GWIP Nomination: **Big Hole River Proposal, Silver Bow County**

Submitted by: **Big Hole Watershed Committee (BHWC)**

Purpose:

Understand the hydrogeologic influences to the Big Hole River that result from irrigation return flow. The investigation includes examining the hydrologic effects to the river that would result from converting to more efficient methods of irrigation (i.e. flood to pivot).

Project merits:

The BHWC continues to take a proactive approach on protecting their watershed by wanting to understand and make predictions on changes to river flows and temperature before deciding on the best way to implement irrigation improvement projects.

The project addresses irrigation return flow and if selected could also serve as a site for the GWIP nomination that similarly seeks to quantify and understand conversion from flood to pivot proposed by the Carbon County Conservation District.

In addition to flow, river temperatures are a continued concern in southwest Montana watersheds. A detailed investigation on the effects of irrigation return flow on both surface water and groundwater temperature will include using various methods to collect this data. Comparing the results from these different methods can help other watersheds seeking to obtain similar information.

The Big Hole River is one of three tributaries to the Jefferson River. Intentional planning on how and where to make irrigation infrastructure changes that minimizes the effects on decreased Big Hole River flows can also benefit downstream users.

Efficiency of Effort:

Previous work and data collected by the MBMG (Marvin and Voeller, 2000; MBMG 417) includes information to help develop a groundwater and surface-water monitoring network, the hydrogeologic framework, and provides sufficient data for a preliminary groundwater flow model of the study area.

Efficency of effort is also realized by including this in the proposed Carbon County irrigation nomination project.

Project considerations:

The MBMG will determine the appropriate size of the study area (Melrose or Glen Valleys/ or both) in consultation with the project sponsor.

Project area size	25 mi^2
Project area population change (2000-2019)	5.4 %
County population change (2000-2019)	2.3 %
Long-term monitoring wells	2
Previous field site visits (GWIC)	53
Previous groundwater chemistry sites (GWIC)	4
Aquifer test analysis in GWIC	0
Pending water rights	0

GWIP Nomination: **Big Muddy Creek, Roosevelt and Sheridan Counties**

Submitted by: **Fort Peck Tribes**

Purpose:
The purpose of the project is to understand the connection between the deep buried valley aquifer, shallow aquifers and Muddy Creek. The concern is that new groundwater development may affect surface water flow while there is potential for increased nutrients in Big Muddy Creek associated with runoff from cropland.

Project merits:
An existing MBMG GWIP groundwater model developed for the Clear Lake aquifer in the Medicine Lake area partially overlaps this area. Irrigation development of the Clear Lake aquifer south of Medicine Lake can be guided by a more thorough understanding of the implications for pumping on Big Muddy Creek.

Information from this study will also be used to make informed water management decisions not only by personnel from the Fort Peck Tribe and the US Fish and Wildlife Service but also by the Sheridan County Conservation District (SCCD). The SCCD has a reserved groundwater right for irrigation from the Clear Lake aquifer under the Sheridan County Water Reservation.

There is the possibility of education and outreach related to the proposed GWIP project through the Fort Peck Community College.

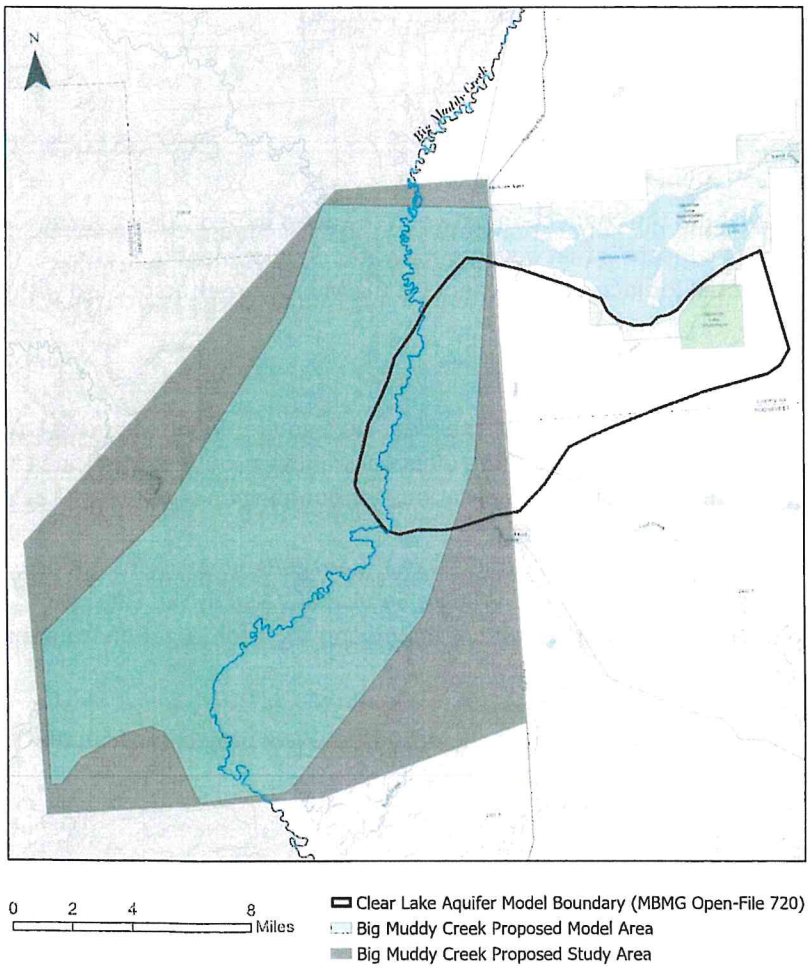
Efficiency of Effort:
The hydrogeologic framework from the adjacent previous GWIP study extends into the proposed project area.

