

Groundwater and Geological Resource Inventory and Investigations Phase 2

Appendix C: Statement of Work

Updating Contact Information from Modification 10

I. Project Description: Conduct groundwater and geological resource inventories and investigations of identified groundwater/surface water management issues within the Chequamegon-Nicolet National Forest (CNNF). Prepare reports and maps and make this information available to the Forest Service and public.

Phase 2 includes two years of work starting in FY2022. A separate statement of work will be provided for future phases.

II. Forest Service Shall:

1. Coordinate with WGNHS on project activities to support field work and deliverables.
2. Provide peer review for draft reports.

III. State Shall:

Complete the proposed project activities for three projects: 1) Drummond area water level investigation, 2) Investigation of hydrogeology near the Bend deposit in Taylor County, and 3) Groundwater level monitoring. See below for study tasks and timeline. The projected project end date for this phase of the work is June 2023.

IV. Goals:

1. Seepage lakes near Drummond WI, including Pigeon Lake, have historically fluctuated widely and currently are at a record high. The goals of this study are to improve our understanding of the groundwater-surface water system to manage and protect the water resource.
2. The Bend copper-gold ore deposit, located in Taylor County, is a potentially viable deposit for mining in an area with fairly little hydrogeologic data. An improved understanding of the local hydrogeology and surface water-groundwater interactions will improve the effectiveness of future management and protection of water resources in this region. The goals of this project are to collect baseline data and characterize the hydrogeology near the Bend ore deposit to contribute to the existing body of knowledge of hydrogeology in Northern Wisconsin and to inform management decisions and future environmental assessments should a mine be proposed.
3. Measure, report, and archive groundwater levels in monitoring wells; TA-217 and nested piezometers PR-088 and PR-089 (deep bedrock well).
4. Protect and manage the groundwater/surface water resource and associated ecosystems.

V. Objectives:

1. For the Drummond area seepage lakes: Characterize the hydrogeologic system around Pigeon Lake and evaluate potential future water level conditions. The deliverable for this phase is an interim project report.

Good Neighbor Supplement Project Agreement 1 – Modification 10

2. For the Bend deposit study: 1) Characterize the groundwater and surface water system near the Bend deposit to inform the protection of water resources in this area, with a focus on characteristics relevant to a potential future mine; 2) collect and publish baseline water chemistry, water table, and stream flow data; and 3) contribute to our understanding of groundwater-surface water interactions in this part of the state where there is little hydrogeologic data. This is planned to be a 3-year project. The project deliverables will consist of an interim summary of work (included in this phase) and a final report in the following phase (year 3). A stream gage installed as part of this project is intended to continue with funding from GNA in future years.
3. Continue funding for US Geological Survey to measure, report, and archive groundwater levels in monitoring wells; TA-217 (Bend well) in the Medford Unit, Taylor County, and nested piezometers PR-088 and PR-089 (deep bedrock well) in the Park Falls Unit, Price County. The water level data will be published on the statewide monitoring level network website.

VI. Tasks and Timeline:

The tasks and general timeline are as follows.

State FY 2021 – FY2022 (April 1, 2021 – June 30, 2022): Total Budget \$209,913

1. Bend hydrogeology (year 1 of 3): Budget \$134,696 (includes approximately \$25K installation and \$15.5K annual maintenance and reporting for stream gage)
 - a. Install 3-4 water-table monitoring wells in the glacial deposits overlying and near the Bend ore body. Monitor water levels and temperature in the wells.
 - b. Install long-term streamflow gaging station on the Yellow River at FR112/Yellow River Rd (completed by USGS). Real-time precipitation and discharge will be recorded on USGS website.
 - c. Monitor stream stage and temperature both at gaging station and at second location on the river. Collect periodic streamflow measurements at second location.
 - d. Collect baseline water quality data for both groundwater and surface water.
 - e. If Aquila plans more exploratory drillholes, coordinate with them to collect geophysical logs, packer tests, and flow logging.
2. Drummond area water level investigation: Budget \$70,228
 - a. Continue to monitor groundwater wells and sample water quality
 - b. Conduct geophysical surveys to evaluate bedrock depth and subsurface changes in key locations
 - c. Evaluate lake water balance
 - d. Prepare interim project report for USFS
3. Bayfield Peninsula: Budget \$4,989
 - a. Continue to monitor groundwater wells and precipitation
 - b. Interpret water quality samples and collected data

Good Neighbor Supplement Project Agreement 1 – Modification 10

4. Groundwater level monitoring: Budget included in Task 2
 - a. USGS will continue to monitor TA-217 (Bend well) in the Medford Unit, Taylor County, and nested piezometers PR-088 and PR-089 (deep bedrock well) in the Park Falls Unit, Price County from July 2021 to June 2023.

