated for any month."

This criterion includes two key parts that must be met for it to be considered. First, there must be connection between groundwater and surface water within the aquifer. Second, the legal demand on the connected surface water must exceed the appropriation threshold, or the "physical availability" of the connected surface water for any month of the year. In simple terms, there is no remaining surface water legally available, and any further reduction in flow would cause an adverse effect to existing water right holders.

Helena Valley Aquifer Connection to Surface Water

Numerous hydrologic studies have concluded that groundwater and surface water are connected within the Helena Valley Aquifer (Lorenz and Swenson, 1951; Briar and Madison, 1992; Madison, 2006). Briar and Madison estimated that approximately 98% of groundwater returns to surface water through upward leakage to streams (mainly Ten Mile Creek or Prickly Pear Creek), drains, and directly to Lake Helena (1992).

Helena Valley Aquifer Legal Demand and Physical Availability

Almost all the groundwater flowing through the Helena Valley discharges to surface water sources that feed Lake Helena and then the Missouri River (Briar and Madison, 1992), therefore extraction of groundwater within the Helena Valley Aquifer would result in diminished surface water flow in Lake Helena and then to the Missouri River. The Upper Missouri River Basin was legislatively closed to new appropriations of surface water in 1993, and any new use of water must be offset by retiring an equal quantity of historically used water. The legislative closure was a result of legal availability of surface water concerns, mainly related to large hydroelectric water rights claiming large sums of water on the Missouri River main stem. Further, any new

permitted use of groundwater that is tributary to surface water must also be mitigated in the Upper Missouri River Basin. Because of the legislative basin closure, a detailed analysis of legal availability of surface water is not necessary; however, a legal availability of surface water analysis on just Ten Mile Creek and Prickly Pear Creek, the two largest streams connected to the Helena Valley Aquifer, is included below (Figure 5 and Figure 6). Both streams are over appropriated for numerous months of the year.

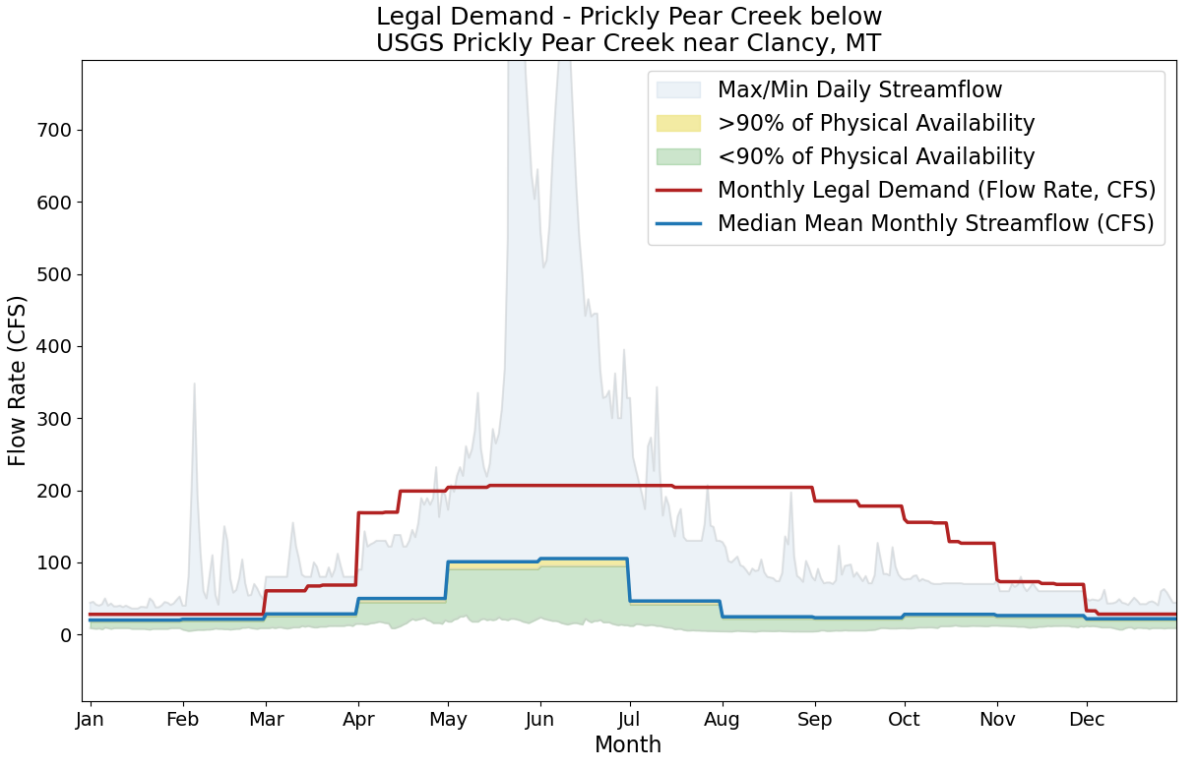

Figure 5. Physical availability and legal demand of surface water on Prickly Pear Creek.

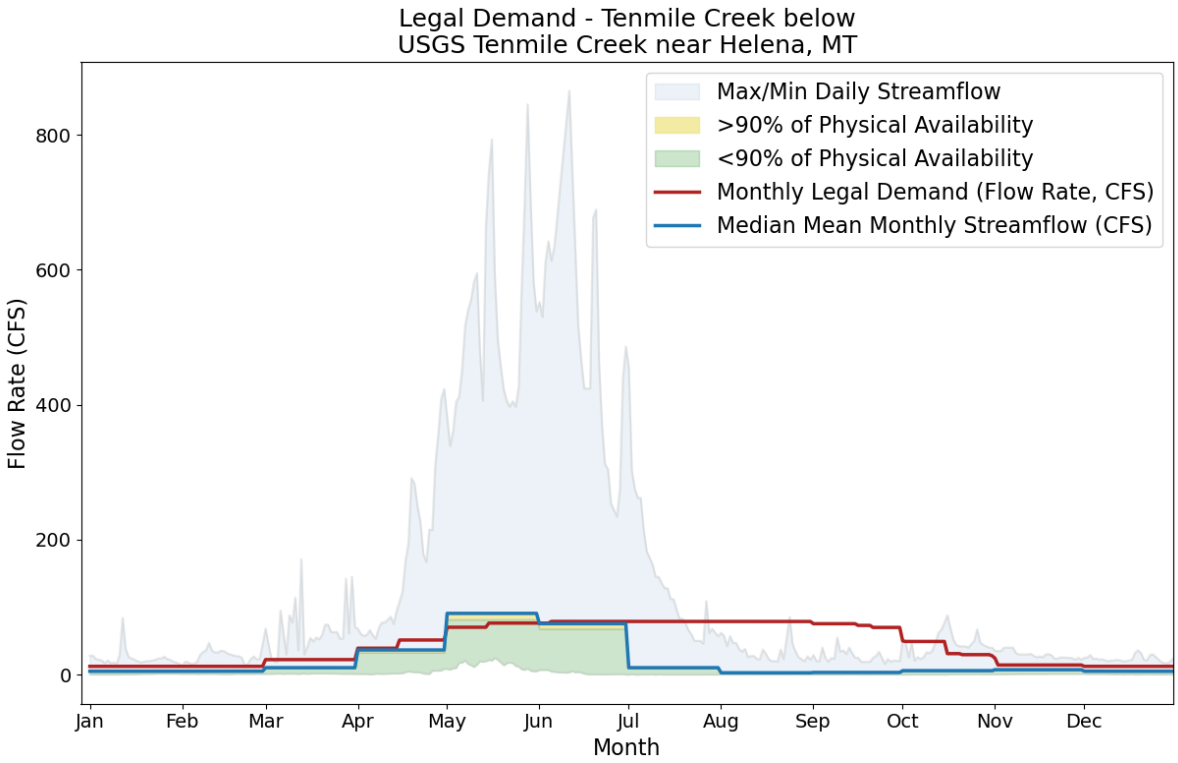

Figure 6. Physical availability and legal demand of surface water on Ten Mile Creek.

Conclusion and Recommendation

1. Physical criteria are not suspected to be a problem in the Helena Valley Aquifer based on previous hydrologic studies that have been conducted throughout the aquifer.
2. There is a large concentration of exempt well use in the Helena Valley Aquifer, especially in concentrated pockets throughout the aquifer.
3. Groundwater in the Helena Valley Aquifer is connected to surface water of Lake Helena which is a tributary of the Missouri River.
4. Surface water in the Upper Missouri River Basin is over appropriated, and the Upper Missouri River Basin is closed for new appropriations. Any further exempt groundwater use would deplete surface water causing an adverse effect to senior water right holders.
5. DNRC recommends designation of the Helena Valley Aquifer as an aquifer closure area.