Project considerations:
The proposed area is large. The study would focus on the area along Muddy Creek.

There is little current development (there are 3 irrigation wells in the study area) in the proposed study area, however the tribe consistently opposes any new wells proposed in the Missouri River tributaries based on the unknown effects to surface water.

Project would require drilling to document groundwater/surface-water interactions along the creek.

Access to the study area is mostly on the Fort Peck Assiniboine and Sioux Tribes Reservation, and they are proposing and support the project.



The above figure shows the proposed Big Muddy study and model areas to the area modeled by Chandler and Reiten (2019) for the previous GWIP South Medicine Lake Clear Lake aquifer project.

Project area size	257 mi^2
Project area Population change (2000-2019)	2.3%
County population change (2000-2019)	
Sheridan	-15.2 %
Roosevelt	5.2%
Long-term monitoring wells	3
Previous field site visits (GWIC)	63
Previous groundwater chemistry sites (GWIC)	37
Aquifer test analysis in GWIC	2
Pending water rights	0

GWIP Nomination: **West Billings, Yellowstone County**

Submitted by: **City of Billings**

Purpose:
Evaluate the effects of how current and future residential and commercial growth impacts groundwater availability and water quality degradation (specifically nitrates).

Project merits:
An existing model developed by the MBMG in 2019 is used by DNRC for subdivision review and other water rights issues is inadequate to address the impacts of current growth. The proposed GWIP project will upgrade the model by adding additional monitoring wells and expanded data collection on groundwater levels, water quality, and changing land use. Use of the previous model demonstrates that the information and the model developed as part of the proposed GWIP project will actively be used.

Rapidly changing land use has the potential to reduce the groundwater availability and quality to existing and proposed developments relying on wells and septic systems.

Information from the proposed GWIP investigation can guide responsible development as it relates to water availability, quality, and provide tools for the future expansion of the City of Billings municipal systems.

City of Billings Public Works will provide in house laboratory analysis of groundwater and surface water samples during the project and provide access to monitoring wells controlled by the city.

Efficiency of Effort:
Updating and expanding the 2019 MBMG groundwater model and collecting additional groundwater data, will provide a historical trend comparison within the existing model coverage area and provide a critical tool for tracking impacts of future residential and commercial development.