State FY 2023: Total budget \$150,822

1. Bend hydrogeology (year 2 of 3): Budget \$81,147 (includes approximately \$15.5K annual maintenance and reporting for stream gage)
 - a. Continue monitoring
 - i. Water levels and temperature in the groundwater wells.
 - ii. Real-time precipitation and discharge (completed by USGS).
 - iii. Stream stage and temperature both at gaging station and at second location on the river. Collect periodic streamflow measurements at second location.
 - iv. Baseline water quality data for both groundwater and surface water (quarterly sampling).
 - b. Evaluate groundwater interactions with the North Fork Yellow River using mini-piezometers, seepage meters, or similar instruments.
 - c. If river is accessible, collect spatially-dense stream data via canoe.
 - d. Conduct pumping tests in the groundwater wells to investigate hydraulic properties.
 - e. Provide an interim summary of data and work to USFS. This will consist primarily of monitoring data and a summary of the conceptual hydrogeologic model of the groundwater and stream system. A final report will be completed in the following phase.
2. Drummond area water level investigation: Budget \$69,675
 - a. Continue to monitor groundwater wells
 - b. Evaluate patterns in precipitation and lake levels with respect to future conditions through water balance analysis
 - c. Continue to analyze results of data collection
3. Groundwater level monitoring: Budget included in Task 2
 - a. USGS will continue to monitor TA-217 (Bend well) in the Medford Unit, Taylor County, and nested piezometers PR-088 and PR-089 (deep bedrock well) in the Park Falls Unit, Price County from July 2021 to June 2023.
 - b. Add Bayfield Peninsula wells to monitoring network.

For context, the below table inserts the above specific tasks with the tasks expected to be completed during the full lifetime of the project.

Time	Description	Phase
FY 2020 Projects	Bayfield Peninsula hydrogeology field data collection core drilling and cross section as part of WGNHS Pleistocene geologic mapping inventory for Bayfield County.	1
	Drummond area seepage lakes investigation of water level fluctuations. Install piezometers, collect data.	1
	Continue annual funding for US Geological Survey to measure, report, and archive groundwater levels in monitoring wells; TA-217 (Bend	1

Estimated Start: In Progress
 Estimated Completion: June 2023

Good Neighbor Supplement Project Agreement 1 – Modification 10

	well) in the Medford Unit, Taylor County, and nested piezometers PR-088 and PR-089 (deep bedrock well) in the Park Falls Unit, Price County. The water quality/level data will be published on the statewide monitoring level network website.	
FY 2021 Projects	2nd year Bayfield Peninsula hydrogeology data analysis bore hole(s) and cross section as part of WGNHS Pleistocene geologic mapping inventory for Bayfield County.	1
	2nd year Drummond area seepage lakes investigation water level fluctuations.	1
	Measure, report, archive monitoring wells; TA-217, PR-088 and PR-089.	1
	Begin Bend site groundwater baseline study (April 2021).	2
FY 2022 Projects	Measure, report, archive monitoring wells; Two Bayfield Highlands wells (names TBD), TA-217, PR-088 and PR-089.	2
	3 rd year Bayfield Peninsula hydrogeology data collection	2
	3rd year Drummond area seepage lakes investigation water level fluctuations.	2
	1 st (full) year Bend Site groundwater baseline study.	2
FY 2023 Projects	Measure, report, archive monitoring wells; TA-217, PR-088 and PR-089, and Bayfield Peninsula well(s).	2
	4th year Drummond area seepage lakes investigation water level fluctuations.	2
	2 nd year Bend Site groundwater baseline study.	2
FY 2024 Projects	Measure, report, archive monitoring wells; TA-217, PR-088 and PR-089, and Bayfield Peninsula well(s).	
	5th year Drummond area seepage lakes investigation water level fluctuations.	
	3 rd year Bend site groundwater baseline study	
	Begin investigation of surface water/groundwater interactions in the Elvoy and Brule creeks watershed located within the Eagle River/Florence Ranger District in Vilas and Forest Counties.	
FY 2025 Projects (Completed by Aug. '25)	Measure, report, archive monitoring wells; TA-217, PR-088 and PR-089, and Bayfield Peninsula well(s).	
	Measure, report, archive Yellow River stream gage.	
	6 th year Drummond area seepage lakes investigation water level fluctuations.	
	2 year investigation of surface water/groundwater interactions in the Elvoy and Brule creeks watershed located within the Eagle River/Florence Ranger District in Vilas and Forest Counties.	