3.0 Recommendation to Designate Bitterroot Valley Aquifer an Aquifer Closure Area

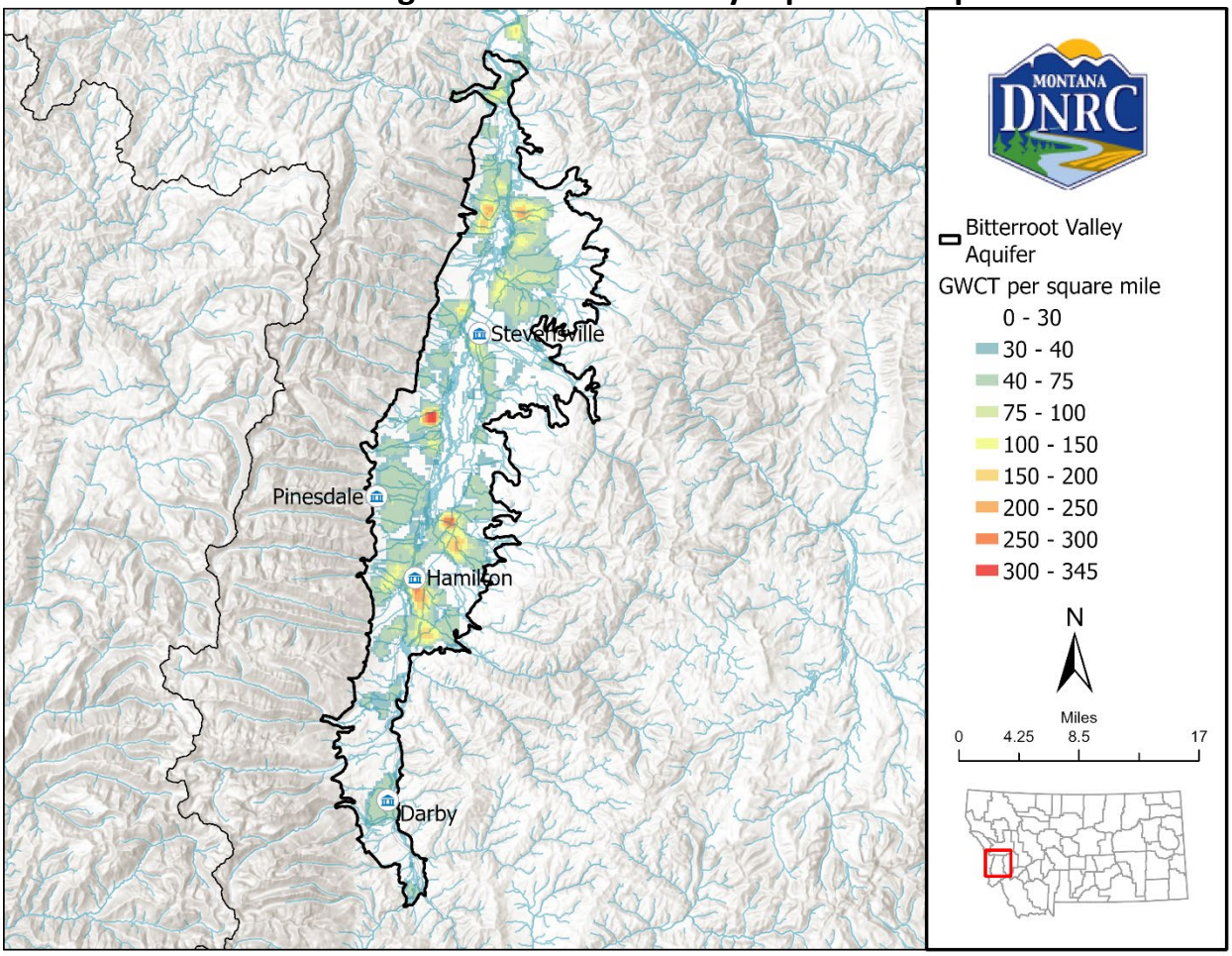

Figure 7. Bitterroot Valley Aquifer boundary and concentration of exempt wells per square mile.

Total Population[3]: 62,202
Area (sq miles): 399
Number of Exempt Wells: 13,953

The first criteria that must be met for the Department to recommend closure of an aquifer or part of an aquifer is that there must be a high concentration of exempt groundwater use. The intent of this criteria was to focus on areas where there may be a larger cumulative impact related to those exempt wells and not include large areas of the state where there is little cumulative impact.

[3] Population calculated in GIS using 2020 Census Tracts that intersect aquifer boundaries. Selected census tracts extended beyond the boundaries of the aquifer and are presented for comparison only.

In the Bitterroot Valley Aquifer, the overall density of exempt wells is 39 exempt wells per square mile of aquifer surface area. Wells are not evenly distributed throughout the valley, and the highest concentration of exempt wells are near population centers such as the communities of Stevensville and Hamilton with densities of up to 266 wells per square mile (Figure 7). The cumulative use of all exempt wells in the Bitterroot Aquifer is approximately 39,605ac-ft per year of groundwater use.

In addition to the first criteria of exempt well concentration, at least one of the other three criteria must be met for the Department to recommend closure of an aquifer or part of an aquifer. Those three other criteria are generalized as: 1.) decreasing groundwater level trend in the aquifer, 2.) legal demand of groundwater vs physical availability of groundwater within the aquifer, and 3.) legal availability of surface water limitation in connected surface water sources within the aquifer.

In the Bitterroot Valley Aquifer, criteria 1 and 2 have not been analyzed in detail by the department, however, criteria 3 has and should be considered for the Department's recommendation to create an aquifer closure area.

Criteria MCA 85-2-506(1)(a)(iv)

"Where the department determines that 100% or more of the legally available hydraulically connected surface water has been appropriated for any month."

This criterion includes two key parts that must be met for it to be considered. First, there must be connection between groundwater and surface water within the aquifer. Second, the legal demand on the connected surface water must exceed the appropriation threshold, or the "physical availability" of the connected surface water for any month of the year. In simple terms, there is no remaining surface water legally available, and any further reduction in flow would cause an adverse effect to existing water right holders.

Bitterroot Valley Aquifer Connection to Surface Water

Groundwater in the Bitterroot Valley generally flows from higher elevation bedrock aquifers into the valley fill aquifer and then in a direction perpendicular to the Bitterroot River (Briar and Dutton, 2000). Throughout the Bitterroot Valley, the Bitterroot River gains flow from upwelling groundwater and loses flow to groundwater, demonstrating that the aquifer system is connected to the surface water of the Bitterroot River. Briar and Dutton state that groundwater from the Bitterroot Valley Aquifer discharges to springs and streams, evapotranspiration, withdrawals by wells, and as subsurface flow to the north out of the basin (2000). Extraction and consumption of groundwater would result in a reduction in surface water flow at some place on the Bitterroot River or the downstream Clark Fork River.

Bitterroot Valley Aquifer Legal Demand and Physical Availability

The Bitterroot River is connected to groundwater at various reaches throughout the Valley Aquifer system, and use of groundwater would result in a depletion of surface water flow to the Bitterroot River. Figure 8 shows the physical availability of surface water and the legal demand

of surface water within the Bitterroot Valley. The legal demand for surface water exceeds the physical availability of the surface water for several months of the year (Figure 8).