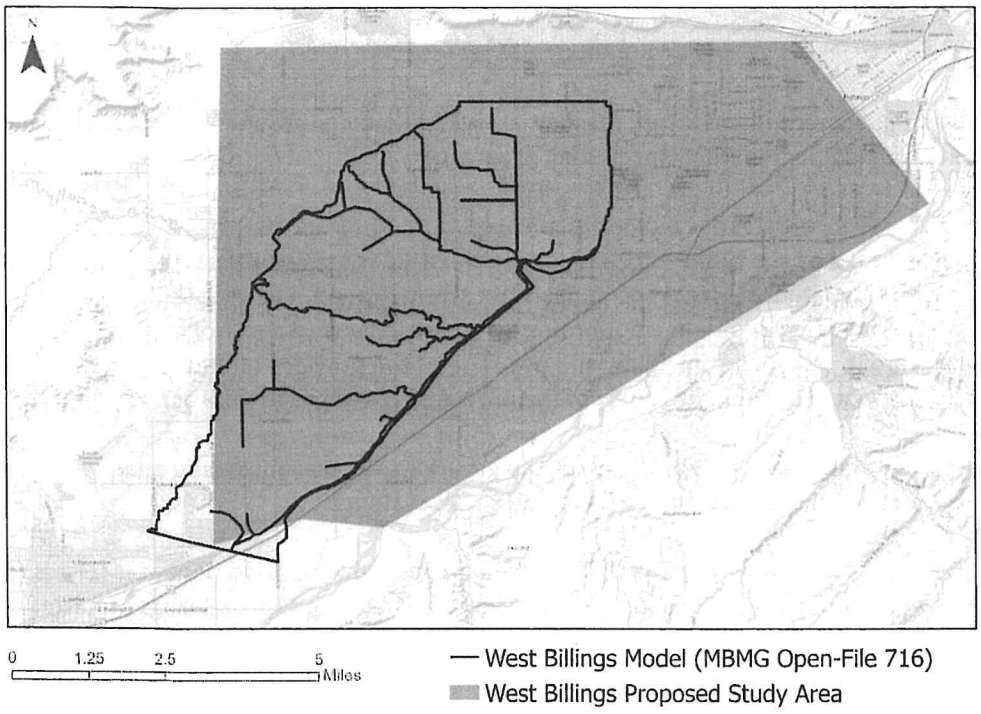
Project considerations:
This proposed groundwater and surface water project is essentially the same as previous projects on the original list of GWIP projects since the inception of GWIP in 2009.

Elevated groundwater nitrates have been documented and demonstrate the need for this project. Recorded readings ranging from 5 mg/l to 15 mg/l. Human Health MCLG is 10 mg/l.

The City of Billings will work closely with project researchers on acquiring landowner access. No significant problems are anticipated.

Although data has been collected from previous work, data collection could get complex since there are multiple land uses in this urban, suburban and agriculture interface. The proposed area is large and the size of the study area would be re-evaluated if this became a GWIP project.

The current model is based on very limited monitoring data from both surface and groundwater sites. More hydrogeologic data will greatly improve the model calibration and usefulness. The rate of growth in the area has exceeded the growth projections used in the initial model.



This figure shows the proposed GWIP study area compared to the groundwater model developed by previous MBMG work (Chandler and Reiten, 2019).

Project area size	62 mi^2
Project area Population change (2000-2019)	15.3%
County population Change (2000-2019)	22.9%
Long-term monitoring wells	5
Previous inventoried wells (GWIC)	173
Previous groundwater chemistry sites (GWIC)	60
Aquifer test analysis in GWIC	24
Pending Water Rights	3

GWIP Nomination: **Eureka, Lincoln County**

Submitted by: **Concerned Citizens and Business People**

Purpose:
Determine the interconnectivity of the area aquifers and the effect of groundwater withdrawals on the groundwater and surface water. Evaluate the effects of various groundwater development scenarios and provide a tool for water permitting applications

Project merits:
There have been concerns and controversy in recent years in the Eureka area about the effects of development on groundwater and surface water as they relate to water rights permitting. This area was a focus of MBMG's Ground Water Assessment Program groundwater characterization of Lincoln County. A GWIP project specific to groundwater/surface-water interactions and development of a groundwater flow model is a logical extension to further understanding of the hydrogeology near Eureka.

Project results would be used in water rights permitting which has been contentious in the past. A groundwater flow model for this area will inform regulatory decisions regarding subdivision water use and the effects of pumping on groundwater and surface water. Lincoln County is dependent upon continued development and residential and commercial construction for its economic well-being.

Efficiency of Effort:
The Ground Water Assessment Program has inventoried and surveyed over 100 wells in the area. The hydrogeologic framework and a preliminary water budget are being developed. A preliminary potentiometric surface map has been published (MBMG GWOF 24). This information will streamline GWIP data collection efforts and development of the groundwater flow model.

Project considerations:
The Eureka area was in the original GWIP project nomination list (2009) due to the shift in land use from agricultural to residential development and the effects on groundwater and surface water.

The glacial geology is complex and additional well drilling is needed.

A preliminary groundwater model can be developed with existing data and will help guide GWIP data collection efforts.

The project has good support from local entities including the banking, real estate, well drilling, a legal, irrigation district representatives.