IV. Point of Contacts:

- **Forest Service: Megan Luick, 715-362-1330, MeganLuick@usda.gov**
- **Wisconsin DNR: Rebecca Diebel, 608-444-5774, Rebecca.diebel@wisconsin.gov**
- **Wisconsin Geological and Natural History Survey: Grace Graham, 608-263-4125 grace.graham@wisc.edu**

Estimated Start: In Progress
 Estimated Completion: June 2023

Groundwater and Geological Resource Inventory and Investigations Phase 2

Appendix C: Statement of Work

Update from Modification 9

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Estimated Start: In Progress

Estimated Completion: June 2023

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Good Neighbor Supplemental Project Agreement 1 – Modification 10

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1. Bend hydrogeology (year 2 of 3): Budget \$81,147 (includes approximately \$15.5K annual maintenance and reporting for stream gage)
 - a. Continue monitoring
 - i. Water levels and temperature in the groundwater wells.
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	Continue annual funding for US Geological Survey to measure, report, and archive groundwater levels in monitoring wells; TA-217 (Bend	1

Estimated Start: In Progress
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Good Neighbor Supplemental Project Agreement 1 – Modification 10

	well) in the Medford Unit, Taylor County, and nested piezometers PR-088 and PR-089 (deep bedrock well) in the Park Falls Unit, Price County. The water quality/level data will be published on the statewide monitoring level network website.	
FY 2021 Projects	2nd year Bayfield Peninsula hydrogeology data analysis bore hole(s) and cross section as part of WGNHS Pleistocene geologic mapping inventory for Bayfield County.	1
	2nd year Drummond area seepage lakes investigation water level fluctuations.	1
	Measure, report, archive monitoring wells; TA-217, PR-088 and PR-089.	1
	Begin Bend site groundwater baseline study (April 2021).	2
FY 2022 Projects	Measure, report, archive monitoring wells; Two Bayfield Highlands wells (names TBD), TA-217, PR-088 and PR-089.	2
	3 rd year Bayfield Peninsula hydrogeology data collection	2
	3rd year Drummond area seepage lakes investigation water level fluctuations.	2
	1 st (full) year Bend Site groundwater baseline study.	2
FY 2023 Projects	Measure, report, archive monitoring wells; TA-217, PR-088 and PR-089, and Bayfield Peninsula well(s).	2
	4th year Drummond area seepage lakes investigation water level fluctuations.	2
	2 nd year Bend Site groundwater baseline study.	2
FY 2024 Projects	Measure, report, archive monitoring wells; TA-217, PR-088 and PR-089, and Bayfield Peninsula well(s).	
	5th year Drummond area seepage lakes investigation water level fluctuations.	
	3 rd year Bend site groundwater baseline study	
	Begin investigation of surface water/groundwater interactions in the Elvoy and Brule creeks watershed located within the Eagle River/Florence Ranger District in Vilas and Forest Counties.	
FY 2025 Projects	Measure, report, archive monitoring wells; TA-217, PR-088 and PR-089, and Bayfield Peninsula well(s).	
	Measure, report, archive Yellow River stream gage.	
	6 th year Drummond area seepage lakes investigation water level fluctuations.	
	2 year investigation of surface water/groundwater interactions in the Elvoy and Brule creeks watershed located within the Eagle River/Florence Ranger District in Vilas and Forest Counties.	