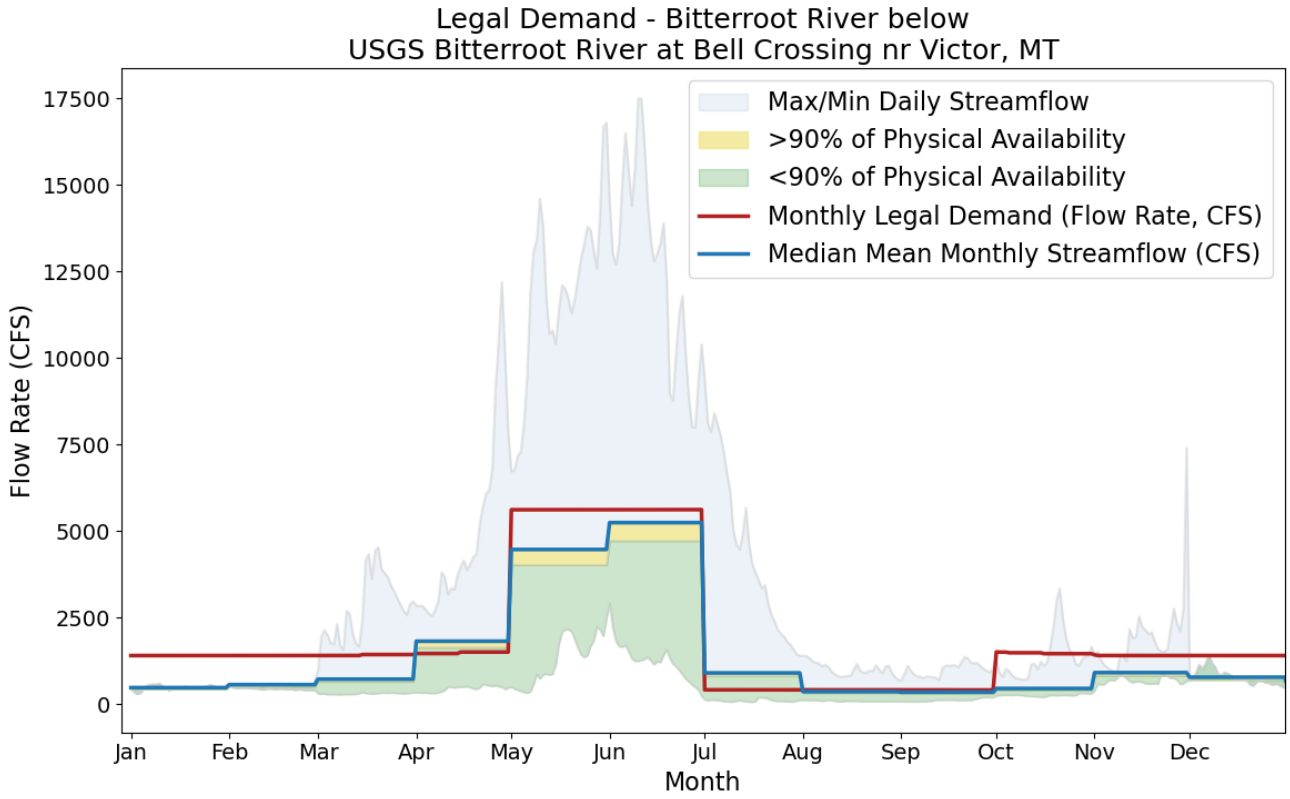

Figure 8. Physical availability and legal demand of surface water on the Bitterroot River.

Conclusion and Recommendation

1. Physical criteria are not suspected to be a problem in the Bitterroot Valley Aquifer based on previous hydrologic studies that have been conducted throughout the aquifer.
2. There is a large concentration of exempt well use in the Bitterroot Valley Aquifer, especially in concentrated pockets near population centers throughout the aquifer.
3. Groundwater in the Bitterroot Valley Aquifer is connected to surface water of The Bitterroot River which is a tributary of the Clark Fork River.
4. Surface water in the Bitterroot River is over appropriated, and any further exempt groundwater use would deplete surface water causing an adverse effect to senior water right holders.
5. DNRC recommends designation of the Bitterroot Valley Aquifer as an aquifer closure area.

4.0 Recommendation to Designate Missoula Valley Aquifer an Aquifer Closure Area

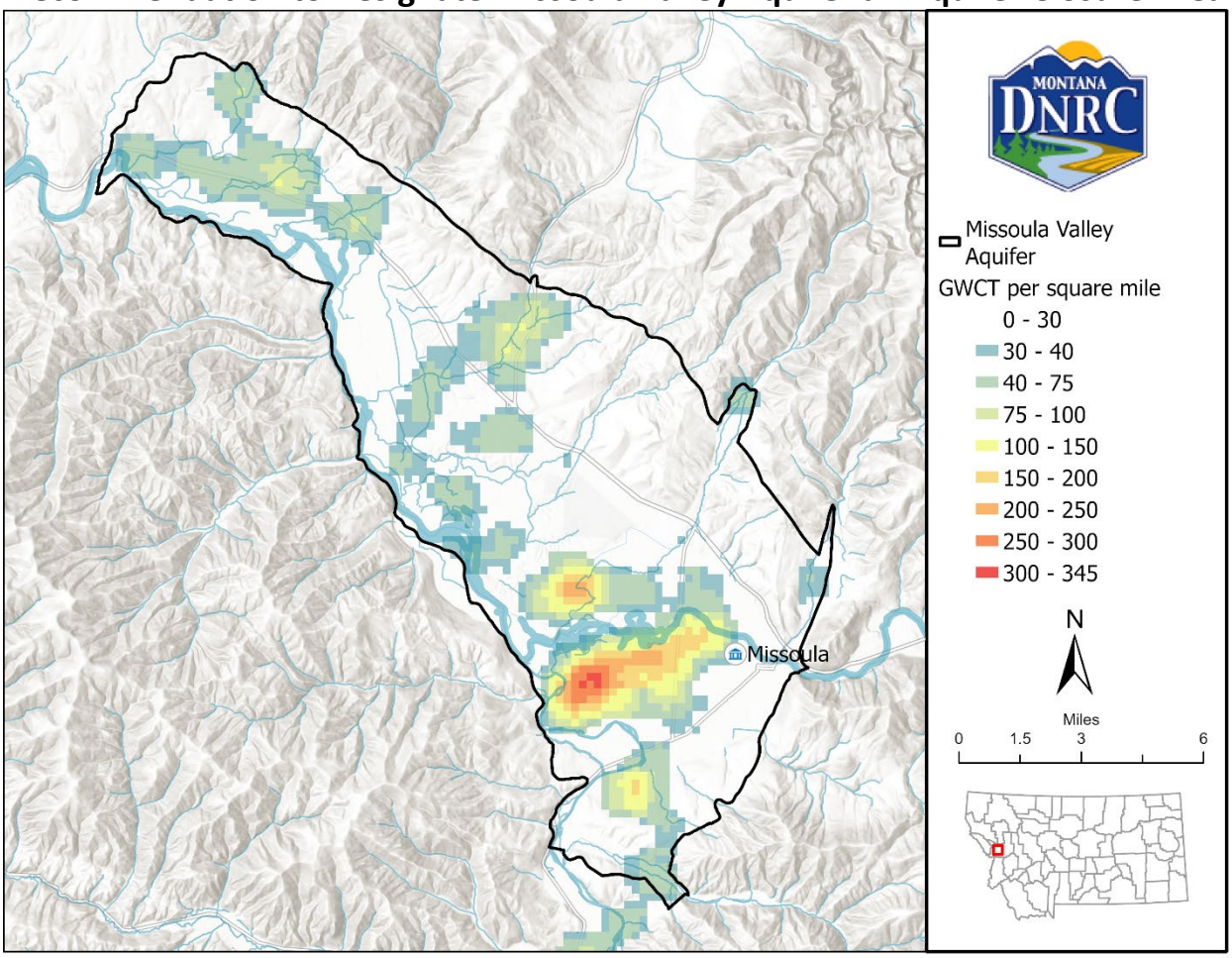

Figure 9. Missoula Valley Aquifer boundary and concentration of exempt wells per square mile.

Total Population[4]: 99,158
Area (sq miles): 133
Number of Exempt Wells: 4,205

The first criteria that must be met for the Department to recommend closure of an aquifer or part of an aquifer is that there must be a high concentration of exempt groundwater use. The intent of this criteria was to focus on areas where there may be a larger cumulative impact related to those exempt wells, and not include large areas of the state where there is little cumulative impact.

[4] Population calculated in GIS using 2020 Census Tracts that intersect aquifer boundaries. Selected census tracts extended beyond the boundaries of the aquifer and are presented for comparison only.

In the Missoula Valley Aquifer, the overall density of exempt wells is 41 exempt wells per square mile of aquifer surface area. Wells are not evenly distributed throughout the valley, and the highest concentration of exempt wells are in the southwest portion of the valley with a density of 249 exempt wells per square mile (Figure 9). The cumulative use of all exempt wells in the Missoula Aquifer is approximately 13,225 ac-ft per year of groundwater use.

In addition to the first criteria of exempt well concentration, at least one of the other three criteria must be met for the Department to recommend closure of an aquifer or part of an aquifer. Those three other criteria are generalized as: 1.) decreasing groundwater level trend in the aquifer, 2.) legal demand of groundwater vs physical availability of groundwater within the aquifer, and 3.) legal availability of surface water limitation in connected surface water sources within the aquifer.

In the Missoula Valley Aquifer, criteria 1 and 2 have not been analyzed in detail by the department, however, criteria 3 has and should be considered for the Department's recommendation to create a controlled groundwater area for water quantity.

Criteria MCA 85-2-506(1)(a)(iv)

"Where the department determines that 100% or more of the legally available hydraulically connected surface water has been appropriated for any month."

This criterion includes two key parts that must be met for it to be considered. First, there must be connection between groundwater and surface water within the aquifer. Second, the legal demand on the connected surface water must exceed the appropriation threshold, or the "physical availability" of the connected surface water for any month of the year. In simple terms, there is no remaining surface water legally available, and any further reduction in flow would cause an adverse effect to existing water right holders.