Project area size	75 mi^2
Project area Population change (2000-2019)	23.8%
County population Change (2000-2019)	3.8%
Long-term monitoring wells	6
Previous field site visits (GWIC)	216
Previous groundwater chemistry sites (GWIC)	112
Aquifer test analysis in GWIC	26
Pending Water Rights	0

GWIP Nomination: **Open Pit and Pond Evaluation, Gallatin County**

Submitted by: **Montana Department of Natural Resources and Conservation**

Purpose:
As originally proposed, the stakeholder is asking GWIP to evaluate local and cumulative stresses on shallow groundwater from open water bodies (i.e. gravel pits and private pond developments) in the Gallatin Valley. This includes evaluating the interaction between groundwater and the ponds, the effects on groundwater flow paths, evaporation rates, and water quality.

Project merits:
The project was proposed to GWIP by the Montana Department of Environmental Quality in 2018. This implies a continued concern because of the lack of information on the hydrogeologic effects, including potential changes in water quality, from open pits and ponds. The information would mainly be used to assist the DNRC and the DEQ in groundwater permitting, however, other state and local entities have expressed interest incorporating results in future planning efforts.

Efficiency of Effort:
Although there have been numerous hydrogeologic studies in the Gallatin Valley, monitoring networks related to these studies are not at the appropriate density or locations for this project.

Project considerations:
The project, as proposed by the sponsor, is a large watershed area. There are many pits and open ponds in the Gallatin Valley, which encompasses 565 mi^2.

The MBMG would select 2 to 3 representative open pit and pond developments to provide a focus for this project, rather than study all ponds in the entire Gallatin Valley. The DNRC has agreed to provide a list of potential sites.

Depending on the results of the site investigations and usefulness to state agencies, the project report may include a set of guidelines, procedures and best practices for hydrologic evaluations of sand and gravel/pond developments in this setting. We envision these guidelines and procedures as generally applicable to other areas throughout Montana.

Project area size	565 mi^2
Project area Population change (2000-2019)	59.3 %
County population Change (2000-2019)	66.8 %
Long-term monitoring wells	57
Previous field site visits (GWIC)	688
Previous groundwater chemistry sites (GWIC)	285
Aquifer test analysis in GWIC	29
Pending Water Rights	5

Note: This table is compiled from information for the entire Gallatin Valley.

GWIP Nomination: **Irrigation Recharge, Carbon County (additional sites also)**

Submitted by: **Carbon County Conservation District**

Purpose: Quantify effects of irrigation method and irrigation efficiencies on groundwater recharge. In the Edgar area and other areas throughout the State, transitioning to water efficient means of irrigation (i.e. flood to pivot) can result in unintended consequences such as a decrease in groundwater recharge. The project scope includes quantifying effects of irrigation method efficiency in various geologic settings.

Project merits:

Hydrogeologists make assumptions that oftentimes over simplify the fate of applied irrigation water and water loss from canals and the effect on groundwater and surface water. Common practice amongst hydrogeologists is to assume that all applied water in excess of crop use, and water loss from canal seepage, are sources of groundwater recharge. GWIP will examine this assumption using methods that focus on groundwater levels, groundwater chemistry, and the fate of irrigation water within the unsaturated zone.

The project has state-wide merit by monitoring conditions in a variety of hydrogeologic settings. It will also evaluate methods to monitor and estimate groundwater recharge from irrigation and recommend best methods for a variety of hydrogeologic settings. Results will support water management decisions, developing accurate water budgets, and robust groundwater models. The project will also address the fate of irrigation water in excess of crop use, evaluating the importance of soil water storage.

Efficiency of Effort:

The MBMG currently has a DNRC RRG grant to evaluate the effects of converting from flood to pivot irrigation in the Edgar area. Twelve wells have been installed as part of the RRG grant. Current work under the RRG grant provides some cost savings and pre-project water level inforamtion. Funding constraints of the current grant limit the scope of work to collecting water levels and water chemistry samples. GWIP would use additional methods to quantify irrigation recharge, such as soil moisture profiling, flow modeling in the vadose zone, isotopic signatures and potentially dye tracing techniques. Combining current field work with GWIP efforts provides an efficiency of effort.

The proposed project will use an efficient approach by selecting sites in new GWIP project areas (2022) and/or previous projects that may have some monitoring infrastructure in place, the hydrogeologic setting is known, and for most projects, a groundwater model has been developed.

Project considerations:

GWIP will consider including 3 to 5 sites in this project. This project also compliments other submissions to GWIP for this project cycle which would provide additional efficiency in effort and resources.