IV. Point of Contacts:

- **Forest Service: Greg Knight, 715-748-4875, greg.knight3@usda.gov**
- **Wisconsin DNR: Rebecca Diebel, 608-444-5774, Rebecca.diebel@wisconsin.gov**
- **Wisconsin Geological and Natural History Survey: Anna Fehling, anna.fehling@wisc.edu**

Estimated Start: In Progress
 Estimated Completion: June 2023

Groundwater and Geological Resource Inventory and Investigations Phase 1

APPENDIX C: Statement of Work

Update from Modification 8

I. Project Description:

Conduct groundwater and geological resource inventories and investigations of identified groundwater/surface water management issues within the Chequamegon-Nicolet National Forest (CNNF). Prepare reports and maps and make this information available to the Forest Service and public.

Phase 1 includes two years of work for projects that begin in FY2020. A separate statement of work will be provided for future phases.

II. Forest Service Shall:

1. Coordinate with WGNHS on project activities to support field work and deliverables.
2. Provide peer review for draft reports.

III. State Shall:

Complete the proposed project activities for three projects: 1) Investigation of hydrogeology in the Bayfield Peninsula, 2) Drummond area water level investigation, and 3) Groundwater level monitoring. See below for study tasks and timeline. The projected project end date for this phase of the work is June 2021

IV. Goals:

1. Investigate hydrogeology including groundwater elevation and flow direction, geologic deposits, and connectivity in the Bayfield Peninsula.
2. Support concurrent mapping of glacial geology in Bayfield County. This project will significantly increase the amount of available data on the geologic material at depth in the Bayfield Peninsula.
3. Measure, report, and archive groundwater levels in monitoring wells; TA-217 and nested piezometers PR-088 and PR-089 (deep bedrock well).
4. Protect and manage the groundwater/surface water resource and associated ecosystems.
5. Investigate Drummond area seepage lakes water level fluctuations.

V. Objectives:

1. The sand barrens along the Bayfield Peninsula is an important recharge area for Bayfield County that contributes groundwater to many wells near Lake Michigan. However, the lack of hydrogeologic data in this location makes it difficult to ascertain the subsurface geologic materials, bedrock depth, hydrogeologic connectivity, groundwater levels, and groundwater flow direction. Data are in particular lacking at depth, which is problematic

Good Neighbor Supplemental Project Agreement 1 - Modification 9

because the bedrock is expected to be more than 400 feet below ground surface. Collecting information on the area's hydrogeology will significantly improve the ability to manage the ecosystem and understand the potential impacts of contaminant transport.

2. Continue funding for US Geological Survey to measure, report, and archive groundwater levels in monitoring wells; TA-217 (Bend well) in the Medford Unit, Taylor County, and nested piezometers PR-088 and PR-089 (deep bedrock well) in the Park Falls Unit, Price County. The water quality/level data will be published on the statewide monitoring level network website.
3. Drummond area seepage lakes investigation of the wide fluctuation in lake levels from apparent wide fluctuation in groundwater levels in response to extreme precipitation events. Record high water levels in Pigeon lake and area lakes caused historic flooding and damage to road infrastructure and private residences.

VI. Tasks and Timeline:

The tasks and general timeline are as follows.

State FY 2020 (Begin July 2019): Total Budget \$191,000

1. Bayfield Peninsula Hydrogeology (year 1 of 2): Budget \$149,000
 - a. Drill up to two rotosonic cores in the Bayfield Peninsula to approximately 200 feet depth. A single, deeper core may be drilled if the water level is deeper than anticipated.
 - b. Complete geophysical logging in both of these locations.
 - c. Install nested monitoring wells in both of these locations and monitor water levels.
 - d. Sample groundwater for isotopes and water quality.
 - e. Log and interpret the core.
 - f. Complete grain size analysis.
2. Drummond area water level investigation: Budget \$40,000 (includes Task 3)
 - a. Install Drummond area lakes piezometers
 - b. Monitor piezometers
3. Groundwater level monitoring: Budget \$2,000 (included in Task 2, total)
 - a. USGS will continue to monitor TA-217 (Bend well) in the Medford Unit, Taylor County, and nested piezometers PR-088 and PR-089 (deep bedrock well) in the Park Falls Unit, Price County from January to June 2020 (already funded through December 2019).

State FY 2021: Total budget \$131,000 (updated to account for anticipated extra costs for drilling and well installation, as well as installing an air line at Horseshoe Lake well)

1. Bayfield Peninsula Hydrogeology (year 2 of 2): Budget \$108,000
 - a. Use data from rotosonic cores to inform 1:100,000 scale Pleistocene mapping. A map and accompanying report will be completed and published as part of a separate project.
 - b. Install air line at Horseshoe Lake well.