Missoula Valley Aquifer Connection to Surface Water

Groundwater in the Missoula Valley is predominantly (80-90%) recharged by the Clark Fork River as it enters the valley from the Hellgate area (Woessner, 1988, Miller, 1991). Groundwater generally flows from a direction of the Clark Fork River near the eastern end of the aquifer, toward the Bitterroot River across the valley to the south and west and to the confluence of the two rivers near the western portion of the aquifer boundary (LaFave, 2002). Groundwater in the Missoula Valley Aquifer generally discharges to the Bitterroot River and to the Clark Fork River downstream from the aquifer (Grimestad, 1977; LaFave, 2002). Depending on the exact location of the well, extraction and consumption of groundwater from the Missoula Valley Aquifer would result in a reduction in surface water flow to either the Bitterroot River or to the Clark Fork River downstream of the aquifer.

Missoula Valley Aquifer Legal Demand and Physical Availability

The Missoula Valley Aquifer is connected to both the Bitterroot River and the Clark Fork River. The Bitterroot River is over appropriated for several months of the year as shown on Figure 8. Any new groundwater permit in the Missoula Valley Aquifer must provide mitigation water at

the same rate and timing to the Bitterroot River if it is determined that a depletion to the Bitterroot River would cause an adverse effect to senior water right holders. The Clark Fork River has no remaining legal availability due to a hydroelectric power plant water right near the Idaho/Montana border. Because of the significant volume of water stored in reservoirs on the Clark Fork River, timing of depletions to the river do not matter. However, a new groundwater permit in the Missoula Valley Aquifer must provide a volume of mitigation water equal to the net depletion volume to the Clark Fork River if it is determined that the depletion would cause an adverse effect to senior water right holders at any point downstream of the Missoula Valley to the Idaho/Montana border.

Conclusion and Recommendation

1. Physical criteria are not suspected to be a problem in the Missoula Valley Aquifer based on previous hydrologic studies that have been conducted throughout the aquifer.
2. There is a large concentration of exempt well use in the Missoula Valley Aquifer, especially in concentrated pockets near population centers throughout the aquifer.
3. Depending on location within the aquifer, groundwater in the Missoula Valley Aquifer is connected to surface water of The Bitterroot River and/or the Clark Fork River.
4. Surface water in the Bitterroot River and Clark Fork River is over appropriated, and any further exempt groundwater use would deplete surface water causing an adverse effect to senior water right holders.
5. DNRC recommends designation of the Missoula Valley Aquifer as an aquifer closure area.

5.0 Recommendation to Designate Flathead Valley Deep and Shallow Aquifer a Water Monitoring Area

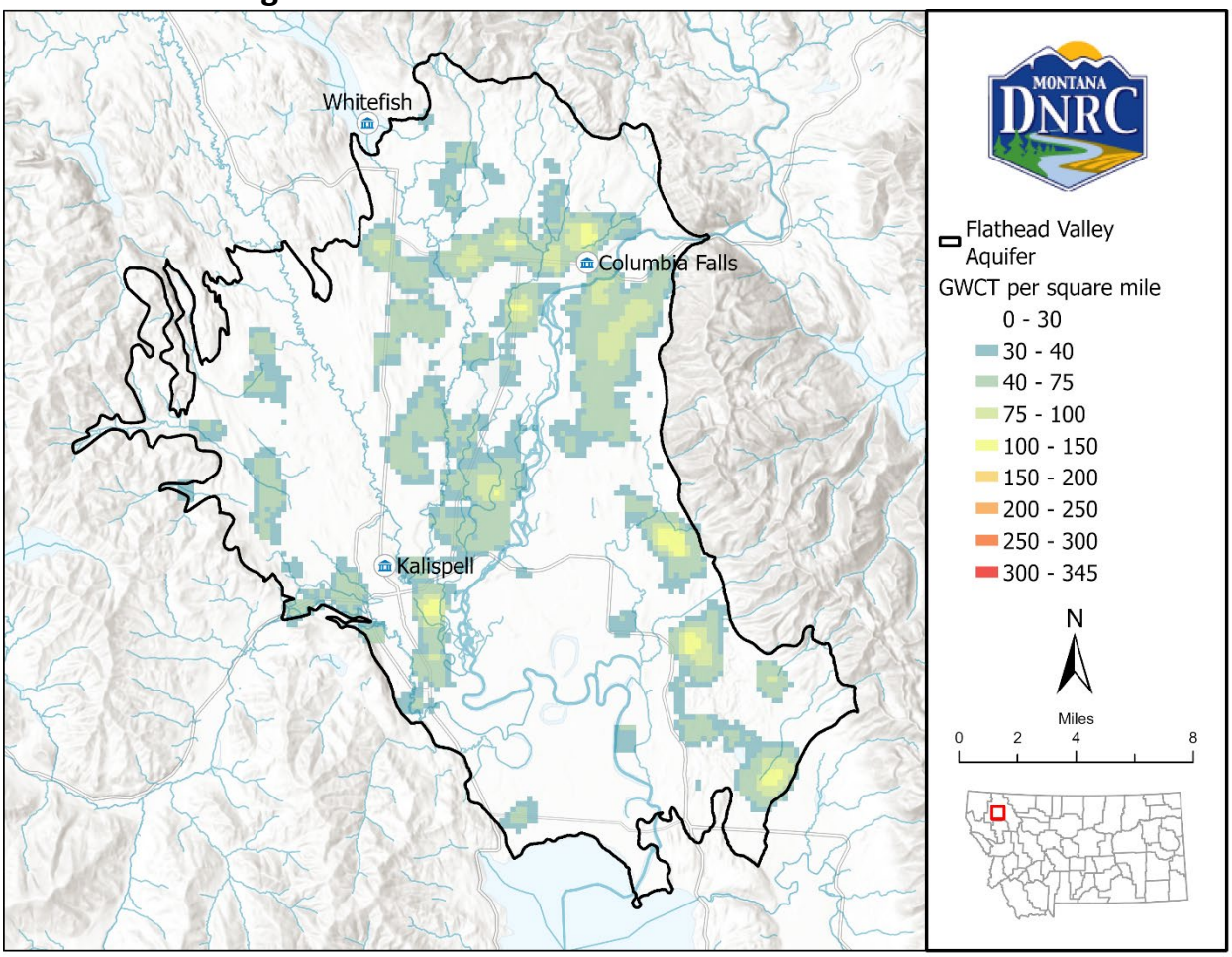

Figure 10. Flathead Valley Deep and Shallow Aquifer boundary and concentration of exempt wells per square mile.

Total Population[5]: 97,750
Area (sq miles): 358
Number of Exempt Wells: 8,170

The first criteria that must be met for the Department to designate or modify water monitoring areas is that there must be a high concentration of exempt groundwater use. The intent of this criteria was to focus on areas where there may be a larger cumulative impact related to those exempt wells, and not include large areas of the state where there is little cumulative impact.

[5] Population calculated in GIS using 2020 Census Tracts that intersect aquifer boundaries. Selected census tracts extended beyond the boundaries of the aquifer and are presented for comparison only.

In the Flathead Valley Deep and Shallow Aquifer, the overall density of exempt wells is 28 exempt wells per square mile of aquifer surface area. Wells are not evenly distributed throughout the valley, and the highest concentration of exempt wells is located just south of the city limits of Kalispell with a density of 124 exempt wells per square mile (Figure 10). The cumulative use of all exempt wells in the Flathead Aquifer is approximately 23,411 ac-ft per year of groundwater use.

In addition to the first criteria of exempt well concentration, at least one of the other four criteria must be met for the Department to designate or modify water monitoring areas for water quantity. Those four other criteria are generalized as: 1.) decreasing groundwater level trend in the aquifer, 2.) legal demand of groundwater vs physical availability of groundwater within the aquifer, and 3.) aquifers that are reliant on irrigation losses or an aquifer with limited storage or 4.) legal availability of surface water limitation in connected surface water sources within the aquifer.

In the Flathead Valley Deep and Shallow Aquifer, criteria 2, 3 and 4 have not been analyzed in detail by the Department, however, criteria 1 should be considered for the Department's recommendation to designate a water monitoring area. The other criteria will be analyzed in detail in the coming years as part of the enhanced monitoring efforts that would occur in the Flathead Valley Deep and Shallow Aquifer.

Criteria MCA 85-2-506(1)(d)(ii)

"Where the department identifies a decreasing ground water level trend in the aquifer, and long-term cause/effect and projected trend need to be analyzed based on data or consultation with Montana Bureau of Mines and Geology or other relevant agencies."

This criterion simply identifies that a decreasing groundwater level trend has been observed and cause and effect should be analyzed further. "Trends in groundwater levels that persist over several years generally indicate that some change, or stress, is affecting an aquifer. Stresses that can cause long-term declines or rises in water levels include cumulative effects of pumping that exceed recovery; land-use changes that alter recharge; climatic trends, including an increase or decrease in total precipitation; or changes in the timing, magnitude, or duration of precipitation." (Rose et. al., 2022)

Flathead Valley Deep and Shallow Aquifer Recharge

A MBMG investigation in 2022 identified numerous wells with decreasing groundwater level trends; predominantly in the central and western portion of the aquifer (Figure 11) (Rose et. al., 2022). The report noted that the decrease in water level was likely due to increased groundwater extraction in some wells, and additional investigation is warranted to definitively determine cause and effect of the trend and to project what future groundwater levels may exist.