The Edgar area is within a pending petition for a Controlled Groundwater Area (CGA). Information from the proposed GWIP study may help address deficiencies noted by the DNRC in the CGA petition related to questions about groundwater recharge.

Project area size	21 mi^2
Project area Population change (2000-2019)	30%
County population Change (2000-2019)	11%
Long-term monitoring wells	1
Previous field site visits (GWIC)	36
Previous groundwater chemistry sites (GWIC)	20
Aquifer test analysis in GWIC	1
Pending Water Rights	0

Note: the following table provides information for the Edgar area only and is not representative of other sites, as these have not yet been selected.

GWIP Nomination: **Seeley Lake, Missoula County**

Submitted by: **Missoula County Health department**

Purpose:
Purpose of the project is to assess the geographical extent, degree of impact, and potential sources of wastewater contamination in the area and to assess the degree of connectivity between ground and surface waters. Elevated nitrate concentrations in groundwater limits residential and commercial growth.

Project merits:
This is a clearly defined issue: nitrate concentrations in some wells exceed the MCL.
This issue is one of the Missoula City-County Health Department's top priorities. They anticipate using the results to inform appropriate waste water regulations for existing and future development.

There is a high likelihood of the results being used since the project sponsor, Missoula County Health Department, has jurisdiction over wastewater regulations for the region.

The project will provide information that aligns with the mission of the Seeley Lake Sewer Board, which in part addresses water quality concerns related to a high density of septic systems.

Efficiency of Effort:
Previous work by the MBMG and current monitoring by the Missoula County Health Department will form the basis for a monitoring network. The Ground Water Assessment Program measured water levels and collected water quality samples in the Seeley Lake area as part of their Missoula County groundwater characterization (MBMG GWAA 4-B-07, 2006; MBMG GWAA 4-B-06).

Project considerations:
The Missoula City-County Board of Health has designated a portion of Seeley Lake as a Special Management area and has placed restrictions on new and increased development. This demonstrates an urgent need for this project.

The project could be carried out with groundwater and surface water monitoring; it would not require a groundwater model.

The Seeley Lake Sewer Board has allocated money for the installation of up to 5 monitoring wells and is willing to work with the MBMG to select appropriate sites.

Although there is good support for the project, local landowner support and access to sites is unclear.

Project area size	10 mi^2
Project area Population change (2000-2019)	-14.6%
County population Change (2000-2019)	22.5%%
Long-term monitoring wells	1
Previous field site visits (GWIC)	32
Previous groundwater chemistry sample sites (GWIC)	26
Aquifer test analysis in GWIC	0
Pending Water Rights	0

GWIP Nomination: **Southeast Helena, Lewis and Clark County**

Submitted by: **Lewis and Clark Water Quality District (LCWQD)**

Purpose:
Evaluate aquifer properties and the capacity of the Tertiary sediments to support water needs from current and future residential development in the south east portion of the Helena Valley. Subdivision development is occurring outside of city limits on Tertiary bench sediments. The Tertiary sediments often have a low water yield and groundwater depletion from residential use-withdrawals is occurring in some areas.

Project Merits:
Given the documented groundwater depletion and potential for future problems, the project results are critical for developing sustainable water supplies for long-term growth in the Helena Area. Problems related to adequate water supplies are anticipated to exacerbate as development continues and the area affected by drawdown of the water table expands with increased pumping.

A groundwater model developed for this proposed GWIP project will provide an essential tool for water managers to make decisions that help reduce the risk of development without adequate water.

Information from previous GWIP studies (North Hills, 2012 and Scratchgravel Hills, 2013) was used in developing the Lewis and Clark County Growth Policy Update (2015). This demonstrates the likelihood that GWIP results will be used in their intended manner to help make informed management decisions.

Efficiency of Effort:
Personnel from the LCWQD have characterized the general hydrogeologic conditions and they have a water level and water chemistry monitoring network across the Helena Valley that includes the study area. This information will provide a starting point for the proposed GWIP investigation.

Project considerations:
This project was proposed during the previous two GWIP project nomination cycles (in the same area but more limited in size). There is documentation of current groundwater depletion. The issue is persistent as development and associated water consumption continue in the Helena area.

In the previous GWIP Helena studies, the LCWQD was instrumental in assisting with data collection efforts. The LCWQD acknowledged that they would be able to assist in this capacity again.