Good Neighbor Supplemental Project Agreement 1 - Modification 9

- c. Evaluate hydrogeology in the vicinity of the two wells, such as horizontal and vertical gradient, baseline water chemistry, findings from geophysical logging, and type and consistency of glacial deposits.
 - d. Publish a technical report of findings. Draft reports will be provided to USFS for peer review.
2. Drummond area water level investigation: Budget \$19,000 (Includes Task 3)
 - a. Continue monitoring water levels in Drummond area
 3. Groundwater level monitoring: Budget \$4,000 (included in Task 2 total)
 - a. USGS to monitor TA-217 and nested piezometers PR-088 and PR-089 for fiscal year.

For context, the below table inserts the above specific tasks with the tasks expected to be completed during the full lifetime of the project.

Time	Description	Phase
FY 2020 Projects	Bayfield Peninsula hydrogeology field data collection core drilling and cross section as part of WGNHS Pleistocene geologic mapping inventory for Bayfield County.	1
	Drummond area seepage lakes investigation of water level fluctuations. Install piezometers, collect data.	1
	Continue annual funding for US Geological Survey to measure, report, and archive groundwater levels in monitoring wells; TA-217 (Bend well) in the Medford Unit, Taylor County, and nested piezometers PR-088 and PR-089 (deep bedrock well) in the Park Falls Unit, Price County. The water quality/level data will be published on the statewide monitoring level network website.	1
FY 2021 Projects	2nd year Bayfield Peninsula hydrogeology data analysis bore hole(s) and cross section as part of WGNHS Pleistocene geologic mapping inventory for Bayfield County.	1
	2nd year Drummond area seepage lakes investigation water level fluctuations.	1
	Measure, report, archive monitoring wells; TA-217, PR-088 and PR-089.	1
FY 2022 Projects	Measure, report, archive monitoring wells; TA-217, PR-088 and PR-089.	
	3rd year Drummond area seepage lakes investigation water level fluctuations.	
	Bend Site groundwater baseline study.	
FY 2023 Projects	Measure, report, archive monitoring wells; TA-217, PR-088 and PR-089.	
	4th year Drummond area seepage lakes investigation water level fluctuations.	
	2nd year Bend Site groundwater baseline study.	
FY 2024 Projects	Measure, report, archive monitoring wells; TA-217, PR-088 and PR-089.	
	5th year Drummond area seepage lakes investigation water level fluctuations.	
	3rd year Bend Site groundwater baseline study.	

Good Neighbor Supplemental Project Agreement 1 - Modification 9

	Begin investigation of surface water/groundwater interactions in the Elvoy and Brule creeks watershed located within the Eagle River/Florence Ranger District in Vilas and Forest Counties.	
FY 2025 Projects	Measure, report, archive monitoring wells; TA-217, PR-088 and PR-089.	
	Investigate surface water/groundwater interactions in the Elvoy and Brule creeks watershed located within the Eagle River/Florence Ranger District in Vilas and Forest Counties.	

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Agreement No. 15-GN-11091300-109
Groundwater and Geological Resource Inventory and Investigations
Phase 1

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Good Neighbor Supplemental Project Agreement 1 - Modification 8

2. Continue funding for US Geological Survey to measure, report, and archive groundwater levels in monitoring wells; TA-217 (Bend well) in the Medford Unit, Taylor County, and nested piezometers PR-088 and PR-089 (deep bedrock well) in the Park Falls Unit, Price County. The water quality/level data will be published on the statewide monitoring level network website.
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VI. Tasks and Timeline:

The tasks and general timeline are as follows.

State FY 2020 (Begin July 2019): Total Budget \$187,288

1. Bayfield Peninsula Hydrogeology (year 1 of 2): Budget \$148,776
 - a. Drill up to two rotosonic cores in the Bayfield Peninsula to approximately 200 feet depth. A single, deeper core may be drilled if the water level is deeper than anticipated.
 - b. Complete geophysical logging in both of these locations.
 - c. Install nested monitoring wells in both of these locations and monitor water levels.
 - d. Sample groundwater for isotopes and water quality.
 - e. Log and interpret the core.
 - f. Complete grain size analysis.
2. Drummond area water level investigation: Budget \$38,512 (includes Task 3)
 - a. Install Drummond area lakes piezometers
 - b. Monitor piezometers
3. Groundwater level monitoring: Budget \$1,550 (included in Task 2, total)
 - a. USGS will continue to monitor TA-217 (Bend well) in the Medford Unit, Taylor County, and nested piezometers PR-088 and PR-089 (deep bedrock well) in the Park Falls Unit, Price County from January to June 2020 (already funded through December 2019).