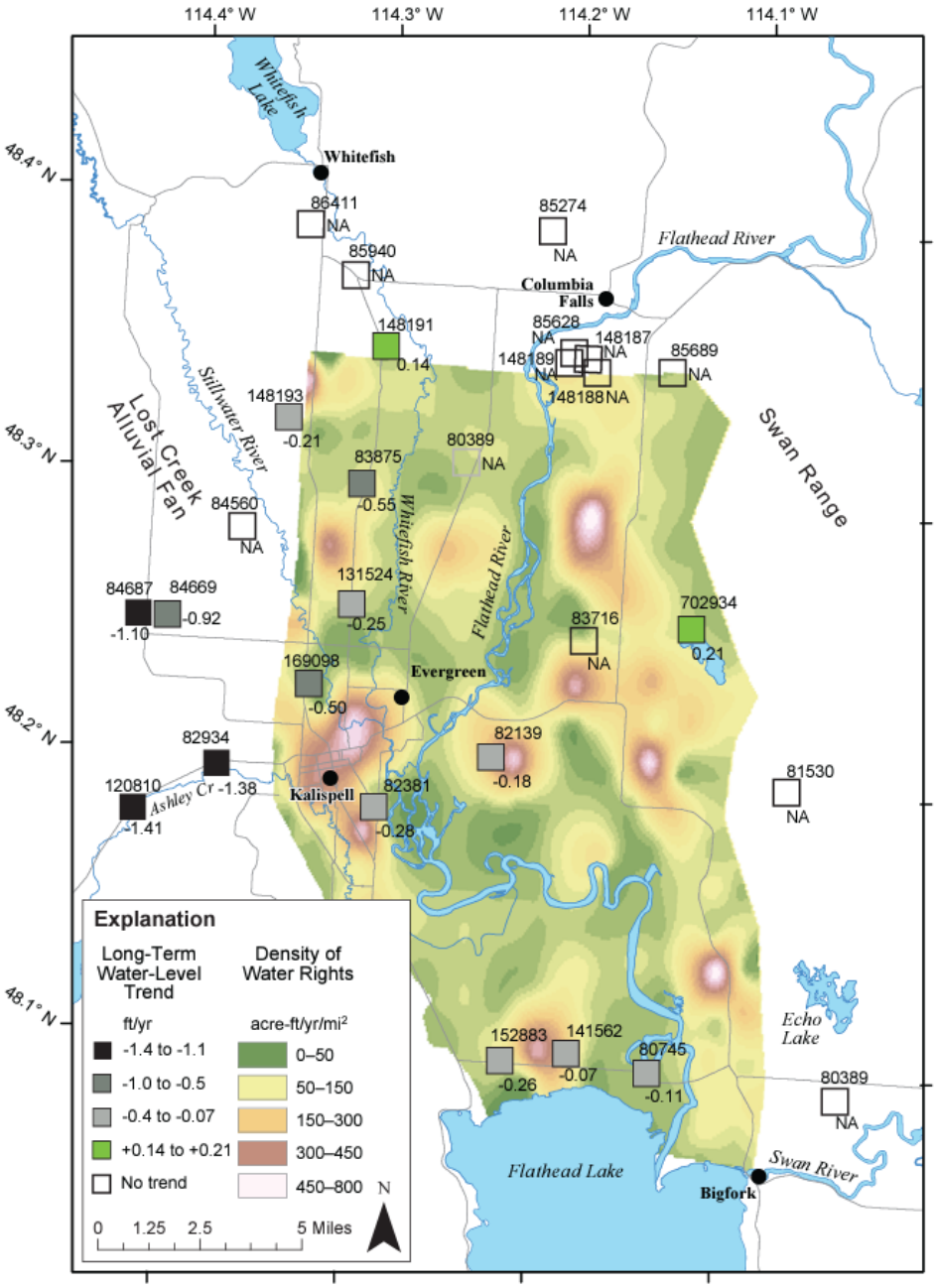

Figure 11. Aquifer water level trends in the Flathead Deep Alluvial Aquifer from 1996 through 2017.

Conclusion and Recommendation

1. There is a large concentration of exempt well use in the Flathead Valley Deep and Shallow Aquifer, especially in concentrated pockets throughout the aquifer.
2. Groundwater level trends are declining in parts of the Flathead Valley Deep and Shallow Aquifer and long-term cause/effect and projected trend should be analyzed therefore, the Flathead Valley Deep and Shallow Aquifer should be designated a water monitoring area.

6.0 Recommendation to Designate Billings Terrace Aquifer a Water Monitoring Area

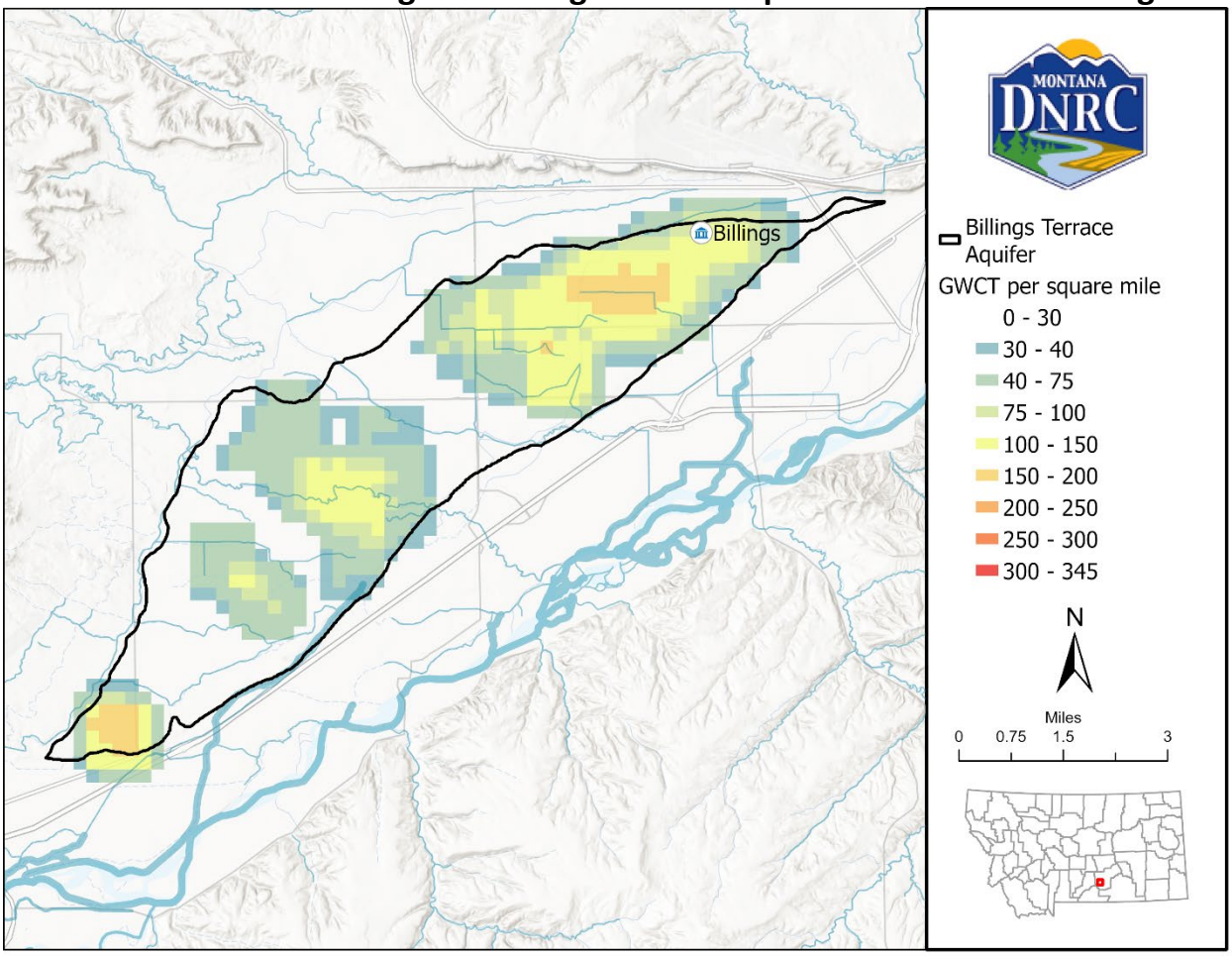

Figure 12. Billings Terrace Aquifer boundary and concentration of exempt wells per square mile.