Project area size	20 mi^2
Project area Population change (2000-2019)	13.5%
County population Change (2000-2019)	21.7%
Long-term monitoring wells	1
Previous field site visits (GWIC)	35
Previous groundwater chemistry sites (GWIC)	24
Aquifer test analysis in GWIC	1
Pending Water Rights	0

GWIP Nomination: **West Flathead Valley, Flathead County**

Submitted by: **Flathead Basin Commission**

Purpose:
The Flathead Basin Commission (FBC) originally proposed to investigate the west side of the Flathead Valley to 1) determine which surface water sources are affected by groundwater withdrawals from the deep alluvial aquifer, 2) understand the current status of groundwater quality (e.g., levels of nitrates and contaminants ofconcern (COC)) in both the shallow and deep aquifers, and 3) determine the source and pathway(s) of nitrate migration through the shallow aquifer and effects on domestic wells, surface water bodies, and the deep alluvial aquifer.

MBMG asked the FBC to prioritize the areas of most importance since the proposed project size and scope was more than one GWIP project. The FBC identified the Ashley Creek and Lost Creek Fan areas as priority areas. Future management of water availability and quality issues depends on understanding the complex aquifer and surface water connectivity.

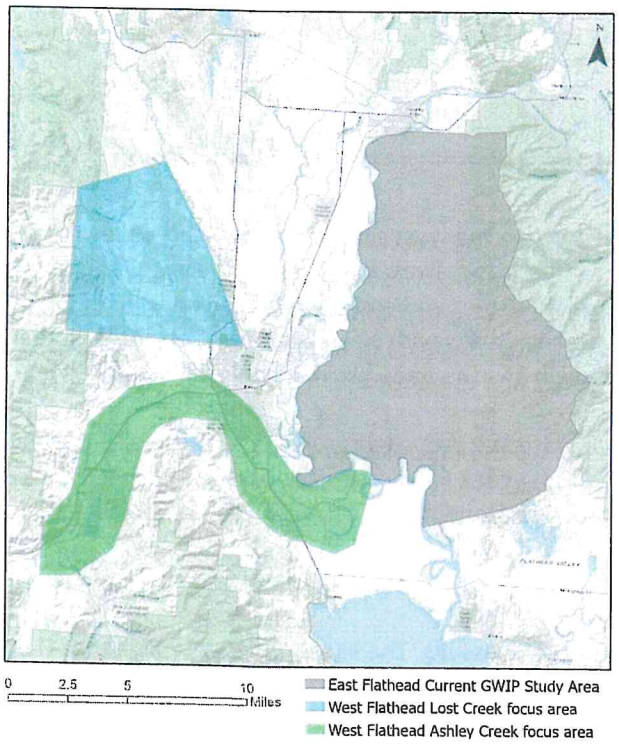
Project merits:
This is a high growth area with both water availability and water quality issues. The likelihood is very high that the results will be used by the project sponsor and supporting entities to make informed management decisions and guide current and future planning efforts. This is illustrated by the support letters included in the project nomination.

The project has a high level of support from state, county, city, and non-profit conservation organizations (see support letters).

Efficiency of Effort:
The project will build on previous Ground Water Assessment Program and GWIP studies by providing local-scale understanding of the hydrogeology and answers to the water resource questions specific to Ashley Creek and the Lost Creek Fan areas. Site inventories, data from previous MBMG investigations, and monitoring from other agencies (such as the DNRC and DEQ) provide a starting point for the proposed GWIP project. Currently, GWIP is completing year two of a three-year project on the east side of the valley. We have developed a hydrogeologic framework that can be extended into the understanding of the proposed project area on the west side of the valley.

Project considerations:
The project boundaries encompassing the Ashley Creek and Lost Creek Fan areas may change during development of the work plan.

The staff in the DNRC Kalispell office are willing to provide additional sampling support. The DEQ support letter also states that they can provide some field work, groundwater sampling and provide historic data.



Lost Creek Fan Area

Project area size	43 mi^2
Project area Population change (2000-2019)	49%
County population Change (2000-2019)	22.5%%
Long-term monitoring wells	1
Previous field site visits (GWIC)	32
Previous groundwater chemistry sample sites (GWIC)	22
Aquifer test analysis in GWIC	11
Pending Water Rights	1

Ashley Creek Area

Project area size	39 mi^2
Project area Population change (2000-2019)	40%
County population Change (2000-2019)	22.5%
Long-term monitoring wells	1
Previous field site visits (GWIC)	78
Previous groundwater chemistry sample sites (GWIC)	25
Aquifer test analysis in GWIC	22
Pending Water Rights	1