State FY 2021: Total budget \$91,955

1. Bayfield Peninsula Hydrogeology (year 2 of 2): Budget \$74,053
 - a. Use data from rotosonic cores to inform 1:100,000 scale Pleistocene mapping. A map and accompanying report will be completed and published as part of a separate project.
 - b. Evaluate hydrogeology in the vicinity of the two wells, such as horizontal and vertical gradient, baseline water chemistry, findings from geophysical logging, and type and consistency of glacial deposits.
 - c. Publish a technical report of findings. Draft reports will be provided to USFS for peer review.

Good Neighbor Supplemental Project Agreement 1 - Modification 8

2. Drummond area water level investigation: Budget \$17,902 (Includes Task 3)
 - a. Continue monitoring water levels in Drummond area
3. Groundwater level monitoring: Budget \$3,100 (included in Task 2 total)
 - a. USGS to monitor TA-217 and nested piezometers PR-088 and PR-089 for fiscal year.

For context, the below table inserts the above specific tasks with the tasks expected to be completed during the full lifetime of the project.

Time	Description	Phase
FY 2020 Projects	Bayfield Peninsula hydrogeology field data collection core drilling and cross section as part of WGNHS Pleistocene geologic mapping inventory for Bayfield County.	1
	Drummond area seepage lakes investigation of water level fluctuations. Install piezometers, collect data.	1
	Continue annual funding for US Geological Survey to measure, report, and archive groundwater levels in monitoring wells; TA-217 (Bend well) in the Medford Unit, Taylor County, and nested piezometers PR-088 and PR-089 (deep bedrock well) in the Park Falls Unit, Price County. The water quality/level data will be published on the statewide monitoring level network website.	1
FY 2021 Projects	2nd year Bayfield Peninsula hydrogeology data analysis bore hole(s) and cross section as part of WGNHS Pleistocene geologic mapping inventory for Bayfield County.	1
	2nd year Drummond area seepage lakes investigation water level fluctuations.	1
	Measure, report, archive monitoring wells; TA-217, PR-088 and PR-089.	1
	Pleistocene mapping 1:100,000 scale CNNF lands Bayfield County.	
FY 2022 Projects	Pleistocene mapping 1:100,000 scale in Ashland County.	
	Measure, report, archive monitoring wells; TA-217, PR-088 and PR-089.	
	3rd year Drummond area seepage lakes investigation water level fluctuations.	
	Bend Site groundwater baseline study.	
FY 2023 Projects	Pleistocene mapping 1:100,000 scale in Sawyer County.	
	Measure, report, archive monitoring wells; TA-217, PR-088 and PR-089.	
	4th year Drummond area seepage lakes investigation water level fluctuations.	
	2nd year Bend Site groundwater baseline study.	
FY 2024 Projects	Pleistocene mapping 1:100,000 scale in Price County.	
	Measure, report, archive monitoring wells; TA-217, PR-088 and PR-089.	
	5th year Drummond area seepage lakes investigation water level fluctuations.	

	3rd year Bend Site groundwater baseline study.	
	Begin investigation of surface water/groundwater interactions in the Elvoy and Brule creeks watershed located within the Eagle River/Florence Ranger District in Vilas and Forest Counties.	
FY 2025 Projects	Pleistocene mapping 1:100,000 scale in Price County.	
	Measure, report, archive monitoring wells; TA-217, PR-088 and PR-089.	
	2 year investigation of surface water/groundwater interactions in the Elvoy and Brule creeks watershed located within the Eagle River/Florence Ranger District in Vilas and Forest Counties.	

IV. Point of Contacts:

- Forest Service: Greg Knight, 715-748-4875, greg.knight3@usda.gov
- Wisconsin DNR: Rebecca Diebel, 608-444-5774, Rebecca.diebel@wisconsin.gov
- Wisconsin Geological and Natural History Survey: Anna Fehling, anna.fehling@wisc.edu