Total Population[6]**:** 76,887
Area (sq miles): 27
Number of Exempt Wells: 1,793

The first criteria that must be met for the Department to designate or modify water monitoring areas for water quantity is that there must be a high concentration of exempt groundwater use. The intent of this criteria was to focus on areas where there may be a larger cumulative impact related to those exempt wells, and not include large areas of the state where there is little cumulative impact.

[6] Population calculated in GIS using 2020 Census Tracts that intersect aquifer boundaries. Selected census tracts extended beyond the boundaries of the aquifer and are presented for comparison only.

In the Billings Terrace Aquifer, the overall density of exempt wells is 76 exempt wells per square mile of aquifer surface area. Wells are not evenly distributed throughout the valley, and the highest concentration of exempt wells is located just west of the city limits of Billings with a density of 189 exempt wells per square mile (Figure 12). The cumulative use of all exempt wells in the Billings Aquifer is approximately 3,221 ac-ft per year of groundwater use.

In addition to the first criteria of exempt well concentration, at least one of the other four criteria must be met for the Department to designate or modify water monitoring areas for water quantity. Those four other criteria are generalized as: 1.) decreasing groundwater level trend in the aquifer, 2.) legal demand of groundwater vs physical availability of groundwater within the aquifer, and 3.) aquifers that are reliant on irrigation losses or an aquifer with limited storage or 4.) legal availability of surface water limitation in connected surface water sources within the aquifer.

In the Billings Terrace Aquifer, criteria 1, 2, and 4 have not been analyzed in detail by the Department, however, criteria 3 should be considered for the Department's recommendation to designate a water monitoring area. The other criteria will be analyzed in detail in the coming years as part of the enhanced monitoring efforts that would occur in the Billings Terrace Aquifer.

Criteria MCA 85-2-506(1)(d)(iv)

"Where the department determines that aquifer recharge is reliant on irrigation losses or where the geologic structure or formation has limited storage or potential for storage based on data or consultation with Montana Bureau of Mines and Geology or other relevant agencies"

This criterion includes two parts, either of which must be met for designation to be considered. First, the aquifer is reliant on irrigation losses and second aquifer has limited storage or potential for storage.

Billings Terrace Aquifer Recharge

Recharge to the Billings Terrace Aquifer is primarily provided by losses from irrigation ditch loss and infiltration from flood irrigated agricultural land (Lopez, 2000; Chandler and Reiten, 2019). Modeling by Chandler and Reiten suggest there is a tipping point, that as irrigated land is developed into residential housing, and irrigation losses decrease, the loss of aquifer recharge will outpace groundwater use leading to long term decline in aquifer water level (2019). The model further identified large reductions in groundwater discharges to known connected surface water sources such as Canyon Creek, Hogan-Shilo drain, and the Danford drain (Chandler and Reiten, 2019). The potential loss of aquifer recharge puts future groundwater availability at risk; therefore, the Billings Terrace Aquifer should be designated a water monitoring area.

Conclusion and Recommendation

1. There is a large concentration of exempt well use in the Billings Terrace Aquifer, especially in concentrated pockets throughout the aquifer.

2. The potential loss of aquifer recharge puts future groundwater availability at risk; therefore, the Billings Terrace Aquifer should be designated a water monitoring area.

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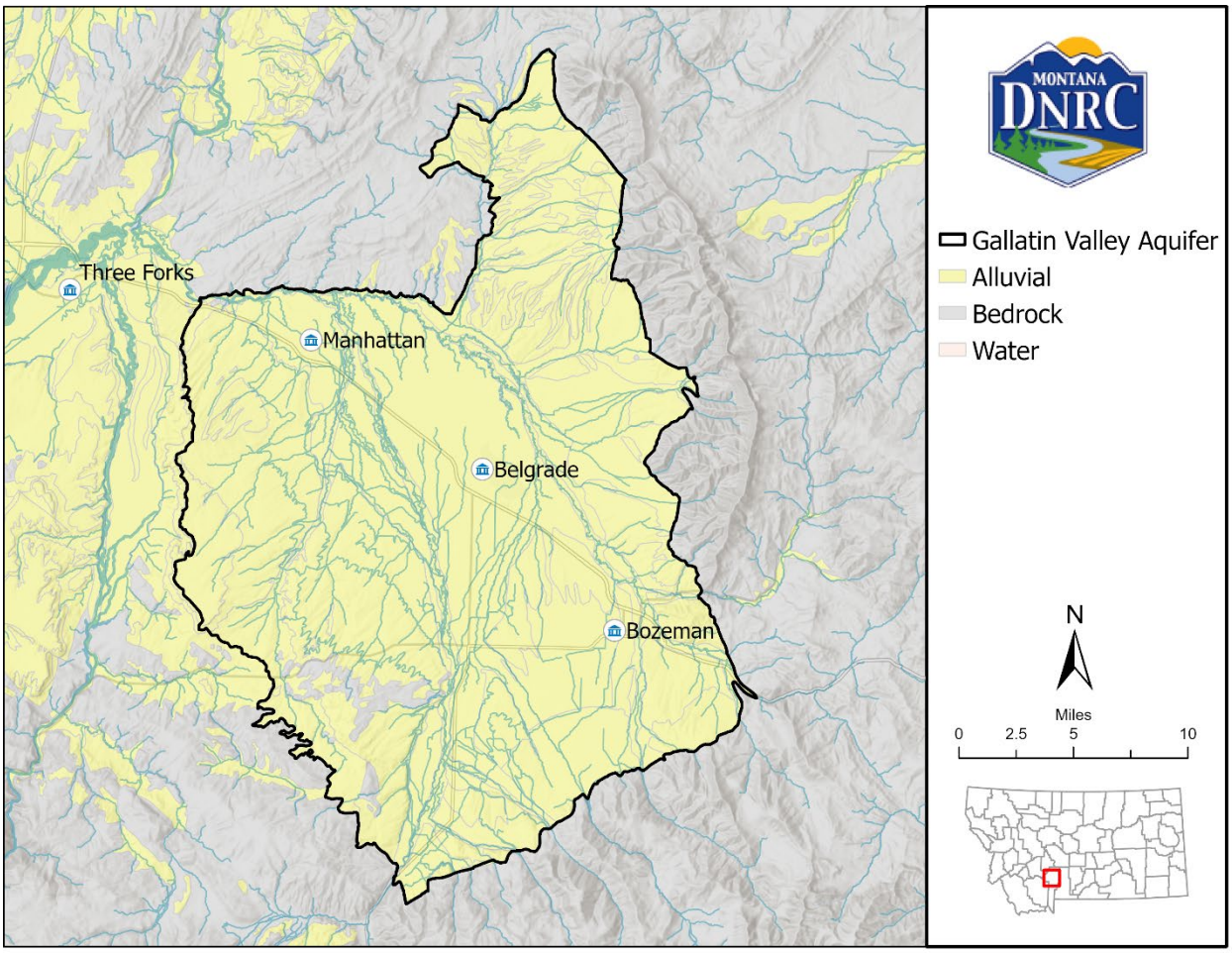
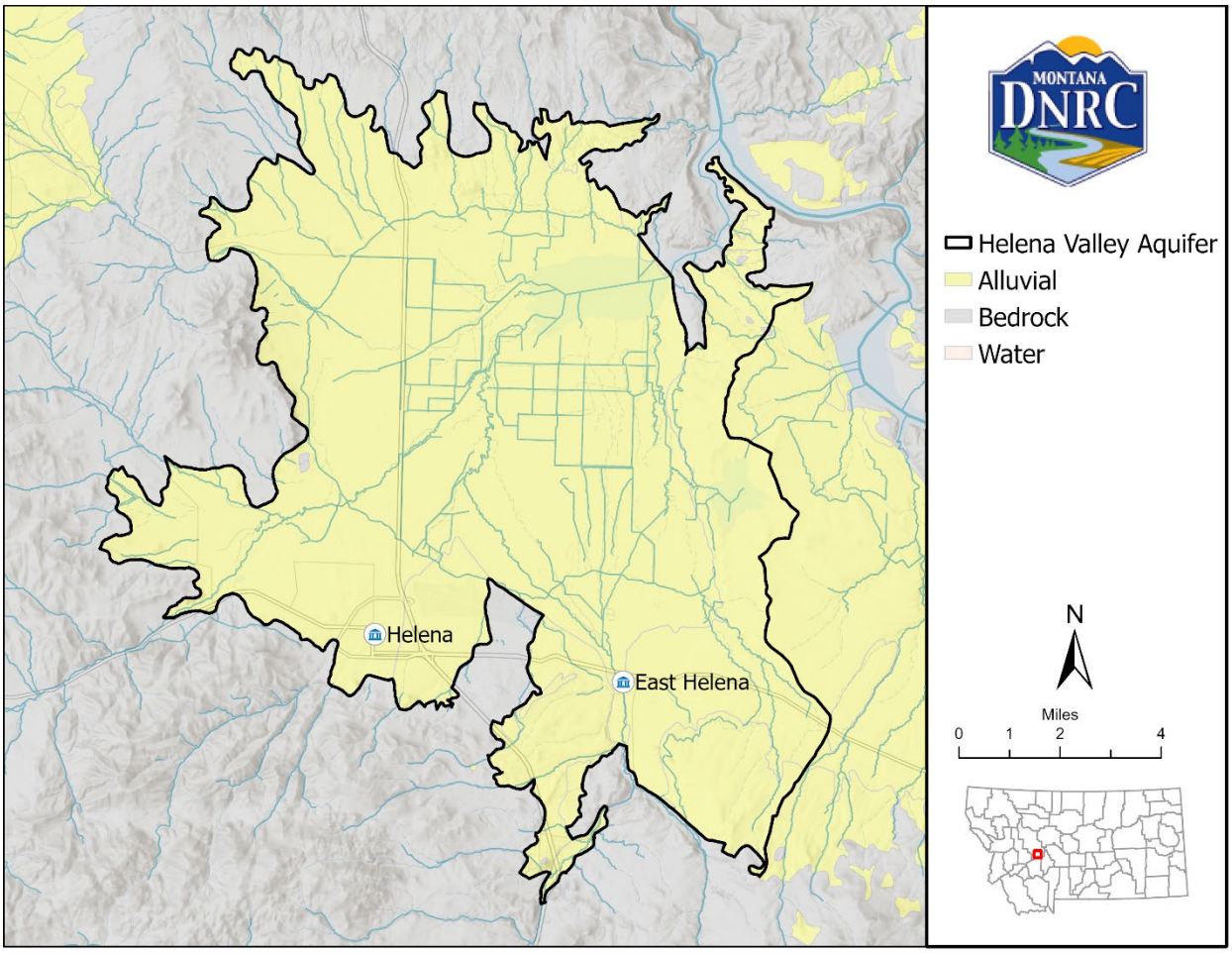
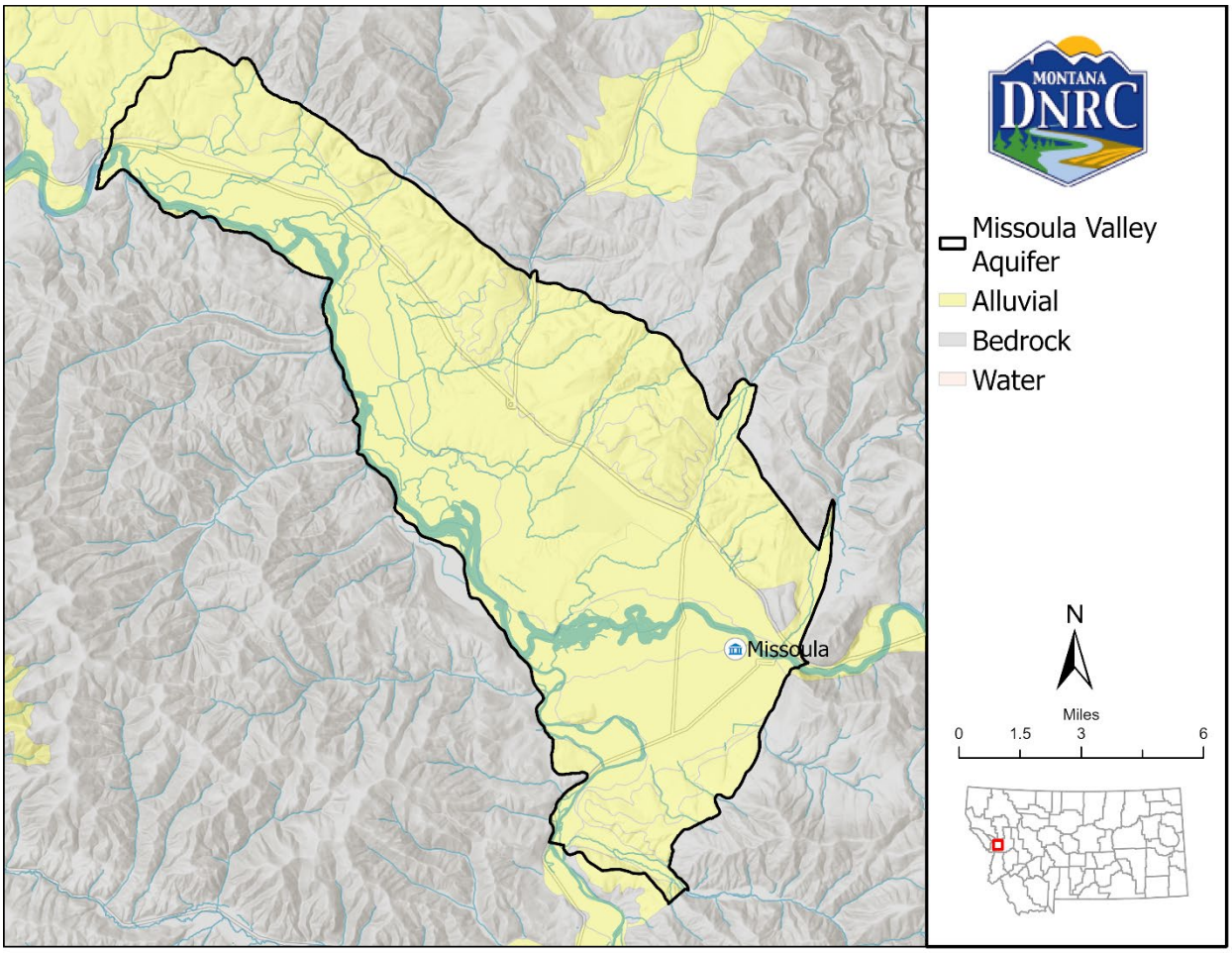
Appendix B. Aquifer Boundary Maps



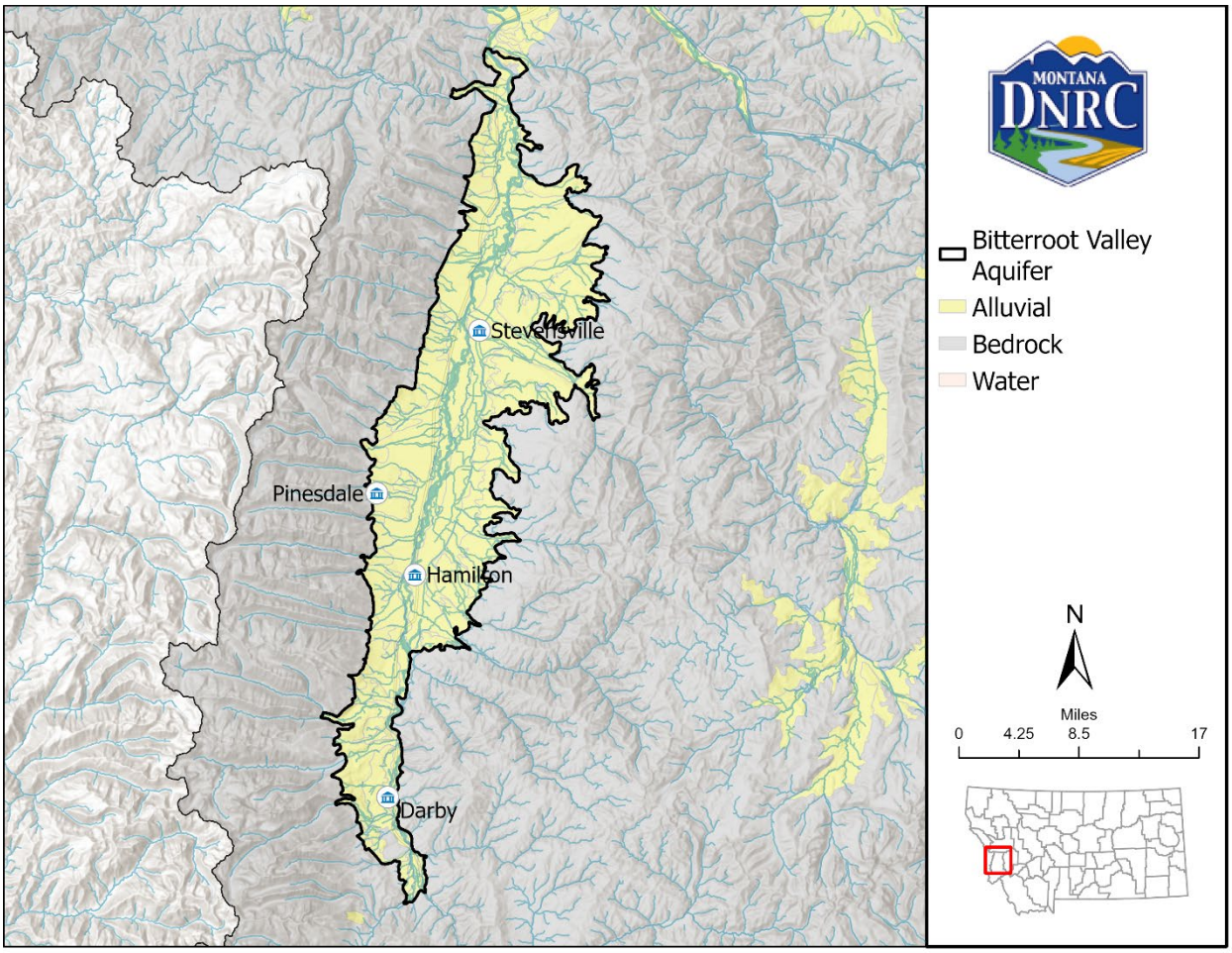
Gallatin Valley Aquifer



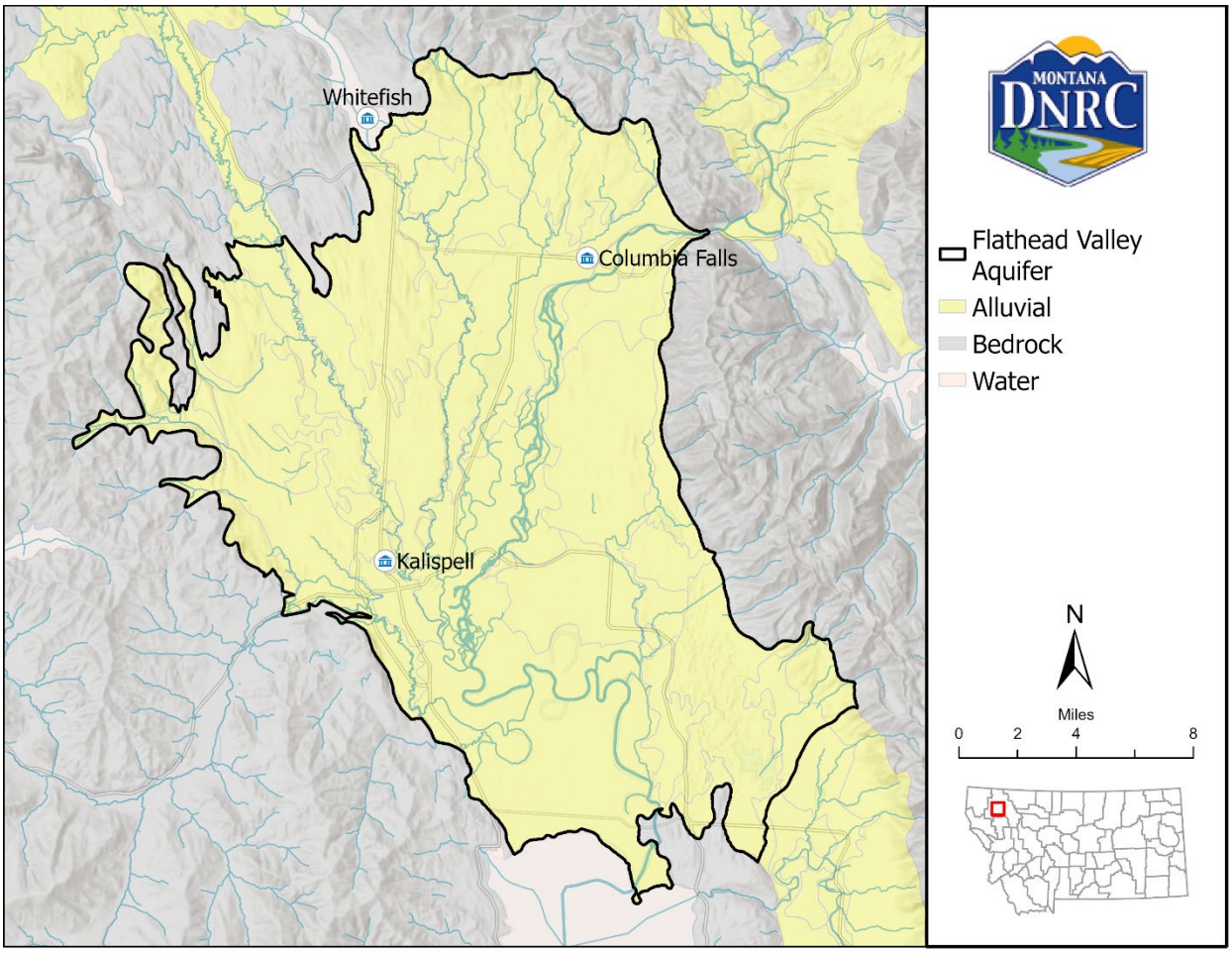
Helena Valley Aquifer



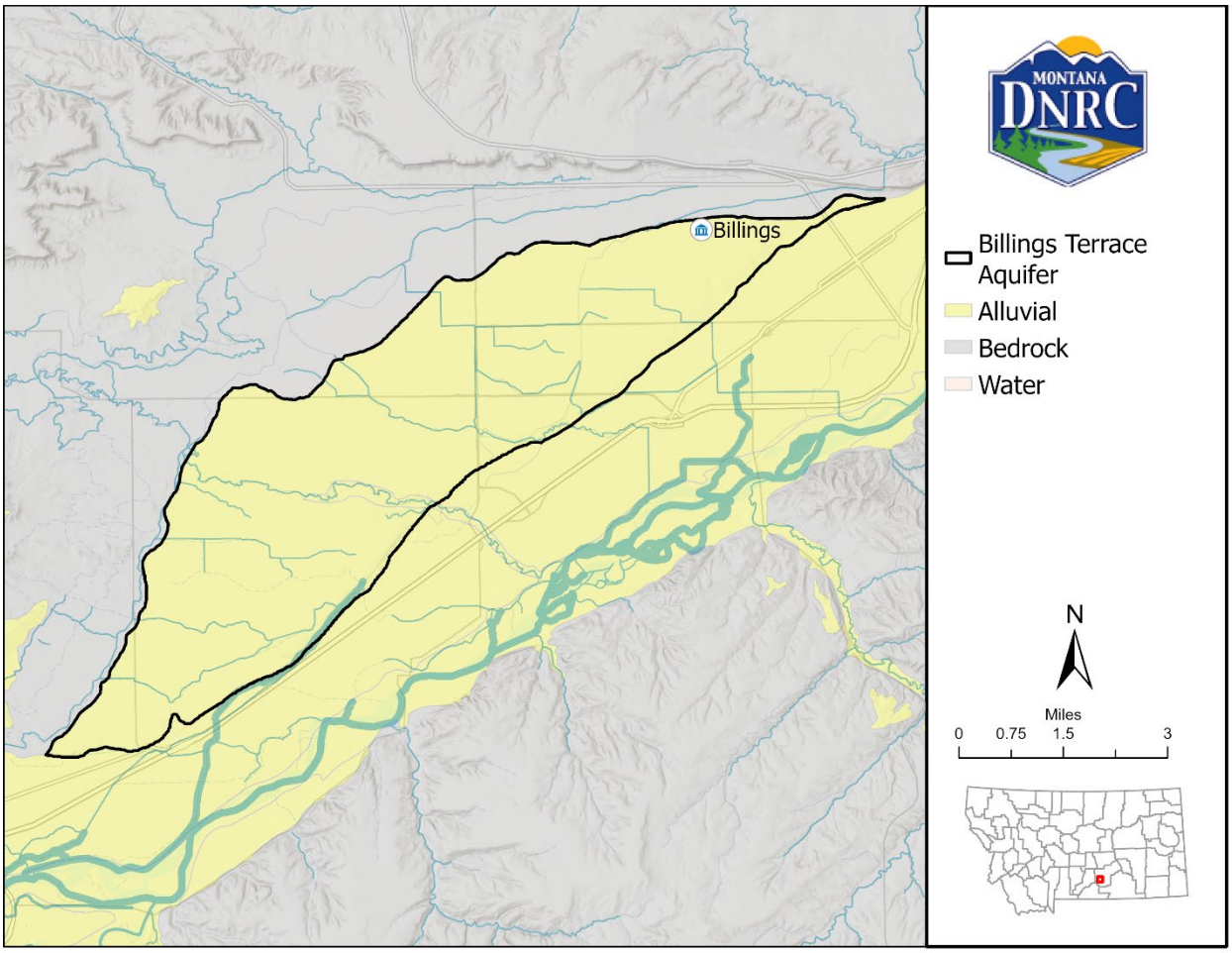
Missoula Valley Aquifer



Bitterroot Valley Aquifer



Kalispell Valley Aquifer



Billings Terrace Aquifer